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DESTRUCTION OF CHEMICAL MUNITIONS AT BLUE GRASS ARMY DEPOT, KENTUCKY

FINAL
ENVIRONMENTAL IMPACT STATEMENT
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AFFECTED JURISDICTION: RICHMOND, KENTUCKY

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ABSTRACT: Public Law 99-145 and subsequent related legislation requires destruction of the U.S. stockpile of lethal unitary chemical agents and munitions. Furthermore, in 1993 an international treaty, the Chemical Weapons Convention (CWC), was signed by 65 nations, including the United States. The CWC, which set the deadline for completing destruction of chemical weapons as 10 years following ratification by the required number of nations, received the necessary ratifications on April 29,1997. Thus, the international deadline for destruction of chemical weapons is April 29, 2007. The Army Chemical Stockpile Disposal Program has prepared this Final Environmental Impact Statement (FEIS) to assess the potential health and environmental impacts of the construction, operation, and closure of a facility to destroy the chemical agent and munitions stored at Blue Grass Army Depot (BGAD), Kentucky.

Four alternatives are addressed in this FEIS for possible use in destruction of the BGAD stockpile: (1) baseline incineration, which is currently in use by the Army at Deseret Chemical Depot (DCD), Utah and was used by the Johnston Atoll Chemical Agent Disposal System (JACADS) to destroy the entire stockpile on Johnston Atoll; (2) chemical neutralization followed by supercritical water oxidation, a developing technology that would be initially operated as a pilot test facility; (3) chemical neutralization followed by supercritical water oxidation and gas phase chemical reduction, a developing technology that would be initially operated as a pilot test facility; and (4) electrochemical oxidation, which is also under development and would be initially operated as a pilot test facility. The latter three alternatives have also been evaluated in a separate EIS prepared by the Army Assembled Chemical Weapons Assessment Program (ACWA) as part of four chemical neutralization technologies being considered for pilot testing at BGAD and three other chemical munitions storage locations. The data and information obtained from testing and full-scale operation of the incineration technology, and available data and information from on-going studies of the technologies provided by ACWA are analyzed and compared to the extent possible in this FEIS.

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ACRONYMS AND ABBREVIATIONS

ACWA	Assembled Chemical Weapons Assessment
AMC	U.S. Army Materiel Command
ANAD	Anniston Army Depot
APG	Aberdeen Proving Ground
BGAD	Blue Grass Army Depot
BRA	Brine Reduction Area
°C	degrees Celsius
CAA	Clean Air Act
CAAT	Citizens' Advisory Technical Team
CAMDS	Chemical Agent Munitions Destruction System
CAS	Chemical Abstracts Service
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CHB	Container Handling Building
cm	centimeter
CONUS	continental United States
CSDP	Chemical Stockpile Disposal Project
CSEPP	Chemical Stockpile Emergency Preparedness Program
CWC	Chemical Weapons Convention
d	day
DAC	1990 Defense Appropriations Conference
dB	decibels
dB(A)	decibels (on the A-weighted scale)
DCD	Deseret Chemical Depot
DEIS	Draft Environmental Impact Statement
DEMIL	demilitarization
DFS	deactivation furnace system
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
FEIS	Final Environmental Impact Statement
FPEIS	Final Programmatic Environmental Impact Statement
ft	foot
GA	chemical nerve agent, also called Tabun
gal	gallon
GB	chemical nerve agent, also called Sarin
g	grams
Gwh	gigawatt hour
H	chemical blister agent, also generally called mustard
ha	hectare

HAP	hazardous air pollutant
HD	blister type agent, also called mustard agent
HHRA	Human Health Risk Assessment
hr	hour(s)
in	inch(es)
JACADS	Johnston Atoll Chemical Agent Disposal System
kg	kilogram
kV	kilovolt
kg/hr	kilogram per hour
km	kilometer
kV	kilovolt
kWh	kilowatt hour
L	liter
lb	pound(s)
LIC	liquid incinerator
m	meter
MAVs	modified ammunition vans
MDB	Munitions Demilitarization Building
mi	mile(s)
min	minute
mm	millimeter
mo	month
MPF	metal parts furnace
µg	microgram
µm	micrometer
NAAQS	National Ambient Air Quality Standards
NECD	Newport Chemical Depot
NEPA	National Environmental Policy Act
ng	nanograms (billionths of a gram)
NHPA	National Historic Preservation Act
NOA	notice of availability
NOI	Notice of Intent
NRC	National Research Council
NRC	Nuclear Regulatory Council
ONC	on-site container
ORNL	Oak Ridge National Laboratory
OVT	operational verification testing
PAS	pollution abatement system
PBA	Pine Bluff Arsenal
PCD	Pueblo Chemical Depot
PDA	Pueblo Depot Activity
PMCD	U.S. Army’s Program Manager for Chemical Demilitarization
PMD	projectile/mortar disassembly
ppm	parts per million
PPM	projectile punch machine
Pub. L	Public Law
RCRA	Resource Conservation and Recovery Act
RMA	Rocky Mountain Arsenal

ROD	Record of Decision
ROI	region of potential impact
RSM	rocket shear machine
s	second
SAAQS	State Ambient Air Quality Standards
SARA	Superfund Amendments and Reauthorization Act of 1986
SBCCOM	Solider Biological and Chemical Command
SCWO	supercritical water oxidation
TNT	Trinitrotoluene
TOCDF	Tooele Chemical Demilitarization Facility
UMDA	Umatilla Chemical Depot
VX	chemical nerve agent
WIPT	Environmental Integrated Process Team

EXECUTIVE SUMMARY

ES.1 PROPOSED ACTION

Under Congressional directive (Public Law 99-145) and an international treaty called the Chemical Weapons Convention (CWC), the U.S. Army is destroying the nation's stockpile of lethal chemical agents and munitions. The U.S. Army's Program Manager for Chemical Demilitarization (PMCD) has prepared this Final Environmental Impact Statement (FEIS) to assess the potential health and environmental impacts of the design, construction, operation and closure of a facility to destroy the types of chemical munitions stored at Blue Grass Army Depot (BGAD) Kentucky. The BGAD stockpile consists of mustard agent (type H) contained in 155-mm projectiles, nerve agent GB contained in M55 rockets and 8-in. projectiles, and nerve agent VX contained in M55 rockets and 155-mm projectiles. The specific goal of the current analysis is to identify and compare the potential environmental impacts among the alternatives that could accomplish the destruction of the stockpile at BGAD.

Four alternatives are addressed in this FEIS for possible use in destruction of the BGAD stockpile: (1) the baseline incineration process used by the Army at Johnston Atoll Chemical Agent Disposal System (JACADS) on Johnston Island in the Pacific Ocean and currently in use at Deseret Chemical Depot (DCD) near Tooele, Utah, and three non-incineration technology alternatives—(2) chemical neutralization followed by supercritical water oxidation (SCWO); (3) chemical neutralization followed by supercritical water oxidation and gas phase chemical reduction (GPCR); and (4) electrochemical oxidation. The Army believes that it is reasonable to limit non-incineration alternatives evaluated in this EIS to those that survived the thorough testing and evaluation conducted by the Assembled Chemical Weapons Assessment program (i.e., through Demonstration I and II and Engineering Design Studies). If any of the non-incineration technologies were selected for implementation at BGAD, a pilot test facility would be constructed and operated prior to full-scale stockpile destruction operations. Two potential sites for destruction facilities, one each on the east (Proposed Area A) and west (Alternative Area B) sides of the Chemical Limited Area (the area where chemical weapons are stored), are evaluated in this FEIS. As required by regulations of the President's Council on Environmental Quality (CEQ), the no-action alternative (i.e., continued storage of the BGAD stockpile) is also addressed in this FEIS, even though it is not a viable alternative because its implementation is precluded by Public Law 99-145.

Under a Congressional directive, provided through Public Laws 104-201 and 104-208, the Department of Defense (DOD) has also created the Assembled Chemical Weapons Assessment (ACWA) Program. The Program Manager for ACWA was required to identify and demonstrate no fewer than two alternatives to the baseline incineration process for destroying assembled chemical munitions. Pursuant to the direction in Public Law 106-52, the ACWA program was required to identify and demonstrate additional technologies that did not receive demonstration contracts under earlier phases of the ACWA program. The ACWA program has considered the viability of these multiple technologies for pilot testing at one or more of four facilities storing assembled chemical weapons: BGAD, Anniston Army Depot (ANAD), Alabama, Pueblo Chemical Depot (PCD), Colorado, and Pine Bluff Arsenal (PBA), Arkansas.

As a result of its demonstration program, the ACWA program has evaluated six alternative technologies to destroy the assembled chemical weapons stored at BGAD; these technologies included the three non-incineration technologies listed above (i.e., chemical neutralization followed by SCWO, chemical neutralization followed by SCWO and GPCR, and electrochemical oxidation) as well as plasma arc technology, neutralization followed by biotreatment, and solvated electron technology. The ACWA program eliminated the plasma arc technology (due to lack of testing with actual chemical agent or propellant, the presence of significant unresolved engineering problems, and probable scale-up problems) and the solvated electron technology (due to lack of demonstration testing) and determined that neutralization followed by biotreatment was not viable as a total solution for destruction of the assembled chemical weapons stored at BGAD because that technology cannot process chemical weapons filled with nerve agent GB or VX.

ACWA prepared and distributed for public review and comment an EIS that evaluates and compares the potential impacts of these options if implemented at the four installations storing assembled chemical weapons. These two separate analyses (i.e., the ACWA EIS and the PMCD EIS) serve complementary purposes. The ACWA EIS is different from this PMCD FEIS for BGAD in that its emphasis is on the feasibility of pilot testing one or more of the demonstrated and approved ACWA technologies, considering the unique characteristics of the four alternative installations. This PMCD FEIS focuses on the environmental impacts of constructing, operating, and closing a facility to destroy the stockpile of chemical weapons stored only at BGAD, using one of the four technologies identified above (i.e., baseline incineration, neutralization followed by SCWO, neutralization followed by SCWO and GPCR, or electrochemical oxidation).

The results of the analyses presented in this Final Environmental Impact Statement (FEIS) show that any of the four chemical munitions destruction alternatives would be environmentally acceptable for destruction of the stockpile stored at Blue Grass Army Depot. Neutralization followed by supercritical water oxidation is the agency's preferred alternative. The Army will continue to look for ways to accelerate the process. Additional NEPA documentation will be completed as required. Following a 30-day comment period on this FEIS, the Department of the Army, on behalf of the Department of Defense, considering the results of this EIS along with other factors including cost, schedule, and public opinion, will publish the Record of Decision in the *Federal Register*.

ES.2 DESTRUCTION ALTERNATIVES

The destruction of the chemical weapons stockpile at BGAD by implementation of any of the four alternatives would take place in structures designed to prevent release of chemical agent to the environment. Disassembly, preparation for destruction, and destruction of energetics would be carried out in an explosion containment area. The overall structure would be designed for agent containment using features such as air locks and negative differential air pressure. Disassembly of the munitions for baseline incineration would involve separation of all the energetics from the munition, followed by draining the chemical agent from the munitions for incineration. After disassembly, the chemical munitions bodies, energetics, and chemical agent would be thermally treated in different types of incinerators.

Under the chemical neutralization alternatives, the munitions would first be disassembled using a process similar to that of the baseline incineration system with the chemical agent being drained from the munition bodies. Following disassembly, the energetics and chemical agent would be chemically neutralized by using water and caustic. The resulting chemicals would then be further treated by using very high temperature and pressure in SCWO units or in the SCWO units followed by GPCR. Under the electrochemical oxidation alternative, the munitions would be disassembled using a reverse assembly process similar to that used by the baseline incineration system to access agents and energetics; agents and energetics would then be mineralized with an electrochemical oxidation process that uses silver nitrate ($AgNO_3$) in concentrated nitric acid (HNO_3), and hardware and solids would be thermally decontaminated. The no action alternative would involve continued storage of the chemical munitions stockpile at BGAD. Current safety procedures for storage and maintenance would continue to be followed, including monitoring and surveillance.

ES.3 ENVIRONMENTAL IMPACTS

BGAD is located in the Blue Grass region of east central Kentucky in the approximate center of Madison County, approximately 5 miles southeast of the center of Richmond and 30 miles southeast of Lexington. The installation encompasses approximately 14,600 acres and includes a variety of buildings, structures (including igloos containing conventional munitions as well as chemical munitions), and undeveloped areas. The Chemical Limited Area, as well as the potential sites of the proposed destruction facility, are located in the northern part of the BGAD installation.

The potential impacts of construction, operation, and hypothetical accidents of the four destruction alternatives along with the impacts of no-action are summarized in Tables ES.1, ES.2, and ES.3, respectively. For each table, the summary of impacts of the baseline incineration alternative is presented in its entirety; where reasonable, the impacts of the alternatives involving non-incineration technologies and the no-action alternative are compared directly with those of the baseline incineration alternative.

ES.3.1 LAND USE

Construction and operation of a destruction facility would not have significant impacts on on-post land use because land disturbance would be limited to a relatively small area within the larger area of BGAD. The footprint for the facility for each destruction alternative is essentially the same and would have a footprint of approximately 25 acres. For a facility sited at Proposed Area A, up to approximately 95 acres could be disturbed when all utility corridors and access routes are included, and up to approximately 88 acres could be disturbed if Alternative Area B were selected. The total quantity of land that would be disturbed is less than 1% of land within BGAD boundaries. A facility located at Alternate Site B would have a much larger impact on current conventional munition storage and maintenance operations at the Depot than the Proposed Site A.

ES.3.2 WATER SUPPLY AND USE

Due to the amount of process water that would be required, water use at BGAD would increase during operation of each of the destruction alternatives. Annual process water requirements for each alternative are 18, 6.3, 18, and 1 million gal/yr for baseline incineration, neutralization with SCWO, neutralization with SCWO and GPCR, and electrochemical oxidation alternatives, respectively. A 500,000 gal water storage tank would be constructed to provide additional capacity and ensure adequate supply would be available during peak demand period or fires or other emergency response demands. The historic demand for water at BGAD, all of which is supplied by surface water from Lake Vega on the installation, has recently approximated 45 million gal/yr. No groundwater is currently used at BGAD or would be required for destruction of the chemical weapons stockpile stored at BGAD.

ES.3.3 ELECTRICAL POWER SUPPLY

BGAD's electrical system would require improvements, including new transmission lines, service connections, and two new substations, no matter which destruction option is selected. The electrochemical oxidation alternative would have the largest demand for electricity (122 Gwh/yr), while the requirements for the neutralization with SCWO alternative would be approximately 50% as much and those for baseline incineration and neutralization with SCWO and GPCR approximately 20% as much as for the electrochemical oxidation alternative. However, the demand would be within the design capacity of the independent, off-site supply.

ES.3.4 NATURAL GAS SUPPLY

Natural gas requirements of any of the destruction alternatives would be met by the current supplier; however, a new pipeline would need to be installed to connect to the existing main south of the Chemical Limited Area. Baseline incineration would have the highest average annual requirements because natural gas is the primary process fuel, and would be followed by neutralization with SCWO and GPCR (approximately 70% less) and neutralization with SCWO and electrochemical oxidation (approximately 90% less). The current natural gas supplier can accommodate the demand of any of the destruction alternatives.

ES.3.5 WASTES

Hazardous solid wastes from incineration would consist mainly of ash residue from the furnace system, brine salts generated from the pollution abatement system and aluminum oxide. Hazardous solid waste would be transported off-site to a permitted waste disposal facility. Hazardous solid wastes generated by the non-incineration alternatives consist mainly of brine salts, aluminum oxide, and anolyte-catholyte wastes (for the electrochemical oxidation alternative) would also be transported to a permitted hazardous waste disposal facility. The largest quantity of solid hazardous wastes would be generated by the neutralization with SCWO and neutralization with SCWO and GPCR alternatives, with baseline incineration expected to generate approximately 25% less and electrochemical oxidation approximately 80% less. The total quantities of wastes generated are presented in Table ES.2.

The quantity of hazardous liquid wastes is expected to be small to non-existent (through recycle) for all alternatives. The baseline incineration alternative is expected to generate some laboratory wastes and spent hydraulic fluids, and the electrochemical oxidation alternative would generate dilute nitric acid. Liquid hazardous wastes would be taken to an off-site permitted treatment, storage, and disposal facility (TSDF).

Nonhazardous wastes would consist of sewage and uncontaminated metals and solids. Sewage would be treated and discharged to Muddy Creek, or pumped to the existing infrastructure in Richmond for the baseline incineration alternative or the non-incineration alternatives and solid wastes would be disposed of in an off-site permitted landfill.

ES.3.6 AIR QUALITY

Impacts of constructing and operating a chemical munitions destruction facility are expected to be lower than National Ambient Air Quality Standards (NAAQS) except for PM2.5, for which background already exceeds NAAQS. Impacts of construction would primarily involve fugitive dust from construction and earthmoving activities. Operation of a baseline incineration facility would involve low emissions levels with no exceedances expected. Impacts of a non-incineration facility would be similar to but less than those from a baseline incineration facility because it would not involve use of an incinerator. However, non-incineration technologies would include stacks for process steam, boilers, diesel generators, and the SCWO or oxidation areas. Any emissions would be below applicable standards.

ES.3.7 HUMAN HEALTH

On the basis of operating experience at other chemical agent destruction facilities, no exceedances of emissions standards or exposure levels are expected at a baseline incineration facility. This experience and the data obtained during testing of those facilities provided the basis for the development of site-specific human health risk analyses for both adults and children. The most recent and applicable of these analyses (at the Anniston, Alabama, site) resulted in lifetime cancer risks of less than 1×10^{-6}, which is below the EPA target for operation of a hazardous waste combustion facility of 1×10^{-5}. For non-cancer endpoints, the results were higher than the target criterion, but alternative scenarios (to modify operational time or remove mercury through the pollution abatement system) produced results at or below the target criteria. A baseline incineration facility at BGAD would be expected to have even lower results since fewer total munitions are present at BGAD as compared with ANAD.

Based on limited demonstration testing, no exceedances of emissions standards or exposure levels established to protect human health and environment are expected for the non-incineration alternatives.

Routine operations of a destruction facility and minor operational fluctuations (e.g., start-up and shut-down) might expose workers or the public to small (below standards) quantities of hazardous materials. A destruction facility implementing any of the four alternatives would be engineered to limit exposures to the greatest degree possible. Measures would include ventilation systems, pollution abatement systems, water recovery and recycling, remote handling of munitions, and personal protective equipment for workers.

A site-specific human health risk assessment will be conducted as part of the RCRA permitting process to ensure that there are no adverse health effects.

ES.3.8 NOISE

Currently, the only on-post noise receptors are the residences and offices located in the Administrative Area in the southwestern part of the depot. The off-post residence closest to the planned destruction facility location is about 1.6 mi north of the site. At the nearest residence, the maximum outdoor noise level expected from facility operations may be slightly audible, and would not be expected to have any impact in terms of activity interference, annoyance, or hearing ability.

ES.3.9 VISUAL RESOURCES

BGAD is located in a rural area where the surrounding landscape is primarily rolling, open farmland and timberland. It is approximately 5 mi southeast of the center of Richmond, and some housing and industrial development has occurred near the installation. BGAD itself is characterized by mixed land use, including pastureland, timberland, and industrial uses. It is expected that the off-site visual impacts of construction of a destruction facility using any of the four alternatives would be limited to the entrance gate and parking area, and during operations it is possible that a stack and small steam plume might be visible. The impacts for the non-incineration facilities would be expected to be similar, and no impacts would be expected to be significant.

ES.3.10 GEOLOGY AND SOILS

Impacts to soils of any of the four alternatives for destruction of the chemical munitions would be essentially the same. A total of approximately 95 acres (Proposed Area A) or 85 acres (Alternative Area B) of land could be disturbed for the facility and associated access roadways and utility corridors. This amount of land constitutes far less than 1% of the entire BGAD installation. Soil disturbance during construction could result in increase erosion, but best management practices should minimize impacts to soils.

ES.3.11 GROUNDWATER

Impacts to groundwater of any of the four alternatives would be negligible during incident-free construction, and the use of best management practices would reduce the potential for any groundwater contamination. Since no groundwater would be used during operations for any of the alternatives, impacts to groundwater should be negligible during incident-free operations. The use of best management practices should minimize the potential for contamination due to accidental spills or leaks of hazardous materials.

ES.3.12 SURFACE WATER

A sedimentation basin and other standard construction practices would minimize impacts to surface water during project construction. The process water required for operations for the four alternatives are all within the capacity of Lake Vega on the installation; the baseline incineration alternative and the neutralization followed by SCWO and GPCR alternative would each have an annual requirement of approximately 18 million gal, the neutralization followed by SCWO alternative would require approximately one-third that amount, and the electrochemical oxidation alternative would require approximately one million gal/yr. During routine operations of any of the alternatives, no liquid effluents, hazardous or otherwise, would be released from either the destruction facility or support facilities into the surrounding environment. Sanitary waste resulting from operation of the facility would be treated and the effluent would be discharged to Muddy Creek (the baseline incineration alternative) or evaporation lagoons (the non-incineration alternatives). There would be minimal impact to the surface water regime from destruction plant discharges during incident-free operation.

ES.3.13 TERRESTRIAL HABITATS AND WILDLIFE

Ecological resources at BGAD are typical of and consistent with its maintenance as fescue-dominated pasture that is periodically mowed interspersed with shrubs and trees. The BGAD encompasses approximately 14,600 acres. Forest stands occur on roughly 2,900 acres, with three general forest types: upland forest, riparian forest, and flatwood forest. Wildlife habitat has been adversely affected by livestock grazing. The diversity of ground nesting birds, amphibians, and reptiles is relatively low compared with similar undisturbed habitats of eastern Kentucky. Impacts of construction and operations would be similar for all alternatives and would mainly result from clearing up to 95 acres of fescue-dominated hayfields (Proposed Area A) or 88 acres of woodlands (Alternative Area B) for the agent destruction facility and utilities. Loss of a relatively small area of habitat, increased human activity in the Chemical Exclusion Area and selected facility site, increased traffic on local roads, and noise would be the most important factors that would affect wildlife species. Given the previously disturbed character of the area, the availability of similar habitat in the area, and the temporary nature of the proposed activity, the impacts would not be significant. Any impacts should reverse upon completion of destruction operations.

ES.3.14 AQUATIC HABITATS AND FISH

Because surface water bodies are absent from the proposed (Area A) and alternative (Area B) construction sites, direct and indirect adverse effects of construction of the baseline incineration alternative on aquatic ecosystems are unlikely. A sedimentation basin designed to contain runoff during construction of any of the alternatives would eliminate potential impacts from sediment input to tributaries of Muddy Creek. None of the alternatives would release process liquid effluents to surface waters on- or off-post. Previous screening level ecological risk assessments conducted as part of the RCRA permitting process for four other chemical demilitarization facilities concluded that adverse effects of atmospheric pollutant deposition on nearby aquatic ecosystems was unlikely. Any impacts should reverse upon completion of destruction operations.

ES.3.15 PROTECTED SPECIES

Two federally listed threatened or endangered species are known to occur at BGAD, the bald eagle and running buffalo clover. The bald eagle, a federal listed threatened species, probably occurs as a winter migrant, being attracted to Lake Vega and other water bodies on post and in the region. The running buffalo clover occurs most commonly on rich soils in habitats with filtered light such as open woodlands, savannas, floodplains, and mesic stream terraces on well-drained sites. Any impacts to protected species would be the same for all destruction alternatives. Construction of a destruction facility in either Proposed Area A or Alternative Area B could adversely affect running buffalo clover. Direct disturbance or loss of individual plants in patches along the proposed 69-kV transmission line could occur unless concerted efforts to protect them are made by conducting clearance surveys, marking patches that are discovered, and avoiding patches when placing towers and erecting conductors. No impacts to running buffalo clover from operation of any of the destruction alternatives are expected to occur because of the low levels of contaminant emissions. A detailed evaluation of the impacts that could occur to running buffalo clover at BGAD from construction and operation of any of the destruction alternatives is provided in the biological assessment covering the project area (Appendix F). Any impacts should reverse upon completion of destruction operations.

ES.3.16 WETLANDS

Wetlands at BGAD occur around streams and large surface water bodies and are scattered throughout the installation. Wetlands were created east of Lake Vega and about 1 mi south of the Chemical Limited Area at BGAD by a dam improvement project. Wetlands also occur along a tributary to Big Muddy Creek located about 0.5 mi south of Proposed Area A, and small wetland areas of less than 1 acre occur along intermittent drainage ways in Proposed Area A and Alternative Area B. Construction of any of the alternative destruction facilities could affect one or more of five small riverine wetlands located in the project area; one small wetland of less than 1 acre would be directly destroyed by construction within the 25 acres needed for a facility in Proposed Area A, and Alternative Area B includes three small (less than 0.5 acre) wetlands that could be adversely affected by construction of the access road and proposed facilities. The impacts of routine operations of any of the destruction alternatives on wetlands and their biotic resources would be temporary and modest to negligible. Any impacts should reverse upon completion of destruction operations.

ES.3.17 CULTURAL RESOURCES

Of the two alternative locations (Proposed Area A and Alternative Area B), only the southwestern portion of Proposed Area A has been surveyed for archaeological resources, and that survey revealed no archaeological sites. The southern portion of Alternative Area B has been designated as having high potential for containing archaeological resources. Although no archaeological finds have been made at the precise locations where any of the four destruction facilities could be built, there are nine sites and three isolated finds recorded in the vicinity of the project area, including where access roads and utility line corridors could be located. No traditional cultural properties are known to exist within either the Proposed Area A or Alternative Area B, however potentially interested Native American organizations have been consulted regarding the proposed action (Appendix F). Although the storage igloos located in the project area are considered to be potentially eligible for inclusion in the National Register of Historic Places, none of those structures would be destroyed or modified during project construction or operation. Initial steps in the consultation process with the Commonwealth of Kentucky Historic Preservation Officer have begun (Appendix F).

ES.3.18 SOCIOECONOMICS

The primary impacting factor for socioeconomics would be the direct employment associated with facility construction, operations and closure. This employment would result in direct income which would be spent in the local economy creating indirect employment and income. Although the four destruction alternatives are expected to have slightly different numbers of direct employment during construction (ranging from 1,100 at peak for the baseline incineration alternative, 960 for the neutralization with SCWO alternative, 1,110 for the neutralization with SCWO and GPCR alternative, and 1,260 for the electrochemical oxidation alternative), direct employment during operations of all four destruction technologies are expected to be the same. The only potential adverse impacts, which are common to all destruction alternatives, are expected to be a possible exceedance of sewage treatment capacity in Berea if all inmigrants move to Berea and increased traffic congestion on US 25/421, KY 52, and KY 876 during peak traffic periods. If the selected access road to BGAD is option 3 (on KY 52) and a traffic signal is provided (if deemed needed), adverse impacts may be avoided due to planned expansion to KY 52.

ES.3.19 ENVIRONMENTAL JUSTICE

Significant environmental justice impacts would occur only in those cases where a high and adverse impact takes place and where the affected area has a disproportionately high number of minority and/or low-income persons. The only high and adverse impact to human populations involves the possible worsening of traffic congestion (see above), and this impact would occur only if planned improvements to KY 52 do not take place as scheduled. No census tracts within Madison County have disproportionately large percentages of minority residents. Two census tracts with disproportionately large percentages of low-income individuals are located within Madison County, roughly in the center of the city of Richmond; these tracts are likely to be comprised largely of Eastern Kentucky University students. Any high and adverse impacts would not appear to disproportionately affect minority and/or low-income individuals. Construction of any of the technology alternatives could provide jobs and income to minority and/or low-income individuals. Under normal operating conditions, the facility would be monitored continuously to ensure that any emissions above permitted levels and standards would be detected and would result in shutdown of agent feed to the destruction process.

ES.3.20 ACCIDENTS

Measures would be employed during the operation of a chemical munitions destruction facility at BGAD, whether incineration or non-incineration technologies were employed, to reduce the potential for an accident. Additional measures would be in place to contain the contamination in the unlikely event that an accident involving agent should occur, and to clean up contaminated facilities and resources in the even more remote possibility that an accident should result in external contamination. In the extremely unlikely event that a large uncontrolled accident (i.e., a major earthquake) were to occur during destruction facility operations using any of the four alternatives or continued storage (i.e., a lightning strike to a storage igloo) of chemical munitions at BGAD, significant environmental and health effects could occur. Because munition and agent quantities stored pending processing would be similar for all destruction alternatives, the potential impacts would be similar. Due to larger inventory, the accident under the no-action (continued storage) alternative would provide the worst case scenario.

ES.3.21 MITIGATION

Mitigation measures include the following categories of safety enhancements (design, layout, and siting) for the destruction facilities under consideration; personnel reliability measures (hiring practices and training); monitoring of all destruction operations; personnel protection (procedures, clothing, and equipment); accident response planning, training, and resources; emergency planning through the Chemical Stockpile Emergency Planning Program for the Madison County area; and ecological mitigation (including best management practices during project construction). As opportunities are identified, fine tuning measures will continue to be taken in each of these categories.

ES.3.22 CLOSURE AND DECOMMISSIONING

With passage of Public Law 99-145 in 1986, Congress directed the Army to destroy the U.S. Stockpile of chemical munitions, and mandated the dismantling and destruction of the demilitarization equipment and buildings upon completion of the stockpile destruction activities. Subsequent federal rule making (Public Law 106-79) and prescribed studies have raised the possibility that some chemical munitions destruction facilities may have other appropriate uses and have given the states involved the “right of first refusal”. Based on current feasibility studies, the Army will recommend that the BGAD stockpile destruction facility be used to destroy four non-stockpile items stored there. The Army currently intends to close and dismantle the BGAD destruction facility upon completion of the destruction activities (for the stockpile and the four non-stockpile items). Accomplishment of this mission will have positive impacts on all aspects of the surrounding environment.

Table ES.1. Summary and comparison of the impacts of construction for all alternatives

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Land use (See Sect. 4.2)	Construction would disturb approximately 95 acres of previously undisturbed land. This is less than 1% of land within BGAD boundaries.	Impacts essentially identical to baseline incineration alternative since the same footprint is assumed.	Impacts essentially identical to baseline incineration alternative since the same footprint is assumed.	Impacts essentially identical to baseline incineration alternative since the same footprint is assumed.	No changes in current land use. Land that would have been disturbed by facility construction would remain undisturbed.
Water supply and use (See Sect. 4.3)	New utility connections would provide process water, potable water, and sanitary sewer services to the site. Construction of 500,000 gal water storage tank for use during operations.	Impacts similar to those for construction of the baseline incineration alternative.	Impacts similar to those for construction of the baseline incineration alternative.	Impacts similar to those for construction of the baseline incineration alternative.	No changes to existing water supply and use. Water storage tank would not be constructed.

Table ES.1. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Waste management (See Sect. 4.6)	Typical construction wastes would be disposed of in accordance with Army, Commonwealth, and federal regulations. No significant impacts would be expected to nearby or regional waste disposal facilities. Hazardous wastes would include solvents, paints, cleaning solutions, waste oils, contaminated cleaning implements and pesticides. Nonhazardous wastes would include sanitary wastes, excavation spoils and building material debris.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	No construction wastes would be produced.

Table ES.1. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Noise (See Sect. 4.10)	Noise impacts would be minimal. Maximum noise levels of about 48 dBA at the BGAD boundary closest to the public and residences (55 dBA is EPA's level to protect against outdoor activity interference).	Noise impacts would be similar to those for the baseline incineration alternative.	Noise impacts would be similar to those for the baseline incineration alternative.	Noise impacts would be similar to those for the baseline incineration alternative.	No changes in current noise levels.
Visual resources (see Sect. 4.11)	Other than construction of entrance gate and parking area, construction in area for destruction facilities not highly visible to off-post viewers. Impacts negligible.	Visual resource impacts would be similar to those for the baseline incineration alternative.	Visual resource impacts would be similar to those for the baseline incineration alternative.	Visual resource impacts would be similar to those for the baseline incineration alternative.	No changes in current visual character of BGAD.
Geology and soils (See Sect. 4.12)	Soil disturbance could result in increased erosion, but best management practices should minimize this impact. Soils used for backfill; small impacts.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	No construction, hence, impacts to soils or mineral resources.

Table ES.1. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Groundwater (See Sect. 4.13)	Impacts negligible with incident-free construction. Best management practices would reduce potential for any groundwater contamination.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	No impacts to groundwater expected.
Surface water (See Sect. 4.14)	No significant on- or off-post impacts expected. Less than 1% of the capacity of the water treatment plant at BGAD would be used during construction. 4.5 million gal sanitary wastes would be generated, treated and discharged to Muddy Creek within requirements of BGAD's KPDES Permit. Use of sedimentation basin and other standard construction practices would minimize impacts to surface water.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	No construction, hence no impacts to surface water.

Table ES.1. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Terrestrial ecology (See Sect. 4.15)	Including access roads and infrastructure, proposed sites A and B each have a footprint of approximately 95 acres that would be disturbed during construction.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No construction; hence no impacts to terrestrial ecology.
Vegetation and habitat	Impacts would be minimal for proposed Site A (fescue-dominated hayfields). Construction would adversely affect vegetation and habitat for Alternate Site B (woodlands).	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No construction; hence no impacts to vegetation and habitat.

Table ES.1. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Wildlife	Some impacts to wildlife immediately around the facility but minimal overall impact at BGAD. Some wildlife species could be displaced due to construction, and members of less mobile species (e.g., amphibians, reptiles) could die during clearing and other activities. Noise during construction may adversely affect small mammals.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No construction; hence no impacts to wildlife.
Aquatic ecology (See Sect. 4.16)	No impacts to aquatic resources would be expected with use of best management practices for erosion control (e.g., sedimentation basin) and spill response.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No construction; hence no impacts to aquatic ecology.

Table ES.1. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Protected species (See Sect. 4.17 and Appendix F)	Construction in either proposed Area A or alternative Area B could adversely affect running buffalo clover (RBC), a federally-listed endangered plant species known to occur at 145 locations on BGAD. Potential habitat for RBC occurs near each area and along possible access routes area. Construction could have a minor impact on bald eagles, forcing them to abandon foraging areas near Lake Vega and move to other water bodies in the area.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No construction, hence no impacts to protected species.

Table ES.1. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Wetlands (See Sect. 4.18)	Construction could affect one or more of five small riverine wetlands (i.e., wetlands associated with intermittent or ephemeral streams) located in the project area. Proposed Area A has one small wetland (< 1 acre) that would be destroyed. Alternative Area B has three small wetlands (<0.5 acre) that would be affected. If alternative route 2 for the access road is selected, a small wetland (1.5 to 2 acres in size) immediately north of that route might be affected. Mitigation measures would reduce or eliminate construction-related impacts on wetlands.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No construction, hence no impacts to wetlands.

Table ES.1. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Archaeological, cultural and historic resources (See Sect. 4.19 and Appendix F)	Based on previous survey results, there is the potential for archaeological sites that would be eligible for listing on the NRHP. Alternative Site B is more likely to have such sites with such features. Archaeological surveys of previously unsurveyed portions of the selected locations are required prior to the start of any project, and consultation with the State Historic Preservation Officer is required. No impacts to traditional cultural properties are expected. No impacts to historic structures are expected.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No construction; hence, no impacts to cultural resources.
Socioeconomics (See Sect. 4.20)	Few significant impacts; see below.	Few significant impacts; see below.	Few significant impacts; see below.	Few significant impacts; see below.	No construction, hence no impacts to socioeconomic resources.

Table ES.1. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Population	Inmigration of up to1,092 individuals	Inmigration of up to 953 individuals	Inmigration of up to 1,102 individuals	Inmigration of up to 1,251 individuals	
Employment	Direct and indirect employment of up to 1,925 individuals	Direct and indirect employment up to 1,670 individuals	Direct and indirect employment of up to 1,920 individuals	Direct and indirect employment of up to 2,160 individuals	
Estimated personal income//payroll	$73.4 million	$63.4 million	$72.9 million	$82.1 million	
Housing	No adverse impacts	No adverse impacts	No adverse impacts	No adverse impacts	
Schools	No adverse impacts	No adverse impacts	No adverse impacts	No adverse impacts	
Public services	Possible exceedance of sewage treatment capacity in Berea if all inmigrants move to Berea; no other significant impacts	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	
Public finances	Minimal impacts	Minimal impacts	Minimal impacts	Minimal impacts	

Table ES.1. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Traffic	Under current road conditions, all key segments of US 25/421, KY 52, and KY 876 would experience severe congestion during the afternoon peak traffic period, as would most of those segments during the morning rush hour. If the selected access road to BGAD is option 3 (on KY 52) and a traffic signal is provided on KY 52 if needed, adverse impacts may be avoided due to planned expansion to KY 52.	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	
Agriculture	No adverse impacts on area agricultural resources expected.	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	

Table ES.1. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Environmental justice (See Sect. 4.21)	No disproportionately high and adverse impacts expected to minority or low income populations. Could provide jobs and income to subgroups within the area.	Same impacts as for baseline incineration alternative.	Same impacts as for baseline incineration alternative.	Same impacts as for baseline incineration alternative.	No construction; hence, no impacts.

Table ES.2. Summary and comparison of the impacts of operations for all alternatives

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Land use (See Sect. 4.2)	No significant impacts to on or off-post land use.	Impacts are the same as for the baseline incineration alternative.	Impacts are the same as for the baseline incineration alternative.	Impacts are the same as for the baseline incineration alternative.	No changes in current land use.
Water supply and use (See Sect. 4.3)	Existing water supply has sufficient capacity for the alternative. Annual destruction process water use would amount to 18 million gal/yr. Annual potable water use would amount to 6.4 million gal/yr.	Other than process water requirements, impacts would be the same as for the baseline incineration alternative. Annual destruction process water use would amount to 6.3 million gal/yr.	Impacts would be the same as for the baseline incineration alternative.	Other than process water requirements, impacts would be the same as for the baseline incineration alternative. Annual destruction process water use would amount to 1 million gal/yr.	No impacts to water use or supply infrastructure.
Electrical power (See Sect. 4.4)	Use of system upgrades installed during construction. Required capacity is within the design parameters of the supplier. Annual requirement of 22Gwh/yr.	Other than annual requirement for electricity, impacts would be the same as for the baseline incineration alternative. Annual requirement (60Gwh/yr) would be approximately three times greater than for the baseline incineration alternative.	Other than annual requirement for electricity, impacts would be the same as for the baseline incineration alternative. Annual requirement (26Gwh/yr) would be approximately the same as for the baseline incineration alternative.	Other than annual requirement for electricity, impacts would be the same as for the baseline incineration alternative. Annual requirement (122Gwh/yr) would be approximately six times greater than for the baseline incineration alternative.	No change in electrical power supply or use.

Table ES.2. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Natural gas (See Sect. 4.5)	Primary fuel for operations. Annual use of 550 million ft^3 can be met by supplier and supported by new pipeline and connections. No significant impact.	Other than annual requirement for natural gas, impacts would be the same as for the baseline incineration alternative. Annual requirement (52 million ft^3) would be approximately one-tenth as much as the baseline incineration alternative.	Other than annual requirement for natural gas, impacts would be the same as for the baseline incineration alternative. Annual requirement (138 million ft^3) would be approximately one-fourth as much as the baseline incineration alternative.	Other than annual requirement for natural gas, impacts would be the same as for the baseline incineration alternative. Annual requirement (52 million ft^3) would be approximately one-tenth as much as the baseline incineration alternative.	No changes to natural gas supply or use.
Waste management (See Sect. 4.6.3)	Energetics destroyed on-site in DFS.	Energetics would be neutralized on-site.	Energetics would be neutralized on-site.	Energetics would be neutralized on-site.	Wastes would continue to be generated during continuing inspection and maintenance activities. Continued degradation of agent containers would likely generate slowly increasing amounts of waste. Estimated 7.5 tons/yr solid and 2.5 tons/yr liquid hazardous wastes produced and disposed of in TSDF
Hazardous solid wastes	Approximately 2,330 total tons of hazardous solid wastes, including ash residues from the furnace systems, brine salts, and spent charcoal filters would be generated, stored, and taken to an off-site permitted TSDF.	Approximately 6,700 total tons of hazardous solid wastes, including brine salts, aluminum oxide and residue from spent carbon filters would be generated, stored, and shipped to an off-site permitted TSDF.	Approximately 6,880 total tons of hazardous solid wastes, including brine salts aluminum oxide and residue from spent carbon filters would be generated, stored, and shipped to an off-site permitted TSDF.	Approximately 995 total tons of hazardous solid wastes, including brine salts anolyte-catholyte and residue from spent carbon filters waste would be generated, stored, and shipped to an off-site permitted TSDF.	

Table ES.2. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Hazardous liquid wastes	A small quantity of laboratory wastes and spent hydraulic fluids would be generated, stored, and taken to an off-site permitted TSDF.	Process liquids would be recycled. A small quantity of laboratory wastes would be generated, stored, and taken to an off-site permitted TSDF.	Process liquids would be recycled. A small quantity of laboratory wastes would be generated, stored, and taken to an off-site permitted TSDF.	Except for dilute nitric acid, process liquids would be recycled. A small quantity of laboratory wastes would be generated, stored, and taken to an off-site permitted TSDF.	
Nonhazardous wastes	A total of approximately 11.7 million gal of sewage and 2,150 tons of nonhazardous solid wastes, including metals and solids and uncontaminated wood dunnage would be generated. Sewage would be treated and discharged to Muddy Creek or pumped to the existing infrastructure in Richmond, and solid wastes would be disposed of in an off-site permitted landfill.	A total of approximately 11.6 million gal of sewage and 2,015 tons of nonhazardous solid wastes, including metals and solids, would be generated. Sewage would be treated and discharged to Muddy Creek or pumped to the existing infrastructure in Richmond or at BGAD, and solid wastes would be disposed of in a permitted landfill.	A total of approximately 9.7 million gal of sewage and 7,980 tons of nonhazardous solid wastes, including metals and solids, would be generated. Sewage would be treated and discharged to Muddy Creek or pumped to the existing infrastructure in Richmond or at BGAD, and solid wastes would be disposed of in a permitted landfill.	A total of approximately 9.7 million gal of sewage and 4,420 tons of nonhazardous solid wastes, including metals and solids, would be generated. Sewage would be treated and discharged to Muddy Creek or pumped to the existing infrastructure in Richmond or at BGAD, and solid wastes would be disposed of in a permitted landfill.	

Table ES.2. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Air quality-criteria pollutants (See Sect. 4.7)	Low level emissions of $N0_X$, $S0_2$, CO, PM_{10}, $PM_{2.5}$, and VOCs, and negligible impacts and no exceedances of NAAQS expected other than for $PM_{2.5}$, for which background already exceeds NAAQS. Negligible concentrations of heavy metals would be emitted.	Expect emissions equal to or less than baseline incineration. Negligible impacts and no exceedances of NAAQS expected other than for $PM_{2.5}$, for which background already exceeds NAAQS. Negligible concentrations of heavy metals would be emitted.	Expect emissions equal to or less than baseline incineration but slightly more than other two non-incineration technologies. Negligible impacts and no exceedances of NAAQS expected other than for $PM_{2.5}$, for which background already exceeds NAAQS. Negligible concentrations of heavy metals would be emitted.	Expect emissions equal to or less than baseline incineration. Negligible impacts and no exceedances of NAAQS expected other than for $PM_{2.5}$, for which background already exceeds NAAQS. Negligible concentrations of heavy metals would be emitted.	No changes in emissions of criteria pollutants.

Table ES.2. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Air quality-hazardous and toxic substances (See Sect. 4.8 and Appendices J and K)	No significant impacts and no exceedances of limits expected. Destruction of PCBs in M55 rocket firing tubes will be monitored and managed to be in compliance with TSCA regulations. Emissions of hazardous air pollutants, including chemical agent, to the atmosphere during process fluctuations mitigated by carbon filter banks. Failure of all filters in carbon banks would result in concentrations less than 3% of the allowable concentrations for general public exposure established by the CDC.	Impacts similar to those for baseline incineration.	Impacts similar to those for baseline incineration.	Impacts similar to those for baseline incineration.	Possibility of an accident with potentially severe impacts remains with continued storage (see impacts from potential accidents and Sect. 4.22).

Table ES.2. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Human health and safety (See Sect. 4.9 and Appendix E)	No exceedances of emissions standards or exposure levels expected on the basis of operating experience at other chemical agent destruction facilities. Site-specific human health risk assessment will be conducted as part of the RCRA permitting process to ensure no adverse health effects.	Based on limited demonstration testing, no exceedances of emissions standards or exposure levels expected.	Based on limited demonstration testing, no exceedances of emissions standards or exposure levels expected.	Based on limited demonstration testing, no exceedances of emissions standards or exposure levels expected.	Small, but well understood risks to workers continue, but no health impacts likely.
Noise (See Sect. 4.10)	Less than 45 dB(A) at nearest residence. No impacts expected.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	Sound levels remain at present low levels.
Visual resources (see Sect. 4.11)	No significant visual impact. Entrance gate and parking area would continue to be visible, and possibility of seeing stack and small steam plume.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	No change in visual character of BGAD.

Table ES.2. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Geology and soils (See Sect. 4.12)	No disturbance or contamination under routine operations.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	Continued absence of impacts to soils.
Groundwater (See Sect. 4.13)	Negligible impacts to groundwater. No use of groundwater required for operations. Best management practices should minimize potential for contamination due to accidental spills or leaks of hazardous materials.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	No impacts to groundwater.
Surface water (See Sect. 4.14)	18 million gal annual process water demand for operations within capacity of Lake Vega, as is annual potable water demand of 6.4 million gal. No process effluents would be released to surface water from incident-free operations.	Approximately one-third of the demand for process water of the baseline incineration alternative . Other impacts not significantly different than for baseline incineration alternative.	Not significantly different from baseline incineration alternative.	Least process water demand (1 million gal/yr). Other impacts not significantly different than for baseline incineration alternative.	Possibility for impacts from a storage accident would remain (See Sect. 4.22).

Table ES.2. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Terrestrial ecology (See Sect. 4.15)	Impacts would be negligible under routine operations. A site-specific screening level ecological risk assessment would be prepared to validate preliminary conclusions.	Impacts the same as for the baseline incineration alternative. A screening level ecological risk assessment would be prepared to validate preliminary conclusions.	Impacts the same as for the baseline incineration alternative. A screening level ecological risk assessment would be prepared to validate preliminary conclusions.	Impacts the same as for the baseline incineration alternative. A screening level ecological risk assessment would be prepared to validate preliminary conclusions.	No change from current low-level impacts of continued storage.
Aquatic ecology (See Sect. 4.16)	Impacts would be negligible under routine operations. A site-specific screening level ecological risk assessment would be prepared to validate preliminary conclusions.	Impacts the same as for the baseline incineration alternative. A screening level ecological risk assessment would be prepared to validate preliminary conclusions.	Impacts the same as for the baseline incineration alternative. A screening level ecological risk assessment would be prepared to validate preliminary conclusions.	Impacts the same as for the baseline incineration alternative. A screening level ecological risk assessment would be prepared to validate preliminary conclusions.	Normal monitoring and maintenance would not affect aquatic habitats.
Protected species (See Sect. 4.17 and Appendix F)	Protected species should not be adversely affected by routine operations.	Impacts the same as for the baseline incineration alternative.	Impacts the same as for the baseline incineration alternative.	Impacts the same as for the baseline incineration alternative.	No impacts would occur to protected species.

Table ES.2. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Wetlands (See Sect. 4.18)	Routine operations could result in minor impacts on nearby downwind wetlands and their biota via the deposition of minute quantities of pollutants. Some new wetland habitat could be created below the outfall from the new sanitary waste treatment facility.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No impacts on wetlands would occur.
Archaeological, cultural and historic resources (See Sect. 4.19 and Appendix F)	No impacts expected from routine operations.	No impacts expected from routine operations.	No impacts expected from routine operations.	No impacts expected from routine operations.	No impacts to resources.
Socioeconomics (See Sect. 4.20)	No significant impacts to public services, housing, or infrastructure expected.	No significant impacts to public services, housing, or infrastructure expected.	No significant impacts to public services, housing, or infrastructure expected.	No significant impacts to public services, housing, or infrastructure expected.	No change in socioeconomic effects of BGAD.
Population	Inmigration of 1,338	Inmigration of 1,338	Inmigration of 1,338	Inmigration of 1,338	

Table ES.2. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Employment	Direct and indirect employment 1,400	Direct and indirect employment 1,450	Direct and indirect employment 1,360	Direct and indirect employment 1,440	
Personal income	$66.0 million	$68.7 million	$63.8 million	$68.1 million	
Housing	No adverse impacts unless more than 75% of workers sought to purchase houses in Madison County, leading to limited choices and higher prices or decisions to locate outside the county.	Same impacts as for baseline incineration alternative.	Same impacts as for baseline incineration alternative.	Same impacts as for baseline incineration alternative.	
Schools	No adverse impacts	No adverse impacts	No adverse impacts	No adverse impacts	
Public services	Possible exceedance of sewage treatment capacity in Berea expected during construction alleviated by expansion of Berea capacity; no adverse impacts.	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	
Public finances	Minimal impacts	Minimal impacts	Minimal impacts	Minimal impacts	

Table ES.2. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Traffic	No substantial impacts are expected if the selected access road to BGAD is option 3 (on KY 52), a traffic signal is provided on KY 52 if needed, and the planned highway improvements are implemented on schedule.	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	
Agriculture	No adverse impacts on area agricultural resources expected.	No adverse impacts on area agricultural resources expected.	No adverse impacts on area agricultural resources expected.	No adverse impacts on area agricultural resources expected.	
Environmental justice	No high and adverse impacts expected to accrue disproportionately to minority or low income populations. Could provide jobs and income to subgroups of area.	Same impacts as for baseline incineration alternative.	Same impacts as for baseline incineration alternative.	Same impacts as for baseline incineration alternative.	No project-related impacts would occur.

Table ES.3. Summary and comparison of the impacts of hypothetical accidents for all alternative

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
All resource categories (See Sect.4.22 and Appendix H)	An earthquake affecting 8-inch GB projectiles in the munitions demilitarization building, the unpack area, and the container handling building (CHB) could produce airborne concentrations up to 16 miles downwind. Potential off-post fatalities could be up to 2,300 under unfavorable meteorological conditions or up to 180 fatalities under more typical meteorological conditions. Deposition of chemical agent could also contaminate off-post land areas, crops, habitat, surface waters, and cultural resources.	Because munition and agent quantities stored pending processing would be similar to those for the baseline incineration alternative, the potential impacts would be similar to the impacts of the baseline incineration alternative.	Because munition and agent quantities stored pending processing would be similar to those for the baseline incineration alternative, the potential impacts would be similar to the impacts of the baseline incineration alternative.	Because munition and agent quantities stored pending processing would be similar to those for the baseline incineration alternative, the potential impacts would be similar to the impacts of the baseline incineration alternative.	A lightning strike to a storage igloo could produce lethal airborne concentrations up to 31 miles downwind. Potential off-post fatalities could be up to 5,900 under unfavorable meteorological conditions or up to 2,200 under more typical meteorological conditions. Deposition of chemical agent could also contaminate off-post land areas, crops, habitat, surface waters, and cultural resources.

1. PURPOSE OF AND NEED FOR THE PROPOSED ACTION

This Final Environmental Impact Statement (FEIS) has been prepared by the U.S. Army's Program Manager for Chemical Demilitarization (PMCD) to address the Army's proposal to design, construct, operate, and close a facility to destroy the stockpile of chemical munitions currently stored at the Blue Grass Army Depot (BGAD) near Richmond, Kentucky. This chapter

- introduces the Army's national destruction program,
- describes the purpose and need for the proposed destruction activities at BGAD,
- discusses the scope of this FEIS and its approach to impact analysis,
- outlines the legal framework for the proposed destruction actions,
- explains the process for public involvement and participation, and
- discusses a separate EIS addressing pilot testing of alternatives (i.e., non-incineration technologies) to destroy the inventory of chemical munitions stored at BGAD.

The EIS addressing the non-incineration alternatives was prepared by the Army's Assembled Chemical Weapons Assessment (ACWA) program. Its purpose is to assess the suitability of several U.S. storage depots, including BGAD, for the construction and operation of one or more pilot facilities to test non-incineration technologies' capability of destroying chemical munitions (i.e., those configured with chemical agent and explosive components).

1.1 INTRODUCTION

Under a Congressional directive, the U.S. Department of the Army is currently destroying the nation's stockpile of lethal chemical agents and munitions, including both nerve and blister agents stored in the continental United States (CONUS). In January 1993, the Chemical Weapons Convention (CWC), an international treaty requiring the destruction of chemical weapons, was signed by 65 nations. The CWC set the deadline for completing destruction of chemical weapons as 10 years after ratification of the treaty by the required number of nations. On April 24, 1997, the Senate of the United States, one of the original signatory nations, ratified the CWC, which to date has been signed by over 130 nations. The necessary number of ratifications was obtained on April 29, 1997; hence, the international deadline for destroying chemical weapons is April 29, 2007; and the U.S. law regarding destruction of the U.S. stockpile was revised to match the April 29, 2007, deadline date.

About 523 tons of chemical agent are stored in more than 101,000 munitions at BGAD. Before destruction operations began at other installations, the quantity at BGAD represented about 1.7% by agent weight of the total U.S. Stockpile of lethal unitary chemical weapons.[1]

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[1] The term "unitary" refers to the use of a single, hazardous compound (i.e., chemical agent) in the munitions. In contrast, "binary" chemical weapons use two relatively nonhazardous compounds that are mixed together to form a hazardous or lethal compound after the weapon is fired or released.

The chemical agents stored at BGAD include all types in the nation's stockpile — nerve agents GB (sarin) and VX and the blister agent H (mustard). Additional information on these chemical agents and the munitions stored at BGAD is presented in Sect. 2.2.1.

As shown in Fig. 1.1, BGAD is one of eight CONUS Army installations where lethal agents and munitions are stored and where destruction is underway or proposed. The other Army installations are:

- Anniston Army Depot (ANAD), near Anniston, Alabama;
- Deseret Chemical Depot (DCD), near Tooele, Utah;
- Aberdeen Proving Ground (APG), near Edgewood, Maryland;
- Newport Chemical Depot (NECD), near Newport, Indiana;
- Pine Bluff Arsenal (PBA), near Pine Bluff, Arkansas;
- Pueblo Chemical Depot (PCD), near Pueblo, Colorado; and
- Umatilla Chemical Depot (UMCD), near Hermiston, Oregon.

Through Public Law 99-145, the U.S. Congress has directed the Army to accomplish the destruction of chemical agents and munitions in a manner that provides for (1) maximum protection of the environment, the general public, and the personnel involved in the destruction process; (2) adequate and safe facilities designed solely for destroying the lethal chemical stockpile; and (3) cleanup, dismantling, and disposal of the facilities when the destruction program is complete.

Under the Congressional directive, PMCD was established for decision making and oversight of the Chemical Stockpile Disposal Program (CSDP). In compliance with the National Environmental Policy Act (NEPA), a Final Programmatic Environmental Impact Statement (FPEIS) was completed for the CSDP in 1988. The Record of Decision (ROD) resulting from the FPEIS identified on-site incineration as the preferred method for destroying the stockpile. Based on the findings of that ROD and substantial previous experience in munitions destruction at several facilities (see Appendix C), the Army initially selected high temperature incineration as the method for destroying chemical agents under the Congressional mandate. The National Research Council (NRC) has endorsed incineration as the method of choice for destroying the stockpile of chemical agents and munitions (NRC 1994).

Following publication of the FPEIS, the Johnston Atoll Chemical Agent Disposal System (JACADS) facility was constructed and became operational in 1990. JACADS, the U.S. Army's first full-scale plant capable of destroying all types of munitions and agents, is located on Johnston Island in the central Pacific Ocean about 825 miles southwest of Honolulu, Hawaii. On November 29, 2000, the JACADS facility successfully completed the destruction of the entire chemical agent and munition inventory (i.e., 2,031 tons of agent] on Johnston Atoll. The JACADS facility employed a disassembly and incineration process involving four incinerators (referred to as "baseline technology") as the best available method for meeting environmental and safety requirements. The JACADS munition disassembly equipment and incinerators were developed as a result of experience gained with destroying munitions at Rocky Mountain Arsenal (RMA) and with the Chemical Agent Munitions Disposal System (CAMDS) at Tooele, Utah. More recently, the Army's second operational, full-scale, baseline facility at DCD began destroying chemical weapons in August 1996.

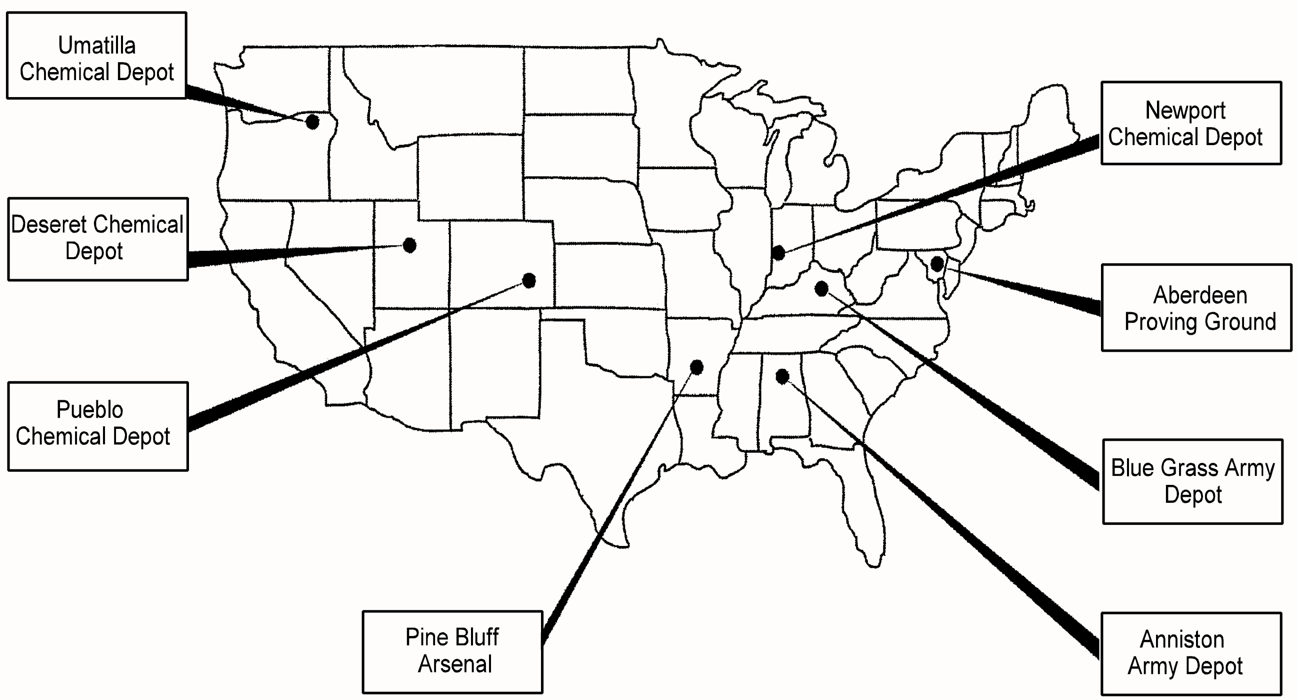

Figure 1.1. Distribution of the U.S. Army's stockpile of lethal unitary chemical agents and munitions throughout the continental United States.

Through November 2000, the Army has successfully destroyed over 6,840 tons of chemical warfare agents at the JACADS and Tooele facilities including over three times as much chemical agent (i.e., individual quantities of agents GB, VX, and H, respectively) as is currently stored at BGAD. Destruction of the total stockpile of nerve and blister agents on Johnston Atoll by JACADS was completed in November 2000, and the JACADS facility is undergoing closure in compliance with the Resource Conservation and Recovery Act (RCRA). Experience at JACADS has provided significant valuable experience and information concerning the destruction of chemical munitions.

During this time, work has continued toward the development of alternative technologies for destruction of chemical weapons. PMCD has facilities under construction to pilot test neutralization with supercritical water oxidation (SCWO) at NECD and neutralization with biotreatment at APG.[2] Additionally, work has continued toward the development of other alternative technologies for destroying chemical weapons. With the establishment of the Assembled Chemical Weapons Assessment (ACWA) program for developing technological alternatives to incineration, the destruction technologies for the BGAD inventory have been expanded to include four non-incineration technology alternatives identified by ACWA (Sect. 1.5).

1.2 PURPOSE AND NEED

All the chemical agents and munitions currently in storage at BGAD were manufactured prior to 1968. Some of them are in good condition, but others are in various stages of deterioration, and a few have developed leaks. Stockpile munitions are monitored through a regular inspection program. All items found leaking have been either repaired on-site and decontaminated or placed in specialized overpack containers and stored separately from non-leaking munitions.

The purpose of the proposed destruction activities at BGAD is to (1) complete the destruction of the BGAD inventory of chemical agents in compliance with U.S. Public Law 99-145 and the CWC and (2) conduct the destruction activities in a safe and environmentally sound manner. The need for the proposed action is to eliminate the risk to the public and to the environment from continued deterioration of the munitions in storage and to destroy obsolete and containerized munitions and agents.

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[2]Recent technical problems with the reliability of the SCWO technology have been discovered since the publication of the Newport Chemical Agent Disposal Facility FEIS. Although the technical problems appear to be solvable, a significant time delay appears inevitable. This has led the PMCD to alternative arrangements (i.e., off-site treatment and disposal at permitted treatment, storage, and disposal facilities) for the final disposal of the neutralized hydrolysate. PMCD has completed construction of a neutralization facility at APG.

1.3 SCOPE

The Army has prepared this FEIS to assess the potential health and environmental impacts of the construction, operation, and closure of a facility to destroy the chemical agents and munitions stored at BGAD. The specific goal of the current analysis is to identify and compare the potential environmental impacts among the alternatives that could accomplish the destruction of the stockpile at BGAD. In addition, the risks and consequences of possible accidental releases of chemical agent are described and compared among alternatives, including no action.

Four alternatives are addressed in this FEIS for possible use in destroying the BGAD stockpile: (1) the baseline incineration process used by the Army at JACADS and currently in use by the Army at DCD, and three non-incineration technology alternatives—(2) chemical neutralization followed by supercritical water oxidation (SCWO), (3) chemical neutralization followed by SCWO and gas phase chemical reduction, and (4) the Silver II technology (electrochemical oxidation). The Army believes that it is reasonable to limit non-incineration alternatives evaluated in this EIS to those that survived the thorough testing and evaluation conducted by the ACWA program (i.e., through Demonstration I and II and Engineering Design Studies). Any of these incineration or nonincineration technology alternatives must be capable of destroying both the chemical agents and the munitions themselves, some of which contain explosive components. Detailed descriptions of each of these alternatives are presented in Sect. 3.

As required by regulations of the President’s Council on Environmental Quality (CEQ), the no action alternative (i.e., not destroying the BGAD stockpile) is also addressed as a fifth alternative in this FEIS, even though it is not a viable alternative because its implementation is precluded by Public Law 99-145. Additionally, risk assessments previously conducted by the Army show that not destroying the BGAD stockpile (under the no-action alternative) would result in continued risks for the members of the public around BGAD.

The baseline incineration technology is a demonstrated destruction process. The lessons learned in destruction of chemical munitions at JACADS have resulted in proposed modifications to portions of the baseline process which could be tailored to the BGAD stockpile. Trial burns would be conducted in the baseline incineration facility before full-scale destruction operations could begin. Initial tests would be conducted without agent; trial burns would also be conducted with each of the types of agent stored at BGAD prior to the actual full-scale destruction of each agent in the proposed facility. If the test burn results were acceptable, the Commonwealth of Kentucky would impose final operating conditions as necessary, based largely on the requirements of the Resource Conservation and Recovery Act (RCRA). As long as chemical agent destruction operations continued, the Army would be subject to a variety of reporting, inspection, notification, and other permit requirements of the Commonwealth of Kentucky. RCRA also requires the Army to submit annual and biannual reports to the Commonwealth of Kentucky.

If any of the non-incineration technologies evaluated in this FEIS were to be selected for implementation at BGAD, a pilot test facility would be constructed and operated prior to full-scale stockpile destruction operations. Prior to operation, a non-incineration technology would undergo trial operations comparable to trial burns for the baseline incineration technology to support regulatory oversight and subsequent systemization of the facility. This FEIS incorporates by reference analyses from the ACWA DEIS and FEIS for these alternatives (see also Sect. 1.5).

The ACWA DEIS and FEIS provide estimated emissions rates and resource requirements for the non-incineration technologies. Thus, information concerning these alternatives has been incorporated into this FEIS for comparison to the known emission rates of the baseline incineration alternative. In order to bound the potential environmental impacts from pilot testing the non-incineration technologies, the ACWA DEIS and FEIS assume an 18.6-month operational period for the neutralization/SCWO alternative and a 15.5-month operational period for the Neut/SCWO/GPCR and Silver II (electrochemical oxidation) alternatives, which would accommodate the complete destruction of the BGAD stockpile.

The results of the analyses presented in this Final Environmental Impact Statement (FEIS) show that any of the four chemical munitions destruction alternatives would be environmentally acceptable for destruction of the stockpile stored at Blue Grass Army Depot. Neutralization followed by supercritical water oxidation is the agency's preferred alternative. The Army will continue to look for ways to accelerate the process. Additional NEPA documentation will be completed as required. Following a 30-day comment period on this FEIS, the Department of the Army, on behalf of the Department of Defense, considering the results of this EIS along with other factors including cost, schedule, and public opinion, will publish the Record of Decision in the *Federal Register*.

1.4 PUBLIC INVOLVEMENT AND THE NEPA PROCESS

For the CSDP, the NEPA review process has been structured to address both programmatic and site-specific decision making. Programmatic-level decision making, which was completed in 1988, focused on alternative strategies, including locations and the destruction technologies for destroying the stockpile. The programmatic decisions regarding on-site destruction versus off-site transport to another installation were national in scope and involved a number of separate but related issues and actions. Site-specific decision making is intended to focus on implementation of the programmatic strategy at a particular site and is not national in scope. This two-level NEPA approach was identified and acknowledged early in the NEPA process for the CSDP (A. A. Hill, Chairman, Council on Environmental Quality, Washington, D.C., letter to A. M. Hoeber, Deputy Under Secretary of the Army, Washington, D.C., June 2, 1986).

Implementation of this NEPA strategy for the CSDP began in January 1986 with the publication of a Notice of Intent (NOI) to prepare a Programmatic EIS. In July 1986, the Army issued a Draft Programmatic EIS for the CSDP. In response to comments on that Draft EIS and after numerous supporting studies were conducted during a 2-year period, an FPEIS was issued for the CSDP in January 1988 (U.S. Army 1988). The FPEIS identified on-site incineration as the environmentally preferred alternative. Subsequently, in the ROD for the FPEIS, the Army selected on-site incineration as its preferred alternative [*Federal Register* 53 5816-17 (Feb. 26, 1988)]. Under the Congressional directive, this FEIS—in concert with the ACWA FEIS—broadens the list of technologies under consideration to include pilot testing of non-incineration technologies secondary treatment options.

The PMCD has worked to establish and coordinate an Environmental Working Integrated Process Team (WIPT) to enhance communication among the U.S. Army, Commonwealth of Kentucky, local officials, and the public in the resolution of environmental issues, particularly related to permitting processes and NEPA. Specific steps are outlined below, which also provide opportunity for public involvement in the preparation of this FEIS. These steps are based on NEPA and its implementing regulations as described in Section 1.7.

1.4.1 Notice of Intent

The first step in the preparation of a DEIS is the publication in the *Federal Register* of an NOI to prepare the DEIS. The publication of the NOI initiates the first opportunity for public involvement in the process. The NOI describes the proposed action, invites the public to participate in the scoping process for the DEIS, provides the location(s) and times for planned scoping meetings, and lists the name and address of the person to be contacted for further information.

The NOI announces the alternatives under consideration at the time the NOI is published. NEPA is a decision making tool, and as the process proceeds, alternatives may be added or eliminated depending on the information collected. New alternatives may also be identified through the public scoping process. NEPA requires Federal agencies to "rigorously explore and objectively evaluate all reasonable alternatives and, for alternatives which are eliminated from detailed study, briefly discuss the reasons for their having been eliminated" [40 CFR 1502.14(a)].

The NOI for the DEIS was published in the *Federal Register* on December 4, 2000 (65 *Federal Register* 75677). A copy of the NOI is provided in Appendix A.

1.4.2 Scoping Process

1.4.2.1 Mailing list

A project mailing list was developed early in the public participation process. The initial list included members of the general public and special interest groups who had expressed interest in prior environmental documents pertaining to the destruction of chemical weapons; federal, state, and local agencies and elected officials; minority, disadvantaged, and Native American groups; public libraries; and regional, state, and local media. This list has been maintained and updated throughout the process, and any additional individuals or organizations that express interest in the process are added to it.

1.4.2.2 Public scoping process

Public scoping meetings have been held to inform the public about the proposed action and to solicit public input concerning the issues to be addressed in the DEIS. The public scoping process assists the DEIS preparers in focusing on those significant environmental issues deserving of detailed study or analysis.

On January 9, 2001, the Army held two public scoping meetings for the DEIS as well as the related ACWA EIS in the Madison County Extension Office in Richmond, Kentucky. The purpose of the meetings was to seek public input for identifying the significant issues related to the proposed action, which should be addressed in the DEIS. The scoping process involved public participation, including federal, Commonwealth of Kentucky, and local agencies, as well as residents within the potentially affected area. At the meeting, several prepared statements were presented by participants, and copies of these presentations were provided to the Army. Additionally, oral comments were transcribed by court reporters, notes were taken by EIS preparers concerning individual comments, and forms were made available to participants for written comments. All of the comments received, including those provided in correspondence to the Army, have been considered in the continuation of the EIS process.

1.4.2.3 Scoping results and key issues

Input was received during the scoping process for the DEIS in the form of statements delivered at the public scoping meetings, correspondence from participants, and comment forms mailed by participants to the Army. Much of the input was provided in the context of support for or opposition to the baseline incineration technology and the alternative technologies. Although support and opposition, by themselves, may be considered in making the final determination (see Sect. 1.4.5), they are not fully evaluated in this FEIS. The rationale for those perspectives, however, is germane, and efforts have been made to assure that the rationale for support for or opposition to all technologies considered in this FEIS have been considered.

The following list provides a summary of issues raised during the scoping process. These issues were taken into consideration in developing the scope of this FEIS.

- consideration of the full range of available destruction technologies, including the presentation of reliable, comprehensive data for all viable technologies;
- the rationale for the concurrent preparation of two EISs for BGAD by two Army programs, PMCD and ACWA, including clear definition of the purposes and scopes of the two EISs;
- permitting requirements and expected schedules for all technologies evaluated in this FEIS;
- use of actual performance data from the Army's JACADS and Tooele Chemical Demilitarization Facility (TOCDF) incineration facilities under all operating conditions including "upset" and "shutdown" conditions (rather than trial burn assessments and processing estimates);
- releases and by-products associated with the various technologies for destroying the chemical weapons stockpile at BGAD; potential effects of these substances on human health and development at all life stages, including those with infirmities; the effects of exposure to chronic low-levels, including below standard levels; effects of heavy metals, dioxins, polychlorinated biphenyls, and other persistent organics; use of all applicable rulemaking requirements under Kentucky Law and the latest EPA Human Health Risk Assessment (HHRA) Guidance;
- potential risks to workers during the construction, systemization, operations and closure of all destruction options;
- worker health and safety incidents from the JACADS and TOCDF incineration facilities, as well as from facilities under construction;
- potential impacts to surface water, wetlands, and floodplains; potential for contamination and/or depletion of groundwater resources;
- potential direct and indirect impacts to fish and wildlife and their habitats; potential direct and indirect impacts to Federal and State-listed endangered and threatened species, migratory birds, and aquatic communities; description of protective measures and mitigative measures that will be included to avoid or minimize adverse impacts to fish and wildlife resources; detailed biological assessment containing an evaluation of selected project locations and

designs and a determination of effect for the running buffalo clover (a federally protected plant species);
- risks, and the costs and benefits associated with the technology alternatives;
- the potential cumulative and direct impacts to plants, animals, and ecosystems; bioaccumulation of products of incomplete combustion;
- potential for impacts on agriculture and agricultural products;
- storage and treatment/disposal of waste products (secondary wastes);
- post operations plans including the fate of the facility constructed (whether full-scale destruction or pilot plant) after completion of destruction operations at BGAD;
- socioeconomic impacts to the surrounding area, including land use, housing, and economic health; environmental justice considerations; cultural and archaeological resources;
- current procedures for monitoring stored agents and munitions; monitoring and inspection during destruction operations;
- need for road construction;
- compliance of the proposed action with applicable laws and regulations, including the control requirements of KRS 224.50-130 during any malfunctions, upsets, or unplanned shutdowns;
- adequacy of installation emergency planning capabilities; and
- consideration of operational experience with incineration; estimates based on worst-case assumptions.

1.4.3 Notice of Availability for DEIS

Following the scoping process, the DEIS is prepared, copies are circulated to other government agencies and to interested members of the public, and a notice of availability (NOA) of the DEIS for public comment is published in the *Federal Register*. Public meetings are held to receive comments of stakeholders and interested parties concerning the DEIS, and a minimum of 45 days must be allowed for the public to comment on the DEIS.

The NOA for the DEIS was published in the *Federal Register* on May 31, 2002, and copies of the DEIS were made available for public review. A 45-day comment period started with the publication of the NOA. Public meetings were held at Eastern Kentucky University in Richmond, Kentucky, on July 11, 2002. The comment period ended on July 15, 2002.

1.4.4 Notice of Availability for FEIS

All comments received on the DEIS are displayed, considered, and addressed in this Final EIS (FEIS). Upon completion of the FEIS, a NOA for that document will be published in the *Federal Register*. A minimum of 30 days must be allowed for final review of the FEIS prior to publication of the ROD.

1.4.5 Record of Decision

After full public review of the FEIS, the concluding step in the NEPA process is the preparation and publication of a ROD for the proposed action. The ROD will identify all alternatives considered by the Army in reaching its decision, specifying the alternative or alternatives which were considered to be environmentally preferable. The Army may discuss differences among alternatives based on other relevant factors, including economic and technical considerations and statutory missions. The Army may also identify and discuss all factors including any essential considerations of national policy (for example, the CWC) which were balanced in making its decision and state how those considerations entered into its final decision. The process for making the decision about which technology to use to destroy the chemical munitions stockpile stored at BGAD, including the relationship of the ROD following the publication of the FEIS for this program, to the ACWA program, is presented below.

1.4.6 Defense Acquisition Executive Decision Process

A decision on which of the alternatives will be implemented in carrying out the proposed action (destruction of the chemical munitions stored at BGAD) will be made by a Department of Defense Defense Acquisition Executive (DAE) through a process that will consider a wide range of factors and will incorporate the review and input of diverse organizations as well as the public. The factors include, but are not limited to, environmental considerations (including the impacts of alternatives assessed through the NEPA process), laws and regulations, mission needs (at BGAD as well as from a national perspective), implications for compliance with the CWC, budget considerations, schedule, public concerns, and political concerns.

The process that has been established to select the technology to be used to destroy the chemical weapons stored at BGAD is displayed in Fig. 1.2. As indicated in that figure, various integrated process teams established within the Department of Defense as part of the DAE Review of the Chemical Demilitarization Program will review information and analyses and develop further analyses and recommendations that will be forwarded up the line to the ultimate decision-maker. These integrated process teams include: (a) three Working Integrated Process Teams (WIPTs) co-chaired by PMCD and PMACWA representatives, one each for cost and schedule, programmatic and acquisition, and safety and environmental factors, (b) an Integrating Integrated Process Team (IIPT) co-chaired by PMCD and PMACWA representatives, and (c) an Over-Arching Integrated Process Team (OIPT) chaired by the Director of Science and Technology for the Department of Defense.

In addition to the analyses, results, and conclusions provided in this EIS and the ACWA EIS, these teams will review analyses, results, and conclusions identified in an independent cost and schedule assessment (being prepared by Mitretek), an independent safety assessment (being prepared by Mitretek), an independent technology evaluation (being prepared by the Army Materiel Systems Analysis Activity (AMSAA), an analysis by the Department of Defense's Cost Assessment Improvement Group (CAIG), and reviews prepared by the National Research Council (NRC). The integrated process teams will also consider input provided by the public through the Kentucky Citizens Advisory Commission (CAC). The OIPT will certify the viability of technology(ies) for BGAD and present its recommendations to the DAE for its consideration. The ROD for the technology to be implemented to destroy the chemical weapons stockpile at BGAD will be made by the DAB. If a non-incineration technology is selected for BGAD, Public Law 105-261 requires it to be certified. Independent analysis will need to be made then to certify that the technologies are as safe, cost effective, and timely as incineration.

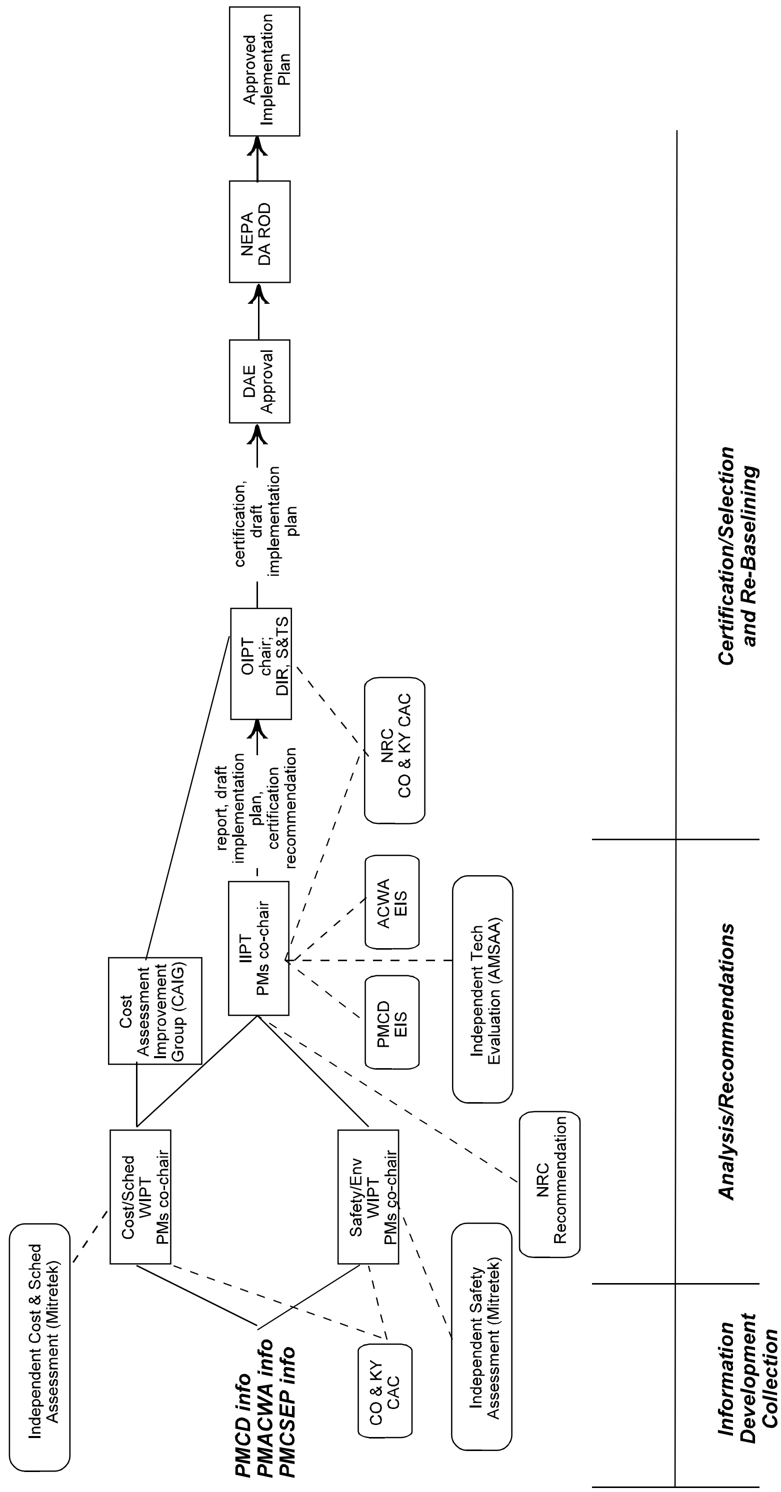

Figure 1.2. Defense Acquisition Executive (DAE) review process for selecting the technology for destroying the BGAD chemical weapons stockpile.

1.5 RELATION OF THIS FEIS TO ACWA ACTIONS

In September 1996, the NRC's committee on Alternative Chemical Disposal Technologies, which evaluated alternatives to incineration, issued a set of findings (NRC 1996). The Army evaluated the NRC's recommendations and, with approval from the Department of Defense (DOD), decided to proceed with pilot-scale testing of two alternative technologies at sites which store bulk agent in non-explosive configurations. PMCD currently has under construction a full-scale pilot facility to test chemical neutralization of the nerve agent VX with SCWO at NECD (U.S. Army 1998a), and a full-scale pilot facility to test chemical neutralization of the blister agent HD (which is very similar to the agent H stored at BGAD) with biotreatment at APG (U.S. Army 1998b).

Additionally, in 1996, Congress enacted Public Law 104-201, which directed DOD to conduct an assessment of the CSDP for destroying assembled chemical munitions and of the alternative destruction technologies and processes (other than incineration) that could be used for destroying the lethal chemical agents that are associated with these munitions. The law required that the assessment be conducted by a program manager not associated with the PMCD. Additionally, through the follow-up Public Law 104-208, the new program manager was required to identify and demonstrate no fewer than two alternatives to the baseline incineration process for destroying assembled chemical munitions. This law also prohibited any obligation of funds for the construction of incineration facilities at BGAD until the demonstrations had been completed and an assessment of results had been submitted to Congress (NRC 1999).

As a result of Public Laws 104-201 and 104-208, DOD created the ACWA program. The Program Manager for ACWA established the following three-phase program to bring at least two technologies to the demonstration stage as mandated by Congress:

- *Phase 1*. Develop evaluation criteria for assessing alternative technologies and issue a request for proposals (RFP) from industry of technologies for destroying assembled chemical weapons without using incineration.
- *Phase 2*. Assess the proposed technologies and select the most promising for demonstration.
- *Phase 3*. Demonstrate whether the selected technologies could destroy assembled chemical munitions.

In August 1997, after detailed evaluation criteria had been developed with extensive input from stakeholders, the Program Manager for ACWA issued an RFP calling for a total system solution for destroying assembled chemical weapons. Twelve proposals were submitted in response to the RFP, and seven were selected for possible demonstration. Because Public Law 104-201 required that DOD conduct the technology assessment in coordination with the NRC, the Program Manager for ACWA asked NRC to perform an independent technical review and evaluation of the seven technology packages that had passed DOD's initial screening criteria. DOD used the NRC review as one factor in determining whether to recommend further development and implementation of any of the technology packages in its report to Congress on September 30, 1999 (NRC 1999). Three technologies were selected from the list of seven:

- Burns and Roe plasma arc technology,
- General Atomics neutralization followed by SCWO, and
- Parsons-Honeywell neutralization followed by biotreatment process.

The Burns and Roe plasma arc technology was subsequently eliminated because of the lack of testing of the technology with actual chemical agent or propellant, the presence of significant unresolved engineering problems with the technology, and the concern that scale-up from the small units in existence to the very large units proposed would likely present significant scientific and engineering challenges (NRC 1999). The ACWA program has determined that the neutralization followed by biotreatment technology is not viable as a total solution to the destruction of assembled chemical weapons stored at BGAD because that technology cannot process the chemical weapons filled with nerve agent GB or VX stored at BGAD.

Pursuant to the direction in the Military Construction Appropriations Act, 2000, Public Law 106-52, section 131, the ACWA program conducted demonstrations of three technologies that did not receive demonstration contracts in July 1998. They were AEA Technology/CH2MHill (SILVER II), Foster Wheeler/Eco Logic/Kvaerner (Neutralization/Transpiring Wall Supercritical Water Oxidation/Gas Phase Chemical Reduction) and Teledyne-Commodore (Solvated Electron Technology). The demonstrations of these technologies are referred to as Demonstration II. The actual demonstrations of these three alternative technologies took place between July and October 2000. The evaluation of these demonstrations took place between October 2000 and February 2001. The evaluation of the Demonstration II technologies was conducted in a similar manner and using the same criteria to those of the Demonstration I technologies.[3] Both the Silver II and the neutralization/transpiring wall SCWO followed by gas phase chemical reduction technologies were validated by the ACWA program as a result of the Demonstration II evaluation, but the solvated electron technology was not validated due to the lack of demonstration testing.

In summary, the ACWA program has evaluated six alternative technologies to destroy the assembled chemical weapons stored at BGAD. ACWA has determined that three of those technologies may be viable for pilot testing at BGAD:

- neutralization followed by supercritical water oxidation,
- neutralization followed by supercritical water oxidation with gas phase chemical reduction, and
- electrochemical oxidation with silver and nitric acid (Silver II™).

This PMCD FEIS and the ACWA FEIS serve complementary purposes. This PMCD FEIS continues the process that began when Congress established the PMCD in 1985. Current law requires the destruction of the chemical weapons stockpile by the CWC deadline of April

[3]These criteria are summarized into four categories: (1) process efficacy/process performance (performance, maturity, operability, process monitoring and control, and applicability); (2) safety/worker health and safety (worker safety, normal operations and facility accidents, and public safety during facility accidents as well as off-site);
(3) human health and environment (effluent characterization, completeness of effluent characterization, effluent management, permitting and compliance, and resource requirements); and (4) potential for implementation (life-cycle cost, schedule, and public acceptance).

2007. This requirement still exists, notwithstanding the establishment or success of the ACWA program.

The ACWA FEIS for follow-on pilot testing of successful ACWA program demonstration tests at BGAD and three other locations, pursuant to the process established by Congress in Public Laws 104-208 and 105-261, addresses a related purpose: to determine which technologies can be pilot tested and, if so, at which site or sites. The ACWA FEIS is different from this PMCD FEIS for BGAD in that its emphasis is on the feasibility of pilot testing one or more of the demonstrated and approved ACWA technologies, considering the unique characteristics of the four alternative installations, to include BGAD. The ACWA FEIS does not specifically address the use of a full-scale facility to accomplish destruction of the inventory stored at BGAD. As discussed above, destruction of the entire BGAD inventory of chemical agents and munitions is considered in this site-specific FEIS.

1.6 APPROACH TO IMPACT ANALYSIS

This FEIS identifies, documents, and evaluates the potential effects of construction, operation, and closure of a facility for destroying the inventory of chemical agents and munitions currently stored at BGAD. An interdisciplinary team of engineers, health and environmental scientists, air quality and water quality specialists, socioeconomic and cultural resource specialists, and planners performed the impact analyses. The team has identified resources and topical areas, incorporated information and comments from the scoping process, analyzed the proposed action against existing conditions, and determined the relevant beneficial and adverse effects associated with the proposed action.

Section 4 of this FEIS generally describes the existing conditions of the potentially affected resources and other areas of special interest on and in the vicinity of BGAD. The region of potential impact (ROI) consists primarily of Madison County, Kentucky, in which the BGAD is located. These conditions constitute the basis for the assessment of potential effects of stockpile destruction at BGAD. The potential effects of the proposed action are also described in Sect. 4. Mitigation measures that could reduce either the likelihood or severity of adverse impacts are identified where appropriate.

This FEIS analyzes direct impacts (i.e., those caused by or directly associated with implementation of the proposed action and occurring at the same time and place) and indirect impacts (i.e. Those caused by implementation of the proposed action and occurring later in time or farther removed in distance but still reasonably foreseeable). Examples of indirect effects include induced changes in the pattern of land use, population growth rates, and related effects on air and water and/or other natural systems, including ecosystems.

Cumulative effects (i.e., those resulting from the incremental impacts of the proposed action when added to other past, present, and future actions regardless of what agency, organization, or person undertakes such other actions) are also addressed. Cumulative effects include those that might result from individually minor, but collectively significant, actions taken over a period of time.

1.7 LEGAL FRAMEWORK FOR THIS ANALYSIS

Chemical agent destruction is being carried out in compliance with both a Congressional mandate and the CWC. The mandate was originally expressed in Title 14, Part B, Sect. 1412 of Public Law 99-145, the *Department of Defense Authorization Act* of 1986. Public Law 99-145 established the CSDP and directed that the destruction of the agents and munitions be accomplished by September 30, 1994. Amendments contained in subsequent Public Laws 100-456, 102-190, and 102-484 extended the deadline, the latter to December 31, 2004. Ratification of the CWC moved the deadline to April 29, 2007.

A federal undertaking, such as the CSDP, must also conform to the provisions of NEPA (Public Law 91-190, as amended by Public Laws 94-52 and 94-83). The procedural aspects of NEPA are implemented by regulations (40 CFR Parts 1500-1508) which were developed by the CEQ. As detailed in those regulations, a NEPA review is conducted to ensure that environmental factors are given adequate consideration early in the decision-making process. The NEPA process provides federal agencies with a firm basis for weighing the significance of the environmental impacts of a proposed action against those of alternatives prior to a decision on implementing any action.

This FEIS has been prepared in fulfillment of the CEQ regulations implementing NEPA. In addition, this document follows Army Regulation 200-2, which contains policy and procedures for implementing both NEPA and CEQ regulations within the U.S. Army system.

In addressing environmental considerations, the Army is guided by several relevant statues (and implementing regulations) and Executive Orders that establish standards and provide guidance on environmental and natural resources management and planning. These include, but are not limited to, the Clean Air Act, Clean Water Act, Noise Control Act, Endangered Species Act, Farmland Protection Policy Act, National Historic Preservation Act, Archaeological Resources Act, Resource Conservation and Recovery Act, Toxic substances Control Act, Executive Order 11988 (*Floodplain Management*), Executive Order 11990 (*Protection of Wetlands*), Executive Order 12088 *(Federal Compliance with Pollution Control Standards*), Executive Order 12898 (*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*), and Executive order 13045 (*Protection of Children from Environmental Health Risks and Safety Risks*). Where useful to better understanding, key provisions of these statutes and Executive Orders are described in more detail in the text of this FEIS.

While NEPA documents often include discussions of technology-related and regulatory issues, they are required to be prepared early in the planning process and, therefore, rarely contain design information sufficiently detailed for the various permits required by other statutes. Regulatory compliance for the CSDP will require the Army to submit a comprehensive, detailed description of the destruction technology selected, as well as the proposed pollution control measures along with the applications for permits to be issued pursuant to RCRA, the Clean Air Act (CAA), the Federal Water Pollution Control Act (FWPCA), and other applicable laws, regulations, and executive orders. Thus, separate regulatory documentation beyond the scope of this FEIS will be prepared, as necessary, independent of the NEPA review process for BGAD. The permitting process may also include public meetings to discuss pertinent environmental issues. In particular, the permitting process for RCRA will address issues that are related to the selected destruction technology; it will also provide an additional forum for public comment.

1.8 CITIZENS' ADVISORY COMMISSIONS

The establishment of Citizens' Advisory Commissions was authorized in the 1993 Defense Authorization Act (Public Law 102-484). According to the law, the Secretary of the Army must establish a Chemical Demilitarization Citizens' Advisory Commission for each state with a low-volume chemical stockpile site (NAAP, BGAD, and APG). The Secretary of the Army was also empowered to establish commissions for other stockpile sites, if requested by the governors of those states.

The Department of the Army provides a representative to meet with each commission to hear citizen and state concerns regarding the CSDP. Each commission is composed of nine members appointed by the governor. Seven of these individuals must be from areas within a 500-mile radius of the stockpile location, and the other two members must be from a state agency with direct responsibilities related to the program.

Each commission has a designated chairman and consists of unpaid volunteers. The commissions meet with the Army representative at least twice a year and will disband after the chemical weapons stockpiles in their respective states are destroyed. The governor of Kentucky has established a Citizens' Advisory Commission for BGAD.

1.9 REFERENCES

NRC (National Research Council) 1994. *Recommendations for the Disposal of Chemical Munitions and Agents*, National Academy Press, Washington, D.C.

NRC (National Research Council) 1996. *Review and Evaluation of Alternative Chemical Disposal Technologies*, National Academy Press, Washington, D.C.

NRC (National Research Council) 1999. *Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons*, National Academy Press, Washington, D.C.

U.S. Army 1988. *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Vols. 1 to 3, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

U.S. Army 1998a. *Final Environmental Impact Statement for Pilot Testing of Neutralization/Supercritical Water Oxidation of VX Agent at Newport Chemical Depot, Indiana*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., December.

U.S. Army 1998b. *Final Environmental Impact Statement for Pilot Testing of Neutralization/Biotreatment of Mustard Agent at Aberdeen Proving Ground, Maryland*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., July.

2. THE PROPOSED ACTION

The proposed action is the construction, operation, and closure of a facility to destroy the stockpile of chemical warfare agents and munitions currently stored at BGAD. This section describes the depot, the chemical munitions stockpile, the generic elements of the destruction process and the handling and transportation processes required. A detailed discussion of the alternative technologies for completing the destruction of the chemical munitions stored at BGAD is presented in Sect. 3 and Appendices D and G of this EIS.

2.1 BLUE GRASS ARMY DEPOT

The BGAD is located in the Blue Grass region of east central Kentucky in the approximate center of Madison County (Fig. 2.1). BGAD encompasses 14,596 acres and is approximately 30 miles southeast of Lexington, 85 miles southeast of Louisville, and 90 miles south of Cincinnati, Ohio. It is adjacent to the southeastern portion of Richmond, Kentucky, and approximately 5 miles southeast of the center of town. Additionally, BGAD is approximately 10 miles northeast of Berea, Kentucky.

The BGAD lies in the Lexington Plain section of the Interior Low Plateau in the Outer Bluegrass physiographic region, approximately 10 miles south of the Kentucky River. The depot is characterized by open fields and rolling hills with gentle slopes dotted with woodlots of varying sizes. BGAD is surrounded by agricultural land, industrial land uses, low-density residential areas, some commercial activities, and public areas, including educational and recreational activities and areas.

BGAD was established by the U.S. Army in 1942 as the Blue Grass Ordnance Depot for the storage of ammunition and general supplies during World War II. In April 1942, construction of an ammunition storage area, a general supply area, and a utilities and administrative area were begun at the site. Actual operation of the installation began on October 2, 1942. The installation was operated by the U.S. Government until October, 1943, and then by a corporation know as the Blue Grass Ordnance Depot, Inc. The U.S. Government reassumed control in October 1945 and has maintained responsibility for the depot since that time. Chemical munitions and agents have been stored at BGAD since 1942; however, during the period from 1949 through 1951, most of BGAD's chemical inventory was shipped to Rocky Mountain Arsenal in Denver. Limited quantities of chemical munitions and agents remain in storage at BGAD. BGAD is a storage facility; chemical weapons have never been used, tested, or manufactured at the depot.

Although BGAD has not been placed on the National Priorities List (Federal site section) of uncontrolled hazardous waste sites by EPA, contamination of surface water, groundwater, and soil has been detected at BGAD (Sect. 3.3.3). This contamination is a result of historical activities associated with the storage, handling, use, and disposal of ammunition. Environmental clean up is being addressed in other environmental compliance documentation and is beyond the scope of this EIS.

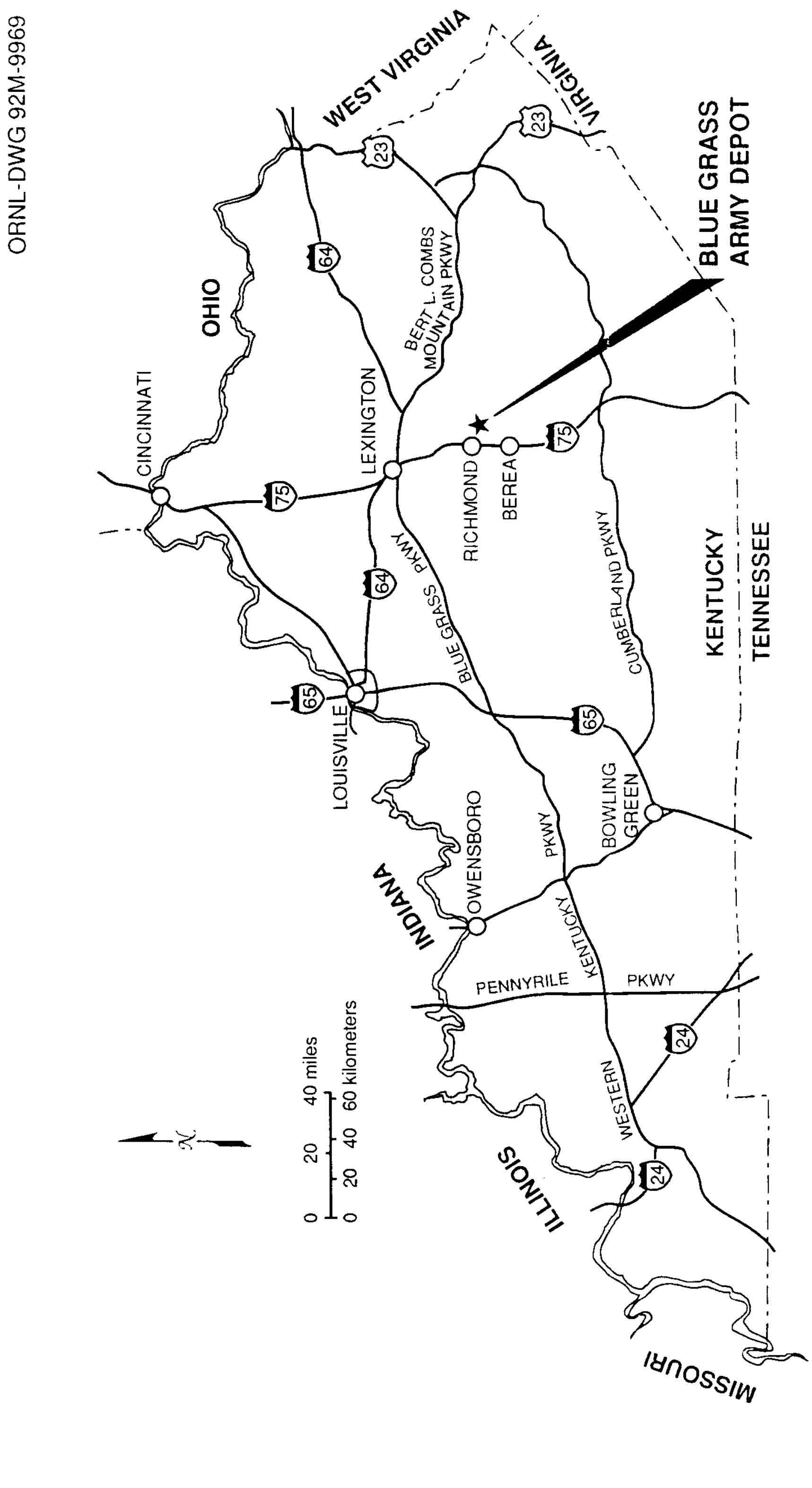

Fig. 2.1. Regional location of the Blue Grass Army Depot.

The current missions at BGAD, now under the Operations Support Command (OSC) are responsibility for (a) storage and shipment of conventional ammunition, (b) surveillance, storage and shipment of contingency stocks of Chemical Defense Equipment, and (c) support to special operations forces. There is also a contractor-operated helicopter maintenance facility located at BGAD. The Blue Grass Chemical Activity (BGCA), a tenant of BGAD, is a subordinate of the Soldier Biological Chemical Command (SBCCOM) and has the following missions: (a) safe storage and monitoring of the chemical stockpile, (b) partnership with the local community, and (c) compliance with international treaties.

There are 1,152 structures at BGAD, including 902 igloos (49 of which are for the storage of chemical munitions and agents and associated equipment), 20 warehouses, 12 above ground magazines, 11 maintenance type buildings, and 207 administrative, operations, medical and housing buildings. The installation has approximately 152 miles of paved road and 40 miles of railroad track; there are also two heliports on the installation. On the basis of the facilities and their function, BGAD can be divided into the following principal areas:

- The *Administration Area*, located in the southwestern portion of the depot near the main BGAD entrance, consists of several permanent structures, including the installation headquarters.
- The *Housing Area* contains two family housing units.
- The *Conventional Munition Storage Area* occupies the majority of the depot. Approximately 850 igloos are available for storage of conventional munitions.
- The *Chemical Agent Storage Area* is located in the northern portion of the depot.

The chemical agent/munition storage area, as well as the site of the proposed destruction facility, is located in the northern part of the BGAD installation. The storage area is approximately 1.1 miles from the installation's northern border; the site of the proposed destruction facilities is 1.3 miles from the northern boundary.

2.2 STOCKPILE DESCRIPTION

2.2.1 Chemical Agents

The lethal unitary chemical agents stored at BGAD include both nerve agents and blister (or vesicant) agents, and prior to initiation of CSDP destruction operations, composed 1.7% (by weight) of the total U.S. stockpile. This inventory is the smallest among the Army's eight CONUS storage sites. Tables 2.1 and 2.2 summarize the characteristics of the agents and munitions stored at BGAD, respectively.

The nerve agents are agent GB (also called Sarin) and agent VX. They are usually odorless, colorless, tasteless, and highly toxic in both liquid and vapor forms. Exposure to high doses can result in convulsions and death because of paralysis of the respiratory system. Death from nerve agents can occur quickly, often within 10 min of absorption of a lethal dose. Sublethal effects of acute exposures include effects on the skeletal muscles (uncoordinated motions followed by paralysis), effects on nervous system control of smooth muscles and glandular secretions (pinpoint pupils, copious nasal and respiratory secretion,

Table 2.1. Characteristics of chemical agents stored at the Blue Grass Army Depot

Agent type	Nerve		Blister
Agent	GB	VX	H
Common name	Sarin	(none)	Mustard
CAS No.[a]	107-44-8	50782-69-9	505-60-2
Chemical name	isopropyl methyl phosphonofluoridate	0-ethyl-S(2-diisopropylamino ethyl) methyl phosphonothiolate	bis-2-chloroethyl sulfide
Chemical formula	$C_4H_{10}FO_2P$	$C_{11}H_{26}NO_2PS$	$C_4H_8Cl_2S$
Vapor pressure [at 25°C (77°F)]	2.9 mm Hg	0.0007 mm Hg	0.08 mm Hg
Liquid density [at 25°C(77°F)]	1.089 g/cm^3	1.008 g/cm^3	1.27 gm/cm^3
Freezing point	-56°C (-70°F)	Below -51°C (-60°F)	8 to 12°C (46 to 54°F)
Color	Clear to straw to amber	Clear to straw	Amber to dark brown
Mode of action	Nervous system poison	Nervous system poison	Blistering of exposed tissue

[a]Chemical Abstracts Service (CAS) number.

bronchoconstriction, vomiting, and diarrhea), and effects on the central nervous system (thought disturbances and convulsions). Agent VX, the most persistent of the nerve agents, is the least volatile and is more toxic than agent GB. Agent GB is the most volatile and would pose the greatest inhalation threat in an accidental release.

The only blister agent stored at BGAD is the agent H. The major toxic chemical in agent H is also known as mustard gas (actually dispersed as a liquid aerosol), sulfur mustard, or mustard. The principal health effect of exposure to agent H is blistering of exposed tissues, which can result in severe skin blisters, injuries to the eyes, and damage to the respiratory tract by inhalation of vapors. Biological evidence indicates that exposure to agent H can result in carcinogenesis.

Table 2.2 Chemical munitions stored at the Blue Grass Army Depot

Type of item[a] (Military designation)	Type of agent fill	Total agent weight (tons) for all items
Rocket (M55)	Agent GB	276.68
Rocket (M55)	Agent VX	88.67
155-mm projectile (M110)	Agent H	90.63
155-mm projectile (M121A1)	Agent VX	38.45
8-in. projectile	Agent GB	28.83
Total for BGAD stockpile		523.26

[a] Military designation numbers are shown in parentheses below the item type.

Nerve and blister agents are hazardous to humans and animals. The type and extent of the hazard depends on the physical and toxicological characteristics of the agent and the extent, route, and duration of the exposure. This FEIS focuses on the health effects that would result from inhalation, since this would be the principal mechanism of exposure to chemical warfare agents. A detailed explanation of the human health effects of exposure to these agents is given in the FPEIS (U.S. Army 1988a, Vol. 3, Appendix B); effects on animals are also discussed in the FPEIS (U.S. Army 1988a, Vol. 3, Appendix O).

2.2.2 Chemical Munitions

The chemical stockpile at BGAD initially comprised 1.7% by agent weight of the total U.S. chemical stockpile. This percentage has changed as JACADS and DCD have destroyed a portion of the stockpile. As shown in Table 2.2, the BGAD inventory includes nerve agents GB and VX and the mustard agent H contained in three munition types (M55 rockets, 155-mm projectiles, and 8-in projectiles). There are two munition configurations in storage at BGAD:

- ***Rocket*****:** A weapon consisting of a chemical agent warhead [with fuze and burster (containing dispersing explosives)] and an attached solid-fuel rocket motor (propellant). The rockets in the chemical weapons stockpile are stored inside individual fiberglass tubes, which also would serve as the launching and firing tube if the rockets were to be deployed.

- ***Projectile*:** A weapon designed to be fired from a cannon, but without propellants attached. Chemical weapons stockpile projectiles contain dispersing explosives. The projectiles stored at BGAD are designed for breech–loading. That is, for artillery with the load, lock, and fire mechanism at the rear of the barrel or firing tube.

The chemical weapons (munitions) to be destroyed at BGAD all consist of a metal casing containing the chemical agent. Some of these munitions also contain propellant and an explosive and a burster for chemical agent dispersal; however, not all of the projectiles stored at BGAD are explosively configured. Figure 2.2 shows schematic illustrations of each munition type. Additional information about each type of munition can be found in the FPEIS (U.S. Army 1988a, Vol. 3; Appendix A).

The explosives used to disperse the agent include tetrytol and Composition B4. Tetrytol is a mixture of tetryl and trinitrotoluene (TNT). These explosives are also used in non–chemical munitions. Although these explosives are powerful, they are relatively insensitive to heat or shock.

A fuze assembly containing a more sensitive explosive compound, such as lead azide, must be used to detonate the explosives listed above. Fuzes are mechanical devices that include a variety of safety mechanisms to protect the explosives from accidental detonation.

The munitions in the stockpile at BGAD were designed to function with a propellant which fired or launched the weapon. The propellants are designed to generate large quantities of gaseous products through rapid burning. The propellants are relatively insensitive to shock and heat and must be ignited by a small charge of black powder or pyrotechnic material. Together, explosives and propellants comprise a category of materials known as “energetics.”

As a result of concerns regarding the integrity of M55 rockets — containing chemical agent fill, explosives, and propellants — stored at five locations throughout the United States, including BGAD, the Army has conducted a number of studies to audit and evaluate the safe storage life for the rockets. First, the Army conducted an independent evaluation of the M55 rocket inventory in 1985 to provide an assessment of the then current condition of the rocket stockpile and its degradation trends (U.S. Army Material Systems Analysis Activity 1985). Samples of rocket components (including the M28 propellant that fuels the rocket motors) were taken and analyzed by several laboratories. It was concluded that the stabilizing agent (a substance that is added to the propellant to control its decomposition) in the rocket motors was not seriously deteriorated from the manufactured condition and will remain effective for at least another 25 years of storage (i.e., until 2010). Results of this M55 rocket assessment program were incorporated into the CSDP programmatic risk analysis, and the probability of spontaneous ignition of the propellant during transport and destruction operations was found to be negligible.

Since the 1985 M55 rocket assessment program was completed, additional work has been done to review the condition of the M55 rockets and determine the expected safe storage life. In June 1990, Hercules Aerospace Company, the manufacturer of the rocket propellant, published a report that estimates the safe storage life at 25° C of the M28 propellant to be 100 years (Landrum and Baczuk 1990). A 1994 report (U.S. Army 1994) focused on the rate of deterioration of the propellant found in the M55 rockets. Technical experts, including the manufacturer of the propellant, derived two separate methodologies for estimating the

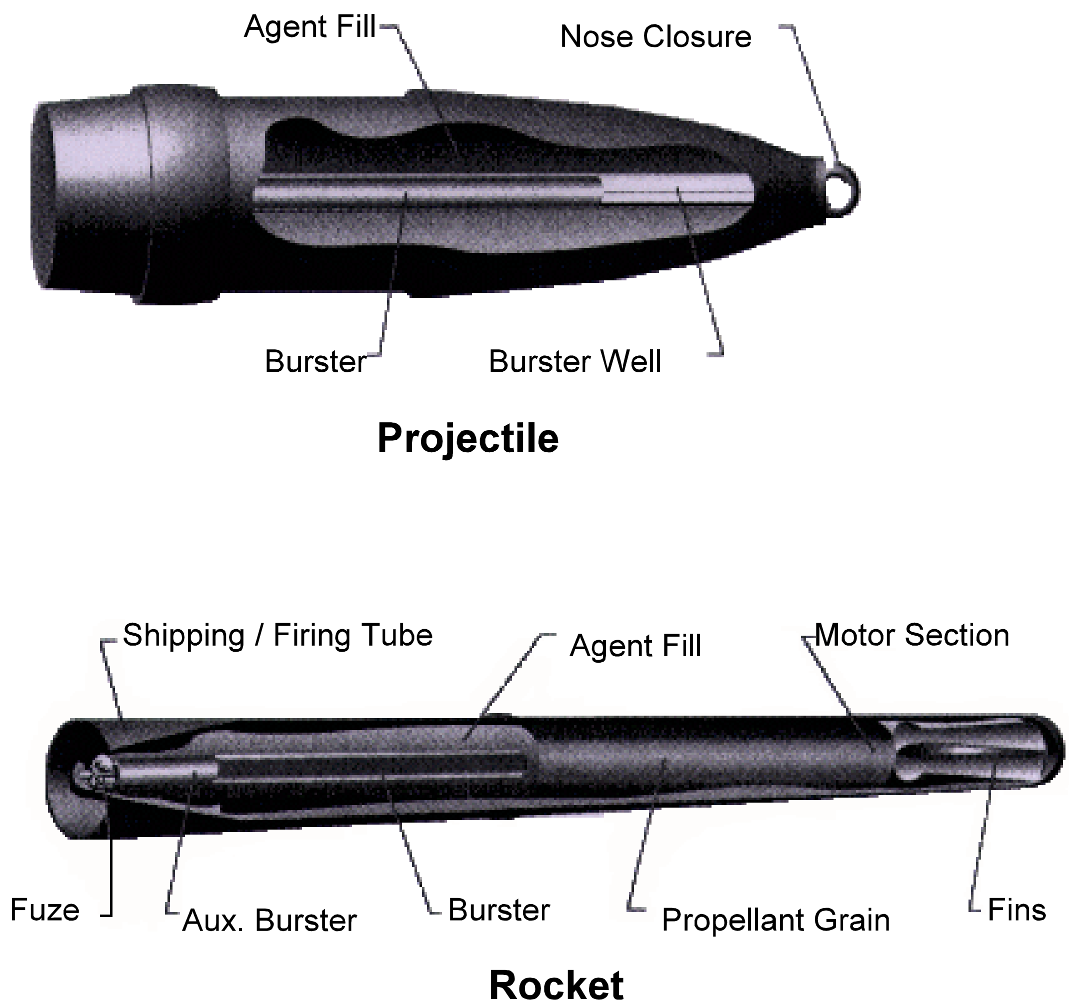

Fig. 2.2. General diagram of a projectile and rocket. ***Source:*** ACWA DEIS (2001), Fig. 3.1-2**.**

remaining storage life of non-leaking M55 rockets. The most conservative model, one proposed by the propellant manufacturer, estimated there is less than a one-in-a-million chance that a rocket will autoignite before the year 2013.

The report cautioned that its conclusions are currently limited to non-leaking rockets because there is some evidence that rockets exposed to chemical agent could have shorter storage lives. The report noted that more data should be obtained to gain additional confidence in the estimate because original samples may not represent all storage locations. It further stated that an investigation is needed to see whether propellant exposure to chemical agent increases the rate of stabilizer depletion. This issue was addressed in another Army report (U.S. Army 1996). The Army plans to address these issues further as part of its Enhanced Stockpile Assessment Program. In addition, the National Defense Authorization Act of FY 91 and the corresponding House Bill, H.R. 4739 (Sec. 173) required the Secretary of Defense to develop a plan setting forth the corrective actions the Department of Defense would perform if the chemical weapons stockpile of the United States began an accelerated rate of deterioration (or experienced any other event that called into question its continued safe storage) before a comprehensive full-scale chemical weapons destruction capability is developed. In response, the U.S. Army Materiel Command (AMC) prepared a contingency plan (AMC 1996) addressing this issue.

2.2.3 Storage Configurations

All chemical agent/munition storage at BGAD is maintained within a chemical storage area at which extensive security precautions are taken to control entry and egress. All chemical munitions are stored inside 45 concrete earth-covered structures (igloos) in the north-central portion of the depot; there are four additional igloos in the chemical storage area used for storing materials, supplies, metal parts, equipment, and hazardous waste.

The storage igloos are designed to protect the munitions from blast and shrapnel if a neighboring igloo were to detonate. A lightning protection system is provided for each igloo. The igloo floors can be decontaminated in the event of a spill or leak. Igloos are designed to prevent water entry. Aisles are maintained so that units in each stack can be inspected, inventoried, and removed for maintenance as necessary.

Munition storage configurations are generally suitable for transport during wartime. These configurations include boxes, drums, protective tubes, or metal overpacks, and all are on pallets. Aisles between pallets are maintained so that units in each stack can be inspected, inventoried, and removed for transportation or maintenance as necessary.

2.2.4 Continued Maintenance, Handling, and Inspection

Storage and maintenance of chemical munitions and containers is overseen by the SBCCOM. Oversight consists of those actions necessary to ensure availability of a chemical deterrent for national defense and to ensure continued safety in storage.

Routine activities associated with chemical agent storage consist of periodic inspection, surveillance, and inventorying of the munitions, as well as of the storage facilities. When inspected, both the munitions and the storage structure are visually examined, and the air inside the igloo is monitored for the presence of agent.

As part of the monitoring program, the igloos are checked periodically to detect leaking items and prevent hazardous releases of agent. If an agent leak is detected, a filtration system would be placed immediately on the rear vent before overpacking the leaking munition. Procedures in place have successfully detected and controlled the leaks in a timely manner without endangering the public or the installation personnel.

In accordance with Army regulations, three basic types of storage inspections are performed:

1. Storage monitoring inspections in accordance with Supply Bulletin 742-1, which include monitoring, entry, and visual inspection of the entire lot in the storage site, are performed at least quarterly.
2. Magazine structural inspections are required annually. The focus of magazine inspection is the condition of the magazine walls, doors, ventilators, spill containment, and lightning protection systems, as well as contents.
3. Magazine monitoring consists of testing the magazine atmosphere for agent contamination. Tubing installed through the headwall of the magazine is connected to detectors (see Sect. 4.26.5).

In addition to Army inspection requirements, depending on the item stored, magazines are monitored quarterly, monthly, or weekly in accordance with applicable Commonwealth regulations. Magazines containing M55 rockets are monitored at least weekly.

2.2.5 Treatment of Leaking Munitions

A few of the stored munitions (mostly M55 rockets) have begun to leak. All igloos containing rockets are monitored at least weekly. Non-leaking rockets which contain agents from production lots which are associated with an increased risk of leaking are housed in three igloos and monitored every duty day. Two igloos are dedicated to containing munitions which have actually leaked and which have then been overpacked as described below.

Leakers are detected through air monitoring and chemical analyses of the vapors which are collected. When agent is detected in an igloo, special procedures are followed to (1) identify the specific munition that is leaking; (2) remove the leaking munition from its original storage configuration; (3) decontaminate as appropriate the individual munition, adjacent munitions, and other contaminated areas; and (4) place the munition into a steel overpack designed to provide a high level of assurance of agent vapor containment, even if the munition were to continue to leak. Overpacked munitions that are known to be leaking are then transported to and stored in one of the two special leaker igloos.

2.3 GENERIC DESTRUCTION FACILITY REQUIREMENTS

2.3.1 Site Selection and Preparation

The proposed site for the BGAD facility, labeled A in Fig. 2.3, is in the north central portion of the depot. The distance to the primary BGAD facilities in the Administration Area is about 4.5 miles (Fig. 2.3).

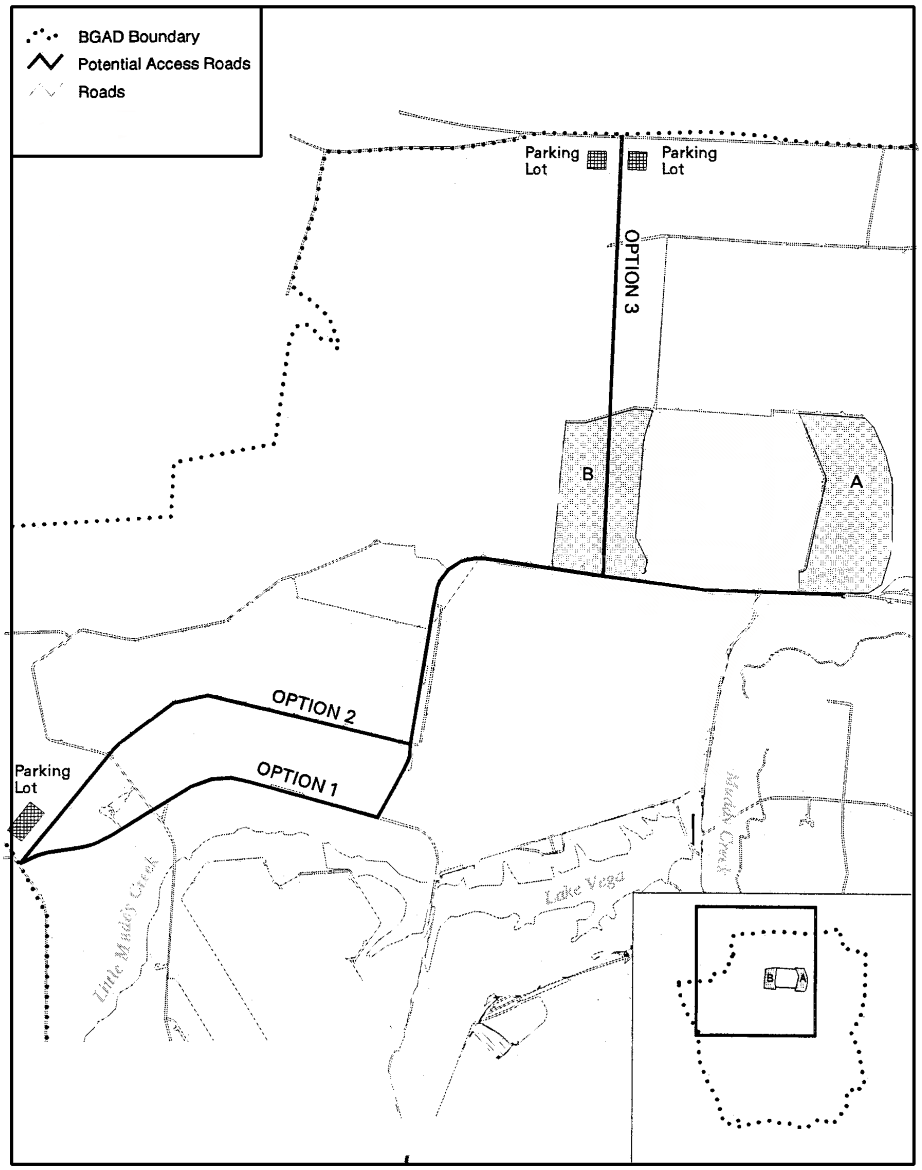

Fig. 2.3. Location of alternative sites and road access corridors identified for the proposed chemical weapons destruction facility at the Blue Grass Army Depot. *Source:* Adapted from Fig. 7.3-1 of the ACWA DEIS (2001).

A buffer area around the proposed site would exist as defined by the Public Access Exclusion Distance. This distance is defined as the greater of the fragmentation hazard distance or the 1% lethality distance (DA Pam 385-61). Personnel not directly associated with demilitarization operations would be excluded from the buffer area defined by this distance or provision would be made for their protection or evacuation.

The area topography consists of undulating terrain with a maximum slope of 13%. Construction of the proposed BGAD facility would involve small amounts of excavation and fill work. Leftover construction debris would be transported to a commercial disposal site. The drainage system would be designed to divert surface runoff from the site of the proposed facility to prevent erosion and surface water accumulation on the site. Clearing, grubbing, and earthwork would be required. The land is relatively level. An unlined sedimentation basin would be developed for use during construction, but no detention pond would be used for stormwater drainage. A detailed description of the soils and terrestrial biota that could be affected is presented in Sect. 4. All destruction alternatives would require clearing at least 25 acres for the facility. Additional area may be needed for construction operations.

The lack of frequent low-altitude military aircraft operations in the airspace over BGAD minimizes the likelihood of aircraft crash damage to the proposed facility. Low-altitude U.S. Air Force radar bombing/scoring flights were cancelled approximately 10 years ago, further reducing the probability of aircraft damage to the proposed facility. The proposed site meets the criteria set by the Nuclear Regulatory Commission (NRC) for distance from airports and federal airways.

In addition to the proposed site, the NEPA analyses consider the use of an alternative site, labeled B in Fig. 2.3. The proposed site (A) and the alternative site (B) were selected initially by the use of criteria for safety and compatibility with existing BGAD operations. For each site, minimum safety distances between facilities handling explosive materials must be maintained in accordance with Army regulations, and interference with existing operations must be avoided. Since the location of Sites A and B are relatively fixed, adjacent igloos containing conventional munitions would require reduction in the amount of conventional munitions that could be safely stored. These reductions could be as much as 2.5 million pounds of class 1.1 explosives for Site A and 15.9 million pounds of Class 1.1 explosives for Site B. The total land area disturbed for construction of a destruction facility at either site is indicated in Table 2.3.

2.3.2 Support Facilities, Utilities, and Access Roads

Provision of support facilities, utilities, and access roads are required for each alternative, and the Army has developed plans for supporting those requirements. See Section 3.1.3 for more detailed information.

Support facilities. The support complex at the proposed plant site or at the alternative sites would include showers and locker rooms, a lunch/conference room, storage rooms, and offices. Other support facilities, whose land requirements are shown in Table 2.3, are off the plant site. They include:

- a new access road to the selected site (see below);
- a new parking area immediately inside the installation boundary and next to the new access road (see below);

Table 2.3. Estimated land area disturbed for construction of a chemical munitions destruction facility at BGAD

	Area disturbed (acres)	
Construction Activity	Proposed Area A	Alternative Area B
Destruction facilities (includes all construction disturbance except the following)	25	25
Wastewater treatment plant	1	1
Transmission lines (69-kV)[a]		
Towers and conductor stringing	<1	<1
Right-of-way clearing	20	18
Communication cables[b]	4	2
Gas pipeline[c]	10	11
Water pipeline[c]	5	7
Parking lots	4	4
Access Road[d]		
Option 1	28	22
Option 2	25	19
Option 3	18	7
Maximum possible area disturbed[e]	95	88

[a]Transmission line would be on wooden single pole structures spaced about 320-ft (98-m) apart; each tower and conductor stringing site would disturb 900-ft^2. A 100-ft corridor would be cleared of trees and shrubs for a right-of-way.

[b]Communication cables would require a maximum right-of-way width of 15-ft.

[c]Gas and water pipeline construction would require a 60-ft-wide right-of-way. Entire right-of-way would be disturbed.

[d]Amount of disturbance does not take into account the use of existing roads incase widening and upgrading would be required. The access road would require a 60-ft-wide right-of-way. Three options for location of an access road were assumed. Option 1 = access road from west entrance along existing roadways. Option 2 = new access road from west BGAD entrance going north to Route 2. Option 3 = access road from north boundary to BGAD.

[e]Total disturbance assuming Option 2 is selected. Unit conversion: 1-acre - 0.4-ha.

Source: Table 7.3-2, ACWA DEIS 2001.

- a new access control building for controlling traffic into the installation and housing the guard post for entry to the chemical demilitarization facility and a storage trailer for gas masks (see below);
- a new warehouse for spare parts, disturbing approximately 4.9 acres, to be located along Route 12 north of Lake Vega;
- a new electrical substation, water tank, and pump house to be just east of the plant (see below);

- a new laundry facility to clean non-agent contaminated clothing, disturbing approximately 0.5 acres, to be located along Route 12 north of Lake Vega;
- a new vehicle storage facility, disturbing approximately 4.6 acres, along the south side of Area F to house trucks, forklifts, and a battery changing station; and
- a new sewage treatment plant to be constructed next to Muddy Creek near Route 3 on the installation.

Utilities. The utilities to support demilitarization operations include water; natural gas, diesel fuel, and fuel oil; electric power; communications; sewage treatment; and storm water drainage (during construction only). The installation is currently evaluating plans to privatize the provision of water, sewer, and electrical services. The Army has identified potential routes for constructing supply lines for electric power, water, natural gas, and communication. These routes could serve either the proposed Site A or the alternative Site B. The land requirements for these routes are shown in Table 2.3.

Water. Facility requirements for potable and process water would be withdrawn from an existing main and tie in. The source of fresh water at the installation is Lake Vega. A new, ground- level 500,000-gal water storage tank would be constructed to supply water for personnel, fire fighting, and to supply water during periods of peak facility demand and, thus, minimize peak water withdrawals from the water source.

Natural Gas. Natural gas would be supplied to the facility by a new pipeline to extend from an existing 8-in. main. This pipeline would run through the middle of the installation and connect with off-site pipelines on the eastern and western boundaries of the installation. It is estimated that approximately 12 acres of land might be disturbed for construction of onsite gas transmission and service lines. The portions of the pipeline on the installation would be designed, installed, and maintained by the Delta Natural Gas Company contingent upon the Government purchasing optimum quantities of gas. Distribution piping for natural gas would be installed in the vicinity of the destruction facility and its support facilities. A natural gas metering and regulating station would also be required.

Communications. The existing communication trunk lines serving BGAD do not have adequate spare capacity to support the proposed facility. Therefore, a new trunk line would be installed from a location south of the main entrance at BGAD to the administration area. From the administration area to the facility site, about 3 miles of new underground cable would be installed.

Access Road. A new road would be constructed to transport construction equipment to the selected site, to transport workers between parking areas and the selected site on shuttle buses, and to remove solid waste (hazardous and nonhazardous) from the facility. Three alternative routes for these roads (and parallel utility corridors) have been identified and are assessed in this document. The first two alternative routes (labeled option 1 and option 2 on Fig. 2.3) would be constructed running in a west-east direction between U.S. Highway 25 and an existing on-post road (Route 2) and then north and east to the selected site. The third alternative route (labeled option 3 on Fig. 2.3) would be approximately 1.5 miles in length and would be constructed running in a north-south direction between Kentucky Highway 52 and Route 2 immediately to the southwest of the existing chemical storage area. Approximately 0.8 mile of roadway would be upgraded and widened to 40 ft, meeting Commonwealth of Kentucky standards, to provide access to and emergency evacuation from the proposed facility. In addition, a new road would connect the existing chemical munitions storage yard with the proposed site;

this road would be designed to withstand the weight of the munition-laden vehicles. Roads in the chemical agent storage area would be upgraded and widened to support the relatively heavy vehicles required for agent transport. The total land area disturbed for construction of the new access road, the new parking area (see below), and Route 2 upgrades are indicated in Table 2.3.

Electrical Power Substation and Power Lines. The existing electrical distribution system for BGAD does not have the capacity to support the proposed facility. New service connections would be made to existing power lines of the Kentucky Utilities Company, with approximately 1.25 miles of overhead 69 kV power lines. As many as two new electrical substations with redundant transformers would also be constructed. They would connect with a new CSDP plant substation no closer than public traffic route distances to the explosive enclosures. Two 4,160-volt buried power lines would be installed to connect the substation to the proposed facility. Power would also be provided to the parking area, the fire and potable water supply pumphouse, and other equipment located in these areas as well as the PSB. A separate power supply would be furnished to the sewage treatment facility, the vehicle storage facility, the laundry, and the access control building. It is estimated that approximately 20 acres might be disturbed for construction of the electrical substation and associated power lines.

Personnel Support Building. A building would be constructed to house the administrative functions of the facility.

Parking. In addition to an employee/visitor parking lot, with a capacity of 40 automobiles and five buses, that would be constructed adjacent to the proposed process support building and entry control facility on the south side of the site, a larger parking area would be constructed near the new gate to BGAD adjacent to the new access road along either U.S. Highway 25 or Route 52; this parking lot would have a capacity of approximately 440 cars and five buses (see Fig. 2.3). Additional parking space would be in the main BGAD administration area.

Waste Transfer Area. A waste transfer area for solid wastes from the proposed facility would be constructed to provide space for dumpsters for RCRA and non-RCRA wastes awaiting transport to an approved disposal location.

Waste Water. A new sewage treatment plant would be constructed near the facility next to Muddy Creek near Route 3 on the installation. The wastewater to this plant would consist of effluent from facilities such as bathrooms, showers, and laundries. The effluents from the sewage treatment plant, approximately 17,000 gal per day of liquid effluents would be discharged to Muddy Creek or pumped to the existing infrastructure in Richmond. No hazardous material of any type would be discharged into this system (i.e., the destruction process itself would not produce any wastewater).

2.3.3 Waste Management

Construction and operation of a chemical munitions destruction facility using any of the technologies (incineration or alternative technologies) being considered for implementation at BGAD would produce hazardous and non-hazardous solid and liquid wastes. The BGAD destruction facility operations, including waste management, would comply with all applicable federal, state, local, and Army regulations for air and water quality, solid waste, hazardous waste, and noise.

The Commonwealth of Kentucky has been delegated authority to oversee the federal programs for air and water quality and for most hazardous waste management requirements, including those associated with the Hazardous and Solid Waste Amendments of 1984. Kentucky should have full authorization to oversee all aspects of the Hazardous and Solid Waste Amendments of 1984 before the issuance of a permit for destruction of the chemical weapons stockpile stored at BGAD. Kentucky adheres to the National Ambient Air Quality Standards (NAAQS) for the prevention of significant deterioration (PSD) of air quality.

2.3.4 Schedules

Whatever technology is selected, construction would begin upon issuance of required environmental permits (RCRA, air) from the Commonwealth of Kentucky and the U.S. Environmental Protection Agency (EPA) , as well as any local zoning ordinances. The permitting process for a facility to destroy the chemical weapons stored at BGAD is being supported by the Kentucky Environmental Working Integrated Process Team (WIPT). The mission of the Kentucky Safety/Environmental WIPT is to facilitate/expedite the permitting process for the safe elimination of chemical weapons stored at BGAD. The Kentucky WIPT is co-chaired by representatives of PMCD and PMACWA and with full voting membership also including BGAD, BGCA, the Kentucky Department for Environmental Protection (KDEP), the Madison County Fiscal Court, and the U.S. EPA Region 4. The permitting process is estimated to take a minimum of two years

Whatever technology is selected for destroying the chemical weapons stored at BGAD, there are certain common programmatic activities that would be pursued, including the construction of certain technology neutral infrastructure facilities (see Section 3.1.3), construction of plant facilities for the selected technology, systemization (i.e., trial burns or system validation and system checkout), and operations. The technology neutral facilities may be initiated prior to the selection of the technology since they would be needed regardless of which technology is selected.

Construction of the baseline incineration technology is projected to require 34 months, as would the neutralization/SCWO alternative. Construction of the neutralization/SCWO/GPCR alternative is projected to require 29 months, and the electrochemical oxidation alternative would require 30 months (ACWA TRD 2001).

Systemization includes preoperational checkout, training, and integrated systems operation under mock conditions with simulated munitions filled with surrogate chemicals. Systemization would be used to ensure that systems are operating as designed prior to operations. For the baseline incineration alternative, systemization (also including trial burns) is projected to take 18 months but would start several months prior to the end of the construction phase. For the non-incineration alternatives, systemization (also called preoperational testing) would begin following facility construction and is projected to last between 8 and 15 months for the neutralization/SCWO alternative and 14 months for the neutralization/SCWO/GPCR and for the electrochemical oxidation alternatives (ACWA TRD 2001).

Operations are projected to require 22 months for the baseline incineration alternative, based on a 24 hr/day, 6 day/week operation, followed by closure of the facility. For the non-incineration alternatives, operations are projected to require 18.6 months for the neutralization/SCWO alternative (based on a 12 hr/day, 6 day/week operation, 46 weeks per year), 15.5 months for the neutralization/SCWO/GPCR alternative, and 15.5 months for the electrochemical oxidation alternative (ACWA TRD 2001).

2.3.5 Future Use

In addition to the directive to destroy the U.S. stockpile, Public Law 99-145 also mandates the dismantling and destruction of the demilitarization equipment and buildings upon completion of the stockpile destruction activities. However, in November 1989, the House and Senate Appropriations Committee of Conferees, in Title VI of the 1990 Defense Appropriations Conference (DAC) Report 101-345, *Chemical Agents and Munitions Destruction, Defense*, directed the Army to investigate and report on the feasibility and desirability of using chemical weapons destruction facilities for other purposes after the stockpile is destroyed.

The proposed incineration facilities were found to be not well suited for many of the possible uses that were investigated, and concluded that "continued use of this facility after completion of its primary mission at LBAD (Lexington Blue Grass Army Depot, now BGAD) is not recommended." The Army currently intends to dismantle and close the BGAD facilities at the completion of destruction activities. Closure and decommissioning of the BGAD facility is addressed in Sect. 4.25 of this FEIS.

In October 1999, Congress modified federal law to remove the above prohibition if the state in which the chemical demilitarization facility (CDF) is located permits it. As a result, the Army is now studying the feasibility and cost-effectiveness of using the CDFs to destroy the NSCM that is also stored at the same location. The Army is not considering moving NSCM among CDF locations, nor is consideration being given to destroying buried NSCM that might be exhumed in the future (U.S. Army 2000).

The Army has tasked Mitretek Systems of McLean, Virginia, to conduct this independent study to determine the technical, cost, schedule, public acceptance, and environmental permitting issues associated with processing NSCM items that are collocated at the stockpile destruction sites. The results of this evaluation will be compared to the technical, cost, schedule, public acceptance, permitting, and environmental issues associated with processing NSCM items in the transportable and other treatment systems that are being developed by the DOD Program Manager for NSCM.

The study was conducted in two stages. Stage 1 involved an initial screening of the feasibility of using the CDFs to destroy NSCM stored at that location. The initial screening considered technical compatibility with the CDF and schedule compatibility with the 2007 CWC deadline, as well as an initial assessment of the political/public outlook regarding the acceptability of the Army implementing such a destruction activity (U.S. Army 2000). Stage 2 of the analysis is addressed in detail those items and facilities selected in the Stage 1 screening analysis. Stage 2 of this study recommended that the BGAD facility be used to destroy four NSCM items (two Department of Transportation bottles containing mustard agent, one ton container with agent GB, and one Department of Transportation bottle containing agent VX) stored at BGAD (PMCD 2001).

2.4 ON-SITE HANDLING AND TRANSPORTATION

The destruction process would begin with handling and loading of the munitions at the storage igloos in the existing storage area in preparation for their transport to the proposed facility. A multistep process would be designed to ensure safety. Munitions would be transported in on-site containers (ONCs) which would provide agent containment. Detailed procedures would be developed for handling of munitions and transportation.

2.5 REFERENCES

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3. DESCRIPTIONS OF ALTERNATIVES

3.1 INTRODUCTION

This chapter describes the alternatives being considered for destroying the stockpile of chemical weapons at Blue Grass Army Depot. As required by NEPA, the no action alternative is presented to establish a basis for comparison even though it is not a viable alternative because its implementation is precluded by Public Law 99-145. Section 3.2 presents the four alternative destruction systems: baseline incineration, neutralization with supercritical water oxidation (SCWO), neutralization with gas phase chemical reduction and transpiring wall SCWO (GPCR/TW-SCWO), and electrochemical oxidation (electrochemical oxidation technology). Section 3.3 presents the specific process operations that make up the destruction systems. Section 3.4 presents the resource requirements and the routine emissions and wastes from the individual destruction systems. Section 3.5 presents the no action alternative. Section 3.6 presents a summary comparison of potential impacts of all considered alternatives.

The information presented on the technologies proposed by U.S. Army ACWA program is derived from the ACWA Technology Resource Document (TRD) (AWCA TRD 2001). These technologies are currently under further development. Any available information concerning substantial changes in the technology descriptions will be incorporated prior to publication of the final version of this EIS.

All the alternative destruction systems provide for the complete destruction of the chemical weapons stockpile at BGAD. The systems accomplish this destruction by using the following interrelated processes: opening the weapons; treating/disposing of the agent, energetics, metal parts, and dunnage; and controlling pollution. The following definitions are employed in discussing the alternatives.

Installation: The Army depot where the chemical weapons stockpile is stored. This term includes both chemical weapons and non-chemical weapons areas. It is the entire parcel of land owned by the Army.

Site: The location on the installation where the chemical weapons stockpile is stored and the location where the destruction structure would be built.

Facility: The structure to be built at the site to implement stockpile destruction.

System: A complete approach to weapons destruction that includes disassembling a munition, destroying agent and energetics, treating component parts (e.g., metal and dunnage), and managing and disposing of effluents. Each system may potentially be considered an alternative action under NEPA.

Process: A category of activity that contributes to a total system. The process categories are munitions access, agent treatment, energetics treatment, dunnage treatment, metal parts treatment, and effluent management/pollution controls.

Technology: The technique or techniques for accomplishing each process. There may be more than one technology involved in a process. In addition, the same (or a similar) technology may be used in multiple processes.

Figure 3.1 illustrates the hierarchy of use of these terms in this analysis.

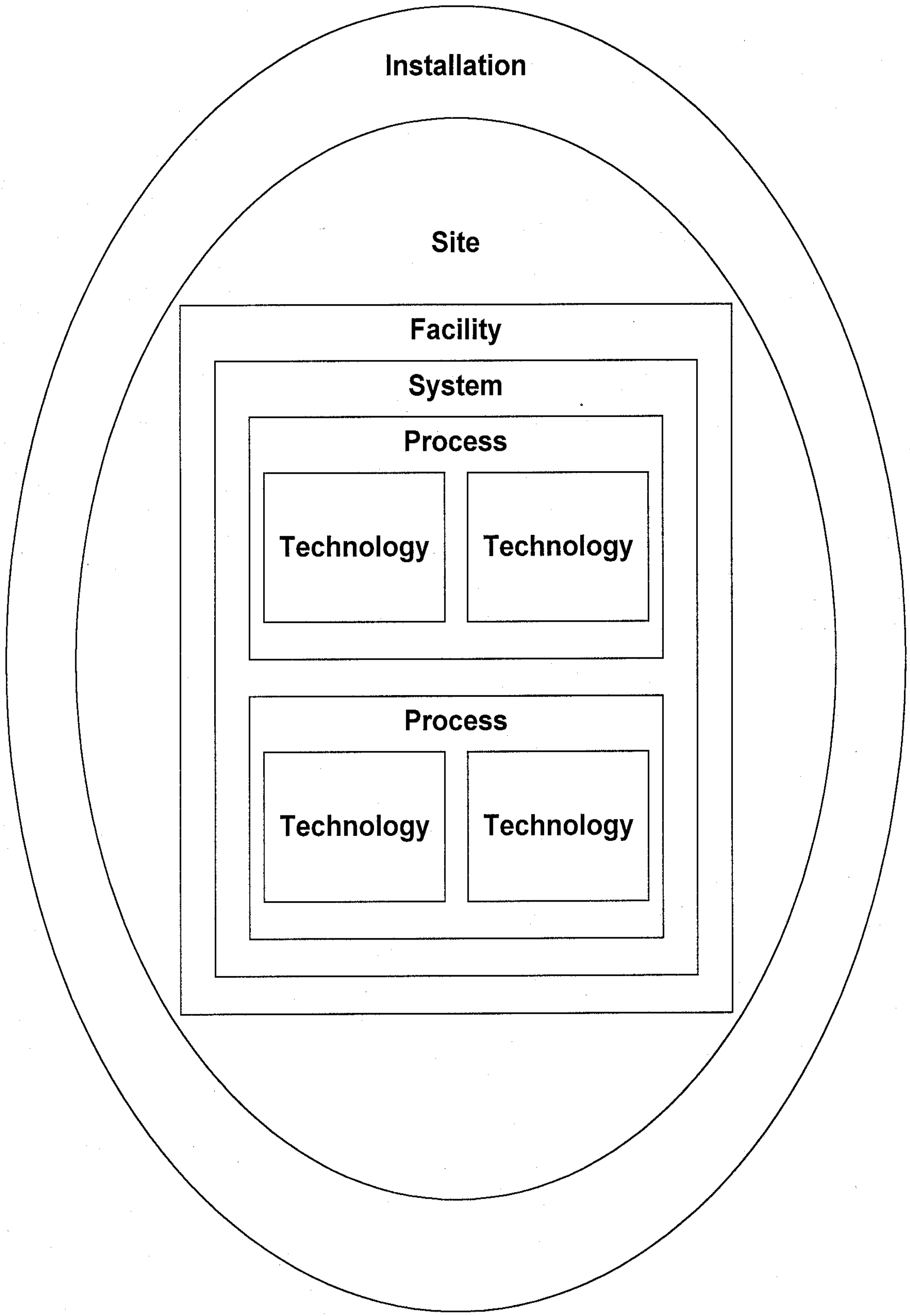

Figure 3.1. Hierarchy of analysis.

3.1.1 Processes Required for Chemical Weapons Destruction

Each of the alternatives being considered for destruction of the munitions and chemical agent stored at BGAD are designed to accommodate four categories of materials: agent, energetics, metal parts, and dunnage (materials including wooden pallets and boxes, metal straps, and packaging are collectively called dunnage). The major processes being considered to accomplish this task using any of the incineration or alternative technologies are illustrated conceptually in Fig. 3.2. The first step, munitions disassembly (i.e., opening the munition), is common to each of the technologies being considered, although some modifications of the baseline process have been proposed, based on the experience gained at JACADS.

After the munitions are disassembled, the components can be separated into materials streams for processing. The materials streams are energetics, agent, metal munition bodies, and dunnage. Destruction of these material streams is addressed in process-specific sections for each alternative: baseline incineration (Sect. 3.2.1), neutralization with SCWO (Sect. 3.2.2), neutralization with GPCR/TW-SCWO (Sect. 3.2.3), and electrochemical oxidation (Sect 3.2.4).

In addition to the primary waste streams, there would be technology-neutral and process-specific secondary wastes. The technology-neutral secondary wastes would include demilitarization protective ensemble (DPE), spent decontamination solution (SDS), and tools. For incineration, these secondary wastes include dried (solid) brine salts from the pollution abatement system (PAS), incinerator residues, and charcoal from charcoal filters; the liquid brine salts would be dried to solids for disposal. The secondary ACWA wastes include spent carbon, solid brine salts, and charcoal from charcoal filters. The secondary wastes would be disposed of off-site in accordance with all applicable regulations (see Sects. 3.4.2 and 4.6).

3.1.2 Containment Structure and Facility Size

The destruction of the chemical weapons stockpile at BGAD would take place in structures designed to prevent release of chemical agent to the environment. Disassembly and disposal of energetics would be carried out in an explosion containment area. The overall structure would be designed for agent containment using features such as air locks and negative differential air pressure. Gases from the ventilation systems would pass through a series of filters, and process gases would pass through a system to minimize pollutants before being released from the structure.

The main building would be constructed of noncombustible materials with a concrete structural frame and a low-slope concrete roof. This building would contain equipment and systems for munitions disassembly, processing of contents and components, and pollution abatement. There would also be a separate chemical analysis laboratory and buildings for support of personnel and maintenance.

The facility footprint would require approximately 25 acres. Additional area may be required for construction operations. With storm-water management and upgrade of access roads and utilities, up to 95 acres may be disturbed.

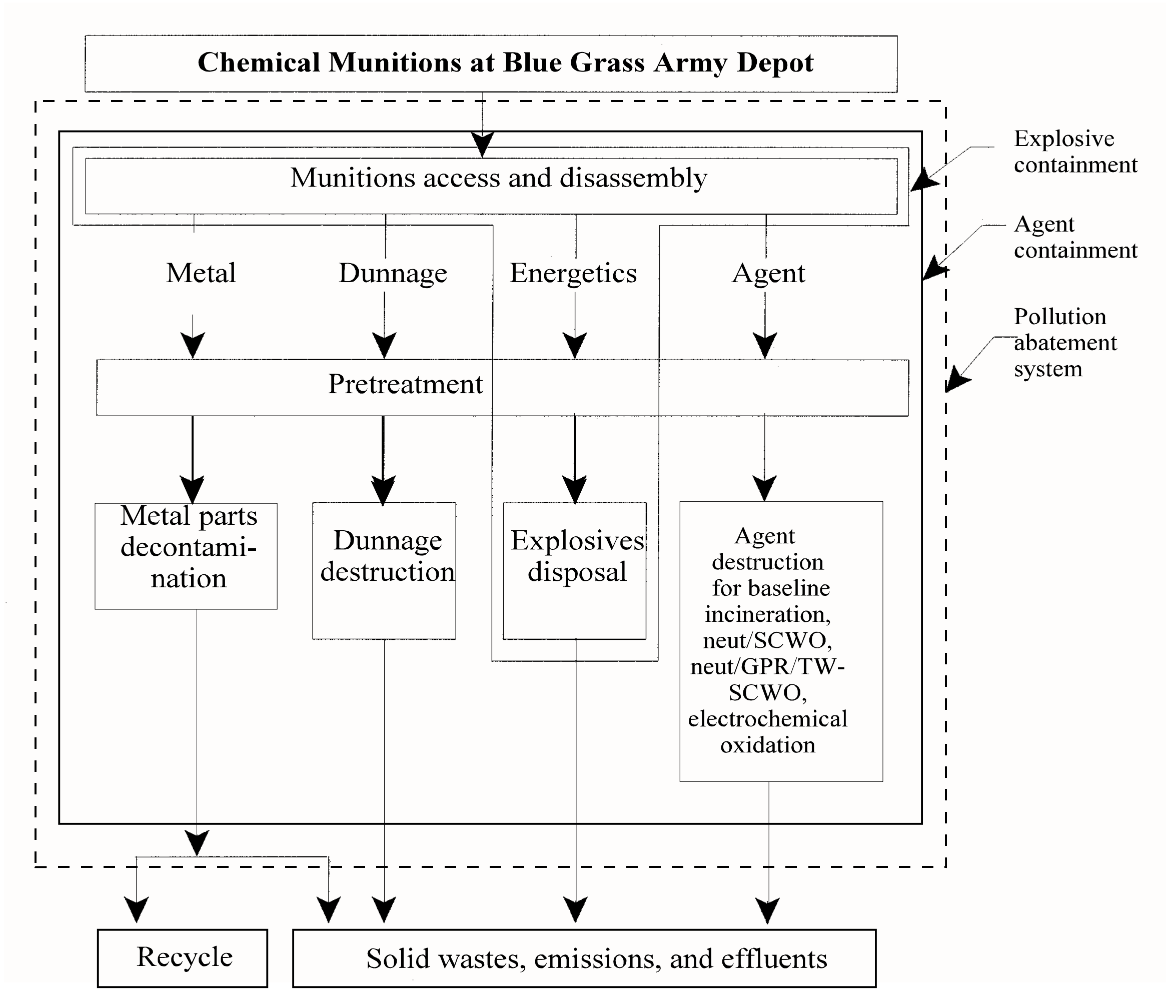

Figure 3.2. Generic processes for destroying the Blue Grass Army Depot stockpile.

3.1.3 Technology Neutral Infrastructure Projects

The Army has determined that improvements to the BGAD infrastructure must be made to support the destruction of the chemical weapons inventory. These improvements are technology neutral, i.e., they would be needed by whichever alternative destruction system is built at BGAD. Although the installation is preparing separate NEPA documentation for these facilities, they are included here for completeness.

3.1.3.1 Gas service line

Natural gas would be supplied by a new pipeline to extend from an existing 4-in. main. The existing offsite pipeline runs outside the eastern boundary of the installation. It is estimated that approximately 12 acres of land might be disturbed for construction of onsite gas transmission and service lines. Distribution piping for natural gas would be installed in the vicinity of the destruction facility and its support facilities (see Sect. 2.3.2 and Fig. 2.4).

3.1.3.2 Communications service line

The existing communication trunk lines serving BGAD do not have adequate spare capacity to support destruction activities. Therefore, a new trunk line would be installed from a location south of the main entrance at BGAD to the administration area. From the administration area to the facility site, about 3 miles of new underground cable would be installed (see Sect. 2.3.2 and Fig. 2.4).

3.1.3.3 Access road to the site

A new road would be constructed to transport construction equipment to the selected site, to transport workers between parking areas and the selected site on shuttle buses, and to remove solid waste (hazardous and nonhazardous) from the destruction facility. Three alternative routes for these roads (and parallel utility corridors) have been identified and are assessed in this document (see Sect. 2.3.2 and Fig. 2.4). In addition, approximately 0.8 mile of existing roadway would be upgraded and widened to 40 ft, meeting Commonwealth of Kentucky standards, to provide access to and emergency evacuation from the destruction facility. In addition, a short, new road would connect the existing chemical munitions storage yard with the selected site. Roads in the chemical agent storage area would be upgraded and widened to support truck transport of the munitions to the destruction facility. The total land area disturbed for construction of the new access road, parking areas, and upgrades of on-site roads would be up to approximately 32 acres.

3.1.3.4 Electrical substation power service

As many as two electrical substations with redundant transformers would be constructed. They would connect with a new CSDP plant substation no closer than public traffic route distances to the explosive enclosures. Power to these substations would be supplied from existing power lines of the Kentucky Utilities Company, with approximately 1.25 miles of overhead 69-kV power lines. Two 4,160-volt buried power lines would be installed to connect the CSDP substation to the destruction facility (see Sect. 2.3.2 and Fig. 2.4). The installation currently plans on privatizing the provision of electrical services.

3.1.3.5 Personnel support facility

A building would be constructed to house the administrative and oversight functions of the destruction facility when in operations and to serve as a management facility during design/construction and systemization. It is anticipated that the building would have approximately 12,800 ft^2 of office facilities.

3.1.3.6 Personnel support facility parking

In addition to an employee/visitor parking lot, with a capacity of 40 automobiles and five buses, that would be constructed adjacent to the proposed process support building and entry control facility on the south side of the site, a larger parking area would be constructed near the new gate to BGAD adjacent to the new access road along either U.S. Highway 25 or Route 52; this parking lot would have a capacity of approximately 440 cars and five buses. Additional parking space would be in the main BGAD administration area (see Sect. 2.3.2 and Fig. 2.4).

3.1.3.7 Sedimentation basin

A sedimentation basin would be constructed for use during the construction period. The basin may be lined with compacted gravel but would not have a plastic liner.

3.1.3.8 Waste transfer area

A waste transfer area for solid wastes from the proposed facility would be constructed to provide space for dumpsters for RCRA and non-RCRA wastes awaiting transport to an approved disposal location.

3.2 DESTRUCTION SYSTEMS

3.2.1 Baseline Incineration

A baseline incineration system is currently being operated at DCD (formerly Tooele Depot, South) near Tooele, Utah. A baseline incineration system on Johnston Island in the Pacific Ocean, the Johnston Atoll Chemical Agent Destruction System (JACADS), completed destruction of the Johnston Island stockpile in November 2000.

For all technologies considered in this EIS (i.e., baseline incineration and non-incineration technologies), the munitions (projectiles and rockets) would be transported to the destruction facility in on-site containers (ONCs), an explosion and impact resistant package hauled by tractor-trailer rig.

After disassembly, the metal munition bodies and chemical agent are thermally treated in different types of incinerators (see Fig. 3.3). Destruction takes place within a two-story structure designed to contain any leakage of the agent. The nerve and mustard agents and energetics are separated from the metal parts within that structure. The energetics would be disposed of on-site

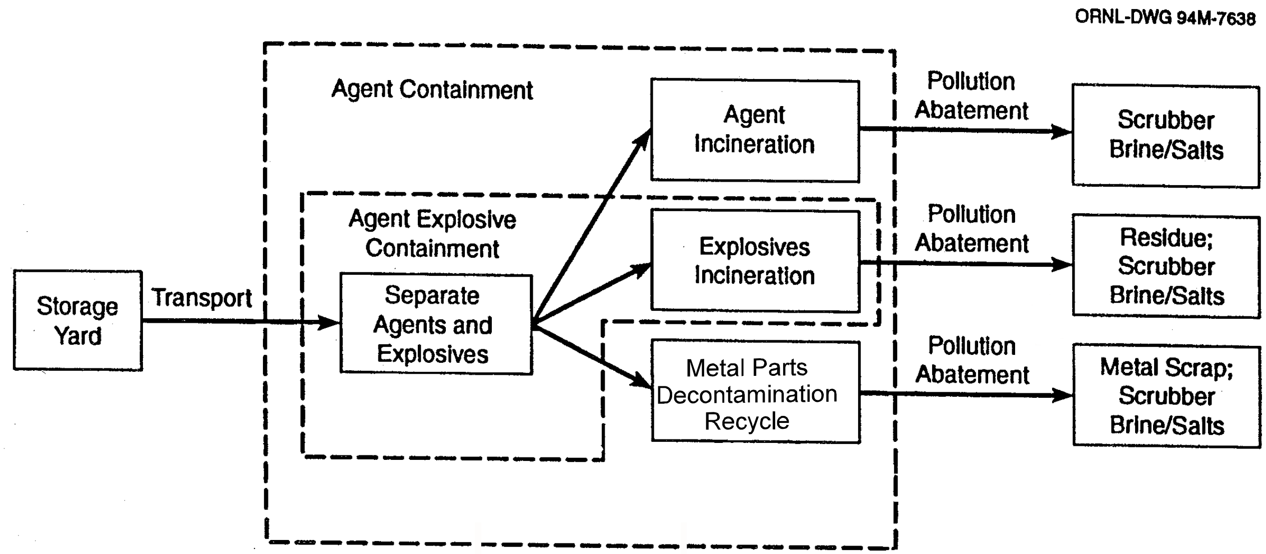

Fig. 3.3. Schematic diagram of the baseline incineration process (contaminated dunnage would be processed in the metal parts furnace).

in a rotary-kiln deactivation furnace(DFS) that is contained within a reinforced, explosive-containment structure. Liquid agent is transferred to the liquid-injection incinerator for destruction. Metal parts, which may contain residual chemical agent, are treated in a roller hearth metal parts furnace (MPF). Contaminated dunnage is size-reduced before incineration. In addition to the primary chamber, all of the incinerators have a secondary chamber to destroy any residual agent or other organic compounds not incinerated in the primary chamber. See Appendix D for more detailed process information. Appendix C contains information about the Army's experience with incinerating chemical agents.

The lessons learned from operating two baseline incineration facilities suggest that BGAD-specific changes should be made in the baseline incineration systems. Prompted by operating difficulties encountered at JACADS and TOCDF, the incinerator designated for dunnage would be eliminated.

Scrubbers, high efficiency particulate air (HEPA) filters, and charcoal filters are used to control emissions to the air. The primary waste materials from the system consist of scrubber brines, incinerator residue (ash and slag), and charcoal from charcoal filters. After treatment, which may be required to reduce leaching of heavy metals, the brines [after being dried to solids in a brine reduction area (BRA)], incinerator ash, and slag would be disposed of in a permitted treatment, storage and disposal facility (TSDF).

Ventilation exhaust air from potentially contaminated areas of the Munitions Demilitarization Building (MDB) and the Container Handling Building (CHB) would be filtered extensively before being discharged. In addition, a pollution abatement system (PAS) filtration system has been developed for the incinerator exhaust gases. The purpose of the PAS Filter System (PFS) is to improve the performance of the pollution control equipment by further reducing low level emissions of products of incomplete combustion (PICs) and metals.

The PFS consists of an inline gas burners, cooling systems, and six filter units [one each for the liquid incinerator (LIC) and the metal parts furnace (MPF), two for the deactivation furnace system (DFS), and two shared spares]. The filter units are rated at 12,000 cfm and are equipped with a prefilter, a high efficiency filter for particulate matter (HEPA), two carbon beds in series, and finally another HEPA filter. HEPA filters remove small particles including trace metals emissions while the carbon filters remove any organic compounds present in the gas stream.

To improve the adsorption of the filters the gas stream is first cooled before it enters the PFS. This is accomplished by routing the brine from the scrubber towers through a series of coolers. The cooled brine is then sprayed into the top of the scrubber, which in turn cools the furnace exhaust. The last step in the conditioning of the furnace exhaust is increasing the dew point. This is done with the use of the inline natural gas burner. The burner raises the temperature of the gas stream such that the gas stream is no longer saturated with water. After the exhaust stream has been conditioned it passes through the filter unit to the induced draft fans and finally to the stack.

Activated carbon filtration is an accepted method of removing hydrocarbon and similar organic chemicals from air and gas streams. It is commonly used in petrochemical industries, and it is the preferred method for treatment of ventilation airflows in chemical weapons facilities. Fixed-bed activated carbon filters have been used effectively in this capacity by the CSDP for several years. Since complete agent destruction will occur during the incineration processes, these activated carbon filter units are being incorporated as an additional safety feature to further preclude the potential for a chemical agent release.

The ventilation and incinerator exhaust stacks would be monitored continuously for the presence of agent. Carbon filter replacement would be rigorously controlled to protect the workers and to prevent release of agent. The spent carbon from the filter units would be incinerated in the DFS. Current plans are to dispose of the incinerated carbon residue in a permitted hazardous waste landfill.

3.2.2 Neutralization with Supercritical Water Oxidation System

In the neutralization with SCWO system, proposed by General Atomics, the munitions would first be disassembled using a process similar to that used by the baseline incineration system (see Fig. 3.4).As Figure 3.4 illustrates, a modified baseline reverse assembly process would be used to disassemble the chemical munitions stored at BGAD, with some differences for projectiles versus rockets. For projectiles, the energetic materials would be removed, and the agent would be accessed by cryofracturing the munition (the cryofracture process is not part of the baseline system). For rockets, the baseline system would be used. Agent would first be accessed using a punch and drain process. Then the rocket would be sheared to access the fuze, burster, and propellant.

The mustard agent H and the nerve agents GB and VX would then be neutralized/hydrolyzed with water (for H) and sodium hydroxide (NaOH) (for GB and VX) in systems operated at 194ºF and atmospheric pressure; energetics would also be neutralized/hydrolyzed with a NaOH solution, in systems also operated at 194ºF and atmospheric pressure. Neutralization of H using water would be followed by a caustic wash using NaOH. The energetics would also be chemically treated (neutralized), and the resulting chemicals (hydrolysate) would be broken down by high temperature and pressure in SCWO units.

Dunnage would be shredded, micronized, hydropulped, and neutralized/hydrolyzed. Resulting hydrolysates would then be treated in separate SCWO units. Dunnage hydrolysate would be added to energetics hydrolysate and treated in the same SCWO unit. Thermal treatment would be used to treat metal parts to a 5X condition.

Additional detail is provided in Appendix G.

3.2.3 Neutralization with Gas Phase Chemical Reduction and Transpiring Wall Supercritical Water Oxidation

For the neutralization with GPCR/TW-SCWO system, proposed by Foster Wheeler/Eco Logic/Kvaerner, the munitions (projectiles and rockets) would first be disassembled using a process similar to that used by the baseline incineration system (see Fig. 3.5). For projectiles, the energetic materials would be removed and the agent would be drained. This would be accomplished using the baseline projectile/mortar disassembly (PMD) and a projectile punch machine (PPM). For rockets, the baseline rocket shear machine (RSM) would be used; however, it has been modified (MRSM) for this application. Agent would be drained from the rockets via a punch and drain process. Then the rocket would be sheared to access the fuze and burster. A tube cutter would be used to section the fiberglass rocket firing tube just forward of the threads of the fin assembly, and the fin assembly would be unscrewed to access the propellant. Propellant would be pulled from of the rocket motor, size-reduced in a grinder, and slurried.

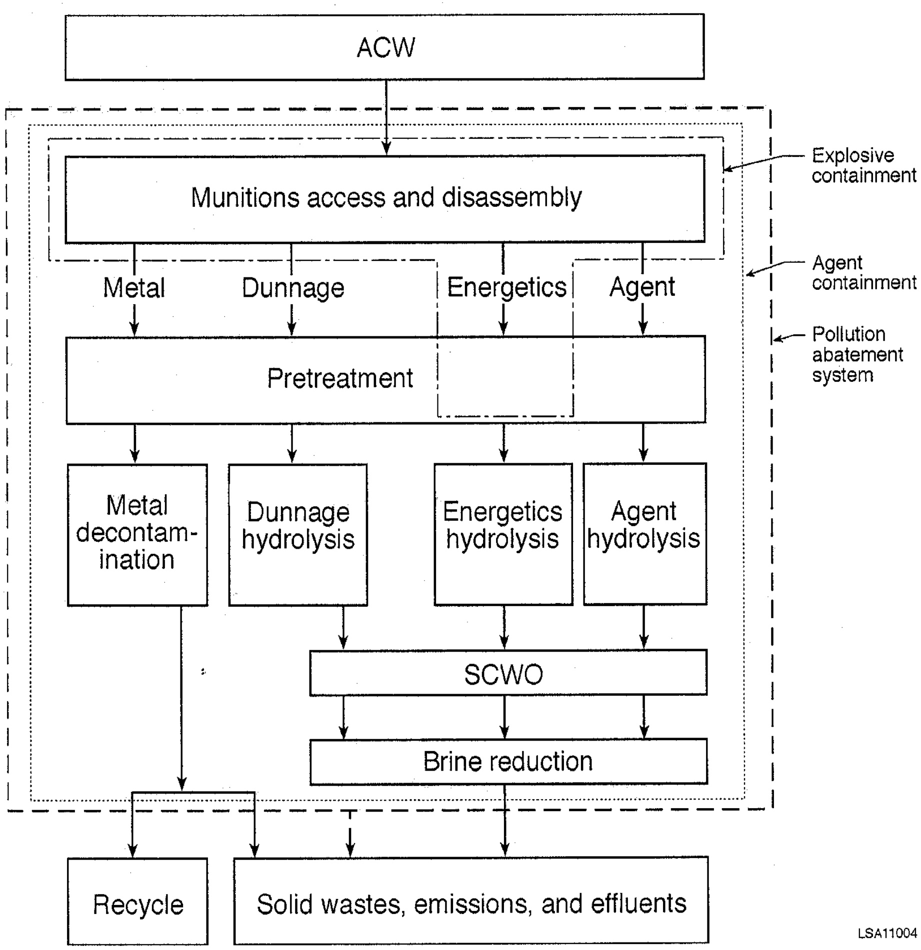

Figure 3.4. Schematic diagram of the Neutralization/SCWO System. *Source*: Fig. 3.2-2, ACWA DEIS 2001.

Munitions casings and other hardware would be processed through the Continuously Indexing Neutralization System (COINS ™). This system would be used to place munitions casings and other solids in hanging baskets that are dipped in caustic baths to separate energetics from metal parts, followed by spray washing.

The drained nerve agents (GB and VX) would then be neutralized/hydrolyzed by using a NaOH solution in systems operated at 194°F and atmospheric pressure. Energetics would be neutralized/hydrolyzed by using a caustic solution in systems also operated at 194°F and atmospheric pressure. Mustard agent would be hydrolyzed using hot water; however, caustic would be used later in the process. Hydrolysates would be treated in a TW-SCWO unit. TW-SCWO differs from solid-wall SCWO (see Sect. 3.2.2) in that a boundary layer of clean water

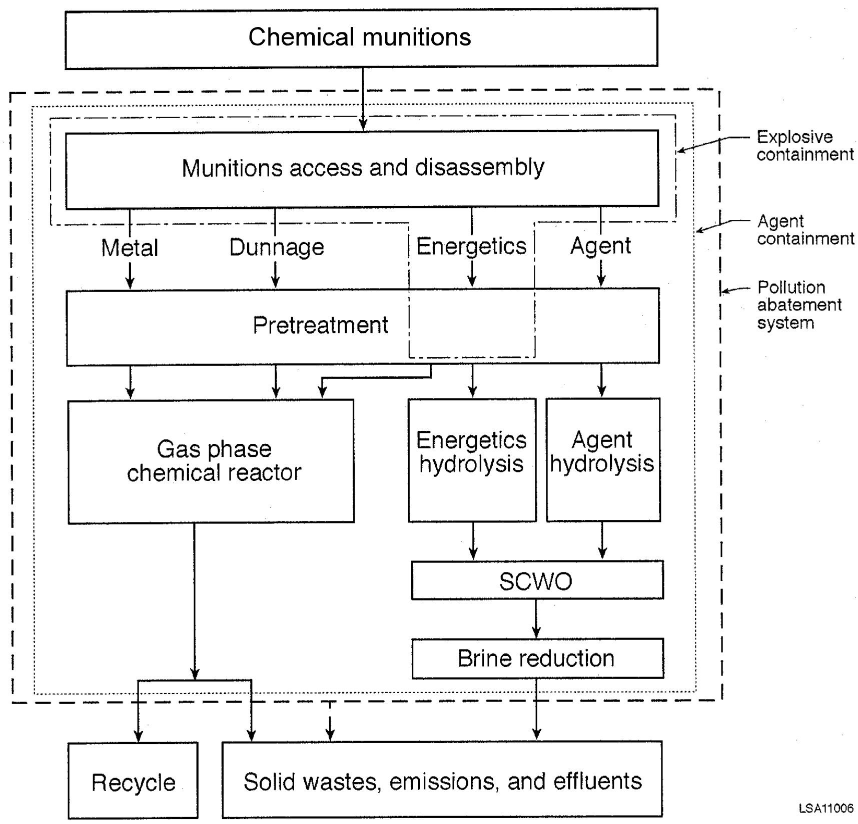

Figure3.5. Schematic diagram of the Neutralization/GPCR/TW-SCWO System.
Source: Fig. 3.2-3, ACWA DEIS 2001.

is dispersed from the sides of the SCWO unit as a means of limiting corrosion and solids buildup. TW-SCWO also differs from the solid-wall unit in that the TW-SCWO can treat agent and energetic hydrolysates simultaneously.

Dunnage and metal parts (e.g., from COINS) would be treated using GPCR. GPCR is a thermal system operated at temperatures above 1,560˚F that uses hydrogen in a steam atmosphere to reduce organic compounds to methane (CH_4), CO2, CO, and acid gases. The system includes solids treatment in a thermal reduction batch processor (TRBP), which uses a flame-heated batch evaporator to volatilize organic materials to the main GPCR reactor. The TRPB would treat metal parts and dunnage to a 5X condition. A batch or continuous mode TRBP may be employed, depending on the nature of the munitions being treated.

Additional detail is provided in Appendix G.

3.2.4 Electrochemical Oxidation System

For the electrochemical oxidation system, proposed by AEA Technology/CH2MHILL and referred to by the provider as the Silver II process, the munitions (projectiles and rockets) would first be disassembled using a process similar to that used by the baseline incineration system (see Fig. 3.6). The process for munitions access differs slightly for M55 rockets and M56 warheads, versus that for projectiles stored at BGAD. For the projectiles, the energetics would be removed and the agent drained. For the rockets, first they would be punched and the agent drained, then they would be cut open using fluid jets and the energetics removed. Following munitions access, treatment of agent and energetics from the various types of chemical weapons is largely independent of munition type and agent fill.

Fuzes and supplementary charges from all chemical munitions at BGAD would be sent to a detonation chamber. The detonation chamber is a thermally initiated, contained detonation device that initiates the energetics by exposing them to heat.

Slurried explosive material from the chemical munitions (20% by weight) would be sent to a number of holding tanks for feed to the SILVER II reactor. Agent would be pumped to a buffer area similar to the baseline TOX holding system.

Agents and energetics would be fed into separate SILVER II reactors. A 2-kW unit for agents and a 12-kW unit for energetics were used during demonstration testing. SILVER II is an aqueous electrochemical process that uses $AgNO_3$ in concentrated HNO_3. An electrochemical cell is used to generate a reactive material (Ag^{2+}) that readily oxidizes organic substrates. End products of this oxidation process are primarily CO_2 and water. Elements present in the organic substrate, such as nitrogen, sulfur, or phosphorous, are oxidized to nitrate ions, sulfate ions, or phosphate ions. Silver compounds (e.g., chloride) would be recycled or recovered off-site, after which they may be returned to the process. Electrochemical oxidation differs from the other non-incineration technologies evaluated in this EIS in that no secondary treatment is needed to address Schedule 2 compounds.

Metal parts and dunnage would be treated thermally. Solid secondary wastes (i.e., dunnage) would be size-reduced using two-stage shredders. Metal components, including projectile bodies, would be thermally treated to a 5X condition, and dunnage would be thermally treated in a batch rotary treater. All process off-gases would pass through a catalytic oxidation unit and through carbon filters prior to release to the atmosphere.

Additional detail is presented in Appendix G.

3.3 PROCESS OPERATIONS

3.3.1 Removal from Storage

Before the storage igloos would be entered the interior would be monitored. The munitions would then be monitored to determine if they are safe for transport. If unsafe munitions were identified, they would be overpacked and made safe for transport.

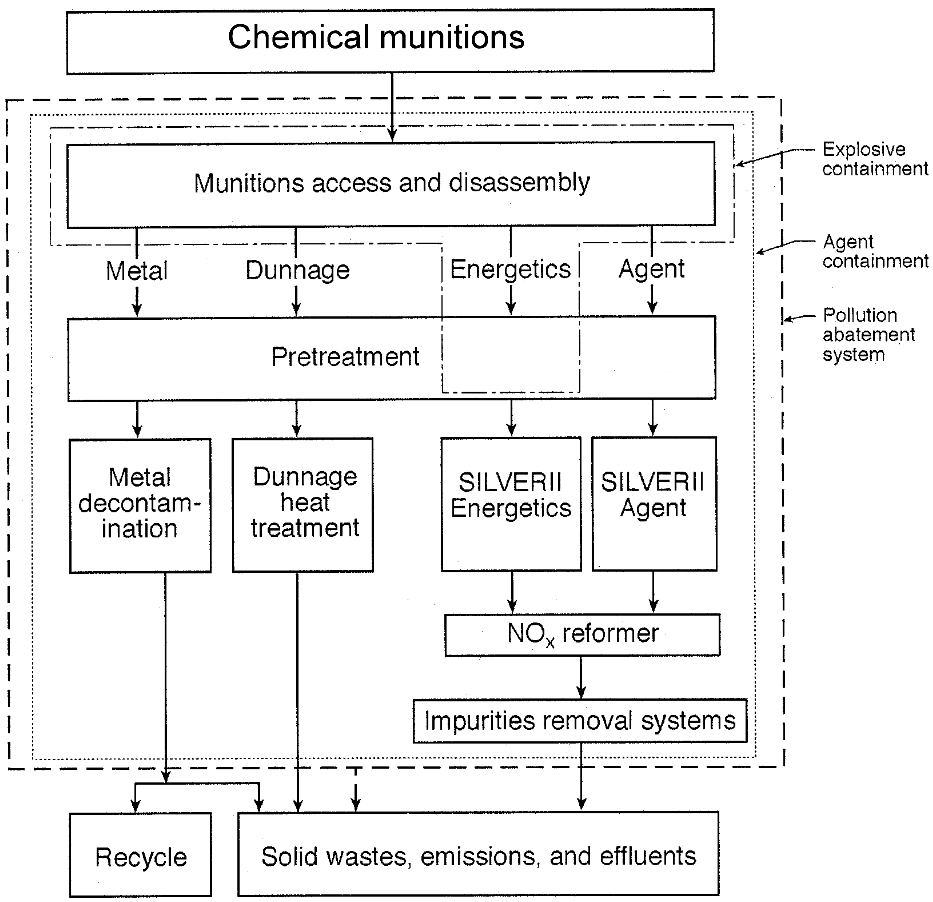

Figure 3.6. Schematic diagram of the Electrochemical Oxidation System.
Source: Fig. 3.2-3, ACWA DEIS 2001.

The destruction process would begin with the removal of the munitions on pallets from the storage igloos. Munitions would be transported to the chemical handling area of the destruction facility in ONCs. All movement of munitions from the storage site to the destruction facility would be within the boundaries of the munitions storage area and the destruction facility site. Monitoring and movement would conform to all applicable safety guidelines and regulations.

3.3.2 Disassembly Process

With regard to the chemical weapons (projectiles and rockets) stored at BGAD, the term disassembly refers to the steps taken to separate the chemical agent and energetics from the metal casing and other metal parts. The first step of the disassembly process would be to remove the energetics.

Based on the JACADS experience, it is difficult to remove the burster well and drain the chemical agent from mustard-filled projectiles. The fuzes and bursters would be removed by using two projectile/mortar disassembly machines (PMDs) to be installed in the MDB. Energetic components (fuzes, bursters, and propellants) may be shipped to an appropriately permitted off-site TSDF or destroyed on-site. Both options are addressed in the following assessment of impacts. For baseline incineration, the second (and last) step of the disassembly process for projectiles is draining the chemical agent into a holding tank.

Rockets would be drained first and then sheared into sections. The energetic components would be removed from the sheared section. The energetics components may be sent to the an appropriately permitted off-site TSDF or destroyed on-site. Both options are addressed in the following assessment of impacts.

The neutralization and electrochemical systems would accomplish energetics removal from projectiles at the beginning of the destruction process by using robotic reverse assembly, which includes two steps shared with baseline incineration: (1) reverse assembly by removal of the burster well to access the mustard agent, and (2) draining of the chemical agent. The remaining steps of disassembly for the ACWA alternatives are to cut open the projectiles and wash out the agent and energetics, or to freeze the munition/chemical agent in liquid nitrogen and fracture the frozen assembly.

3.3.3 Destruction Process

3.3.3.1 Baseline incineration process

There are three incineration steps in the baseline incineration process: incineration (destruction) of liquid nerve or mustard agent, deactivation of energetics, and decontamination of metal parts and decontamination/disposal of dunnage [raise the temperature above 1000ºF for 15 min]. Each of these incineration processes is conducted in a furnace (incinerator) designed specifically for the physical form and chemical characteristics of the expected incoming materials. For additional details, see Appendix D. All three incineration processes operate between 1000 and 1500ºF to ensure the destruction of mustard agent. Each incinerator has a secondary incinerator (afterburner) through which the exhaust gases must flow. The afterburner operates at 2000ºF with a residence time of at least 1.0 sec to destroy any nerve or mustard agent or other organic compounds which exit the primary incinerator. Before being released to the atmosphere the exhaust gases from the afterburner are treated in a pollution abatement system, which has a filtration system at its outlet. Uncontaminated dunnage would not be incinerated. It would be stored and transported to an appropriately permitted off- site disposal facility. Contaminated dunnage would be destroyed in the metal parts furnace or the deactivation furnace.

Destruction of energetics would be accomplished differently for uncontaminated and chemical agent-contaminated components. After agreements are reached with Kentucky Department for Environmental Protection (KDEP), EPA, other involved states, and the receiving TSDFs, the uncontaminated energetics would be shipped off-site to the TSDFs where the components would be destroyed. Nerve or mustard agent-contaminated energetics would be destroyed on-site in a deactivation furnace (DFS).

3.3.3.2 Neutralization with supercritical water oxidation process

Neutralization (hydrolysis) is the agent destruction process that is common to two of the ACWA destruction systems evaluated in this EIS: neutralization with SCWO and neutralization with GPR/TW-SCWO. The process uses hot water followed by caustic solution (sodium hydroxide in water) to break down mustard agent. Caustic solution is also used to break down nerve agents and reduce the hazards of energetic compounds. The resulting material (hydrolysate) must be treated further. Agent and energetics hydrolysate streams are treated separately.

SCWO is a thermal-oxidation process that takes place at temperatures and pressures above the critical point of water [temperatures greater than 705ºF and pressures greater than 220 bar. Both chemical agent and energetics tend to break down under these conditions. The process would produce both gases and liquids. The solution would be dried to remove salts and other materials; these would be treated as needed prior to disposal. The neutralization with SCWO system would use thermal treatment processes to decontaminate metal parts only. Potential processes include using steam, hot gas, or radiant heat.

3.3.3.3 Neutralization with gas phase chemical reduction and transpiring wall supercritical water oxidation process

Neutralization with GPCR/TW-SCWO has the same neutralization process described above, Section 3.3.3.2. GPCR is a process for treating metal parts, dunnage, and gas streams emanating from other parts of the destruction facility. GPCR is a thermal system (operated at temperatures above 1560°F) that uses hydrogen in a steam atmosphere to reduce organic compounds to methane (CH_4), CO_2, carbon monoxide (CO), and acid gases.

TW-SCWO is a SCWO unit that has a barrier of clean water dispersed from the sides of the unit to limit corrosion and solids buildup. Unlike the solid-wall SCWO that treats agent and energetics hydrolysate streams separately, the TW-SCWO treats a combined agent and energetics hydrolysate stream.

3.3.3.4 Electrochemical oxidation process

Electrochemical oxidation (electrochemical oxidation) is a single-stage agent-destruction process would use an electrical current to establish a strongly oxidizing environment. Electrochemical oxidation occurs when an electric current is applied across an anode and cathode in a cell containing acids in compartments separated by a membrane. The organic feed containing the agents or energetics is metered into the cell, which also contains silver nitrate. When the current is applied, the silver ions ($Silver^{2+}$) that are generated oxidize the organic materials, while the nitric acid is reduced to NO_x and water. This single-stage process destroys chemical agents and energetics. A thermal process must be used to treat metal parts and other solids. Thermal processes being considered use steam, hot gas (such as hydrogen), or radiant heat to raise the temperature above 1,000°F for 15 minutes.

3.3.4 Pollution Abatement and Waste Handling Processes

The effluents from all the chemical munitions destruction alternatives would include gases and solids. The electrochemical oxidation system would also have liquid effluents. Liquid brines from the baseline incineration alternative would be dried to solids in a brine reduction area (BRA). The ACWA systems, except electrochemical oxidation, would recycle their process liquids; there would be a dilute nitric acid waste stream for the electrochemical oxidation technology. Plant ventilation systems would be designed to cascade airflow from areas least likely to be contaminated to those where there would be a greater possibility of contamination. Filters (HEPA and activated charcoal) and liquid scrubbers would control air pollution. Additionally, catalytic purifiers (similar to automotive catalytic converters) would control air pollution from the ACWA systems. The ACWA systems could hold and test ventilation air before releasing it through the pollution control processes.

Solid residues, such as salts, would be considered hazardous wastes if they leach heavy metals above levels allowed by the RCRA Toxicity Characteristic Leaching Procedure (TCLP). Liquid wastes which fail the TCLP or are derived from a listed waste would be considered hazardous wastes. (Kentucky has classified all demilitarization residues as hazardous wastes.) Stabilization of these waste forms would be required before they would be disposed of in a permitted hazardous waste disposal facility. Metal parts would be treated to remove residual agent and then be recycled.

3.4 INPUTS AND OUTPUTS

3.4.1 Resource Requirements

The estimates of resource requirements that follow are not exact but provide an envelope for possible levels of annual throughput. Resource use could differ from the estimates presented here due to downtime for maintenance or operating less than 24 hours per day, 7 days per week.

Table 3.1 presents estimated resource requirements for all four alternatives. For the incineration processes, 24-hr/day, 7-day/week operations are assumed. Operations of the ACWA alternatives would be on a 12-hr/day, 6-day/week, 46-week/year basis, with the remainder of the time set aside for equipment maintenance and other activities.

3.4.2 Routine Emissions and Wastes

3.4.2.1 Incineration process

Air emissions and solid wastes are the main components of waste from the incineration process. Ventilation air would pass through a series of filters and be monitored before release to the atmosphere. Process gases would pass through a pollution abatement system and be monitored before release to the atmosphere. Sanitary wastes would be the liquid effluents expected from the facility. Agent-contaminated liquid laboratory wastes would be decontaminated until the concentration of agent achieves commonwealth permit requirements. Liquid laboratory waste and decontaminated liquid laboratory waste meeting commonwealth permit requirements would be shipped off-site to an appropriately permitted facility for treatment and disposal. Liquid and solid wastes identified as hazardous would be stored and disposed of in accordance with RCRA requirements. It is expected that decontaminated metal would be sold for recycling. Nonhazardous solid wastes would be disposed of in a commercial landfill.

Table 3.1 Approximate annual input requirements[a]

Input	Baseline incineration	Neutralization/ SCWO	Neutralization/ GPCR/TW-	Electro- chemical oxidation
Electric power[b] (GWh)	22	60	26	122
Natural gas (million ft^3)	550	52	138	52
Fuel oil[c] (thousand gal)	45	48	48	48
Potable[d] water (million gal)	6.4	6.4	6.4	6.4
Process water (million gal)	18	6.3	18	1

Conversion factors: 1 ft^3 = 0.028 m^3, 1 gal = 3.8 L, 1 ton = 0.91 metric ton

[a]Except where noted, baseline incineration values are based on 24 hours/day 365 days of operations per year and ACWA technologies values are based on 12 hours/day, 6 days/week, 276 days of operations per year.

[b]Based on 365 days of operation per year and average power rating of 80%.

[c]Fuel oil use is for emergencies. It would power generators to maintain electrical power to critical control and safety systems during shutdown of the primary electrical power system. Fuel oil use is based on an estimate of 600 hours of emergency generator operation per year.

[d]Values for potable water are based on 365 days of operation.

Source: ACWA FEIS Tables 3.4-2, 3.4-3, and 3.4-4. Baseline incineration values are based on operating data from JACADS.

3.4.2.2 Neutralization and electrochemical processes

Air emissions and solid wastes are the main components of waste from the neutralization process. Electrochemical oxidation would have a liquid waste stream: nitric acid which would be disposed as a hazardous liquid waste. Ventilation air and process gases would pass through a pollution abatement system and be monitored before release to the atmosphere. Liquid laboratory wastes would be processed by neutralization followed SCWO or by electrochemical oxidation, as appropriate. Sanitary wastes would be the only liquid effluent expected from the neutralization or electrochemical oxidation facility. Solid wastes identified as hazardous, such as carbon filters, would be destroyed in the process facility. Hazardous solid wastes that could not be processed by the facility would be stored and disposed of in accordance with RCRA requirements. It is expected that decontaminated metal would be sold for recycling. Nonhazardous solid wastes would be disposed of in a commercial landfill.

3.5 NO ACTION ALTERNATIVE

The no action alternative is the continued storage of the lethal chemical stockpile at BGAD (i.e., the stockpile would not be destroyed).

As noted in Sect. 1.3, the no action alternative, continued storage, is evaluated, as required by CEQ regulations, even though it is not a viable alternative because its implementation is precluded by Public Law 99-145. It is assumed, for the purpose of comparing the impacts of this alternative with those of the proposed action, that existing Army storage procedures would be followed during the period of continued storage. These procedures include monitoring, surveillance, and handling activities as described in Sects. 2.2.3 and 2.2.4. For the purposes of impact assessment and risk analysis, an arbitrary assumption must be made with respect to the time period to be analyzed. It is therefore assumed in this document that the continued storage alternative would last for the next 25 years (Sect. 4.22).

As noted in Sect. 2.2.3, the stockpile is currently stored in a variety of configurations in compliance with Army regulations. The chemical agents must be stored in a manner that protects the environment; explosively configured munitions must be stored in igloos. These requirements would continue to be met under the no action alternative. The principal hazards of continued storage involve possible accidental releases of agent that could result from (1) handling activities associated with munition inspection and maintenance (see Sect.2.2.4) and with the treatment of leaking munitions (see Sect.2.2.5); (2) external events, such as earthquakes, lightning strikes, or airplane crashes; and (3) continued degradation of the munition and agent items. A recent risk assessment determined that over 99% of the continued storage risk is associated with externally-initiated events (SAIC 1997).

Monitoring for the presence of chemical agent vapor in the storage areas would continue. Monitoring capabilities and practices could be enhanced as a result of improvements in instrumentation and safety standards derived through ongoing studies supporting the CSDP.

The Army currently has chemical accident/incident response and assistance (CAIRA) plans in place at BGAD to guide emergency response in the unlikely event of a release of chemical agent during storage. This capability would be maintained as long as the chemical agents were to remain on-site. In addition, civilian emergency response capabilities are being supplemented (see Sect. 4.26.4).

3.6 SUMMARY COMPARISON OF POTENTIAL IMPACTS

This section provides a comparative summary of the potential impacts of alternative technologies for carrying out the construction, operation, and closure of a facility to destroy the chemical munitions currently stored at BGAD. The impacts of the alternatives are addressed in greater detail in Section 4. The four alternative technologies for destruction of the chemical munitions stockpile at BGAD, as described in earlier portions of Section 3, are: (1) baseline incineration; (2) neutralization followed by supercritical water oxidation; (3) neutralization followed by supercritical water oxidation and gas phase chemical reduction; and (4) electrochemical oxidation. The potential impacts of these alternatives are summarized and compared in Tables 3.2 through 3.4 along with the impacts of no-action (i.e., continued storage and maintenance of chemical munitions at BGAD) as required by NEPA. Table 3.2 addresses the impacts of construction, Table 3.3 addresses the impacts of operations, and Table 3.4 addresses the impacts of hypothetical accidents.

For each table, the summary of impacts of the baseline incineration alternative is presented in its entirety; where reasonable, the impacts of alternatives involving non-incineration technologies are compared directly with those of the baseline incineration alternative.

3.7 REFERENCES

ACWA (Assembled Chemical Weapons Assessment) DEIS 2001. *Draft Environmental Impact Statement for Follow-on Tests Including Design, Construction and Operations of One or More Pilot Test Facilities for Assembled Chemical Weapon Destruction Technologies at One or More Sites*, Program Manager for Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., May.

ACWA TRD 2001. ACWA *Technology Resource Document*, SAIC, June 2000.

SAIC (Science Applications International Corporation) 1997. *Blue Grass Chemical Agent Disposal Facility Phase 1 Quantitative Risk Assessment*, SAIC-96/1118, prepared for U.S. Army Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., by SAIC, Abingdon, Md., January.

Table 3.2. Summary and comparison of the impacts of construction for all alternatives

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Land use (See Sect. 4.2)	Construction would disturb approximately 95 acres of previously undisturbed land. This is less than 1% of land within BGAD boundaries.	Impacts essentially identical to baseline incineration alternative since the same footprint is assumed.	Impacts essentially identical to baseline incineration alternative since the same footprint is assumed.	Impacts essentially identical to baseline incineration alternative since the same footprint is assumed.	No changes in current land use. Land that would have been disturbed by facility construction would remain undisturbed.
Water supply and use (See Sect. 4.3)	New utility connections would provide process water, potable water, and sanitary sewer services to the site. Construction of 500,000 gal water storage tank for use during operations.	Impacts similar to those for construction of the baseline incineration alternative.	Impacts similar to those for construction of the baseline incineration alternative.	Impacts similar to those for construction of the baseline incineration alternative.	No changes to existing water supply and use. Water storage tank would not be constructed.

Table 3.2. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Waste management (See Sect. 4.6)	Typical construction wastes would be disposed of in accordance with Army, Commonwealth, and federal regulations. No significant impacts would be expected to nearby or regional waste disposal facilities. Hazardous wastes would include solvents, paints, cleaning solutions, waste oils, contaminated cleaning implements and pesticides. Nonhazardous wastes would include sanitary wastes, excavation spoils and building material debris.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	No construction wastes would be produced.

Table 3.2. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Noise (See Sect. 4.10)	Noise impacts would be minimal. Maximum noise levels of about 48 dBA at the BGAD boundary closest to the public and residences (55 dBA is EPA's level to protect against outdoor activity interference).	Noise impacts would be similar to those for the baseline incineration alternative.	Noise impacts would be similar to those for the baseline incineration alternative.	Noise impacts would be similar to those for the baseline incineration alternative.	No changes in current noise levels.
Visual resources (see Sect. 4.11)	Other than construction of entrance gate and parking area, construction in area for destruction facilities not highly visible to off-post viewers. Impacts negligible.	Visual resource impacts would be similar to those for the baseline incineration alternative.	Visual resource impacts would be similar to those for the baseline incineration alternative.	Visual resource impacts would be similar to those for the baseline incineration alternative.	No changes in current visual character of BGAD.
Geology and soils (See Sect. 4.12)	Soil disturbance could result in increased erosion, but best management practices should minimize this impact. Soils used for backfill; small impacts.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	No construction, hence, impacts to soils or mineral resources.

Table 3.2. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Groundwater (See Sect. 4.13)	Impacts negligible with incident-free construction. Best management practices would reduce potential for any groundwater contamination.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	No impacts to groundwater expected.
Surface water (See Sect. 4.14)	No significant on- or off-post impacts expected. Less than 1% of the capacity of the water treatment plant at BGAD would be used during construction. 4.5 million gal sanitary wastes would be generated, treated and discharged to Muddy Creek within requirements of BGAD's KPDES Permit. Use of sedimentation basin and other standard construction practices would minimize impacts to surface water.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	Impacts would be similar to those for the baseline incineration alternative.	No construction, hence no impacts to surface water.

Table 3.2. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Terrestrial ecology (See Sect. 4.15)	Including access roads and infrastructure, proposed sites A and B each have a footprint of approximately 95 acres that would be disturbed during construction.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No construction; hence no impacts to terrestrial ecology.
Vegetation and habitat	Impacts would be minimal for proposed Site A (fescue-dominated hayfields). Construction would adversely affect vegetation and habitat for Alternate Site B (woodlands).	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No construction; hence no impacts to vegetation and habitat.

Table 3.2. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Wildlife	Some impacts to wildlife immediately around the facility but minimal overall impact at BGAD. Some wildlife species could be displaced due to construction, and members of less mobile species (e.g., amphibians, reptiles) could die during clearing and other activities. Noise during construction may adversely affect small mammals.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No construction; hence no impacts to wildlife.
Aquatic ecology (See Sect. 4.16)	No impacts to aquatic resources would be expected with use of best management practices for erosion control (e.g., sedimentation basin) and spill response.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No construction; hence no impacts to aquatic ecology.

Table 3.2. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Protected species (See Sect. 4.17 and Appendix F)	Construction in either proposed Area A or alternative Area B could adversely affect running buffalo clover (RBC), a federally-listed endangered plant species known to occur at 145 locations on BGAD. Potential habitat for RBC occurs near each area and along possible access routes area. Construction could have a minor impact on bald eagles, forcing them to abandon foraging areas near Lake Vega and move to other water bodies in the area.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No construction, hence no impacts to protected species.

Table 3.2. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Wetlands (See Sect. 4.18)	Construction could affect one or more of five small riverine wetlands (i.e., wetlands associated with intermittent or ephemeral streams) located in the project area. Proposed Area A has one small wetland (< 1 acre) that would be destroyed. Alternative Area B has three small wetlands (<0.5 acre) that would be affected. If alternative route 2 for the access road is selected, a small wetland (1.5 to 2 acres in size) immediately north of that route might be affected. Mitigation measures would reduce or eliminate construction-related impacts on wetlands.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No construction, hence no impacts to wetlands.

Table 3.2. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Archaeological, cultural and historic resources (See Sect. 4.19 and Appendix F)	Based on previous survey results, there is the potential for archaeological sites that would be eligible for listing on the NRHP. Alternative Site B is more likely to have such sites with such features. Archaeological surveys of previously unsurveyed portions of the selected locations are required prior to the start of any project, and consultation with the State Historic Preservation Officer is required. No impacts to traditional cultural properties are expected. No impacts to historic structures are expected.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No construction; hence, no impacts to cultural resources.
Socioeconomics (See Sect. 4.20)	Few significant impacts; see below.	Few significant impacts; see below.	Few significant impacts; see below.	Few significant impacts; see below.	No construction, hence no impacts to socioeconomic resources.

Table 3.2. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Population	Inmigration of up to1,092 individuals	Inmigration of up to 953 individuals	Inmigration of up to 1,102 individuals	Inmigration of up to 1,251 individuals	
Employment	Direct and indirect employment of up to 1,925 individuals	Direct and indirect employment up to 1,670 individuals	Direct and indirect employment of up to 1,920 individuals	Direct and indirect employment of up to 2,160 individuals	
Estimated personal income//payroll	$73.4 million	$63.4 million	$72.9 million	$82.1 million	
Housing	No adverse impacts	No adverse impacts	No adverse impacts	No adverse impacts	
Schools	No adverse impacts	No adverse impacts	No adverse impacts	No adverse impacts	
Public services	Possible exceedance of sewage treatment capacity in Berea if all inmigrants move to Berea; no other significant impacts	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	
Public finances	Minimal impacts	Minimal impacts	Minimal impacts	Minimal impacts	

Table 3.2. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Traffic	Under current road conditions, all key segments of US 25/421, KY 52, and KY 876 would experience severe congestion during the afternoon peak traffic period, as would most of those segments during the morning rush hour. If the selected access road to BGAD is option 3 (on KY 52) and a traffic signal is provided on KY 52 if needed, adverse impacts may be avoided due to planned expansion to KY 52.	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	
Agriculture	No adverse impacts on area agricultural resources expected.	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	

Table 3.2. [construction for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Environmental justice (See Sect. 4.21)	No disproportionately high and adverse impacts expected to minority or low income populations. Could provide jobs and income to subgroups within the area.	Same impacts as for baseline incineration alternative.	Same impacts as for baseline incineration alternative.	Same impacts as for baseline incineration alternative.	No construction; hence, no impacts.

Table 3.3. Summary and comparison of the impacts of operations for all alternatives

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Land use (See Sect. 4.2)	No significant impacts to on or off-post land use.	Impacts are the same as for the baseline incineration alternative.	Impacts are the same as for the baseline incineration alternative.	Impacts are the same as for the baseline incineration alternative.	No changes in current land use.
Water supply and use (See Sect. 4.3)	Existing water supply has sufficient capacity for the alternative. Annual destruction process water use would amount to 18 million gal/yr. Annual potable water use would amount to 6.4 million gal/yr.	Other than process water requirements, impacts would be the same as for the baseline incineration alternative. Annual destruction process water use would amount to 6.3 million gal/yr.	Impacts would be the same as for the baseline incineration alternative.	Other than process water requirements, impacts would be the same as for the baseline incineration alternative. Annual destruction process water use would amount to 1 million gal/yr.	No impacts to water use or supply infrastructure.
Electrical power (See Sect. 4.4)	Use of system upgrades installed during construction. Required capacity is within the design parameters of the supplier. Annual requirement of 22Gwh/yr.	Other than annual requirement for electricity, impacts would be the same as for the baseline incineration alternative. Annual requirement (60Gwh/yr) would be approximately three times greater than for the baseline incineration alternative.	Other than annual requirement for electricity, impacts would be the same as for the baseline incineration alternative. Annual requirement (26Gwh/yr) would be approximately the same as for the baseline incineration alternative.	Other than annual requirement for electricity, impacts would be the same as for the baseline incineration alternative. Annual requirement (122Gwh/yr) would be approximately six times greater than for the baseline incineration alternative.	No change in electrical power supply or use.

Table 3.3. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Natural gas (See Sect. 4.5)	Primary fuel for operations. Annual use of 550 million ft^3 can be met by supplier and supported by new pipeline and connections. No significant impact.	Other than annual requirement for natural gas, impacts would be the same as for the baseline incineration alternative. Annual requirement (52 million ft^3) would be approximately one-tenth as much as the baseline incineration alternative.	Other than annual requirement for natural gas, impacts would be the same as for the baseline incineration alternative. Annual requirement (138 million ft^3) would be approximately one-fourth as much as the baseline incineration alternative.	Other than annual requirement for natural gas, impacts would be the same as for the baseline incineration alternative. Annual requirement (52 million ft^3) would be approximately one-tenth as much as the baseline incineration alternative.	No changes to natural gas supply or use.

Table 3.3. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Waste management (See Sect. 4.6.3)	Energetics destroyed on-site in DFS.	Energetics would be neutralized on-site.	Energetics would be neutralized on-site.	Energetics would be neutralized on-site.	Wastes would continue to be generated during continuing inspection and maintenance activities. Continued degradation of agent containers would likely generate slowly increasing amounts of waste. Estimated 7.5 tons/yr solid and 2.5 tons/yr liquid hazardous wastes produced and disposed of in TSDF
Hazardous solid wastes	Approximately 2,300 total tons of hazardous solid wastes, including ash residues from the furnace systems, brine salts, and spent charcoal filters would be generated, stored, and taken to an off-site permitted TSDF.	Approximately 6,700 total tons of hazardous solid wastes, including brine salts, aluminum oxide, and residue from spent carbon filters would be generated, stored, and shipped to an off-site permitted TSDF.	Approximately 6,880 total tons of hazardous solid wastes, including brine salts, aluminum oxide, and residue from spent carbon filters would be generated, stored, and shipped to an off-site permitted TSDF.	Approximately 995 total tons of hazardous solid wastes, including brine salts, anolyte-catholyte, and residue from spent carbon filters wastes would be generated, stored, and shipped to an off-site permitted TSDF.	

Table 3.3. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Hazardous liquid wastes	A small quantity of laboratory wastes and spent hydraulic fluids would be generated, stored, and taken to an off-site permitted TSDF.	Process liquids would be recycled. A small quantity of laboratory wastes would be generated, stored, and taken to an off-site permitted TSDF.	Process liquids would be recycled. A small quantity of laboratory wastes would be generated, stored, and taken to an off-site permitted TSDF.	Except for dilute nitric acid, process liquids would be recycled. A small quantity of laboratory wastes would be generated, stored, and taken to an off-site permitted TSDF.	
Nonhazardous wastes	A total of approximately 11.7 million gal of sewage and 2,150 tons of nonhazardous solid wastes, including metals and solids and uncontaminated wood dunnage would be generated. Sewage would be treated and discharged to Muddy Creek or pumped to the existing infrastructure in Richmond, and solid wastes would be disposed of in an off-site permitted landfill.	A total of approximately 11.6 million gal of sewage and 2,015 tons of nonhazardous solid wastes, including metals and solids, would be generated. Sewage would be treated and discharged to Muddy Creek or pumped to the existing infrastructure in Richmond or at BGAD, and solid wastes would be disposed of in a permitted landfill.	A total of approximately 9.7 million gal of sewage and 7,980 tons of nonhazardous solid wastes, including metals and solids, would be generated. Sewage would be treated and discharged to Muddy Creek or pumped to the existing infrastructure in Richmond or at BGAD, and solid wastes would be disposed of in a permitted landfill.	A total of approximately 9.7 million gal of sewage and 4,420 tons of nonhazardous solid wastes, including metals and solids, would be generated. Sewage would be treated and discharged to Muddy Creek or pumped to the existing infrastructure in Richmond or at BGAD, and solid wastes would be disposed of in a permitted landfill.	

Table 3.3. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Air quality-criteria pollutants (See Sect. 4.7)	Under development.	Under development for comparing to baseline incineration.	Under development for comparing to baseline incineration.	Under development for comparing to baseline incineration.	No changes in emissions of criteria pollutants.
	Expect to find low level emissions of $N0_X$, $S0_2$, CO, PM_{10}, $PM_{2.5}$, and VOCs, and negligible impacts and no exceedances of NAAQS expected other than for $PM_{2.5}$, for which background already exceeds NAAQS. Negligible concentrations of heavy metals would be emitted.	Expect emissions equal to or less than baseline incineration. Negligible impacts and no exceedances of NAAQS expected other than for $PM_{2.5}$, for which background already exceeds NAAQS. Negligible concentrations of heavy metals would be emitted.	Expect emissions equal to or less than baseline incineration but slightly more than other two non-incineration technologies. Negligible impacts and no exceedances of NAAQS expected other than for $PM_{2.5}$, for which background already exceeds NAAQS. Negligible concentrations of heavy metals would be emitted.	Expect emissions equal to or less than baseline incineration. Negligible impacts and no exceedances of NAAQS expected other than for $PM_{2.5}$, for which background already exceeds NAAQS. Negligible concentrations of heavy metals would be emitted.	

Table 3.3. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Air quality-hazardous and toxic substances (See Sect. 4.8 and Appendices J and K)	No significant impacts and no exceedances of limits expected. Destruction of PCBs in M55 rocket firing tubes will be monitored and managed to be in compliance with TSCA regulations. Emissions of hazardous air pollutants, including chemical agent, to the atmosphere during process fluctuations mitigated by carbon filter banks. Failure of all filters in carbon banks would result in concentrations less than 3% of the allowable concentrations for general public exposure established by the CDC.	Impacts similar to those for baseline incineration.	Impacts similar to those for baseline incineration.	Impacts similar to those for baseline incineration.	Possibility of an accident with potentially severe impacts remains with continued storage (see impacts from potential accidents and Sect. 4.22).

Table 3.3. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Human health and safety (See Sect. 4.9 and Appendix E)	No exceedances of emissions standards or exposure levels expected on the basis of operating experience at other chemical agent destruction facilities. Site-specific human health risk assessment will be conducted as part of the RCRA permitting process to ensure no adverse health effects.	Based on limited demonstration testing, no exceedances of emissions standards or exposure levels expected.	Based on limited demonstration testing, no exceedances of emissions standards or exposure levels expected.	Based on limited demonstration testing, no exceedances of emissions standards or exposure levels expected.	Small, but well understood risks to workers continue, but no health impacts likely.
Noise (See Sect. 4.10)	Less than 45 dB(A) at nearest residence. No impacts expected.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	Sound levels remain at present low levels.
Visual resources (see Sect. 4.11)	No significant visual impact. Entrance gate and parking area would continue to be visible, and possibility of seeing stack and small steam plume.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	No change in visual character of BGAD.

Table 3.3. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Geology and soils (See Sect. 4.12)	No disturbance or contamination under routine operations.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	Continued absence of impacts to soils.
Groundwater (See Sect. 4.13)	Negligible impacts to groundwater. No use of groundwater required for operations. Best management practices should minimize potential for contamination due to accidental spills or leaks of hazardous materials.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	Not significantly different from baseline incineration alternative.	No impacts to groundwater.
Surface water (See Sect. 4.14)	18 million gal annual process water demand for operations within capacity of Lake Vega, as is annual potable water demand of 6.4 million gal. No process effluents would be released to surface water from incident-free operations.	Approximately one-third of the demand for process water of the baseline incineration alternative . Other impacts not significantly different than for baseline incineration alternative.	Not significantly different from baseline incineration alternative.	Least process water demand (1 million gal/yr). Other impacts not significantly different than for baseline incineration alternative.	Possibility for impacts from a storage accident would remain (See Sect. 4.22).

Table 3.3. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Terrestrial ecology (See Sect. 4.15)	Impacts would be negligible under routine operations. A site-specific screening level ecological risk assessment would be prepared to validate preliminary conclusions.	Impacts the same as for the baseline incineration alternative. A screening level ecological risk assessment would be prepared to validate preliminary conclusions.	Impacts the same as for the baseline incineration alternative. A screening level ecological risk assessment would be prepared to validate preliminary conclusions.	Impacts the same as for the baseline incineration alternative. A screening level ecological risk assessment would be prepared to validate preliminary conclusions.	No change from current low-level impacts of continued storage.
Aquatic ecology (See Sect. 4.16)	Impacts would be negligible under routine operations. A site-specific screening level ecological risk assessment would be prepared to validate preliminary conclusions.	Impacts the same as for the baseline incineration alternative. A screening level ecological risk assessment would be prepared to validate preliminary conclusions.	Impacts the same as for the baseline incineration alternative. A screening level ecological risk assessment would be prepared to validate preliminary conclusions.	Impacts the same as for the baseline incineration alternative. A screening level ecological risk assessment would be prepared to validate preliminary conclusions.	Normal monitoring and maintenance would not affect aquatic habitats.
Protected species (See Sect. 4.17 and Appendix F)	Protected species should not be adversely affected by routine operations.	Impacts the same as for the baseline incineration alternative.	Impacts the same as for the baseline incineration alternative.	Impacts the same as for the baseline incineration alternative.	No impacts would occur to protected species.

Table 3.3. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Wetlands (See Sect. 4.18)	Routine operations could result in minor impacts on nearby downwind wetlands and their biota via the deposition of minute quantities of pollutants. Some new wetland habitat could be created below the outfall from the new sanitary waste treatment facility.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	Impacts would be identical to those for the baseline incineration alternative.	No impacts on wetlands would occur.
Archaeological, cultural and historic resources (See Sect. 4.19 and Appendix F)	No impacts expected from routine operations.	No impacts expected from routine operations.	No impacts expected from routine operations.	No impacts expected from routine operations.	No impacts to resources.
Socioeconomics (See Sect. 4.20)	No significant impacts to public services, housing, or infrastructure expected.	No significant impacts to public services, housing, or infrastructure expected.	No significant impacts to public services, housing, or infrastructure expected.	No significant impacts to public services, housing, or infrastructure expected.	No change in socioeconomic effects of BGAD.
Population	Inmigration of 1,338	Inmigration of 1,338	Inmigration of 1,338	Inmigration of 1,338	

Table 3.3. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Employment	Direct and indirect employment 1,400	Direct and indirect employment 1,450	Direct and indirect employment 1,360	Direct and indirect employment 1,440	
Personal income	$66.0 million	$68.7 million	$63.8 million	$68.1 million	
Housing	No adverse impacts unless more than 75% of workers sought to purchase houses in Madison County, leading to limited choices and higher prices or decisions to locate outside the county.	Same impacts as for baseline incineration alternative.	Same impacts as for baseline incineration alternative.	Same impacts as for baseline incineration alternative.	
Schools	No adverse impacts	No adverse impacts	No adverse impacts	No adverse impacts	
Public services	Possible exceedance of sewage treatment capacity in Berea expected during construction alleviated by expansion of Berea capacity; no adverse impacts.	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	
Public finances	Minimal impacts	Minimal impacts	Minimal impacts	Minimal impacts	

Table 3.3. [operations for all alternatives (continued)]

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
Traffic	No substantial impacts are expected if the selected access road to BGAD is option 3 (on KY 52), a traffic signal is provided on KY 52 if needed, and the planned highway improvements are implemented on schedule.	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	Same impacts as for baseline incineration alternative	
Agriculture	No adverse impacts on area agricultural resources expected.	No adverse impacts on area agricultural resources expected.	No adverse impacts on area agricultural resources expected.	No adverse impacts on area agricultural resources expected.	
Environmental justice	No high and adverse impacts expected to accrue disproportionately to minority or low income populations. Could provide jobs and income to subgroups of area.	Same impacts as for baseline incineration alternative.	Same impacts as for baseline incineration alternative.	Same impacts as for baseline incineration alternative.	No project-related impacts would occur.

Table 3.4. Summary and comparison of the impacts of hypothetical accidents for all alternative

Potentially Affected Resource	Baseline Incineration	Neutralization with SCWO	Neutralization with SCWO and Gas Phase Chemical Reduction	Electrochemical Oxidation	No Action
All resource categories (See Sect.4.22 and Appendix H)	An earthquake affecting 8-inch GB projectiles in the munitions demilitarization building, the unpack area, and the container handling building (CHB) could produce airborne concentrations up to 16 miles downwind. Potential off-post fatalities could be up to 2,300 under unfavorable meteorological conditions or up to 180 fatalities under more typical meteorological conditions. Deposition of chemical agent could also contaminate off-post land areas, crops, habitat, surface waters, and cultural resources.	Because munition and agent quantities stored pending processing would be similar to those for the baseline incineration alternative, the potential impacts would be similar to the impacts of the baseline incineration alternative.	Because munition and agent quantities stored pending processing would be similar to those for the baseline incineration alternative, the potential impacts would be similar to the impacts of the baseline incineration alternative.	Because munition and agent quantities stored pending processing would be similar to those for the baseline incineration alternative, the potential impacts would be similar to the impacts of the baseline incineration alternative.	A lightning strike to a storage igloo could produce lethal airborne concentrations up to 31 miles downwind. Potential off-post fatalities could be up to 5,900 under unfavorable meteorological conditions or up to 2,200 under more typical meteorological conditions. Deposition of chemical agent could also contaminate off-post land areas, crops, habitat, surface waters, and cultural resources.

4. EXISTING CONDITIONS AND ENVIRONMENTAL IMPACTS

4.1 POTENTIAL SITES AND FACILITY LOCATIONS FOR CHEMICAL MUNITIONS ACTIVITIES AT BLUE GRASS

BGAD, located in the Blue Grass region of east central Kentucky in the approximate center of Madison County (Fig. 2.1). BGAD encompasses 14,596 acres and is approximately 30 miles southeast of Lexington, 85 miles) southeast of Louisville, and 90 miles south of Cincinnati, Ohio. It is adjacent to the southeastern portion of Richmond, Kentucky, and approximately 5 miles southeast of the center of Richmond and 10 miles northeast of Berea, Kentucky (Fig. 2.1). The installation includes a variety of buildings, structures, and undeveloped areas.

BGAD is located in the Outer Blue Grass Subdivision of the Blue Grass physiographic region. The topography of the Outer Blue Grass Subdivision is characterized by moderately undulating to gently rolling hills that steepen near major streams. The depot is characterized by open fields and rolling hills with gentle slopes dotted with woodlots of varying sizes. BGAD is surrounded by agricultural land, industrial land uses, low-density residential areas, some commercial activities, and public areas, including educational and recreational activities and areas.

As discussed in Section 2 of this FEIS, it is assumed that any munitions disposal facility would be constructed within the vicinity of the chemical agent storage area.

The area considered appropriate for construction of a destruction facility was subdivided into two smaller areas labeled A and B (Fig. 4.1). Two potential corridors for constructing supply lines for electric power, and one corridor for constructing a supply line for natural gas were identified. Also, three potential access roads to the destruction site were identified and labeled Options 1, 2, and 3 (Fig. 4.1). Regardless of which corridor and route are selected, they could serve either of the two destruction facility areas. Because of these delineations, descriptions of the affected environment at BGAD focus on Areas A and B and Options 1, 2, and 3. However, information about other parts of BGAD is presented as needed to support the assessment of potential impacts from constructing and operating a chemical munitions destruction facility.

4.2 LAND USE

4.2.1 Site History and Uses

The U.S. Army opened Blue Grass Ordnance Depot in 1942 (Geo-Marine, Inc. 1996). The depot's main mission was to store ammunition, although it also served as a general supply site and included utilities and administration facilities. The U.S. Government operated the installation from when it opened in April 1942 until October 1943. From October 1943 to October 1945, the facility was operated by the Blue Grass Ordnance Depot, Inc., a subsidiary

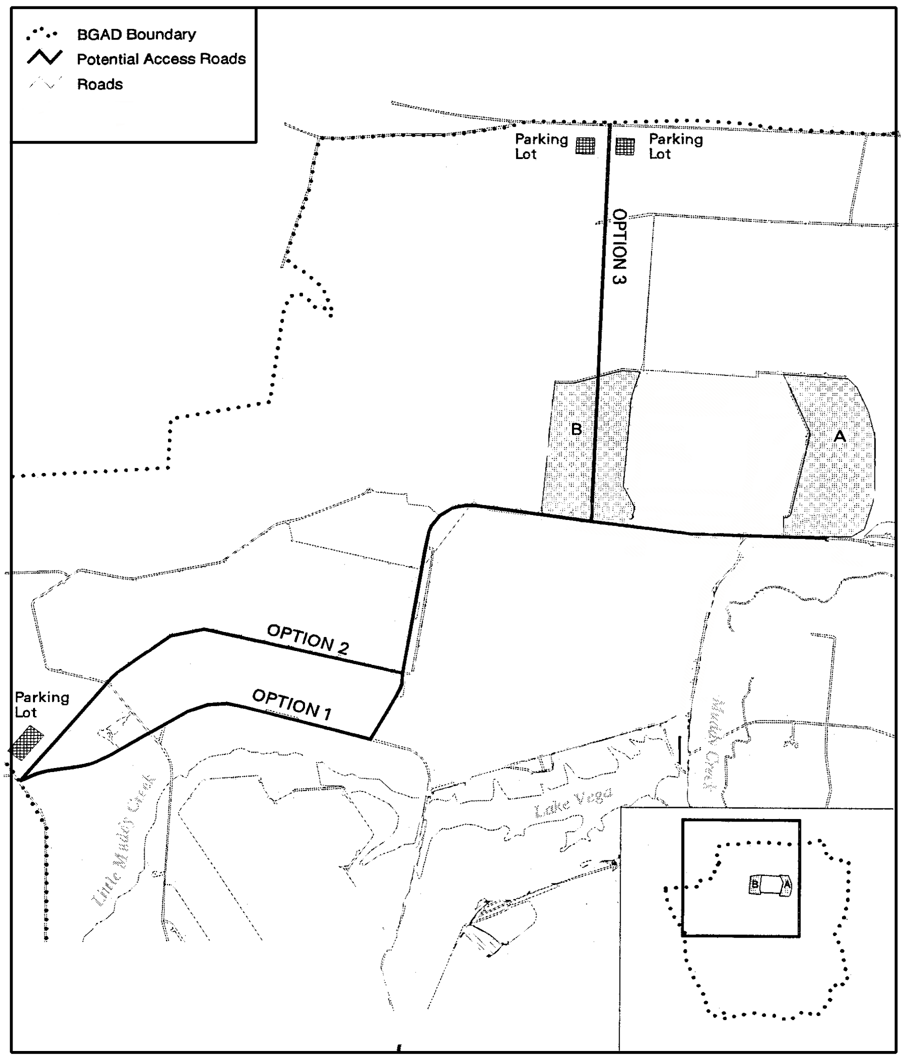

Fig. 4.1. Location of alternative sites and road access corridors identified for the proposed chemical weapons destruction facility at the Blue Grass Army Depot. *Source:* ACWA DEIS 2001, Fig. 7.3-1.

of Firestone Tire and Rubber Company. The U.S. Government resumed operation of the installation in October 1945 and has continued to operate it to the present.

In 1964, the Blue Grass Ordnance Depot (located in Richmond, Kentucky) merged with the Lexington Signal Depot (located in Lexington, Kentucky) to form Lexington-Blue Grass Army Depot. Lexington-Blue Grass Army Depot operated until 1992, providing ammunition and general supply support and maintaining communications and electronics equipment. In response to a Base Realignment and Closure (BRAC) Commission decision in 1988, the federal government directed that the Lexington facility close by 1995. In 1992, the general supply and maintenance mission that the Lexington facility had undertaken ended. Final closure was completed in 1994. The federal government is in the process of transferring the Lexington facility to the Commonwealth of Kentucky. The remaining Blue Grass facility was reorganized and renamed Blue Grass Army Depot in 1992.

In addition to conventional munitions, the Army began to store chemical weapons at its Blue Grass installation in 1944. Chemical weapons storage at the installation was interrupted in 1949 after the chemical weapons inventory was shifted to Rocky Mountain Arsenal. Blue Grass began to receive shipments of more modern chemical agents and weapons in 1952, and this activity continued until the mid-1960s. Since that time, one of the roles of BGAD has been the safe storage of existing chemical weapons (Geo-Marine, Inc. 1996).

In 1996, the Army established the Blue Grass Chemical Activity (BGCA) as a special unit focused on the management and storage of chemical weapons on BGAD. The BGCA is a tenant organization of BGAD, reporting to the U.S. Army Soldier and Biological Chemical Command (SBCCOM). The primary mission of BGCA is the safe storage and monitoring of the chemical weapons stockpile that is located within the Chemical Limited Area, a highly secured 250-acre site in the northern part of BGAD.

Currently BGAD is a Tier I Operations Support Command (OSC) depot whose core business is providing munitions, chemical defense equipment, and special operations support to the U.S. Department of Defense (DOD). As a Tier I facility, BGAD is staffed to store conventional munitions for training and major force deployment. BGAD is the Army's major storage site for chemical defense equipment. The conventional munition operations at BGAD include shipping and receiving, storage, maintenance, inspection, and demilitarization. The OSC and SBCCOM are major subordinate commands of the Army Materiel Command (AMC).

4.2.2 Current and Planned On-Post Land Use

Current land use on BGAD primarily involves industrial and related activities associated with the storage and maintenance of conventional and chemical munitions. A total of 1,152 structures are located on BGAD. Most of these—902 in all—are steel-reinforced, earthen-covered concrete magazines (igloos) used to store munitions. Of the 902 total, 49 igloos are used specifically by the BGCA; of these, 45 contain chemical munitions and agents and four contain materials, supplies, metal parts, equipment, and hazardous waste. In addition, BGAD includes 20 warehouses, 12 aboveground magazines, 11 maintenance buildings, and 207 operations, administrative, and medical buildings and military family housing structures. There is also a contractor-operated helicopter maintenance facility located at BGAD.

The most dominant features of the 14,600-acre facility are large tracts of undeveloped woodland and more than 7,000 acres of land currently leased to local farmers for hay production and pasture (BGAD 2000b). BGAD can be divided into major areas on the basis of the arrangement of the structures discussed above, as follows:

- Administrative area, containing the installation headquarters and several other permanent features;
- Housing area, containing two family housing units (one not currently in use);
- Conventional munitions storage area, containing the 853 igloos used for munitions storage; and
- Chemical agent storage area (Chemical Limited Area) containing 49 igloos used for chemical munitions storage.

Anticipated future use of BGAD would remain broadly consistent with current use, focusing primarily on conventional munitions storage. One main modification would be the eventual removal of chemical weapons from BGCA, which would allow that portion of BGAD to be converted back for conventional munitions or other storage use.

4.2.3 Current and Planned Off-Post Land Use

BGAD lies near the geographic center of rural Madison County, Kentucky, roughly 30 mi southeast of Lexington and adjacent to the southeastern portion of Richmond, Kentucky. Communities in the vicinity of the installation consist primarily of small towns, including Berea, Brodhead, Crab Orchard, Ford, Irvine, Kirksville, Lancaster, Mount Vernon, Nicholasville, Paint Lick, Waco, Wilmore, and Winchester.

BGAD lies on a plain roughly 10 mi south of the Kentucky River. The installation features gently rolling open fields and woodlots. Land use in the vicinity of BGAD is mixed and includes agricultural, industrial, low-density residential (within communities and isolated residences), and commercial uses. A large recreational facility, the Lake Reba Recreational Complex, occupies 350 acres on the northwestern border of the facility. It includes a golf course, several ball fields, and a children's play area (Kentucky Center for Economic Development 1993). Parcels of agricultural land have been rezoned for industrial uses, including the 175-acre Richmond Industrial Park along the western boundary of BGAD (Howard 1995). Each of Madison County's two major municipalities, Richmond and Berea, has land use planning and is home to an institution of higher learning (Eastern Kentucky University and Berea College, respectively).

More distant from BGAD, agriculture remains an important land use in Madison County. In 1997, the county contained more than 1,400 farms covering more than 220,000 acres (U.S. Department of Agriculture [USDA] 1999). Cropland on these farms totaled more than 140,000 acres; the remaining area (roughly one-third) was used for grazing.

Land use in the vicinity of BGAD likely will remain fairly constant in the foreseeable future. The main trend emerging in the area near the installation is the conversion of small blocks of farmland to residential and light industrial use. Depending on economic conditions and the success of local industrial parks located near BGAD, this trend, coupled with increasing residential development and use, will probably continue in coming years.

4.2.4 Impacts on Land Use

The total land area that would be disturbed for construction and operation of a chemical munitions destruction facility, including all support facilities and infrastructure, is the same for all evaluated alternatives. Use of proposed Area A would disturb slightly more land area than alternative Area B (see Table 4.1), with a maximum of 95 acres for Area A as compared to 88 acres for Area B. A facility located at Alternate Site B would have a much larger impact on current conventional munition storage and maintenance operations at the Depot than the Proposed Site A.

Because the proposed action would be conducted within the BGAD boundaries and project-induced population growth in the area surrounding BGAD is expected to be relatively small, any resulting changes in off-post land use would be minimal. Impacts to soils, groundwater, surface water, agriculture and other resources are described in subsequent subsections.

4.2.5 Impacts of No Action

Under this alternative, no changes in on-site or off-post land use are anticipated.

4.2.6 Cumulative Impacts

4.2.6.1 Impacts of baseline incineration alternative

The proposed project is not expected to contribute in any substantial manner to cumulative impacts to off-post land use.

4.2.6.2 Impacts of neutralization and electrochemical oxidation alternatives

The proposed project is not expected to contribute in any substantial manner to cumulative impacts to off-post land use.

4.3 WATER SUPPLY AND USE

4.3.1 Current Water Supply and Use

The BGAD water supply is Lake Vega, which is located within the BGAD reservation. Lake Vega is a 135-acre impoundment of Little Muddy Creek located upstream from the confluence of Little Muddy Creek and Muddy Creek (Fig. 4.2). Lake Vega has an estimated

Table 4.1. Estimated land area disturbed for construction of a chemical munitions destruction facility at BGAD

	Area Disturbed (acres)	
Construction Activity	Proposed Area A	Alternative Area B
Destruction facilities (includes all construction disturbance except the following)	25	25
Wastewater treatment plant	1	1
Transmission lines (69-kV)[a]		
Towers and conductor stringing	<1	<1
Right-of-way clearing	20	18
Communication cables[b]	4	2
Gas pipelines[c]	10	11
Water pipelines[c]	5	7
Parking lots	4	4
Access road[d]		
Option 1	28	22
Option 2	25	19
Option 3	18	7
Maximum possible area disturbed[e]	95	88

[a]Transmission line would be on wooden single pole structures spaced about 98 m (320 ft) apart; each tower and conductor stringing site would disturbed 84 m^2 (900ft^2). A 30-m (100-ft) corridor would be cleared of trees and shrubs for a right-of-way.

[b]Communication cables would require a maximum right-of-way width of 5 m (15 ft).

[c]Gas and water pipeline construction would require a 18-m-wide (60-ft-wide) right-of-way. Entire right-of-way would be disturbed.

[d]Amount of disturbance does not take into account the use of existing roads in case widening and upgrading would be required. The access road would require a 18-m-wide (60-ft-wide) right-of-way. Three options for location of an access road were assumed. Option 1 = access road from west entrance along existing roadways. Option 2 - new access road from west BGAD entrance, going north to Route w. Option 3 = access road from north boundary of BGAD.

[e]Total disturbance assuming Option 2 is selected.

Unit conversion: 0.4 ha = 1 acre.

Source: Adapted from ACWA DEIS 2001, Table 7.3-2.

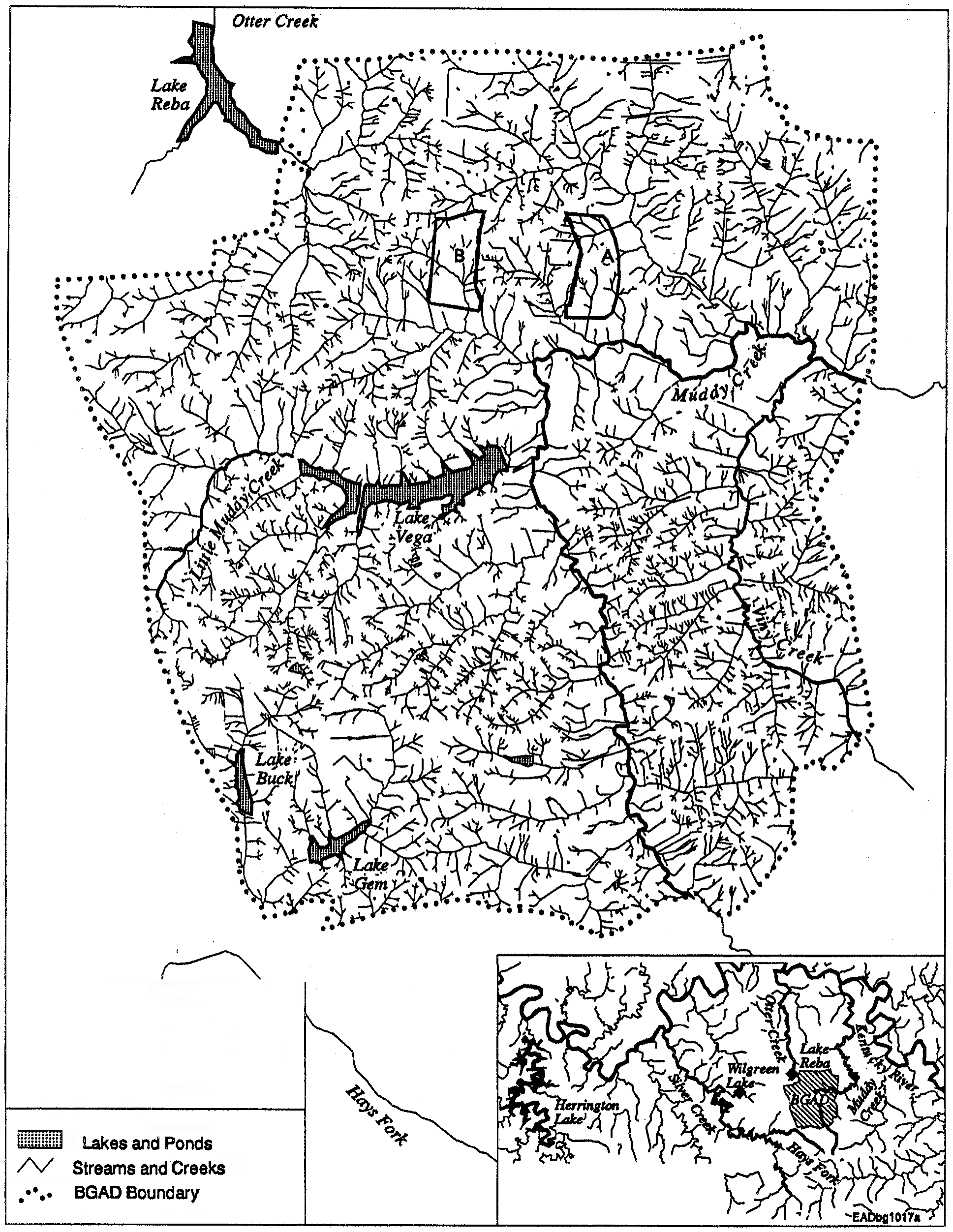

Figure 4.2. Surface water resources of BGAD.
Source: ACWA DEIS 2001, Fig. 7.12-1.

capacity of 1840 acre-ft. Water withdrawn from Lake Vega is treated prior to use in the BGAD water treatment plant, which has a capacity of 720,000 gpd (U. S. Army 1988). For the period of 1999 - 2000, the annual average water treatment plant production was 17.2 % of capacity or 45,000,000 gal. The peak daily production during this period was 51% of capacity or 370,000 gal (ACWA DEIS 2001).

Water is distributed from the water treatment plant by a pumping system composed of three pumps each rated at 50% of the plant capacity. An existing water main is located just to the south of the Chemical Limited Area (Fig. 4.1). The installation is currently evaluating plans to privatize the provision of water resources.

4.3.2 Destruction System Requirements

Process water requirements for the baseline incineration alternative average about 49,000 gpd, and potable water requirements average about 17,500 gpd. The neutralization alternatives have average process water requirements ranging from 3,600-65,000 gpd. The potable water requirements for the neutralization alternatives average about 23,000 gpd. The water requirements for the baseline and non-incineration alternatives are summarized in Table 4.2 (U.S. Army 2001b). Additional discussions of impacts to groundwater and surface water are found in Section 4.13 and 4.14, respectively.

Table 4.2. Water requirements for proposed action and alternatives

Technology	Potable Water (million gallons/year)	Process Water (million gallons/year)
Incinerator	6.4	18[a]
Neutralization/SCWO	6.4	6.3[b]
Neutralization/SCWO/GPCR	6.4	18.0[b]
Electrochemical oxidation	6.4	1.0[b]

[a] 24 hour/d, 365 d/year operations
[b] 12 hour/d, 276 d/year operations

Source: Adapted from ACWA DEIS 2001, Table 7.3-1.

4.3.3 Impacts on Water Supply and Use

4.3.3.1 Impacts of baseline incineration alternative

On-Post Impacts. Water use during construction would include preparing concrete aggregate and other construction materials, rinsing equipment, structures and materials, dust suppression, and fire protection. The existing water supply system would be sufficient to meet these needs. While these water supply needs have not been estimated quantitatively, the water uses during construction would be small, when compared to the available supply of Lake Vega and the water treatment plant. Impacts to the water supply system would be limited to local and short-lived disruptions from connection to the existing infrastructure.

Water use during operation would increase over that during construction; however, the existing water supply and treatment system has sufficient capacity to meet the needs of the project. If the installation decides, on the basis of economic, environmental, and legal criteria, to privatize water services (see Section 2.3.2), on-post impacts would be even less than stated here. The construction of an additional 500,000 gal water storage tank as part of the baseline alternative would provide additional capacity and ensure an adequate water supply is available during peak demand periods or fires or other emergency response demands. Process water would be incinerated (transformed to steam) and would not be sent to the waste water treatment plant or Muddy Creek.

Off-Post Impacts. Water use during construction and operation would have no off-post impacts on the water supply infrastructure. The water supply infrastructure is entirely within the boundary of the BGAD and any impacts would be limited to the installation. If the installation decides to privatize water services, there would be negligible off-post impacts because the water requirements would be within the existing capacity of the public provider.

4.3.3.2 Impacts of neutralization and electrochemical oxidation alternatives

On-post impacts from construction of the neutralization and electrochemical oxidation alternatives would be similar to those of the construction of the baseline incineration alternative. The existing water supply system is sufficient to meet the needs of construction and any impacts to the water supply would be limited to local and short-lived disruptions from connection to the existing infrastructure.

Water use during operation of the neutralization and electrochemical oxidation alternatives would increase from construction; however the existing water supply system has adequate capacity to meet the needs of these alternatives. The projected process water demand for the neutralization and electrochemical oxidation alternatives varies by technology as follows: for the neutralization/SCWO alternative, demand is about the same as the potable water demand during operation; for the neutralization/SCWO-GCPR alternative, the demand is about three times greater than the potable water demand; and for the electrochemical oxidation alternative, the demand is about six times less than the potable water demand. The impact to the on-post water supply system of the neutralization and electrochemical oxidation alternatives are less (neutralization/SCWO-GPCR) or significantly less (neutralization/SCWO and electrochemical oxidation) than those of the baseline incineration alternative.

There are no off-post impacts to the water supply system from construction and operation of the neutralization and electrochemical oxidation alternatives because the systems are entirely within the BGAD. The impact to the off-post water supply system is the same as the baseline incineration alternative. If the installation decides, on the basis of economic, environmental, and legal criteria, to privatize water services (see Section 2.3.2), on-post impacts would be even less than stated here, and off-post impacts would be negligible because water requirements would be within the existing capacity of the private provider.

4.3.4 Impacts of No Action

Under the no action alternative, there would be no impacts to the water use and supply infrastructure. Water supply, treatment and use would continue as described for the current conditions.

4.3.5 Cumulative Impacts

4.3.5.1 Impacts of baseline incineration alternative

Cumulative uses of water for construction of the baseline incinerator alternative would be small when compared to the existing water supply capacity. Additional water distribution pipelines and a 500,000 gal storage tank would be built to augment the water supply system for the baseline incinerator alternative, which would reduce any impacts to the water supply system from any fires or other emergencies.

Cumulative uses of water for operation of the baseline incinerator alternative would increase above current levels. No present or planned activities have been identified that would have water demands that would result in withdrawals in excess of the quantity specified in the water permit issued to the BGAD by the Commonwealth of Kentucky (monthly average of 500,000 gal/day). The monthly average water withdrawal for 2000 was 107,000 gal/day. If necessary, this permit could be modified to include an increased demand for water, but the proposed 500,000 gal storage tank is likely to attenuate short-term peak demands for water. In the event of an extreme and prolonged drought, which could reduce the available supply of water in Lake Vega, incinerator operations would be halted before the reduced water supply jeopardized plant safety. Operations would resume once Lake Vega refilled.

No off-post impacts on water supply would occur from the baseline incineration alternative, since the water supply system is entirely within the BGAD installation.

4.3.5.2 Impacts of neutralization and electrochemical oxidation alternatives

Cumulative uses of water for construction of the neutralization and electrochemical oxidation alternatives would be small when compared to the existing water supply capacity. Additional water distribution pipelines and a 500,000 gal storage tank would be built to augment the water supply system for the neutralization and electrochemical oxidation alternatives, which would reduce any impacts to the water supply system from any fires or other emergencies.

Cumulative uses of water for operation of the neutralization and electrochemical oxidation alternatives would increase above current levels. No present or planned activities have been identified with water demands that would result in withdrawals in excess of the quantity specified in the water permit issued to the BGAD by the Commonwealth of Kentucky (monthly average of 500,000 gal/day). The monthly average water withdrawal for 2000 was 107,000 gal/day. If necessary, this permit could be modified to include an increased demand for water, but the proposed 500,000 gal storage tank is likely to attenuate short-term peak demands for water. In the event of an extreme and prolonged drought, which could reduce the available supply of water in Lake Vega, operations of any of the neutralization and electrochemical oxidation alternatives would be halted before the reduced water supply jeopardized plant safety. Operations would resume once Lake Vega refilled.

No off-post impacts on water supply would occur from the neutralization and electrochemical oxidation alternatives, since the water supply system is entirely withing the BGAD installation.

4.4 ELECTRICAL POWER SUPPLY

4.4.1 Current Electrical Power Supply

Electricity is provided to BGAD by Kentucky Utilities Company. The current capacity of the depot is about 31 GWh/yr of electric power, and the installation consumed approximately 7.8 GWh in 2000. Kentucky Utilities Company distributes power to BGAD via 69-kV transmission lines. The installation is currently evaluating plans to privatize the provision of electrical services.

4.4.2 Impacts on Electrical Power Supply

The current electrical distribution system is limited in extent and would not be able to support the proposed destruction facility. New service connections would have to be added, and two new substations would need to be constructed. The new electrical service would supply only the destruction facility and associated areas, and it would be independent of the other BGAD electrical power supply infrastructure. Therefore, no impact from operations on the existing electric power supply at BGAD is anticipated.

4.4.2.1 Impacts of baseline incineration alternative

During construction, electrical power would be used for a variety of activities. The quantity of electrical power needed for construction cannot be estimated precisely, but it is expected that it would not exceed the existing capacity of the electrical distribution system. Although destruction facility construction would not have significant impacts on the electrical system, it would include the construction of a new 69-kV overhead power line, two new electrical substations near the site of the destruction facility, and related facilities that would be required for destruction operations. Buried power lines would be installed to connect the new substations with the destruction facility.

Operating a baseline incineration facility would require 22 GWh/year of electricity (see Table 4.3). Although this is only slightly less than the depot electrical power supply capacity, it would have no impact because the facility and depot electrical power supplies would be independent. Also the required capacity of the destruction facility would be within the design parameters of the independent supply.

4.4.2.2 Impacts of neutralization and electrochemical oxidation alternatives

It is expected that impacts to the BGAD electrical power supply would not require a significant portion of the 23 GWh/yr available electrical power capacity at BGAD during construction of facilities for any of the neutralization and electrochemical oxidation alternatives, similar to the construction of a baseline incineration facility. As part of the proposed action, the Army would install electrical system upgrades, including an overhead power line and new substations. This upgraded system would be designed to handle the electrical power needs of operating any of the technology alternatives (i.e., neutralization or electrochemical oxidation), including any related facilities needed for destruction operations.

Table 4.3. Annual electrical power supply requirements

Alternative technology	Annual electricity requirement (GWh)
Baseline incineration[a]	22
Neutralization with supercritical water oxidation[b]	60
Neutralization with gas phase chemical reduction and transpiring-wall supercritical water oxidation[b]	26
Electrochemical oxidation[b]	122

GWh = gigawatt hours = 1 thousand megawatt hours = 1 million kilowatt hours

[a]Operates 24 h/d, 7 d/wk, 365 d/yr
[b]Operates 12 h/d, 6 d/wk, 276 d/yr

Source: Table 3.1.

Operating the neutralization or electrochemical oxidation facilities would require variable amounts of electrical power, as follows (see Table 4.3): the neutralization/SCWO alternative would require 60 GWh/year of electricity (approximately twice the existing depot electrical power capacity); the neutralization with SCWO-GPCR would require 26 GWh/year of electricity (slightly less than the existing depot electrical power capacity); and the electrochemical oxidation would require 122 GWh/year of electricity (approximately four times the existing depot electrical power capacity). Although some of these alternatives would require more than the existing depot electrical power capacity, they would have no impact on other BGAD activities because the selected destruction facility and depot electrical power supplies would be independent. Additionally, the independent supply would be designed to meet the needs of the selected destruction alternative.

4.4.3 Impacts of No Action

Under the no action alternative, there would be no project-related changes to the existing electrical power supply. Upgrades to the BGAD electrical power system that would be implemented under any of the destruction options would not be implemented under the no action alternative. This lack of upgrades would be unlikely to affect activities at BGAD because current use is substantially below the available capacity.

4.4.4 Cumulative Impacts

Constructing and operating a chemical destruction facility could have the cumulative impact of diverting electrical power from other potential on-post uses in the future. However, positive cumulative impacts could result if the upgrades proposed for the existing electrical distribution system would be implemented on a scale that would improve service to the entire BGAD. There are no known or reasonably foreseeable off-site developments that would affect or be affected by electric power requirements of any of the alternatives.

4.5 NATURAL GAS SUPPLY

4.5.1 Current Natural Gas Supply

Delta Natural Gas Company provides natural gas to BGAD. The main gas line at BGAD does not extend to the proposed project area; a new pipeline could connect to the existing main south of the proposed project area. An off-site natural gas pipeline also runs outside the eastern boundary of BGAD. In fiscal year (FY) 2000, the installation used slightly more than 45,000 ft^3 of natural gas. Several buildings at BGAD were converted to use natural gas, and more are scheduled for conversion over the next several years.

4.5.2 Disposal System Requirements

The current supplier would meet the natural gas requirements of any of the destruction alternatives. The current infrastructure would not be able to meet the needs for natural gas of the destruction facility. New pipelines would have to be added to an existing main, and a new metering station would need to be constructed.

4.5.3 Impacts on Natural Gas Supply

4.5.3.1 Impacts of baseline incineration

During construction of the baseline incineration facility, natural gas would not be needed, and it is expected that there would be only minimal impacts to the existing natural gas supply. However, construction would include the installation of a new natural gas pipeline extending from the existing main south of the proposed project area to the proposed Site A and alternative site B.

Operating a baseline incineration facility would require 550 million ft^3 annually (see Table 4.4). The current supplier can accommodate the new natural gas supply for the incineration facility and associated areas. Therefore, operation is expected to have no impact on the existing natural gas supply at BGAD.

Table 4.4. Annual natural gas requirements

Alternative technology	Annual natural gas volume (million ft^3)
Baseline incineration[a]	550
Neutralization with supercritical water oxidation[b]	52
Neutralization with gas phase chemical reduction and transpiring-wall supercritical water oxidation[b]	138
Electrochemical oxidation[b]	52

[a]Operates 24 h/d, 7 d/wk, 365 d/yr
[b]Operates 12 h/d, 6 d/wk, 276 d/yr

Source: Table 3.1.

4.5.3.2 Impacts of neutralization and electrochemical oxidation alternatives

No natural gas would be required during construction of any of the neutralization or electrochemical oxidation alternatives, and it is expected that there would be only minimal impacts to the existing natural gas supply. As described in Sect. 4.5.3.1, a new pipeline would have to be installed to connect either the proposed site A or the alternate site B to the existing main.

Operating the neutralization or electrochemical oxidation alternatives would require variable amounts of natural gas (see Table 4.4), as follows: neutralization with SCWO would require 52 million ft^3 of natural gas annually; neutralization with SCWO-GPCR would require 138 million ft^3 of natural gas annually; and electrochemical oxidation would require 52 million ft^3 of natural gas annually. The current supplier of natural gas can accommodate the new natural gas requirements for any of the neutralization or electrochemical oxidation alternatives. Therefore, operation of any of these alternatives is expected to have no impact on the existing natural gas supply at BGAD.

4.5.4 Impacts of No Action

Under the no action alternative, there would be no project-related changes to the existing natural gas supply.

4.5.5 Cumulative Impacts

Constructing and operating chemical agent destruction facilities could have the cumulative impact of temporarily diverting a portion of the natural gas supply from other potential on-post uses in the future. There are no known or reasonably foreseeable off-site developments that would affect or be affected by natural gas requirements of any of the alternatives.

4.6 WASTE MANAGEMENT AND FACILITIES

Kentucky hazardous waste regulations designate chemical agents, at the point of becoming a solid waste, as listed hazardous wastes. Mustard agent and nerve agents (GB, VX) are N-listed wastes in the Kentucky hazardous waste regulations (Kentucky listed wastes N001, N002, and N003). The Army has declared M55 rockets containing chemical agent to be hazardous waste. Therefore, as is true for listed hazardous wastes that do not contain chemical agents, wastes derived from the treatment of these wastes, wastes mixed with these wastes, wastes that contain these wastes, and any residue from the cleanup of a spill of these wastes may also be a listed hazardous waste.

The listed wastes retain the hazardous classification regardless of their hazardous characteristics unless they are delisted by the Commonwealth of Kentucky. The environmental waste management consequences from construction and operation of a facility to destroy the chemical munitions stored at BGAD are addressed in this section. Following a description of current waste management practices and facilities, the potential impacts of a baseline incinerator and four ACWA program technologies for chemical agent destruction, as well as the impacts of no action, are assessed and compared.

Impacts Summary. Construction of a chemical munitions destruction facility using any of the four technology alternatives addressed in this FEIS would generate both solid and liquid nonhazardous wastes, as well as small amounts of solid[1] and liquid hazardous wastes. No significant impacts to waste management are expected as a result of construction of a destruction facility. Wastes would be collected and disposed of in accordance with U.S. Army, Commonwealth, and federal regulations. Any wastes that are listed as hazardous in the RCRA regulations would be stored and disposed of as prescribed by EPA and applicable Commonwealth and local regulations.

Wastes resulting from operation of the incineration alternative would include both liquids and solids. All process-generated liquid effluents from the disposal facility would be disposed of internally by incineration. Liquid brines from the PAS would be concentrated in an evaporator, and the volume of the remaining brine salts would be minimized in a dryer. The major solids that would be generated by the incineration alternative would be metal parts/ash that exit the metal parts furnace and the energetics treatment furnace and brine salts. Additionally, waste charcoal would be generated from filters. The brine salts, metal parts/ash, and charcoal would be disposed of off-site in accordance with all applicable regulations. The brine salts and ash could contain significant amounts of heavy metals. If stabilization of these solid wastes would be required under RCRA, either an on-site process for stabilizing the solid wastes would be used, or alternatively, the wastes would be shipped off-site to an appropriately permitted TSDF where they would be stabilized and disposed. Agent-contaminated dunnage would be processed through incineration. Uncontaminated dunnage would be disposed of in an off-site permitted facility. Destruction of solid wastes produced from operations is not expected to result in significant impacts on waste management systems or the environment.

[1]Although the term solid waste has a statutory definition that includes wastes that are physically solid and wastes that are physically liquid, the following discussion is organized by the physical characteristics of the wastes.

Wastes resulting from operation of either of the neutralization alternatives would include metal parts and dunnage as well as residues, such as scrubber sludge and brine salts generated from processing the chemical agents and energetics. The residues could contain significant amounts of heavy metals. If stabilization of the solid residues would be required under RCRA, either an on-site process for stabilizing the solid wastes would be used, or alternatively, the wastes would be shipped off-site to an appropriately permitted TSDF where they would be stabilized and disposed. Operating plans call for recycling all process liquids back through the reaction vessel. Destruction of solid wastes produced from operations are not expected to result in significant impacts on waste management systems or the environment.

Wastes resulting from operation of the electrochemical oxidation alternative would include both liquids and solids. The solid waste would include metal parts and dunnage as well as residues, such as scrubber sludge and brine salts generated from processing the chemical agents and energetics. The residues could contain significant amounts of heavy metals. If stabilization of the solid residues would be required under RCRA, either an on-site process for stabilizing the solid wastes would be used, or alternatively, the wastes would be shipped off-site to an appropriately permitted TSDF where they would be stabilized and disposed. Operating plans call for recycling as many process liquids as possible. There would be a liquid waste stream of dilute nitric acid. Operations are not expected to result in significant impacts on waste management systems or the environment.

Polychlorinated biphenyls (PCBs) have been identified as a constituent in the firing tubes of M55 rockets held in the chemical munitions inventory at BGAD. The concentrations of PCBs in these munitions can range from less than 50 to more than 2,000 parts per million (ppm). Therefore, treatment of these munitions with any of the destruction technologies would involve the treatment of PCB wastes. In addition, the treatment process could generate brine wastes containing more than 50 ppm of PCBs, i.e., unacceptable amounts of toxic PCBs. Destruction of PCBs with a destruction and removal efficiency of 99.9999%, as required by regulations implementing the Toxic Substance Control Act (TSCA), has been achieved by the baseline incineration technology. Although PCB destruction by the non-incineration technologies has not been demonstrated (so as to avoid triggering TSCA regulatory requirements during ACWA demonstration projects), tests were conducted using pentachlophenol, a PCB surrogate; these tests indicated that PCBs would be destroyed in compliance with TSCA requirements.

4.6.1 Current Waste Management and Facilities

The amounts and types of waste generated at BGAD during 2000 (Williams 2001) are summarized in Table 4.5.

4.6.1.1 Hazardous wastes

Most hazardous wastes generated presently at BGAD are packaged and transported off-site to appropriately permitted TSDFs. BGAD generates hazardous wastes from maintenance of conventional munitions, demilitarization of obsolete conventional munitions, and storage of obsolete chemical munitions.

Table 4.5. Wastes generated at BGAD during 2000

Type of waste	Amount generated	Shipped off-site
Hazardous liquids	26,000 lb	yes
Hazardous solids	1,300,000 lb	yes
Hazardous solids	160,000 lb	no
Nonhazardous solids	725,000 lb	yes
Sanitary wastes	28 million gal	no

Source: Adapted from ACWA DEIS 2001, Table 7.4-1.
Unit conversations: 1 lb = 0.45 kg; 1 gal = 3.78 L

Activities that are sources of hazardous wastes at BGAD include the following:

- Facility maintenance (paints, solvents, water conditioners, etc.);
- Vehicle maintenance (used oil, batteries, coolant, etc.);
- Chemical agent decontamination (field test materials, toxic chemical agents analysis, personal protective equipment [PPE], etc.)
- Conventional munitions washout facilities (explosive-contaminated activated charcoal, explosive-sludge-contaminated filters, etc.)
- Other items related to the storage, maintenance, and demilitarization of conventional munitions.

Hazardous wastes are stored at a number of locations around the BGAD installation. There are two types of hazardous waste storage facilities at BGAD:

1. Facilities to store hazardous solids from the washout of conventional ammunitions, explosive-contaminated charcoal, and explosive-sludge-contaminated filters; solids from demilitarization operations and maintenance; explosives; sandblast media; and baghouse dusts. These wastes are stored in igloos B402 and B404.
2. Facilities to store obsolete and/or leaking chemical munitions and associated wastes generated during the monitoring, filtration, and decontamination of tools, PPE, and equipment stored in the Chemical Limited Area. These wastes are stored in 39 igloos in the Chemical Limited Area.

4.6.1.2 Nonhazardous wastes

Solid wastes. BGAD routinely generates about 30 tons/mo of nonhazardous solid wastes. These wastes are disposed of off-site at a local sanitary landfill.

Sanitary wastes. Two wastewater treatment plants with a total capacity of about 115,000 gal/d and several septic systems exist on BGAD (see Section 4.14.2). Average usage is about 80,000 gal/d. A study to privatize the provision of installation sewage service is on-going.

4.6.2 Impacts of Construction

The potential waste management impacts of constructing a chemical munition destruction facility at BGAD are assessed in the following sections.

4.6.2.1 Impacts of baseline incineration alternative

All wastes resulting from constructing an incineration facility at BGAD would be collected and disposed of in accordance with U.S. Army, Commonwealth, and federal regulations. It is expected that the maximum quantity of hazardous wastes created during construction (Table 4.6) would be 100 yd^3 (roughly 65 tons) of solids and 39,000 gallons (roughly 166 tons of liquids). The combined 231 tons of hazardous wastes generated during construction is roughly 0.1% of the amount of hazardous wastes generated in Kentucky in 1999 (EPA 2001a). The maximum volume of solid nonhazardous wastes (Table 4.6) produced during construction would be about 2,040 yd^3. Spread out at a landfill, this waste would cover a 1-acre area to a depth of approximately 15.2 inches. No significant impacts would be expected from the management and disposal of hazardous and nonhazardous wastes resulting from the construction of an incineration facility.

Hazardous Wastes. Construction of an incineration facility would generate small amounts of both solid and liquid hazardous wastes including solvents, paints, coatings, waste, fuel/water, adhesives, empty containers, and concrete placement chemicals (Table 4.6). Any wastes that are listed as hazardous in the RCRA regulations would be stored and disposed of at an off-site TSDF as prescribed by EPA and applicable state and local regulations.

Nonhazardous Wastes. Construction would primarily generate solid wastes in the form of excavation spoils and building material debris. Excavation spoils would be used to the extent possible for backfill and reestablishing surface grade. Building material debris would be disposed of by transport off-site to a permitted landfill. Liquid nonhazardous wastes would include flushwater, sanitary waste (sewage), waste glycol, and concrete curing compounds. Sanitary waste would be handled by the use of portable toilets. Collected sanitary wastes would be transported to an appropriately permitted treatment works for disposal. The remainder of liquid nonhazardous wastes would be stored and disposed of in an appropriately permitted off-site disposal facility.

4.6.2.2 Impacts of neutralization or electrochemical oxidation alternatives

Construction activities would generate both solid and liquid nonhazardous wastes. Solid nonhazardous wastes would primarily be in the form of building material debris and excavation spoils. Liquid nonhazardous wastes would include wastewater from wash-downs and sanitary wastes. The nonhazardous wastes would be disposed of in an off-site permitted landfill. Construction would also generate small amounts of both solid and liquid hazardous wastes such as solvents, paints, cleaning solutions, waste oils, contaminated rags, and pesticides. As shown above, the total quantity of wastes from construction is relatively small, and no significant impacts would be expected from the management and disposal of solid and liquid construction wastes (Table 4.6). The hazardous wastes would be collected on the site

Table 4.6. Wastes generated from construction of the alternative destruction facilities

Waste	Baseline incineration	Neutralization with supercritical water oxidation	Neutralization with gas phase chemical reduction and transpiring-wall supercritical water oxidation	Electrochemical oxidation
Hazardous waste				
Solid[a]	2 $yd^{3(c)}$	90 yd^3	80 yd^3	100 yd^3
Liquid[B]	3,200 gal[D]	37,000 gal	34,000 gal	39,000 gal
Nonhazardous waste				
Solid				
Concrete	230 $yd^{3(e)}$	210 yd^3	230 yd^3	220 yd^3
Steel	36 ton[e]	36 ton	29 ton	33 tons
Other	1,800 $yd^{3(e)}$	1,700 yd^3	1,800 yd^3	1,800 yd^3
Liquid				
Wastewater	0.009 million gal[f]	2.4 million gal	2.2 million gal	2.5 million gal
Sewage	5.6 million gal[e]	5.3 million gal	4.8 million gal	5.6 million gal
Other[g]	0.001 million gal[h]			

[a]Hazardous waste solids include adhesives, solvents rags, and propane containers.
[b]Hazardous liquid wastes include fuel/water, concrete placement chemicals, waste paint, and coatings.
[c]Reported as 1760 lbs. Converted to a conservative volume by assuming that the waste density is one-half the density of water (31.214 lbs/ft^3).
[d]Reported as 27,000 lbs. Converted to a conservative volume by assuming that the waste density is equal to the density of water (8.345 lbs/gal).
[e]No value reported; chosen to be the largest of the non-incineration values.
[f]Reported as 73,000 lbs. Converted to volume by assuming that the wastewater has the density of water.
[g]Non hazardous other liquid wastes include waste glycol and concrete curing compounds.
[h]Reported as 11,000 lbs. Converted to a conservative volume by assuming that the density of the liquids is equal to the density of water.

Source: Adapted from ACWA TRD 2001, Tables 5.13, 5.71, and 5.103. Baseline values are reported by the Army from construction of the destruction facility at Anniston, Alabama.

until they are shipped to an offsite, permitted TSDF. Based on the quantities and types of construction wastes, no significant impacts would be expected to nearby or regional waste disposal facilities.

4.6.3 Operations Impacts

4.6.3.1 Impacts of baseline incineration alternative

Wastes from the operation of an incineration facility would include both hazardous and nonhazardous solid and liquid wastes. Liquids generated by the agent disposal process would be disposed of internally by incineration (e.g., spent decontamination solution) or dried (e.g., liquid brines) and the resulting solids would be shipped to a permitted, off-site TSDF. The systems contractor would develop processes for laboratory waste handling and specify these processes in a laboratory hazardous waste management plan. A summary of hazardous and non-hazardous wastes is presented in Table 4.7. The total hazardous wastes expected to be produced by incineration, about 2,480 tons, would be roughly 1.2% of the amount of hazardous wastes generated in Kentucky in 1999 (EPA 2001a). Solid process wastes would consist primarily of ash, brine salts, and metal scrap from the incinerators. Hourly waste generation rates are shown in Table 4.8. The total process solid waste expected to be generated during the life of the facility is 4,480 tons, a volume of about 20,000 yd^3. These quantities include approximately 1,611 tons of scrap metal primarily from munition bodies, which would be sold to a scrap dealer or smelter for reuse if possible. However, if selling the scrap metal were not possible, it would be disposed of in an off-site, permitted landfill. There would be over 160 truckloads of scrap metal leaving BGAD. Construction debris and some non-process wastes would be disposed of in a commercial landfill. Items of salvageable value would be provided to the Defense Reutilization Management Office for recycling.

Hazardous Wastes. Hazardous solid wastes would consist mainly of ash residue from the furnace systems. Projected hazardous solid waste quantities are included in Table 4.7. Hazardous solid wastes would be stored and taken to an off-site permitted TSDF. Transportation of the solid hazardous wastes would require over 205 truck trips. Based on the quantities and types of solid hazardous wastes produced, no significant impacts would be expected at off-site disposal facilities. There would be two liquid hazardous waste streams produced during operations: laboratory wastes and spent hydraulic fluids. Because these wastes may contain or be derived from wastes listed as hazardous wastes by the Commonwealth of Kentucky, they are classified as hazardous wastes and retain that classification until delisted by the state. It is expected that 3,600 gal. of laboratory wastes and 33,000 gal of spent hydraulic fluid would be generated during operations. There would be over 30 truckloads of hazardous liquid wastes going to an off-site, permitted TSDF.

Nonhazardous Wastes. The primary nonhazardous liquid discharged from an incineration facility would be sewage, estimated to average about 17,000 gal/day. Peak sewage generation is estimated to be about 35,000 gal/day. No process wastewater or hazardous liquid would be discharged into the sewage system. Sewage from the destruction facility would be processed in a new treatment facility and the effluent would be discharged to Muddy Creek or pumped to the existing infrastructure in Richmond (additional details about discharges to surface water are provided in Sect. 4.14).

Nonhazardous solid wastes would be collected and disposed of in an off-site permitted landfill. The quantities and types of nonhazardous wastes from operations would not be expected to produce significant impacts on nearby off-site or regional waste disposal facilities.

4.6.3.2 Impacts of neutralization and electrochemical oxidation alternatives

Hazardous Wastes. Wastes resulting from normal operations would include components from the treatment of metal parts and dunnage as well as process residues, such as contaminated salts generated from treating chemical agents and energetics. The neutralization facilities and the electrochemical oxidation facility would produce brine salts as solid waste. These salts could contain significant amounts of toxic heavy metals (e.g., lead). If the hazardous brine salt failed the RCRA test, stabilization of the waste may be required for disposal. Either the waste would be

Table 4.7. Estimated total wastes generated from operations of the destruction facilities

Waste	Baseline incineration	Neutralization with supercritical water oxidation	Neutralization with gas phase chemical reduction and transpiring-wall supercritical water oxidation	Electrochemical oxidation
Hazardous waste				
Brine salt	1335 ton	4840 ton	4840 ton	210 ton
Aluminum oxide	—[a]	1860 ton	1025 ton	—
Anolyte-catholyte waste	—	—	—	785 ton
Ash	926 ton	—	—	—
Spent charcoal or carbon filters	65 ton	65 ton[d]	65 ton[d]	65 ton[d]
Liquids				
Laboratory				
Spent hydraulic fluids	0.004 million gal 0.033 million gal	— —	— —	— —
Process liquids	—	—	—	16.8 ton
Nonhazardous waste				
Sewage	11.7 million gal	11.6 million gal	9.7 million gal	9.7 million gal
Metal & Solid	1611 ton	2015 ton	7980 ton	4420 ton
Wood dunnage, Uncontaminated	518 ton	—	—	—
Ventilation filter system frames	18 ton	—	—	—
Recyclable[b]	—	1120 yd^3	1130 yd^3	1130 yd^3
Other solids[c]	—	2790 yd^3	2830 yd^3	2830 yd^3

[a]A dash means that the waste stream is not generated by the specific technology.

[b]Includes paper and aluminum

[c]Domestic trash and office waste

[d]The spent carbon filters would be processed through the appropriate ACWA destruction facility.

Source: Adapted from ACWA FEIS 2001, Table 7.4-3 and 7.4-4.

Table 4.8. Summary of process wastes for an incineration facility at the Blue Grass Army Depot

Source	Type	Generation rate[a] (lb/hr)
Metal parts furnace	Metal scrap, scrap/ash	17,576
Deactivation furnace	Scrap/ash	1,060
Liquid incinerator	Solids	Negligible
Pollution abatement system	Brine salts	830

[a]Rates are maximal and based on peak-limiting process step. Scrap rates reflect maximum throughput. The total solid process wastes (including protective suits and charcoal residue ash, in addition to munition-specific solid waste) that would be generated during the lifetime of the proposed destruction facility are expected to be about 25 thousand tons (about 550 thousand ft^3). This quantity does not include munition overpacks, or transport overpacks.

Source: Ralph M. Parsons Co. 1988. *CSDP Waste Management Study*, prepared for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.

stabilized prior to shipment to an off-site permitted TSDF or, alternatively, the waste would be shipped directly to an off-site appropriately permitted TSDF where it would be stabilized prior to disposal. The wastes expected to be generated from operation of the neutralization or electrochemical oxidation facilities are given in Table 4.7. The amounts of solid hazardous wastes expected to be produced during operations vary from about 6765 tons for neutralization with supercritical water oxidation, to about 1060 tons for electrochemical oxidation. Thus, the expected hazardous wastes would make up between 3.1% and 0.5% of the amount generated in Kentucky in 1999 (EPA 2001a).

Current operating plans for the neutralization facilities include recycling all process liquids obtained in the operation phase back through the reaction vessel. Such recycling in a closed-loop system would eliminate these liquids from the waste streams. Current operating plans for the electrochemical oxidation facility include recycling as many process liquids as possible. However, there would be a waste stream of dilute nitric acid. No activities or operations that would result in significant impacts on waste management systems were identified. It is assumed that most wastes generated by the proposed action would be collected and disposed of off the site in accordance with U.S. Army, Commonwealth, and federal regulations.Any wastes identified as hazardous in the RCRA regulations, such as carbon filters, would be destroyed in the process facility. Hazardous solid wastes that could not be processed by the facility would be stored and disposed of at an off-site TSDF as prescribed by the EPA and applicable state and local regulations. It is expected that hazardous wastes generated from destruction operations would not produce significant impacts at off-site disposal facilities.

Nonhazardous Wastes. Sanitary wastes generated during construction and operations would be treated and discharged to Muddy Creek or pumped to the existing infrastructure in Richmond. The existing infrastructure at BGAD could also be used for sewage treatment. The nonhazardous solid wastes would be disposed of in a permitted landfill. The sanitary wastewater would be processed in a packaged treatment system with treated effluent discharged to Muddy Creek (see Sect. 4.1.4.2). The quantities and types of nonhazardous operation wastes would not be expected to produce significant impacts on off-site nearby or regional, waste disposal facilities (see Table 4.7).

4.6.4 Impacts of No Action

The no action alternative at BGAD would be continued storage of the chemical weapons stockpile. No construction activities would be anticipated under the continued storage alternative. However, wastes would be generated during continuing inspection and maintenance activities. In addition, the continued degradation of agent containers over time would probably generate slowly increasing amounts of waste, as the storage duration of the chemical munitions would be extended. Estimates of the wastes that would be generated from storing chemical munitions at BGAD are shown in Table 4.9. Any hazardous waste would be disposed of, as prescribed by EPA and applicable state and local regulations, in a permitted offsite TSDF.

Table 4.9. Hazardous wastes generated by the no action alternative

Impact category	Quantity of waste
Hazardous solids	
Solids from storage	12,000 lb per year
Hazardous liquids	
Liquids from storage	2,000 lb per year

4.6.5 Cumulative Impacts

The Chemical Stockpile Destruction Program is not long-lived. Construction, operations, and decontamination and decommissioning would each take two to three years. Because of the relatively small volumes of wastes, both hazardous and non-hazardous, and the short duration of the program, cumulative impacts from wastes are expected to be small.

4.7 AIR QUALITY—CRITERIA POLLUTANTS

This section describes the existing meteorology, air emissions, and air quality at BGAD and the air emissions and impacts on air quality that might result from constructing and operating a facility for destroying the inventory of chemical agents and munitions currently stored at BGAD. Data on potential emissions and impacts on air quality under the no action alternative are also presented. Potential impacts on human health as a result of air emissions during construction and normal operations are described in Section 4.9. Potential impacts on air quality and human health as a result of air emissions from accidents involving explosives and chemical agents are described in Section 4.22.

National Ambient Air Quality Standards (NAAQS) exist for sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO), lead (Pb), and particulate matter less than or equal to 10 µm in aerodynamic diameter (PM-10) and less than or equal to 2.5 µm in aerodynamic diameter (PM-2.5).[2] These are called criteria pollutants because the criteria for regulating them must be published, reviewed, and updated periodically to reflect the latest scientific knowledge (Clean Air Act, Section 108). On July 18, 1997, EPA promulgated an 8-hour O_3 NAAQS to replace the 1-hour standard (62 FR 38856) and added NAAQS for PM-2.5 (62 FR 38652). These standards have survived court challenges (U.S. Supreme Court 2001) and are expected to be implemented in the near future when the required 3 years of data are available to determine compliance.

The NAAQS are expressed as concentrations of pollutants in the ambient air {i.e., in the outdoor air to which the general public has access [40 CFR Part 50(e)]}. Primary NAAQS define levels of air quality that the U.S. Environmental Protection Agency (EPA) deems necessary, with an adequate margin of safety, to protect human health. Secondary NAAQS are similarly designated to protect human welfare by safeguarding environmental resources (such as soils, water, plants, and animals) and manufactured materials. Primary and secondary standards are currently the same for all pollutants and averaging periods except for 3-hour SO_2 averages, which have a secondary standard only. States may modify NAAQS to make them more stringent, or set standards for additional pollutants. Kentucky has adopted the NAAQS as the state standards without modifications and has also adopted standards for hydrogen sulfide (H_2S), gaseous fluorides [expressed as hydrogen fluoride (HF)], total fluorides, and odors (see Sect. 4.7.1.2).

The analyses of impacts on air quality from both construction and operations were conducted for proposed Area B (see Fig. 4.1), which is the area that is closest to the BGAD installation boundary and to the nearest off-post residence. The two potential locations for the proposed facility are adjacent to the chemical limited area (storage area) and would require similar infrastructures. Therefore, the analysis for one location provides an adequate representation of the potential impacts from construction and operations for either of the two locations.

Because the facility size, number of construction workers, and infrastructure required for each of the proposed technologies would be similar, only one model analysis of the impacts from construction on air quality was conducted. The analyses presented in the following sections conclude that the total (modeled plus background) concentrations associated with fugitive dust emissions during construction would be below applicable standards, except for annual average concentrations of PM-2.5, for which the background levels at statewide monitoring stations are already over the standard. Concentrations of air pollutants due to facility emissions, by themselves or added to background, would also be within applicable standards, except for the annual average concentration of PM-2.5.

4.7.1 Existing Meteorology, Existing Air Quality, and Emissions

4.7.1.1 Existing meteorology

The climate of the area surrounding BGAD is continental and temperate, with a rather large diurnal temperature range. The following description of climate is based on data recorded at Lexington Airport (Bluegrass Field), which is located about 30 mi northwest of BGAD (National

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[2]PM = particulate matter. PM-10 = coarse, inhalable PM with a mean aerodynamic diameter of 10 µm or less. PM-2.5 = fine, inhalable PM with a mean aerodynamic diameter of 2.5 µm or less.

Oceanic and Atmospheric Administration [NOAA] 1999). Wind data measured at a BGAD on-post meteorological tower (Demil tower[3]) are also presented (Rhodes 2000).

The average wind speed measured at a height of 23 ft above ground at Lexington Airport, Kentucky, is about 9.1 miles per hour (mph). Average wind speeds from November through April are 10.5 mph; these speeds are higher than average speeds from May through October of 7.6 mph. The prevailing wind direction is from the south throughout the year.

Wind data at the Demil tower, which is located near the northeast corner of BGAD, have been measured at three heights above ground 30, 100, and 200 ft) since August 1998. The wind roses at the three heights at the Demil tower for the two-year period (August 1998 through July 2000) are shown in Figure 4.3. For comparison, the wind rose at 23 ft at Lexington Airport for the eight-year period (1984–92) is also presented in Figure 4.3 (EPA 2000b). Wind patterns at 100 and 200 ft levels at the Demil tower were almost the same, but the wind speed at 100 ft was lower than at 200 ft. These wind patterns at the Demil tower were similar to those at Lexington Airport, but the predominant wind direction was slightly different. The prevailing wind direction was from the south-southwest at the Demil tower, whereas it was from the south at Lexington Airport. However, wind patterns at 30 ft at the Demil tower showed bimodal (southeast and southwest) dominance, with the average wind speed being half the speed at Lexington Airport. This result suggests that winds measured at heights of 30 ft) at BGAD were strongly influenced by nearby vegetation. In the two-year period, the average wind speed measured at 30 ft at the Demil tower was about 4.5 mph, while the highest wind speed was about 28.6 mph.

The average annual temperature at Lexington Airport is 55.1°F. January is the coldest month, averaging 32.2°F, and July is the warmest month, averaging 76.2°F. The area is subject to sudden, large changes in temperature that are generally of short duration. Temperatures above 100°F and below 0°F are relatively rare. Extreme temperatures have ranged from -21°F in January 1963 to 103°F in July 1988. There are approximately 269 frost-free days per year (i.e., days when the daily minimum temperature is greater than 32°F); this period extends from the beginning of May through the end of September. Temperatures of 90°F or higher occur on an average of about 18 days per year, most of which fall (16 days) during June, July, and August.

Average annual precipitation at the Lexington Airport is 44.6 in. Precipitation is evenly distributed throughout the winter, spring, and summer seasons, with about 12 in. recorded, on average, for each season. The fall season averages nearly 8.5 in. The greatest amount of precipitation in a single month was 16.7 in. in January 1950, and the greatest amount in a day (i.e., 24-hour period) was 5.9 in. in June 1960. Annual snowfall averages about 17.5 in. The greatest amount of snow reported in a month was 21.9 in. in January 1978, and the greatest amount in a day was 14.0 in. also in January 1978. Snowfall amounts vary, and the ground typically does not retain snow cover more than a few days at a time.

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[3]Currently, four meteorological towers (three CSEPP [Chemical Stockpile Emergency Preparedness Program] towers and one Demil tower) are operating at BGAD. Wind data from the Demil tower were selected to represent the conditions at BGAD because the tower meets the EPA's siting criteria and because the instruments and associated data were checked for quality assurance/quality control (QA/QC) more comprehensively than were the data from CSEPP towers (Rhodes 2000).

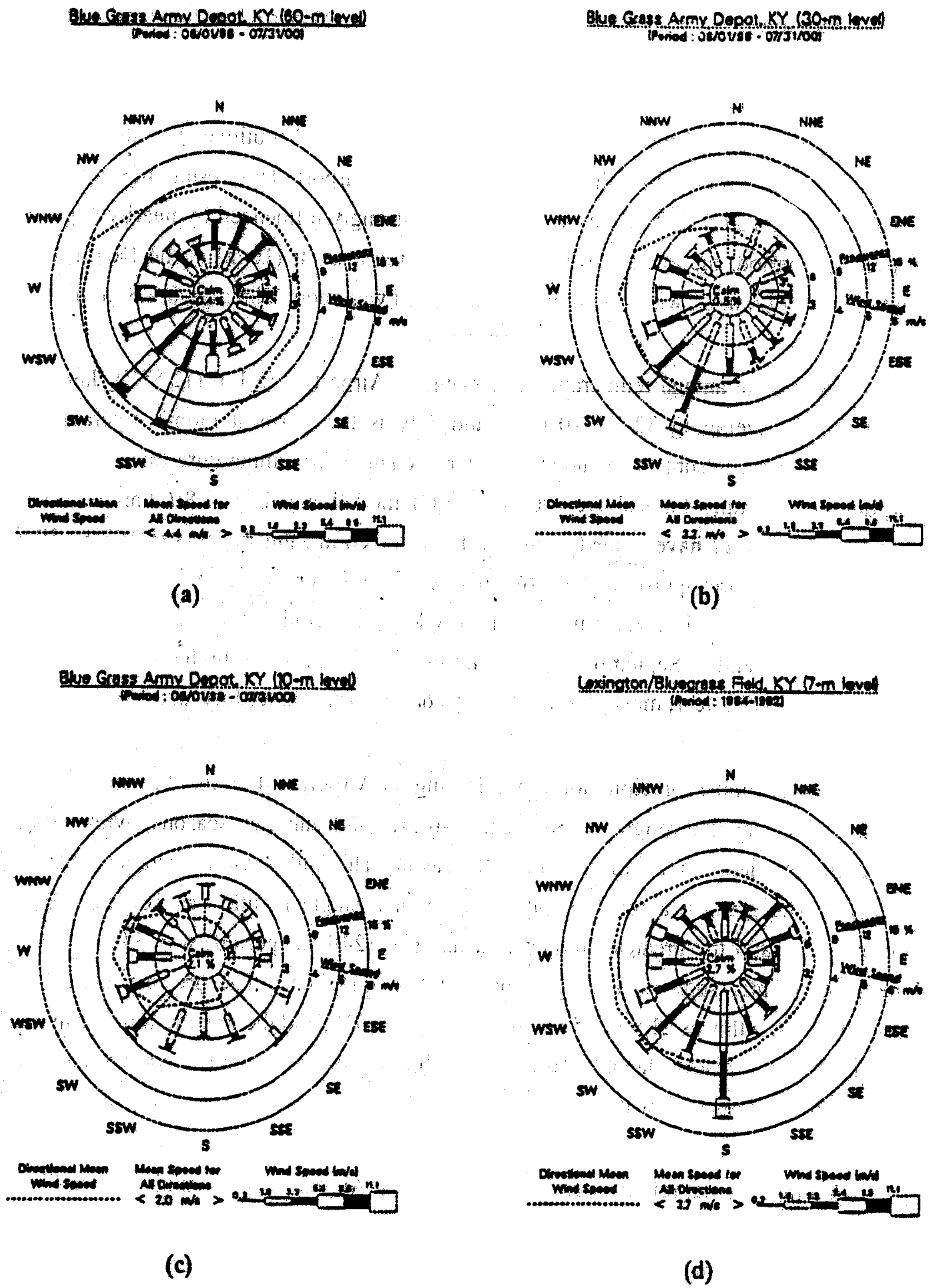

Figure 4.3. Annual Wind Roses for three heights aboveground at the Demil Tower at BGAD from August 1998 through July 2000 (a - 60 m, b - 30 m, c = 10 m) and for one height at Lexington Airport from 1984 through 1992 (d = 7 m) (*Source:* ACWA DEIS 2001, Fig. 7.5-1.

Average annual relative humidity at Lexington Airport is 70%, ranging from 77% to 82% during the first half of the day and 60% to 64% during the second half. Heavy fogs are rather rare in the area. The average number of days with heavy fog (visibility $\leq$ 0.25 mi) is about 19, and these days are relatively evenly distributed throughout the year except during spring. Thunderstorms can occur in any month but are more frequent from March through September. The mean number of days with thunderstorms at Lexington Airport is about 44. The storms are occasionally accompanied by damaging hail, but the area affected is nearly always small.

Three tornadoes struck Madison County in the 1990s. However, data for the 46-year period of 1950 through 1995 indicate that tornadoes are less frequent and destructive in Kentucky (average of nine tornadoes per year) than they are elsewhere in the Midwest (averages from 14 per year in Ohio to 48 per year in Kansas) (Storm Prediction Center 2000). From 1950 through 1995, 403 tornadoes were reported in Kentucky (tornado event frequency of $2.2 \times 10^{-4}/mi^2$ per year) and 10 tornadoes were reported in Madison County (tornado event frequency of $4.9 \times 10^{-4}/mi^2$ per year). Except for a deadly tornado in April 1974, most tornadoes that occurred in Madison County were relatively weak.

4.7.1.2 Existing air quality

The Kentucky State Ambient Air Quality Standards (SAAQS) for six criteria pollutants—SO_2, PM (both PM_{10} and $PM_{2.5}$), CO, ozone (O_3), nitrogen dioxide (NO_2), and Pb—are identical to the National Ambient Air Quality Standards (NAAQS) (401 *Kentucky Administration Regulation* [KAR] 53:010) (Table 4.10). States or commonwealths may set standards that are more stringent than the NAAQS or that address specific pollutants not covered by the NAAQS. As mentioned above, Kentucky has adopted the NAAQS and, in addition, has adopted standards for hydrogen sulfide (H_2S), gaseous fluorides [expressed as hydrogen fluoride [HF]), total fluorides, and odors. These additional standards are presented in Table 4.11.

The monitoring station for SO_2, NO_2, CO, and O_3 nearest to BGAD is in Lexington, while the stations for PM_{10} and $PM_{2.5}$ nearest to BGAD are in Richmond. $PM_{2.5}$ monitoring was started in Richmond in January 1999, but the annual average values are near or above the standard, as are those values at most statewide monitoring stations. As a direct result of the phase-out of leaded gasoline in automobiles, lead concentrations in urban areas decreased dramatically. Thus, ambient lead concentration is no longer monitored in many parts of the country including the Commonwealth of Kentucky. Fluorides are of concern near the Paducah Gaseous Diffusion Plant in western Kentucky but are not monitored near Lexington. Odors from hydrogen sulfide and other chemicals are of local concern around facilities that produce odoriferous chemicals. Monitoring for such pollutants is often prompted by citizen complaints, is very localized, and seldom continues for very long time periods. The highest values for background air quality measured at the monitoring station closest to BGAD for pollutants subject to the NAAQS are also presented in Table 4.10.

Table 4.10. National ambient air quality standards (NAAQS), Kentucky State Ambient Air Qaulity Standards (SAAQS), maximum allowable increments for prevention of significant deterioration (PSD), and highest background levels representative of BGAD[a]

		NAAQS (µg/m^3)[b]		PSD increment (µg/m^3)		Highest background level		
Pollutant	Averaging Time	Primary	Secondary	Class I	Class II	Concentration[c]	Location	Year
SO_2	3 hours	–	1,300 (0.50 ppm)	25	512	0.066 ppm (13)	Lexington	1998
	24 hours	365 (0.14 ppm)		5	91	0.031 ppm (22)	Lexington	1998
	Annual	80 (0.03 ppm)		2	20	0.008 ppm (27)	Lexington	1999
NO_2	Annual	100 (0.05 ppm)	100 (0.05 ppm)	2.5	25	0.017 ppm (32)	Lexington	1995
CO	1 hour	40,000 (35 ppm)	–	–	–	8.6 ppm (25)	Lexington	1997
	8 hours	10,000 (9 ppm)	–	–	–	6.0 ppm (67)	Lexington	1997
O_3	1 hour	235 (0.12 ppm)	235 (0.12 ppm)	–	–	0.122 ppm (102)	Lexington	1998
	8 hours	157 (0.08 ppm)	157 (0.08 ppm)	–	–	0.111 ppm (139)	Lexington	1998
PM_{10}	24 hours	150	150	8	30	70 µg/m^3 (47)	Richmond	1995
	Annual	50	50	4	17	29 µg/m^3 (57)	Richmond	1995
$PM_{2.5}$	24 hours	65	65	–	–	35 µg/m^3 (53)	Richmond	1999
	Annual	15	15	–	–	17 µg/m^3 (114)	Richmond	2000
Pb	Calendar quarter	1.5	1.5	–	–	0.04 µg/m^3 (2.7)	Versailles	1996

[a]A hypen indicates that no standards or monitoring data exist.

[b]NAAQS, other than those for 0_3 and PM_{10} and those based on annual averages, are not to be exceeded more than once per year. The 0_3 1-hour standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is less than or equal to one. The 0_3 1-hour standard applies only to areas that were designated nonattainment when the 0_3 8-hour standard was adopted in July 1997. The 0_3 8-hour standard is attained when the average of the annual fourth-highest daily maximum 8-hour average concentration is less than or equal to the standards. The PM_{10} 24-hour standard is attained when the expected number of days with a 24-hour average concentration above the standard is less than or equal to one. The PM_{10} annual standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard. The $PM_{2.5}$ 24-hour standard is attained when the 98th percentile 24-hour concentration is less than or equal to the standard ppm = part(s) per million.

[c]Values in parentheses are monitored concentrations as a percentage of NAAQS.

Sources: ACWA DEIS 2001, Table 7.5-3 using [40 CFR 50; Kentucky Division of Air Quality (1998, 1999b) 40 CFR 52.21; EPA (2001); and ACWA TRD (2001)].

Table 4.11. Commonwealth of Kentucky ambient air quality standards[a]

		Standard (µg/m^3)	
Pollutant	Averaging time	Primary	Secondary
Hydrogen sulfide	1 hour	—	14 (0.01 ppm)[b]
Gaseous fluorides (expressed as HF)	12 hours	—	3.68 (4.50 ppb)[b]
	24 hours	800 (1.0 ppm)[b]	2.86 (3.50 ppb)[b]
	1 week	—	1.64 (2.00 ppb)[b]
	1 month	—	0.82 (1.00 ppb)[b]
	1 year	400 (0.5 ppm)	—
Total fluorides	1 month	80 ppm	—
	2 months	60 ppm	—
	Growing season[c]	40 ppm	—
Odors	At any time when one volume unit of ambient air is mixed with seven volume units of odorless air, the mixture must have no detectable odor		

[a]These standards are in addition to the Kentucky SAAQS listed in Table 4.7.3. A hyphen indicates that no standard exists.

[b]This average is not to be exceeded more than once per year.

[c]Average concentration of monthly samples over the growing season (not to be exceeded during six consecutive months).

Source: Adapted from ACWA DEIS 2001, Table 7.5-4 [using Appendix A to 401 *Kentucky Administrative Regulation* (KAR) 53:010].

BGAD, situated near the center of Madison County, is located in the southeastern part of the Bluegrass Intrastate Air Quality Control Region (AQCR), which covers the east central part of Kentucky (Fig. 4.4). Currently, Madison County is designated as being in attainment for all federal and Commonwealth of Kentucky ambient air quality standards (40 CFR 81.318). On the basis of monitoring data from 1995 to 2000, concentration levels for SO_2, NO_2, CO, and PM_{10} around BGAD are below their respective NAAQS. However, the highest O_3 concentrations are somewhat higher than the applicable NAAQS. These high concentrations of regional concern are associated with high precursor emissions from the Ohio Valley Region and long-range transport from southern states. In addition, the annual averages of $PM_{2.5}$ at most statewide monitoring stations are over the standard.

Prevention of significant deterioration (PSD) regulations (40 CFR 52.21) limit the maximum allowable incremental increases in ambient concentrations of SO_2, NO_2, and PM_{10} above established baseline levels, as shown in Table 4.10. The PSD regulations, which are designed to protect ambient air quality in Class I and Class II attainment areas,[4] apply to major

[4]In 1975, the EPA developed a classification system to allow some economic development in clean air areas while still protecting air from significant deterioration. These classes are defined in the 1977 *Clean Air Act Amendments* (CAAA). Very little deterioration is allowed in Class I areas (e.g., larger national parks and wilderness areas). Class II areas allow moderate deterioration. Class III areas allow deterioration up to the secondary standard. However, no Class III areas have been designated.

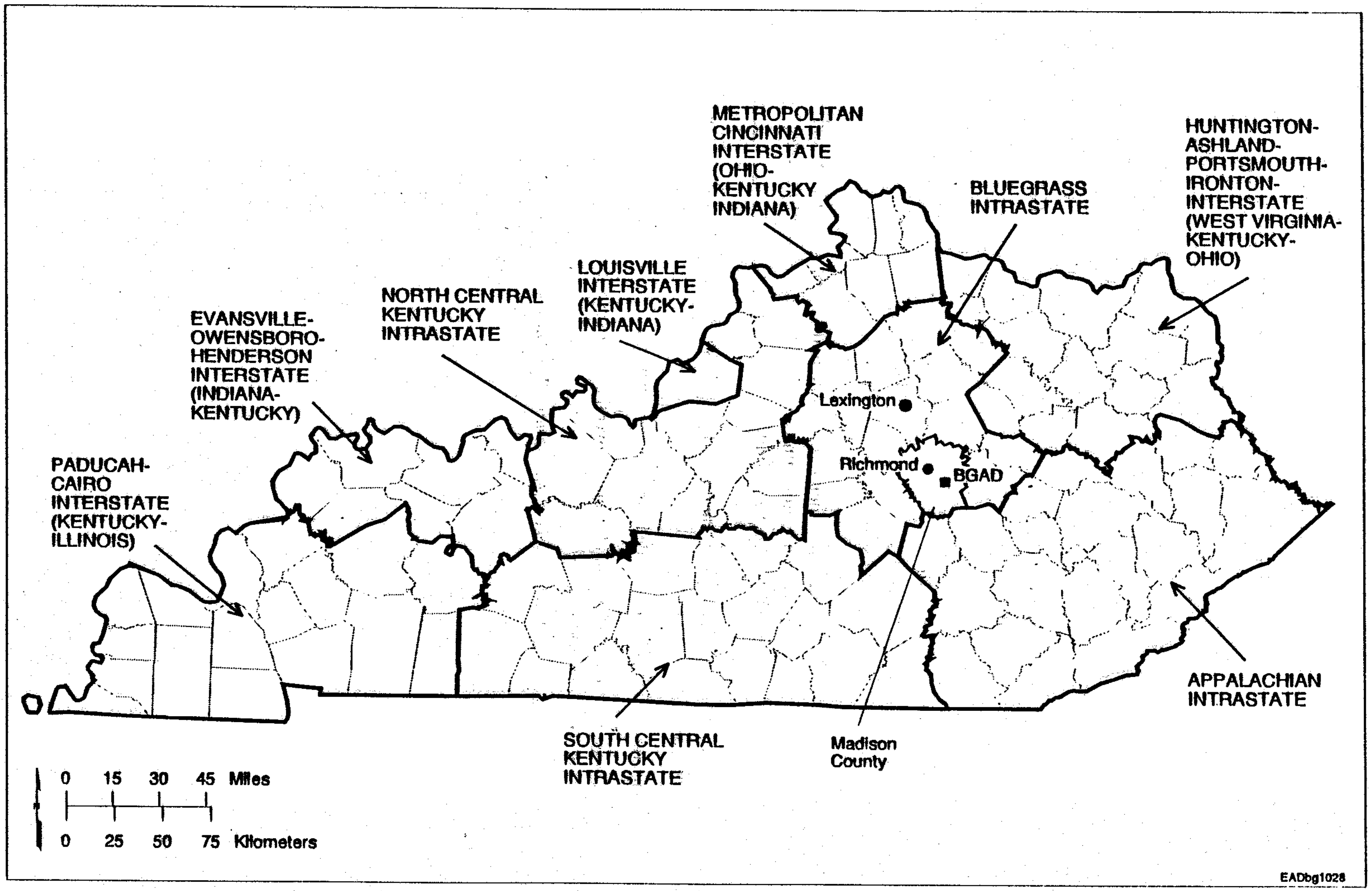

Figure 4.4. The BGAD site and Blue Grass Intrastate Air Quality Control Region.
***Source:* ACWA DEIS 2001, Fig. 7.5-2.**

new sources and major modifications to existing sources. Mammoth Cave National Park is the PSD Class I area nearest to BGAD (it is the only PSD Class I area in Kentucky). Mammoth Cave National Park is located 100 mi west-southwest of BGAD, upwind of prevailing winds. All remaining areas in Kentucky are designated as PSD Class II areas.

4.7.1.3 Existing emissions

The existing sources of criteria pollutants and their precursors at BGAD include boilers, ovens, incinerators, surface coating and metal cleaning operations, fuel storage and handling, woodworking, and other miscellaneous industrial operations. These sources are being operated under a permit from KDEP's Division of Air Quality (previously Division of Air Pollution Control [DAPC]) in the Kentucky Natural Resources and Environmental Protection Cabinet (Cabinet 1986). Maximum potential emissions for these sources are estimated in Table 4.12. Other emissions include vehicle exhaust emissions and fugitive particulate emissions, including road dust. Emissions from open burning and open detonation are included in the Toxics Release Inventory (TRI) report and discussed separately in Section 4.8.1.

Actual annual total emissions from all categories of BGAD sources with permits from the Kentucky DAPC during 1998 were about 4.9 tons/yr of volatile organic compounds (VOCs); 1.9 tons/yr of particulate matter (PM_{10}); 1.1 tons/yr of sulfur dioxide (SO_2); 1.0 ton/yr of NO_x; 0.2 ton/yr of carbon monoxide (CO); and 0.0018 ton/yr of lead (Pb). Estimates of actual air pollutant emissions in 1998 from Madison County and BGAD are listed in Table 4.13. The significance of BGAD emissions is expressed as a percentage of the total Madison County emissions. As the table indicates, BGAD emissions account for very small fractions of the emissions released from Madison County (i.e., about 1.2%, 0.9%, 0.8%, 0.3%, 0.1%, and 0.1%, respectively, of the total Madison County emissions for VOCs, Pb, PM_{10}, SO_2, NO_x, and CO).

4.7.2 Criteria Pollutant Emissions

4.7.2.1 Emissions from construction

Emissions of criteria pollutants (such as SO_2, NO_x, CO, PM_{10}, and $PM_{2.5}$) and VOCs during the construction period would include fugitive dust emissions from earth-moving activities and exhaust emissions from equipment and commuter and delivery vehicles. Exhaust emissions are expected to be relatively small when compared with fugitive dust emissions from earth-moving activities (Kimmell et al. 2001). Accordingly, only the potential impacts on ambient air quality from fugitive emissions of PM_{10} and $PM_{2.5}$ from earth-moving activities were analyzed. Emission factors and other assumptions used in estimating emission rates of PM_{10} and $PM_{2.5}$ are described in Appendix J.

4.7.2.2 Emissions from operations

Although BGAD currently emits less than 100 tons/yr of any regulated air pollutant and would not be required to obtain a permit as a major source, BGAD holds an operating permit issued by the Commonwealth of Kentucky for certain older air sources. In addition, BGAD has

Table 4.12. Potential emissions of air pollutants from existing BGAD stationary sources in 1999

	Emissions (tons/yr)[a]					
Stationary source category	SO_2	NO_x	CO	VOCs	PM_{10}	Pb
Boilers/ovens	32.36	23.37	5.80	0.45	1.22	0.0005
Solid waste disposal	1.04	1.82	4.16	1.25	0.53	–
Surface coating	–	–	–	80.18	1.40	0.0013
Metal cleaning	–	–	–	–	0.06	–
Fuel storage and handling	–	–	–	5.89	–	–
Woodworking	–	–	–	–	1.95	–
Miscellaneous	4.72	12.00	8.44	–	3.15	–
Total	38.13	37.20	18.39	87.74	8.30	0.0018

[a]A hyphen means that there was no emission, the emission was negligible, or the emission was not estimated.

[b]Stationary sources' potential to emit is usually based on 24-hour, 7 days/week operations and a worst-case assumption that pollution control equipment is not functioning (Elliott 2000).

Source: Adapted from ACWA DEIS 2001, Table 7.5-1.

Table 4.13. Emissions of air pollutants from Madison County, Kentucky, and BGAD sources in 1998

	Emissions (tons/yr)	
Air pollutant	Madison County	BGAD[a]
SO_2	351.5	1.1 (0.3)
NO_x	686.1	1.0 (0.1)
CO	205.2	0.2 (0.1)
VOC	420.8	4.9 (1.2)
PM_{10}	227.0	1.9 (0.8)
Pb	0.2	0.0018 (0.9)

[a]Numbers in parentheses are BGAD emissions as a percent of Madison County emissions.

Source: Adapted from ACWA DEIS 2001, Table 7.5-2.

registered certain minor air emission sources with the Commonwealth of Kentucky. Emission factors and other assumptions that were used to estimate emission rates of criteria pollutants and VOCs during operations are described in Appendix J. Maximum short-term and annual total emission rates, along with stack parameters (heights, inside diameters, gas exit temperatures, gas exit velocities) used in the dispersion modeling are listed in Table 4.14 for Incineration, Table 4.15 for Neut/SCWO, Table 4.16 for Neut/GPCR/TW-SCWO, and Table 4.17 for Elchem Ox.

Table 4.14. Emission rates of criteria pollutants and volatile organic compounds and stack parameters associated with normal operations of the baseline incineration technology at BGAD

Stack parameters and peak emission rates	Steam boilers	Furnaces
Stack parameters[a]		
Height	50 ft	140 ft
Inside diameter	1.3 ft	5 ft
Gas exit temperature	350°F	215 °F
Gas exit velocity	47 ft/s	30 ft/s
Emission rates		
SO_2	0.11 ton/yr (0.03 lb/h)	91.4 ton/yr (20.9 lb/h)
NO_x ($NO + NO_2$)	22.2 ton/yr (5.1 lb/h)	249.2 ton/yr (56.9 lb/h)
CO	5.0 ton/yr (1.1 lb/h)	38.2 ton/yr (8.7 lb/h)
PM_{10}	0.9 ton/yr (0.2 lb/h)	23.8 ton/yr (5.4 lb/h)
$PM_{2.5}$	0.9 ton/yr (0.2 lb/h)	23.8 ton/yr (5.4 lb/h)
VOCs	0.18 ton/yr (0.04 lb/h)	—

[a]For the modeling analysis, because the exact location of the stacks has not yet been decided, all proposed stacks were modeled as being co-located.

[b]$PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions.

The Compliance Assurance Monitoring (CAM) rule is applicable only at a major source that would be required to obtain a Part 70 or Part 71 permit (40 CFR 70 or 40 CFR 71). Based on annual emissions presented in Table 4.12, BGAD is not currently a major source. Therefore, the CAM rule would only be applicable if one of the chemical disposal technologies produced enough additional emissions to cause BGAD to become a major source (i.e., in which BGAD facility-wide potential emissions would exceed 100 tons per year for any of the criteria pollutants). Based on estimated emissions (Tables 4.14 through 4.17), only the incineration technology would cause BGAD to be classified as a major source which, in turn, would require compliance with the CAM rule. In addition to a source having a Part 70 or Part 71 permit, the following items must be applicable to a source for the CAM rule to be invoked:

(1) The unit is subject to an emission limitation or standard for the applicable regulated air pollutant (or a surrogate thereof), other than an emission limitation or standard that is exempt under 40 CFR 64.2 paragraph (b)(1);

Table 4.15. Emission rates of criteria air pollutants and volatile organic compounds and stack parameters associated with normal operations of the neutralization/SCWO technology at BGAD

Stack parameters and estimated peak emission rates	Steam boilers	Emergency diesel generators	SCWO stack[d]
Stack parameters[a]			
Height	70 ft	47 ft	80 ft
Inside diameter	0.8 ft	0.67 ft	2.5 ft
Gas exit temperature	325NF	925NF	77NF
Gas exit velocity	60 ft/s	323 ft/s	40.74 ft/s
Emission rates[b]			
SO_2	0.02 ton/yr (0.01 lb/h)	0.95 ton/yr (32.0 lb/h)	—
No_x ($NO + NO_2$)	3.64 ton/yr (2.12 lb/h)	14.5 ton/yr (48.4 lb/h)	—
CO	2.18 ton/yr (1.3 lb/h)	3.12 ton/yr (10.4 lb/h)	—
PM_{10}	0.20 ton/yr (0.12 lb/h)	1.02 ton/yr (3.4 lb/h)	—
$PM_{2.5}$[c]	0.20 ton/yr (0.12 lb/h)	1.02 ton/yr (3.4 lb/h)	—
HC	0.14 ton/yr (0.09 lb/h)	1.18 ton/yr (4.0 lb/h)	—

[a]For the modeling analysis, emissions from the three boilers were assumed to come from one stack location. Similarly, emissions from the two emergency generators were assumed to come from one stack location.

[b]Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c]$PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers and diesel generators (EPA 2000a).

[d]The only criteria pollutant emissions estimated for the SCWO stack are N_2O and H_2. The hourly and annual emission rates for these are 139 lb/h and 146.1 tons/yr for N_2O and 33 lb/h and 37.4 tons/yr for H_2.

Source: ACWA TRD 2001, Tables 5.20 and 5.21.

(2) The unit uses a control device to achieve compliance with any such emission limitation or standard; and

(3) The unit has potential pre-control device emissions of the applicable regulated air pollutant that are greater than or equal to 100% of the amount, in tons per year, required for a source to be classified as a major source.

If the CAM rule is determined to apply at BGAD, then a monitoring and recordkeeping plan would need to be prepared in accordance with 40 CFR 64.2 through 64.9. This plan would be prepared and submitted as part of the Part 70 or Part 71 permit application for the chemical weapons destruction facility at BGAD.

Incineration. Potentially significant sources of air pollutants include 8 stacks at the proposed facility. The most significant source would be the common stack serving the liquid incinerator, the deactivation furnace, and the metal parts furnace. In addition, there would be 4 stacks for boilers that produce process heat and building heat, and one stack each for the

Table 4.16. Emission rates of criteria air pollutants and volatile organic compounds and stack parameters associated with normal operations of the neutralization/GPCR/TW-SCWO technology at BGAD

Stack parameters and estimated peak emission rates	Steam boilers	Emergency diesel generators	Process gas burner
Stack parameters[a]			
Height	70 ft	47 ft	80 ft
Inside diameter	1.1 ft	0.67 ft	0.42 ft
Gas exit	325NF	925NF	77NF
temperature	60 ft/s	323 ft/s	62 ft/s
Gas exit velocity			
Emission rates[b]			
SO_2	0.03 ton/yr (0.02 lb/h)	0.95 ton/yr (3.2 lb/h)	0.007 ton/yr (0.004 lb/h)
No_x ($NO + NO_2$)	6.65 ton/yr (4.0 lb/h)	14.5 ton/yr (48.4 lb/h)	0.18 ton/yr (0.11 lb/h)
CO			
PM_{10}	3.99 ton/yr (2.4 lb/h)	3.12 ton/yr (10.4 lb/h)	0.29 ton/yr (0.17 lb/h)
$PM_{2.5}$[c]	0.36 ton/yr (0.2 lb/h)	1.02 ton/yr (3.4 lb/h)	0.05 ton/yr (0.03 lb/h)
HC	0.36 ton/yr (0.2 lb/h)	1.02 ton/yr (3.4 lb/h)	0.05 ton/yr (0.03 lb/h)
	0.26 ton/yr (0.2 lb/h)	1.18 ton/yr (4.0 lb/h)	0.08 ton/yr (0.05 lb/h)

[a]For the modeling analysis, emissions from the three boilers were assumed to come from one stack location. Similarly, emissions from the two emergency generators were assumed to come from one stack location.

[b]Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c]$PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers and diesel generators (EPA 2000a).

Source: ACWA TRD 2001, Tables 5.78 and 5.79.

laboratory, the munition demilitarization building ventilation system, and the brine reduction area pollution abatement system (BRA PAS). In general, the BRA PAS outlet is considered a small source.

Neutralization/SCWO. In a Neut/SCWO facility, air pollutants would be emitted from four types of stacks: (1) three stacks for the natural-gas-burning boilers (two operating, one on standby) used to generate process steam and building heat, (2) two stacks for the diesel-powered generators used to provide emergency electricity, (3) a filter farm stack for building circulating exhaust air and non-SCWO air effluents (e.g., rotary hydrolyzer, MPT), and (4) a stack for exhaust from the SCWO process. The principal sources of criteria pollutant and VOC emissions would be the boilers and emergency generators, while the primary sources of hazardous air pollutant (HAP) emissions would be the filter farm stack and SCWO stack (HAPs are discussed in Section 4.8).

Table 4.17. Emission rates of criteria air pollutants and volatile organic compounds and stack parameters associated with normal operations of the electrochemical oxidation technology at BGAD

Stack parameters and estimated peak emission rates	Steam boilers	Emergency diesel generators
Stack parameters[a]		
Height	70 ft	47 ft
Inside diameter	0.8 ft	0.67 ft
Gas exit temperature	325NF	925NF
Gas exit velocity	60 ft/s	323 ft/s
Emission rates[b]		
SO_x	0.02 ton/yr (<0.01 lb/h)	0.95 ton/yr (3.2 lb/h)
No_x (NO + NO_2)	3.64 ton/yr (2.2 lb/h)	14.5 ton/yr (48.4 lb/h)
CO	2.18 ton/yr (1.3 lb/h)	3.12 ton/yr (10.4 lb/h)
PM_{10}	0.20 ton/yr (0.1 lb/h)	1.02 ton/yr (3.4 lb/h)
$PM_{2.5}$[c]	0.20 ton/yr (0.1 lb/h)	1.02 ton/yr (3.4 lb/h)
HC	0.14 ton/yr (0.1 lb/h)	1.18 ton/yr (4.0 lb/h)

[a]For the modeling analysis, emissions from the three boilers were assumed to come from one stack location. Similarly, emissions from the two emergency generators were assumed to come from one stack location.

[b]Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c]$PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers and diesel generators (EPA 2000a).

Source: ACWA TRD 2001, Tables 5.110 and 5.111.

Neutralization/GPCR/TW-SCWO. In a Neut/GPCR/TW-SCWO facility, air pollutants would be emitted from four different kinds of stacks, similar to those of the Neut/SCWO facility. The only difference is that a process gas burner stack would replace a SCWO stack. This stack would be used to discharge treated supplementary process fuel gas produced from the GPCR process (which consists of a central reactor for destroying organic waste streams). This stack would emit criteria pollutants, VOCs, and various HAPs. Its criteria pollutant and VOC emissions would amount to much less than those from boilers or diesel generators. In lieu of using a process gas burner stack, the fuel gas could be used as fuel by the facility boilers.

Electrochemical Oxidation. In an Elchem Ox facility, air pollutants would be emitted from three different kinds of stacks. The major difference from a Neut/SCWO facility is the absence of a SCWO stack. Thus, the assumption is that all air effluents from all treatment processes would be emitted into the atmosphere via the filter farm stack.

Other Sources. Other sources of air pollution during operations would include vehicular traffic (i.e., cars, pickup trucks, and buses transporting personnel to and from the facility). Trucks and forklifts would be used to deliver supplies to the facility. Emissions from these vehicles are not expected to add appreciably to pollutant concentrations in the area. Parking lots and access roads to the facility would be paved with asphalt concrete to minimize fugitive dust emissions.

Other potential emissions would include VOCs from the aboveground and underground fuel storage tanks. However, these emissions would be negligible because diesel fuel has a low volatility and because facility operations would consume a low level of fuel and thus require infrequent refilling.

Global Climate Change. A major worldwide environmental issue is the possibility of major changes in the global climate (e.g., global warming) as a consequence of increasing atmospheric concentrations of "greenhouse" gases (Mitchell 1989). The atmosphere allows a large percentage of incoming solar radiation to pass through to the earth's surface, where it is converted to heat energy (infrared radiation) that does not pass back through the atmosphere as easily as the solar radiation passes in. The result is that heat energy is "trapped" near the earth's surface. This phenomenon is commonly called the greenhouse effect because of an analogy with the glass in a greenhouse. However, the use of the term greenhouse effect to describe these radiative processes is somewhat of a misnomer because the main effect of the glass in a greenhouse is to act as a physical barrier that keeps the warm air inside.

Greenhouse gases include water vapor, CO_2, methane, nitrous oxide, O_3, and several chlorofluorocarbons. The greenhouse gases constitute a small percentage of the earth's atmosphere; however, their collective effect is to keep the temperature of the earth's surface about 60°F warmer, on average, than it would be if there were no atmosphere. Water vapor, a natural component of the atmosphere, is the most abundant greenhouse gas. The second-most abundant greenhouse gas is CO_2, which has increased about 30% in concentration over the last century. Fossil fuel burning is generally considered the primary contributor to increasing concentrations of CO_2 (DOE 1989). The increasing CO_2 concentrations may have contributed to a corresponding increase in globally averaged temperature in the lower atmosphere (IPCC 1992).

Because CO_2 is stable in the atmosphere and essentially uniformly mixed throughout the troposphere and stratosphere, the climatic impact does not depend on the geographic location of sources. Therefore, an increase in CO_2 emissions at a specific source is effective in altering CO_2 concentrations only to the extent that it contributes to the global total of fossil fuel burning that increases global CO_2 concentrations.

For proposed emissions at BGAD, based on applying the emission factor for the combustion of natural gas (http://cdiac.esd.ornl.gov/pns/faq.html) to the expected use of natural gas (Table 3.1), the incineration technology would increase global CO_2 emissions by about 33,550 tons per year. This increase is about 0.0006% and 0.0001% of annual U.S. and global CO_2 emissions of 5,802,385,000 tons per year and 26,410,000,000 tons per year, respectively, from fossil fuel combustion (Marland et al. 2000). This incremental amount from the incineration technology is small in comparison with U.S. and global totals of CO_2 and would not contribute any significant impacts to global warming. CO_2 emissions associated with the other technologies would be less because they would use less natural gas (Table 3.1); consequently, these technologies also would not contribute any significant impacts to global warming.

4.7.3 Impacts of Construction

Potential impacts of air pollutant emissions during facility construction were evaluated by estimating maximum ground-level concentration increments of criteria air pollutants resulting from construction, adding these estimates to background concentrations, and comparing the results with applicable ambient air quality standards. As indicated in Table 4.10, the Kentucky SAAQS for criteria air pollutants are identical to the NAAQS (401 KAR 53:010).

The air quality model, model input data (meteorological data, source and receptor locations, elevation data), and other assumptions used in estimating potential construction impacts on ambient air quality at the BGAD boundaries and surrounding areas are described in Appendix J.

The modeling results for both PM_{10} and $PM_{2.5}$ concentration increments that would result from construction-related fugitive emissions are summarized in Table 4.18. At the installation boundaries, for both PM_{10} and $PM_{2.5}$, the maximum 24-hour and annual average concentration increments above background would occur about 1.2 mi north and 1.3 mi north-northeast of the proposed facility, respectively. At these locations, for PM_{10}, the maximum 24-hour and annual average concentration increments above background would be about 36% and 1.2% of the NAAQS, respectively. For $PM_{2.5}$, the maximum 24-hour and annual average concentration increments above background would be about 42% and 2% of the NAAQS, respectively.

Table 4.18. Maximum predicted off-site concentration increments and total concentrations of PM_{10} and $PM_{2.5}$ during construction at BGAD

		Concentration (µg/m^3)				
Pollutant	Averaging time	Maximum increment[a,b]	Background[c]	Total[d]	NAAQS	Percent of NAAQS[e]
PM_{10}	24 hours	54	70	124	150	83 (36)
	Annual	0.6	29	29	50	58 (1.2)
$PM_{2.5}$	24 hours	27	35	62	65	95 (42)
	Annual	0.3	17	17	15	116 (2.0)

[a]The maximum concentration increments were estimated by using the Industrial Source complex ISCST3 model (EPA 1995).

[b]Modeled maximum 24-hour and annual average concentrations occur at receptors about 1.9 km (1.2 mi) and 2.2 km (1.3 mi) to the north and north-northeast of the proposed facility, respectively.

[c]See Table 7.5.3.

[d]Total equals maximum modeled concentration plus background concentration.

[e]The values are total concentration as a percent of NAAQS. The values in parentheses are maximum concentration increments as a percent of NAAQS.

Source: ACWA DEIS 2001, Table 7.5-9.

To obtain the overall concentrations for comparison with applicable NAAQS, the maximum PM_{10} and $PM_{2.5}$ concentration increments (Table 4.18) were added to background values (from Table 4.10). For PM_{10}, the estimated maximum 24-hour and annual average concentrations would be about 83% and 58% of the NAAQS, respectively. For $PM_{2.5}$, the estimated maximum 24-hour and annual average concentrations would be about 95% and 116% of the NAAQS, respectively. The annual average $PM_{2.5}$ background concentration of 17.1 µg/m^3 around the BGAD area is already above the standard of 15 µg/m^3. Accordingly, construction activities should be conducted so as to minimize further impacts on ambient air quality.

In summary, the estimated maximum 24-hour and annual average concentration increments of PM_{10} and $PM_{2.5}$ that would result from construction-related fugitive emissions would be relatively small fractions of the applicable NAAQS. The total (maximum increments plus background) estimated maximum 24-hour and annual average concentrations of PM_{10} and 24-hour average concentrations of $PM_{2.5}$ would be below the applicable NAAQS. However, the total estimated annual average concentrations of $PM_{2.5}$ would be above the applicable NAAQS, primarily because of high background concentration levels.

4.7.4 Impacts of Operations

Potential impacts of air pollutant emissions during facility operation were evaluated by estimating maximum ground-level concentration increments of criteria air pollutants resulting from operations, adding these estimates to background concentrations, and comparing the results with applicable ambient air quality standards. As indicated in Table 4.10, the Kentucky SAAQS for criteria air pollutants are identical to the NAAQS (401 KAR 53:010).

The air quality model, model input data (meteorological data, source and receptor locations, elevation data), and other assumptions used in estimating potential operational impacts on ambient air quality at the BGAD boundaries and surrounding areas are described in Appendix J.

In the air quality analysis for the operational period, air quality impacts were modeled for each of the four technologies. The results are presented in tabular format for each case. The modeling results for concentration increments of SO_2, NO_2, CO, PM_{10}, and $PM_{2.5}$ due to emissions from the proposed facility operations are summarized in Tables 4.19–4.22, respectively, for the Incineration, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox systems. The receptor locations where maximum concentration increments would occur are also listed in these tables.

The estimated maximum concentration increments due to operation of the proposed facility would contribute less than 4% of applicable NAAQS for all pollutants (Tables 4.19–4.22). It is expected that potential impacts from proposed facility operations on the air quality of nearby communities would be negligible. Irrespective of the technology used, maximum concentration increments would occur mostly in the west-to-north quadrant from the proposed facility.

The total concentrations of criteria pollutants obtained by adding the predicted maximum concentration increments to background values (from Table 4.10) are compared with applicable NAAQS (Tables 4.19–4.22). The maximum estimated concentrations of all criteria pollutants except $PM_{2.5}$, for which the background level is already over the standard, would be less than 70% of the NAAQS.

To evaluate air quality impacts from BGAD operations with respect to PSD requirements, estimated maximum increments in ground-level concentrations that would result from the operation of the proposed facility were compared with allowable PSD increments above the baseline. Applicable PSD increments are summarized in Table 4.10.

The maximum 3-hour, 24-hour, and annual SO_2 concentration increments predicted to result from the proposed facility operations (Tables 4.19–4.22) would be less than 10% of the applicable PSD increments (Table 4.10). The maximum predicted increments in annual average NO_2 concentrations due to the proposed facility operations would also be less than 10% of the applicable PSD increments. The increases in 24-hour and annual PM_{10} concentrations predicted to result from the proposed operations would also be less than 10% of the applicable PSD increments.

Table 4.19. Maximum predicted off-site concentration increments and total concentrations of criteria pollutants during normal operations of the Baseline Incineration Technology at BGAD

		Concentration ($\mu g/m^3$)					Receptor location[e]	
Pollutant	Averaging Time	Maximum increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [km (mi)]	Direction
SO^2	3 hours	43	172	215	1,300	17 (3.3)	2.1 (1.3)	N
	24 hours	9.0	81	90	365	25 (2.5)	1.9 (1.2)	WNW
	Annual	0.50	21	22	80	27 (0.63)	2.2 (1.4)	NNW
NO_2	Annual	1.8	32	34	100	34 (1.8)	1.9 (1.2)	NNW
CO	1 hour	39	9,800	9,839	40,000	25 (0.10)	2.1 (1.3)	N
	8 hours	15	6,700	6,715	10,000	67 (0.15)	1.9 (1.2)	N
PM_{10}	24 hours	2.5	70	73	150	48 (1.7)	1.9 (1.2)	WNW
	Annual	0.14	29	29	50	58 (0.28)	2.2 (1.4)	NNW
$PM_{2.5}$	24 hours	2.5	35	38	65	58 (3.8)	1.9 (1.2)	WNW
	Annual	0.14	17	17	15	114 (0.93)	2.2 (1.4)	NNW
Pb	Quarterly	0.0003[f]	0.04	0.04	1.5	2.7 (0.02)	1.9 (1.2)	N

[a]Maximum concentration increments were estimated by using the ISCST3 model (EPA 1995).
[b]See Table 4.7.3.
[c]Total equals maximum concentration increment plus background concentration.
[d]The values are total concentration as percent of NAAQS. The values in parentheses are maximum concentration increments as percent of NAAQS.
[e]Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the incineration facility.
[f]Conservatively based on maximum monthly average estimated by using the ISCST3 model.

Concentration increments at the nearest PSD Class I area (Mammoth Cave National Park), which is located about 100 mi west-southwest of BGAD, would be less than 1% of the applicable PSD increments. For the Class I analysis, the ISCST3 model was used to predict concentration increments at a receptor located 30 mi (50 km) away from the proposed facility in the direction of Mammoth Cave National Park. A distance of 50 km was used because it is the maximum distance at which the ISCST3 model would be appropriate to estimate concentrations. Because predicted concentration increments at the receptor are less than 1% of the corresponding PSD Class I increments, actual concentration increments at Mammoth Cave National Park, which is about 100 mi away, would also be less than 1% of the increments.

Concentration increments for lead were modeled for the incineration technology alone because the other technologies would have negligible lead emissions. The estimated maximum concentration increment due to operation of the proposed facility would contribute about 0.02% of the applicable NAAQS (Table 4.20). The total concentration of lead obtained by adding the predicted maximum concentration increment to the background value (from Table 4.10) would be less than 3% of the NAAQS (Table 4.20). Emissions of other heavy metals are all expected to be negligible for all alternatives (see Appendix I).

Table 4.20. Maximum predicted off-site concentration increments and total concentrations of criteria pollutants during normal operations of the Neutralization/SCWO Technology at BGAD

		Concentration (μg/m³)					Receptor location[e]	
Pollutant	Averaging Time	Maximum increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [km (mi)]	Direction
SO^2	3 hours	6.7	172	179	1,300	14 (0.52)	4.6 (2.8)	SW
	24 hours	1.7	81	83	365	23 (0.47)	1.9 (1.2)	W
	Annual	0.007	21	21	80	26 (0.009)	2.2 (1.4)	NW
NO_2	Annual	0.14	32	32	100	32 (0.14)	2.2 (1.4)	NW
CO	1 hour	45	9,800	9,900	40,000	25 (0.11)	4.0 (2.5)	W
	8 hours	14	6,700	6,700	10,000	67 (0.14)	2.1 (1.3)	N
PM_{10}	24 hours	1.9	70	72	150	48 (1.3)	1.9 (1.2)	W
	Annual	0.009	29	29	50	57 (0.018)	2.2 (1.4)	NW
$PM_{2.5}$	24 hours	1.9	35	36	65	56 (2.9)	1.9 (1.2)	W
	Annual	0.009	17	17	15	114 (0.06)	2.2 (1.4)	NW

[a]Maximum concentration increments were estimated by using the ISCST3 model (EPA 1995).
[b]See Table 7.5.3.
[c]Total equals maximum concentration increment plus background concentration.
[d]The values are total concentration as percent of NAAQS. The values in parentheses are maximum concentration increments as percent of NAAQS.
[e]Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the Neut/SCWO facility.

Source: ACWA DEIS 2001, Table 7.5-10.

Concentration increments for the remaining criteria pollutant, ozone, were not modeled. Contributions to the production of ozone, a secondary pollutant formed from complex photochemical reactions involving ozone precursors (including NO_x and VOCs), cannot be accurately quantified. As discussed in Section 4.7.1, Madison County, including BGAD, is currently in attainment for ozone (40 CFR 81.318). The amounts of ozone precursor emissions that would result from the proposed facility's operations would be small, accounting for about 2.6% and 0.3% of the actual emissions of NO_x and VOCs, respectively, from Madison County in 1998. As a consequence, the cumulative impacts of potential releases from BGAD facility operations on regional ozone concentrations would not be of any concern.

With regard to additional standards adopted by Kentucky, the maximum annual off-post concentration of hydrogen fluoride is estimated to be less than 0.02 μg/m³ (Table I.1), which is much less than 1% of Kentucky's annual primary standard of 400 μg/m³ (Table 4.11). Similarly, the maximum 24-hour off-post concentration of hydrogen fluoride would be much less than 1% of Kentucky's 24-hour primary standard of 800 μg/m³ (Table 4.11). The use of conversion factors given for EPA's SCREEN3 model yields an estimate of 0.25 μg/m³ for a maximum 1-hour average of hydrogen fluoride. Because estimates of the maximum off-post concentrations corresponding to Kentucky's secondary standards for averaging times between 12 hours and 1 month would

Table 4.21. Maximum predicted off-site concentration increments and total concentrations of criteria pollutants during normal operations of the Neutralization/GPCR/TW-SCWO Technology at BGAD

		Concentration (µg/m³)					Receptor location[e]	
Pollutant	Averaging Time	Maximum increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [km (mi)]	Direction
SO^2	3 hours	6.7	172	179	1,300	14 (0.52)	4.6 (2.8)	SW
	24 hours	1.7	81	83	365	23 (0.47)	1.9 (1.2)	W
	Annual	0.007	21	21	80	26 (0.009)	2.2 (1.4)	NW
NO_2	Annual	0.16	32	32	100	32 (0.16)	2.2 (1.4)	NW
CO	1 hour	49	9,800	9,900	40,000	25 (0.12)	4.1 (2.5)	WSW
	8 hours	15	6,700	6,700	10,000	67 (0.15)	2.1 (1.3)	N
PM_{10}	24 hours	2.0	70	72	150	48 (1.3)	1.9 (1.2)	W
	Annual	0.011	29	29	50	57 (0.032)	2.2 (1.4)	NW
$PM_{2.5}$	24 hours	2.0	35	37	65	56 (3.1)	1.9 (1.2)	W
	Annual	0.011	17	17	15	114 (0.07)	2.2 (1.4)	NW

[a]Maximum concentration increments were estimated by using the ISCST3 model (EPA 1995).
[b]See Table 7.5.3.
[c]Total equals maximum concentration increment plus background concentration.
[d]The values are total concentration as percent of NAAQS. The values in parentheses are maximum concentration increments as percent of NAAQS.
[e]Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the Neut/GPCR/TW-SCWO facility.

Source: ACWA DEIS 2001, Table 7.5-12.

range between the annual estimate of 0.02 µg/m³ and the 1-hour estimate of 0.25 µg/m³, the estimates would be less than the corresponding Kentucky secondary standards, which range between 0.82 and 3.68 µg/m³ (Table 4.11). Similarly, total fluorides are not expected to exceed Kentucky standards, which are set nearly two orders of magnitude greater than Kentucky's primary hydrogen fluoride standards. Because of the composition of the fuel and agent and the high temperatures experienced during combustion, negligible emissions of hydrogen sulfide are expected and no detectable odors are expected.

4.7.5 Impacts of Process Fluctuations

To assess the impacts that could result from possible process fluctuations in operations, it was assumed that levels of organic compound emissions would be 10 times higher than the estimated annual average for 5% of the time and that levels of inorganic compound emissions would be 10 times higher than the estimated annual average for 20% of the time. These assumptions were based on EPA guidance (EPA 1994, as cited in National Research Council 1997a).

Table 4.22. Maximum predicted off-site concentration increments and total concentrations of criteria pollutants during normal operations of the Electrochemical Oxidation Technology at BGAD

		Concentration (μg/m^3)					Receptor location[e]	
Pollutant	Averaging Time	Maximum increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [km (mi)]	Direction
SO^2	3 hours	6.7	172	179	1,300	14 (0.52)	4.6 (2.8)	SW
	24 hours	1.7	81	83	365	23 (0.47)	1.9 (1.2)	W
	Annual	0.007	21	21	80	26 (0.009)	2.2 (1.4)	NW
NO_2	Annual	0.14	32	32	100	32 (0.14)	2.2 (1.4)	NW
CO	1 hour	45	9,800	9,900	40,000	25 (0.11)	4.0 (2.5)	W
	8 hours	14	6,700	6,700	10,000	67 (0.14)	2.1 (1.3)	N
PM_{10}	24 hours	1.9	70	72	150	48 (1.3)	1.9 (1.2)	W
	Annual	0.009	29	29	50	57 (0.018)	2.2 (1.4)	NW
$PM_{2.5}$	24 hours	1.9	35	36	65	56 (2.9)	1.9 (1.2)	W
	Annual	0.009	17	17	15	114 (0.06)	2.2 (1.4)	NW

[a]Maximum concentration increments were estimated by using the ISCST3 model (EPA 1995).
[b]See Table 7.5.3.
[c]Total equals maximum concentration increment plus background concentration.
[d]The values are total concentration as percent of NAAQS. The values in parentheses are maximum concentration increments as percent of NAAQS.
[e]Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the Elchem Ox facility.

Source: ACWA DEIS 2001, Table 7.5-13.

Over long periods, such conditions would be assumed to increase organic emissions to 145% of their normal values and metal emissions to 280% of their normal values (National Research Council 1997a). VOCs contribute to the formation of ozone, a criteria pollutant; multiplying VOC emissions from the proposed facility by 1.45 would result in less than 2 tons per year, or less than 0.5% of the 1998 VOC emissions in Madison County (Kentucky Division of Air Quality 1999a). Therefore, the potential increase in ozone concentration that could result from VOC emissions from proposed facility operations under process upsets or fluctuating conditions would be almost the same as that under normal operating conditions. Lead (Pb) is the only metal among criteria pollutants. Emissions of lead from the proposed facility are currently too small to quantify; therefore, increasing these emissions by 280% of their normal value would probably not cause any appreciable increase in atmospheric lead concentrations. Therefore, when process upsets or fluctuating operations are considered, the potential impacts of criteria pollutants involved would still be expected to be insignificant.

4.7.6 Impacts of No Action

The principal sources of air pollutant emissions associated with stockpile maintenance are the exhaust and road dust generated by vehicles. These emissions contribute to the background air quality at the installation. Emissions of air pollutants from these sources are minor both in absolute terms and in comparison with emissions from other natural and anthropogenic sources of emissions on and off BGAD. Therefore, impacts on air quality that would occur as a result of the continued storage of the stockpile are expected to be minimal.

4.7.7 Cumulative Impacts

During construction, PM_{10} and $PM_{2.5}$ from fugitive emissions would be the pollutants of principal concern. Emissions of pollutants from worker and delivery vehicles, construction equipment, fuel storage, and refueling operations would be small. Off-post concentrations from these sources would not exceed NAAQS levels (Sect. 4.7.2). Construction of the facility alone would produce, at most, an emission level that would be 42% of any particulate NAAQS level. When current on-post and off-post sources are taken into account (the background levels), total PM_{10} concentrations would be less than 83% of the NAAQS levels. The total 24-hour $PM_{2.5}$ concentration would be 95% of the NAAQS level, and the total annual $PM_{2.5}$ concentration of 17.4 $\mu g/m^3$ would exceed the NAAQS level. However, even without the proposed facility or any other reasonably foreseeable on-post or off-post actions, annual levels of $PM_{2.5}$ are already 114% of the NAAQS level of 15 $\mu g/m^3$. (Annual background concentrations of $PM_{2.5}$ throughout Kentucky tend to be higher than the NAAQS level.) Construction of the proposed facility would contribute another 0.3 $\mu g/m^3$ (Table 4.19).

Construction of the Site Security Control Center and vehicle storage facility area simultaneously with the proposed facility would increase off-post particulate concentrations. Other reasonably foreseeable future on-post actions include the operation of a molten salt operation facility and an explosive detonation chamber for the destruction of conventional munitions. The molten salt operation facility is located about 2 mi south of proposed Areas A and B. The detonation chamber is located about 4 mi south of proposed Areas A and B. Both are far enough away to preclude significant interactions. Local road construction, including the widening of Duncannon Lane and widening of Interstate 75, would be too far away to cause significant particulate concentrations in the areas receiving the greatest impacts from the proposed facility.

For all technologies, the largest incremental air quality impact from operating the facility by itself would be about 3% of the applicable NAAQS levels for all pollutants. Except for the annual $PM_{2.5}$ level, the maximum estimated concentrations of all criteria pollutants, including the effects of current on-post and off-post sources (background), would be less than 67% of the NAAQS levels (see Tables 4.19–4.22 for the four technologies). Even without the proposed facility or any other reasonably foreseeable on-post or off-post action, annual levels of $PM_{2.5}$ are already 114% of the NAAQS level of 15 $\mu g/m^3$. Operating the proposed facility would add, at most, 0.11 $\mu g/m^3$. For the reasons noted above, other reasonably foreseeable on-post and off-post actions would not cause significant criteria pollutant concentrations in areas receiving the greatest impacts from the proposed facility. As a replacement for open detonation, the detonation chamber is expected to reduce particulate emissions from detonation activities (U.S. Army 1998b).

4.8 AIR QUALITY–RELEASE OF HAZARDOUS AND TOXIC SUBSTANCES

4.8.1 Existing Emissions and Air Quality

The reportable emissions from BGAD for 1999 under the TRI regulations resulted from open burning and open detonation. A total of approximately 1,200 lb of materials were subjected to open burning, and a total of about 36,000 lb of materials were subjected to belowground open detonation (Allen 2000). Because the open burning and open detonation processes destroy most of the material, the actual quantities released to the air are much lower than those reported. The largest contributor to open burning releases was dinitrotoluene; about 800 lb were burned. The largest contributor to open detonation releases was zinc (about 19,000 lb); releases of zinc do not have to be reported under the TRI.

A summary of the materials and quantities released is given in Table 4.23. Not all of the materials released as given in Table 4.23 had to be reported under the TRI; several were recorded for other purposes and are included here for completeness. No TRI threshold values were exceeded.

Other minor sources of emissions at BGAD include boilers; gasoline, fuel oil, and diesel storage; surface coating work; abrasive blasting of metal parts; operation of small furnaces; and miscellaneous industrial processes. In addition, a total of about 1 ton of HAPs (as defined in Title III, Section 112 of the *Clean Air Act* [CAA]) were emitted from these sources in 1999 (Kentucky Division of Air Quality 2000). The largest emission of a non-hazardous air pollutant (HAP) substance in 1999 was about 4 tons of 2-ethoxyethanol acetate, associated with surface coating operations.

4.8.2 Hazardous and Toxic Air Pollutant Emissions

A summary of the estimated emissions of toxic air pollutants that would result from operation of the proposed facility at BGAD is given in Kimmell et al. (2001). Estimated emissions (including those from diesel generators and boilers) from an Incineration, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox facility are provided in Appendix I. For the facility stacks (SCWO vent, product gas burner vent, and catalytic oxidation unit [CatOx]/filter farm stack vent), emission estimates were based on demonstration test data and installation-specific munitions inventories compiled by Mitretek Systems, Inc. (2001a–d). Estimates of emissions from diesel generators and boilers were based on standard algorithms that used fuel consumption estimates as input (Kimmell et al. 2001). For many substances (e.g., acetaldehyde, formaldehyde), the estimated emissions from boilers and diesel generators would exceed the after-treatment emissions from facility processes by many orders of magnitude Appendix I.

The estimates of air emissions from operating the facility were based on the assumption that organic substances from the filter farm stacks and the SCWO vent would be filtered from stack emissions by a series of carbon filters, each having a removal efficiency of 95%. For particulate matter (e.g., dioxins and furans on PM and metals), it was assumed that two high-efficiency particulate air (HEPA) filters, each with a removal efficiency of 99.97%, would be used for treatment. For the Neut/GPCR/TW-SCWO facility, it was assumed that emissions from the product gas burner vent would not be further treated after release from the facility’s scrubber system.

Table 4.23. Emissions from BGAD in 1999

Substance	Quantity (lb)[a] Open Burning	Open Detonation
Aluminum		8,334
Antimony compounds		2*
Barium compounds		17*
Benzene		
Beryllium		<0.1
Cadmium		345
Chromium	0.2	345
Chromium (IV) compounds		17*
Cobalt		40
Copper	0.1	5,265 (441*)
Dibutylphthalate	278*	30*
Dinitrotoluene	805*	75*
Diphenylamine	81*	4*
Ethylene		3
Lead		154
Lead compounds (inorganic)	18*	26*
Manganese	<0.1	949 (103*)
Nickel	<0.1	72
Nitroglycerin		789 (294*)
Phosphorous		51
Silver		53
Sodium o-phenylphenate		<0.1
Thiourea		0.2
Toluene		<0.1
Vanadium		10
Vinyl acetate		<0.1
Zinc	<0.1	19,268
Zinc compounds		131
Total	1,183	35,981

[a]Value given is larger value from either the TRI chemicals summary report or the MIDAS database for calendar year 1999 (Allen 2000). No TRI threshold values were exceeded. Items marked with an astrick were reported under TRI; the other values were from MIDAS reporting. Items in parentheses were TRI-reported values, for comparison with larger MIDAS-reported values. A blank space means that this substance was not emitted in 1999.

Source: ACWA DEIS 2001, Table 7.6-1.

4.8.3 Impacts of Construction

During construction, low-level emissions of potentially toxic air pollutants would result from the use of construction chemicals such as paints, thinners, and aerosols. These emissions would be expected to be minor and were not quantitatively estimated for this EIS. The main emissions from construction-related heavy equipment and from the commuter vehicles used by construction workers would consist of criteria pollutants (Kimmell et al. 2001) and HAPs. HAPs emissions were not quantified for this assessment because of insufficient data (e.g., whether the engine type is two-stroke, four-stroke, or diesel) (EPA 2000c). Although not quantified for this assessment, the emission levels would be expected to be less than reportable quantities and similar across the technology systems evaluated.

4.8.4 Impacts of Operation

Estimates of emissions of toxic air pollutants that would result from the operation of the proposed facility are provided in Appendix I. Many of the toxic air pollutants that would be emitted from the facility stacks are HAPs as defined in Title III, Section 112 of the *Clean Air Act* (CAA). With regard to the applicability of recently promulgated National Emissions Standards for Hazardous Air Pollutants (NESHAPs), the District of Columbia Circuit Court of Appeals vacated the final Standards for Hazardous Air Pollutants from Hazardous Waste Combustors, which are promulgated in September 1999. In February 2002, EPA responded to the court's decision with an Interim Standards Rule and a Final Amendments Rule, which apply to several categories of hazardous waste combustion facilities including incinerators, cement kilns, and lightweight aggregate kilns. Accordingly, the rules apply only to the baseline incineration technology alternative at BGAD. Because the permit for BGAD incinerator operations would incorporate the NESHAP standards as permit conditions, the facility would comply with the applicable NESHAP requirements through permit compliance.

PCBs have been identified as a constituent in the firing tubes of M55 rockets. Trial burns at JACADS and DCD have demonstrated that the baseline incineration technology achieves or exceeds the 99.9999% destruction and removal efficiency for PCBs as required by TSCA regulations (see Appendix C) and that PCB emissions were significantly lower than those found at other EPA-permitted incinerators. PCBs were not tested as part of the ACWA demonstration project, since doing so would have triggered regulatory requirements under TSCA that would have added considerably to the cost and difficulty of the demonstration. Demonstration tests were conducted by using wood spiked with pentachlorophenol (PCP, a chlorinated substance similar to PCBs). Results showed degradation of the PCP in the test systems, indicating that PCBs would also likely be destroyed. During destruction of M55 rockets, appropriate TSCA regulations on monitoring PCBs and limiting them in effluents would be followed and a permit with treatment standards would be obtained prior to rocket pilot testing. For the purposes of this assessment, it was assumed that the technology systems evaluated would achieve a PCB destruction efficiency of 99.9999%. For filtered stacks, further removal by carbon filtration was also assumed.

In order to assess health risks associated with toxic air pollutant emissions, the locations of maximum on-post and off-post concentrations of the emitted compounds listed in Appendix I were identified through air modeling. The ISCST3 model was used (EPA 1995), as it was used for assessing criteria air pollutant emissions in Section 4.7. Details on the modeling conducted are presented in Appendix J.

The main emissions from commuter vehicles and delivery trucks are criteria pollutants (Kimmell et al. 2001); toxic air pollutant emissions have not been quantified for these vehicles.

4.8.5 Impacts of Process Fluctuations

To account for possible process fluctuations in operations that could occur, it was assumed that levels of organic compounds would be 10 times higher than the estimated annual average for 5% of the time and that levels of inorganic compounds would be 10 times higher than the estimated annual average for 20% of the time. These assumptions were based on EPA guidance (National Research Council 1997a) and were used to generate ambient air concentrations for exposure estimates as identified in Appendix J.

During fluctuating process operations, it is possible that agent could be released from the filter farm stack, which is the ventilation stack for the Munitions Demilitarization Building (MDB) process area. Regardless of the technology selected for implementation at BGAD, the filter farm stack would be equipped with multiple carbon filter banks and with agent monitoring devices between banks. These devices would ensure that, in the unlikely event that some agent were not destroyed during facility operation and subsequent treatment, it would be detected and the causes mitigated immediately.

For the purpose of estimating the maximum potential emissions of chemical agent, only the MDB process area was assumed to be a potential source. The filter systems would be designed to remove agent from the ventilation air stream to a level below the detectable level (Kimmell et al. 2001). Therefore, if any agent were detected in the exhaust stream, alarms would sound, the cause would be identified and mitigated, and emissions of agent (if any) would be short-term at low levels. Since no estimates of potential chemical agent emission levels were made on the basis of demonstration test results, it was conservatively assumed for this assessment that an agent could hypothetically be emitted continuously from the stack at the detection limit level for that agent. However, this situation would be extremely unlikely because it would require that all filters within the filter bank failed and no corrective action would be taken. Modeling dispersion from the source at these levels resulted in the maximum hypothetical on-post and off-post agent concentrations presented in Table 4.24. All these values are less than 3% of the allowable concentrations for general public exposure established by the Centers for Disease Control (CDC 1988). In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent were detected in the stacks. The reasons for the presence of the agent would thus be identified, and the agent would be eliminated.

4.8.6 Impacts of No Action

Activities associated with continued storage at BGAD would include inspecting, monitoring, and conducting an annual inventory of all munitions; overpacking any leaking munitions discovered during inspections; and transporting overpacked leakers to a separate storage igloo. All chemical munition storage igloos would continue to be routinely inspected and monitored in accordance with strict U.S. Army regulations. All of the igloos containing the overpacked leakers would continue to be inspected and monitored in accordance with applicable Army and Commonwealth of Kentucky RCRA requirements. Upon discovery of a leaker, a filter would be installed and the entry door would be sealed. The amount of agent that might spill from

Table 4.24. Maximum annual average estimated on-site and off-site concentrations of agent during operations at BGAD[a]

	Maximum annual average off-site concentration (μg/m^3)		Maximum annual average on-site concentration (μg/m^3)		Percent of limit off-site[b]		Percent of limit on-site[b]	
Technology	Mustard	GB/VX	Mustard	GB/VX	Mustard	GB/VX	Mustard	GB/VX
Baseline incineration	2.4×10^{-4}	2.4×10^{-6}	2.9×10^{-3}	2.9×10^{-5}	0.24	0.08	2.9	1.0
Neut/SCWO	2.8×10^{-5}	2.8×10^{-7}	2.3×10^{-4}	2.3×10^{-6}	0.03	0.01	0.23	0.08
Neut/GPCR/TW-SCWO	3.8×10^{-5}	3.8×10^{-7}	2.6×10^{-4}	2.6×10^{-6}	0.04	0.01	0.26	0.09
Elchem Ox	3.5×10^{-5}	3.5×10^{-7}	2.6×10^{-4}	2.6×10^{-6}	0.04	0.01	0.26	0.09

[a]Estimated concentrations account for fluctuating operations.

[b]The general population exposure limits for 72-hour time-weighted average exposures, as estimated by CDC (1988), are as follows: mustard = 0.1 μg/m^3, GB and VX - 0.003 μg/m^3.

[c]NA = not applicable.

Source: ACWA DEIS, Table 7.6-6.

a leaking munition would likely be small, and any vapor that might form as a result of the spill would likely be contained within the igloo. These statements are especially true for mustard agent and VX, which have very low volatilities (900 and 10 mg/m^3 at 77°F, respectively). Liquid that could leak from a munition would tend to spill slowly over the munition(s) and onto the igloo floor. A VX or mustard liquid spill would evaporate very slowly because of the still air conditions inside the igloo and the low volatility of the agent. In addition, with igloo temperatures typically below 15.6°C (60°F), a mustard leak (liquid spill on igloo floor) would be much less likely considering the relatively high melting point, 58°F, of mustard. Because of GB's greater volatility (21,000 mg/m^3), a liquid spill would more readily evaporate. However, because of the still air conditions inside igloos and the small spill areas that typically occur, spilled liquid and vapors coming from a GB munition leak would remain contained inside the igloo long enough for inspection crews to detect and remediate them. If the munition leak were from an M55 rocket, the shipping and handling containers for these munitions would contain any GB or VX liquid that might leak from the rocket. During Chemical Stockpile Emergency Preparedness Program (CSEPP) exercises, maximum credible events (MCEs) involving the spill of agent onto the igloo floor have been simulated with the D2PC model. These exercises have shown that the hazard zone from such an event would be contained within the Chemical Limited Area for BGAD.

4.8.7 Cumulative Impacts

Emissions of toxic and hazardous air pollutants and agent are of interest primarily because of their potential impacts on human health and biological resources. Sections 4.9, 4.15, 4.16 and 4.17 discuss potential cumulative impacts in these areas.

4.9. HUMAN HEALTH AND SAFETY ROUTINE OPERATIONS

4.9.1 Existing Conditions

Currently the BGAD's operations involve monitoring stored munitions. There are few sources of atmospheric emissions except those related to heating, transportation and disposal of energetic material. Criteria pollutants and a discussion of the open burning and open detonation are discussed in Section 4.8.1.

Contamination of surface water, groundwater, and soil has been detected at BGAD. This contamination is a result of historical activities associated with the storage, handling, use, and disposal of hazardous chemicals. Chemical agent contamination of environmental media has not been detected. Environmental cleanup is being addressed in other environmental compliance documents and is beyond the scope of this EIS. Several solid waste management units (SWMUs) have been identified at BGAD. These are being evaluated and remediated in accordance with RCRA regulations. SWMUs or past contamination have not been identified at either of the sites being considered for a proposed incineration or neutralization facility or at the proposed locations for support facilities.

The chemical agent storage area itself has been designated a regulated unit, as well as being classified as an area requiring environmental evaluation due to the suspected presence of agent and degradation products. The proposed sites for the destruction facilities are outside the existing storage areas and are free from known environmental problems.

On-Post Workers and Residents. Employment at BGAD stands at approximately 400 civilians (Erwin 2000). In addition, approximately 50 employees work at the BGCA (Baber 2000). Five military personnel also work at this location site for the depot or tenant organizations. Since base realignment in the 1990s, a number of commercial and industrial tenants have occupied land and buildings formerly used by the military. Commercial and industrial activities employ approximately 300 civilian tenants (Erwin 2000). The types of workers employed at BGAD include environmental protection specialists, fire and emergency services specialists, munitions specialists, facility management and maintenance workers, and administrative and office workers. The hazards associated with these jobs vary; workers receive training to address their specific job hazards.

Although occupational hazards exist for all types of work (rates for various industry classifications are published in various documents; see National Safety Council (1999) for an example), hazards can be minimized when workers adhere to safety standards and use protective equipment as necessary. On-post workers and residents at BGAD could be exposed to chemicals released to air, water, or soil. As discussed in Section 4.8.1, the only releases at BGAD reportable under TRI regulations are from open burning and open detonation. These activities take place in an area in the south central portion of the installation, more than a mile from the administrative area where most workers and residents at BGAD are located (Fig. 4.5). The annual quantities of materials subject to open burning and open detonation are not very large; no TRI threshold values were exceeded for 1999. Therefore, although health risks from ongoing operations at the BGAD have not been quantitatively estimated, the above information suggests that risks for BGAD workers and residents from air emissions would be minimal.

Other potential effects to people include air quality and solid waste. A discussion on air quality issues is found in Sect 4.8.3. Nonhazardous solid waste is sent to off-post landfills, and hazardous solid waste is stored in approved facilities (see Section 4.6.1), so that any contamination of water or soil at BGAD from routine operations should be minor and not result in increased health risk to workers or on-post residents.

Off-Post Public. A discussion of air quality issues is presented in Section 4.8.1. No increased health risks to the off-post public are associated with normal BGAD operations. Procedures are in place to minimize risks associated with occupational accidents, on-site and no off-site impacts are expected.

4.9.2 Impacts of Construction

4.9.2.1 Impacts of baseline incineration alternative

On-post Workers and Residents. No on-post human health impacts are expected from construction activities or from exposure to possibly contaminated soils during earth moving operations. It is anticipated that some exposures to solvents, caustics and other chemicals would occur during construction, but no unusual materials are anticipated to be used. Therefore, construction would not affect air quality to the extent of causing human health impacts. No deleterious effects to the on-post workers and residents’ health are expected from construction activities.

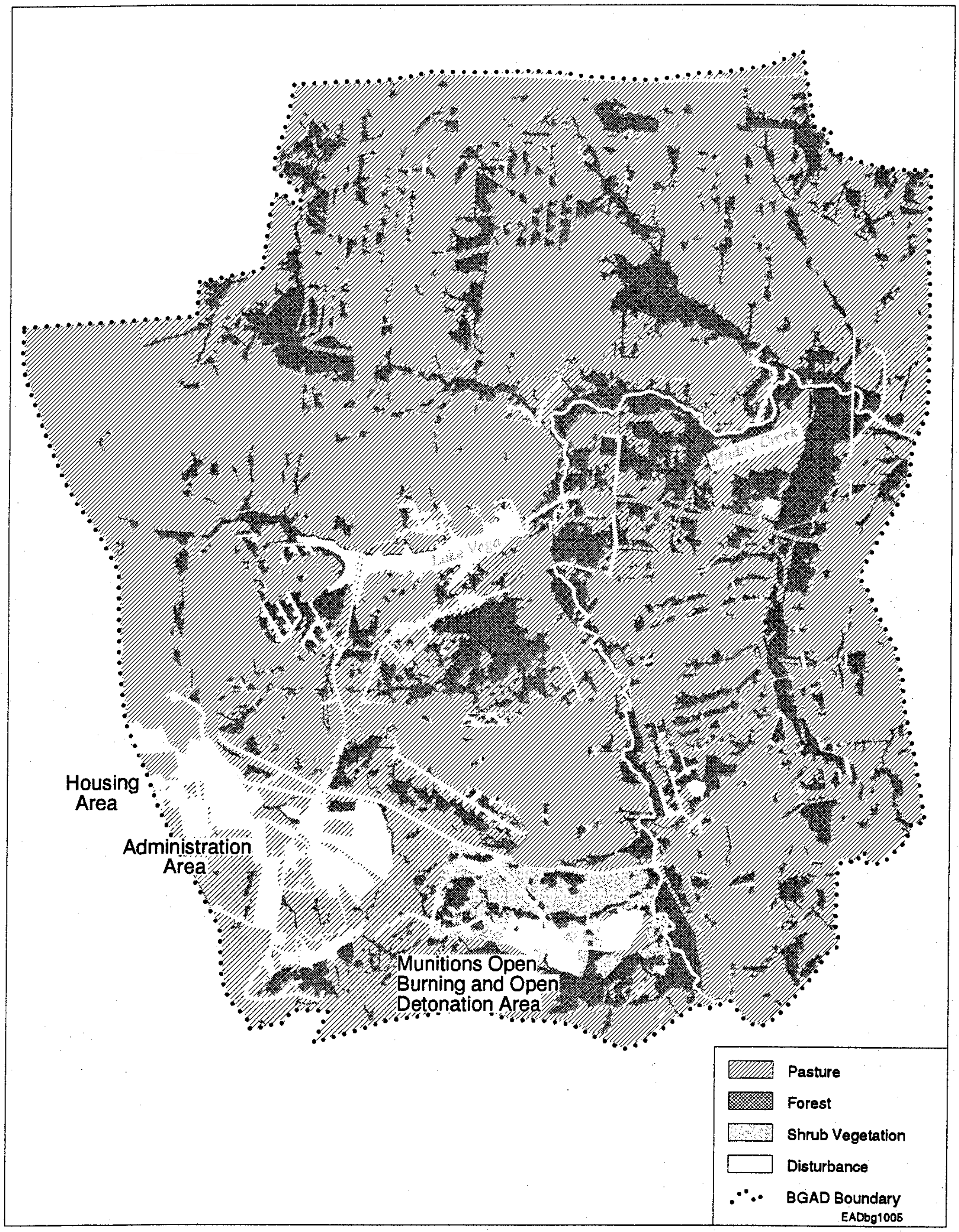

Fig. 4.5. Principal areas within the Blue Grass Army Depot.
Source: ACWA DEIS 2001, Fig. 7.2-1.

The potential for human health impacts due to construction of the incineration facility would be limited to occupational hazards. Routine and well-known safety hazards would be present during the operation of heavy construction vehicles and machinery. The occupational health impacts from construction would be minor during routine activities because standard procedures, construction practices, and protective clothing and equipment would be used by workers to minimize exposure to unhealthy levels of noise and airborne emissions.

The expected number of construction worker fatalities and injuries were calculated on the basis of data from the Bureau of Labor Statistics as reported by the National Safety Council (1999) and estimates of total worker hours required for construction activities. Annual construction fatality and injury rates were used. The incidence rates are as follows:

- estimated fatalities during construction are 13.9 per 100,000 workers per yr;
- estimated injuries during construction are 4.4 per 100 full-time workers per yr;

Fatality and injury numbers were calculated using the appropriate incidence rate, the number of years for construction, and the number of full-time equivalent employees. The estimated fatalities and injuries are shown in Table 4.25. The available fatality and injury statistics by industry are not refined enough to warrant analysis of workers as separate classes. It was assumed that any activity would result in some estimated risk of fatality and injury.

Table 4.25. Estimated construction worker fatalities and injuries

Alternative	Worker Fatalities	Worker Injuries
Incineration	None (<1)	86
Neutralization SCWO	None (<1)	57
Neut/GPCR/TW-SCWO	None (<1)	53
Electrochemical Oxidation	None (<1)	53

Off-post population. Since no adverse health effects would be expected for on-post non-construction workers and residents, no adverse health impacts for the off-post population would be expected.

4.9.2.2 Impacts of neutralization and electrochemical oxidation alternatives

On-post Workers and Residents. The potential for human health impacts due to construction of the various alternative facilities would be limited to occupational hazards. Routine and well-known safety hazards would be present during the operation of heavy construction vehicles and machinery. The occupational health impacts from construction would be minor during routine activities because standard procedures, construction practices, and protective clothing and equipment would be used by workers to minimize exposure to unhealthy levels of noise and airborne emissions. No human health effects to the non-construction on-post workers and residents are expected from construction activities from any of the neutralization alternative facilities or the electrochemical oxidation facility.

Neutralization/Electrochemical Oxidation Occupational Construction Worker Fatality and Injury Rates. The potential for human health impacts due to construction of the various alternative facilities would be limited to occupational hazards. Occupational fatalities and injuries are limited when construction workers follow safety standards, best work practices and use personal protective equipment. Occupational fatality and injury numbers are presented in Table 4.25.

Construction of the Neut/SCWO, Neut/GPCR/TW-SCWO, or Elchem Ox facility is estimated to require approximately 1,300, 1,200, or 1,200 FTE-yr, respectively. The estimated time required varies from about 29 to 34 months. Annual fatality and injury risks were calculated as the product of the appropriate incidence rate (given above), and the number of FTE employees. No distinctions were made among categories of workers (e.g., supervisors, laborers), because the available fatality and injury statistics by industry are not refined enough to warrant analysis of worker rates in separate categories. The estimated number of fatalities for all the ACWA technologies assessed is less than 1; the estimated annual number of injuries for construction of a Neut/SCWO facility is 57, a Neut/GPCR/TW-SCWO facility is 53, and an Elchem Ox facility is 53.

Off-post population. Since there are no adverse health effects expected for on-post workers and residents, no adverse health impacts for the off-post population are expected. While there is a potential for adverse occupational health impacts for construction workers, it would be limited to construction workers on-post and would not impact the off-post population.

4.9.3 Impacts of Operations

4.9.3.1 Occupational impacts

The expected number of systemization and operations worker fatalities and injuries were calculated on the basis of data from the Bureau of Labor Statistics as reported by the National Safety Council (1999) and on estimates of total worker hours required for systemization and operations activities. Annual manufacturing fatality and injury rates were used. The specific rates used are:

- estimated fatalities during systemization and operations are 3.2 per 100,000 workers per yr;
- estimated injuries during systemization and operations are 4.8 per 100 full-time workers per year.

Fatality and injury numbers were calculated using the appropriate incidence rate (given above), the number of years for systemization and operations, and the number of full-time-equivalent employees. The estimated fatalities and injuries rates are shown in Table 4.26. The available fatality and injury statistics by industry are not refined enough to warrant analysis of workers as separate classes. It was assumed that any activity would result in some estimated risk of fatality and injury.

4.9.3.2 Discussion of principle hazardous chemicals

Destruction of agents result in the production of other materials, many of which may also be hazardous. In addition, it is never possible to destroy exactly 100% of any material. For these reasons, this section will contain discussions about the agents and some of the most hazardous products that may result from the destruction process.

Table 4.26. Estimated systemization and operations worker fatalities and injuries over the total period of operations

Alternative	Worker Fatalities	Worker Injuries
Systemization		
Incineration	None (<1)	35
Neutralization SCWO	None (<1)	15
Neut/GPCR/TW-SCWO	None (<1)	15
Electrochemical Oxidation	None (<1)	15
Operations		
Incineration	None (<1)	104
Neutralization SCWO	None (<1)	54
Neut/GPCR/TW-SCWO	None (<1)	45
Electrochemical Oxidation	None (<1)	45

Chemical agents. The nerve and mustard agents to be destroyed at BGAD are hazardous to humans. The type and extent of hazard are determined by the physical characteristics of the agent, the quantity and mode of release, the duration of exposure, and the prevailing meteorological conditions. Table 4.27 summarizes agent characteristics and toxicity; a much more detailed description of agents and their antidotes is provided in FPEIS (U.S. Army 1988). Additional references can be found online at http://chppm-www.apgea.arm.mil.hrarcp/caw/.

The safety standards or control limits outlined in Table 4.28 identify regulations currently in place in addition to new limits proposed by the U.S. Army and the Centers for Disease Control (CDC). Both the U.S. Army and the CDC have undertaken a reanalysis of available data to determine if changes should be made to the airborne exposure limits (occupational and general population) for chemical warfare agents. Both organizations have reviewed and recalculated those limits using current risk assessment methods recommended by the U.S. Environmental Protection agency and other organizations, and incorporated all available information including some data previously classified by allied nations. One of the major reasons that some exposure guidelines are reduced is that the current risk assessments have included minor occular effects, and these are very sensitive to chemical warfare agents. Some changes are recommended as seen in Table 4.28 but, according the CDC: "There is no indication that the current exposure limits, as implemented by the U.S. Army Program Manager for Chemical Demilitarization, have been less than fully protective of human health. This may be due to rigorous exposure prevention efforts in recent years as well as the conservative implementation of the existing limits." [Fed. Regist. 67, pages 894-901, January 8, 2002, Centers for Disease Control and Prevention, "Airborne Exposure Limits for Chemical Warfare Agents GA (Tabun), GB (Sarin), and VX”].

All information gathered so far indicates that exposure to nerve agents GB and VX at concentrations much greater than those present in the above table does not cause mutations or cancer, fetal damage, or reproductive problems [U.S. Army 1988a, Vol. 3, Appendix B; Fed. Regist. 66, (Pt 85) pages 21940-21964, May 2, 2001, (Environmental Protection Agency, "National Advisory Committee for Acute Exposure Guideline Levels (AEGLs) for Hazardous Substances; Proposed AEGL Values"]. Delayed neuropathy is of concern only for GB concentrations at many times the lethal dose; such elevated exposures would not occur during incident-free operation.

Table 4.27. Chemical agents stored at the Blue Grass Army Depot and biological/physical characteristics relevant to their toxic effects

Chemical agent	Chemical Abstracts Service (CAS) no.	Chemical name	Mode of action	Special characteristics	
				Acute toxicity	Chronic toxicity
GB (Sarin)	107-44-8	isoproply methyl-phosphono-fluoridate	Anticholinesterase	Volatile, therefore poses less of a threat by absorption through the skin, either as aerosol or liquid, than by inhalation About half as toxic as VX by inhalation Less effective than VX in inducing miosis	Low dose study did not show carcinogenic activity Teratogenicity study negative; other reproductive parameters were unaffected Potential for a delayed neuropathy syndrome at high (supralethal) doses if protection from acute lethality is achieved by drugs Changes in electroencephalograph recordings after exposure; consequences unknown
VX	50782-69-9	O-ethyl-S-(2-diisopropyl-aminoethyl)-methyl-Phosphono-thiolate	Anticholinesterase	Many times as toxic in humans as GB, after skin administration Head and neck areas of humans very sensitive to VX penetration Effective lethal dose decreases with increasing windspeed Contaminated vegetation can cause toxicity upon ingestion VX is about 25 times more potent than GB in inducing miosis	Mutagenicity studies were negative Teratogenicity studies were negative Inactive delayed neuropathy induction Carcinogenic activity unknown
HD[a] (Mustard gas, sulfur mustard)	505-60-2	Bis(2-chloroethyl) sulfide	Blister agent	Produces skin blisters, damages eyes and respiratory tract. Toxic effects are delayed (latent period); therefore, exposed personnel may not seek immediate treatment. Secondary infections of damaged tissue can easily occur. Eye is most sensitive organ; instant removal of agent required if no symptomology is to be seen. High doses can induce acute systemic reactions and injury to the immune system.	Carcinogenic under appropriate conditions of exposure. Potential increased risk of chronic bronchitis after exposure. Mutagenic in a wide variety of test systems. Teratogenesis studies were negative; one dominant lethal mutagenic study was positive. Potential for permanent impairment of vision if eye damage is severe. Skin lesions may show permanent changes in pigmentation and be hypersensitive to mechanical injury.

[a]Only H is present at BGAD but HD is described because it is a more purified form that is better characterized.

Table 4.28. Existing and recommended airborne exposure limits (mg/m3) for agents GB, VX, and sulfur mustard

	GB			VX			Sulfur mustard		
	Existing Army and/or CDC	Recommended		Existing Army and/or CDC	Recommended		Existing Army and/or CDC	Recommended	
		Army	CDC		Army	CDC		Army	CDC
Worker Population Limit (WPL)[a]	1×10^{-4}	1×10^{-4}	3×10^{-5}	1×10^{-5}	1×10^{-5}	1×10^{-6}	3×10^{-3}	4×10^{-4}	[e]
General Population Limit (GPL)[b]	3×10^{-6}	3×10^{-6}	1×10^{-6}	3×10^{-6}	3×10^{-7}	6×10^{-7}	1×10^{-4}	2×10^{-5}	[e]
Short Term Exposure Limit (STEL)[c]	—	4×10^{-4}	1×10^{-4}	—	4×10^{-5}	4×10^{-6}	—	3×10^{-3}	[e]
Immediately Dangerous to Life and Health (IDLH)[d]	2×10^{-1}	1×10^{-1}	1×10^{-1}	2×10^{-2}	1×10^{-2}	3×10^{-3}	—	2×10^{0}	[e]

[a]Time-weighted average, 8 hr/d, 40 hr/wk.
[b]Time-weighted average, 24 hr/d, 7 d/wk, lifetime.
[c]Time-weighted average, 15 min × 4/d.
[d]Maximum airborne concentration from which, in the event of respiratory failure, one could escape within 30 min without a respirator and without experiencing any escape-imparing or irreversible health effects.
[e]Recommended airborne exposure limits for sulfur mustard not yet published by the CDC.

Source: Federal Register 67(5), 2002, pp 894-901 "Airborne Exposure Limits for Chemical Warfare Agents GA (Taban), BG (Sarin) and VX."; U.S. Army 2000. Technical Report 47-EM-3767-00 "Evaluation of Airborne Exposure Limits for Sulfur Mustard: Occupational and General Population Exposure Criteria, Nov. 2000, U.S. Army Center for Health Promotion and Preventive Medicine, http://chppm-www.apgea.army.mil/hrarcp/caw/hdfinal.pdf.

No available evidence suggests that latent human health effects would result from exposure to control-limit concentrations of nerve agents [Fed. Regist. 67, pages 894-901, January 8, 2002, (Centers for Disease Control and Prevention, "Airborne Exposure Limits for Chemical Warfare Agents GA (Tabun), GB (Sarin), and VX”].

The latent health effect of major concern for exposure to mustard agent is respiratory carcinogenesis. This concern is based on retrospective studies of World War I veterans and World War II poison-gas factory workers from Japan, Germany, and Great Britain (U.S. Army 1988; USEPA 1991; IOM 1993; Yamakido et al. 1996, as referenced in U.S. Army 2000). At the present time, neither Congress nor regulatory agencies have enunciated comprehensive cancer risk goals in terms of a single point that delineates acceptable from unacceptable risk. The general range of acceptable risk for known or suspected carcinogens is an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6}. In decisions concerning hazardous waste sites where the affected geographic area is small and where population risks are also small, past regulatory decisions indicate that 10^{-4} was used as a *de minimis* risk level for those sites (Travis et al, 1987); a *de minimis* risk being an acceptable level that is below regulatory concern.

In its reevaluation of sulfur mustard exposure limits, the Army (U.S. Army 2000), reviewed the overall extant data and identified 8 different estimates of "unit risk" for cancer upon chronic exposure to sulfur mustard. Using the geometric mean of these "unit risk" estimates (0.0041 per ìg/m^3) adjusted for the conservative EPA default assumptions regarding lifetime exposure for the general residential exposure scenario, and the Army's proposed airborne exposure limit for the General Population (Table 4.28), the estimated upper bound individual excess cancer risk is 3.4 x 10^{-5}. This risk level is considered within the range generally identified by regulatory agencies as "acceptable risk" and provides evidence for a safe basis for the proposed airborne exposure limits. Actual risks must be calculated using site specific information in site specific risk assessments.

Guidelines have been established by the EPA for acceptable exposure levels for operation of a RCRA hazardous waste combustion facility and the proposed facility life. The guidance states, “To ensure protection of human health from emissions of toxic constituents, the total incremental risk from the high-end individual exposure to carcinogenic constituents should not exceed 10^{-5}. For systemic toxicants, the hazard quotient (e.g., the ratio of the total daily oral intake to the reference dose) for the constituent or, when appropriate, the mixture should be less than 0.25" (EPA 1994).

The EPA guidance explains, “The selection of these target levels (as opposed to, for example, an incremental cancer risk level of 10^{-4} and a hazard quotient of 1.0) was done in part to account for exposure to background levels of contamination (including indirect exposures from other combustion units) which should be considered as part of the risk estimation and decision-making process to set emission levels at a combustion unit” (EPA 1994).

Dioxins and furans. The terms “dioxin” and “furan” refer to classes of organic compounds. The polychlorinated varieties of these compounds have caused the most concern in regard to their toxicity. Dioxins and furans are common contaminants in a number of widely used commercial products; some scientists claim that dioxins and furans are trace products of almost all type of combustion that include chlorine and, therefore, are ubiquitous in the environment (U.S. Army 1997). The pathways for human exposure to dioxins and furans would primarily involve inhalation of contaminated particles or ingestion of contaminated food. An evaluation of the state of knowledge regarding dioxin and dioxin-like substances is presented in Appendix E and is summarized below.

The EPA completed a draft reassessment document of dioxin exposure and health assessment in 1994 and submitted it for review. The EPA Science Advisory Board (SAB) conducted a critical review of the document in 1995 (SAB 1995). After the 1995 SAB review, the EPA worked with stakeholders to revise the document. This process is nearing completion (EPA 2001b). EPA uses 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) as the basis for analysis and applies Toxic Equivalency Factors (TEF) to address the broad range of dioxin-like compounds having common biological mechanism properties and related responses. Collectively, many of these compounds are referred to as polychlorinated dibenzo-*p*-dioxins (PCDDs) or simply dioxins.

The EPA's exposure document concluded that the principal pathway by which people are exposed to dioxin-like compounds is through the diet, with the consumption of animal products contributing over 90% of the average daily intake. It is hypothesized that the principal mechanism by which dioxin-like compounds enter the terrestrial food chain is via atmospheric transport and deposition (SAB 1995, EPA 2001b). Estimates of dioxin exposures at BGAD, can be inferred from data accumulated at the operating agent disposal facilities at Johnston Atoll and at Tooele, Utah.

4.9.3.3 Impacts of incineration

Facility Workers. There is some potential for workers to experience exposure to agent or to some byproduct of the neutralization process. Experience at incinerators would suggest a very small likelihood of exposures approaching prescribed exposure limits. Identifying inhalation exposures and risks for workers would depend in large part on detailed facility designs that are not yet available. However, the workplace environment would be monitored to ensure that airborne chemical concentrations were below applicable occupational exposure limits. Health risks from occupational exposure through all pathways would be minimized because operations would be enclosed to the maximum extent possible and because protective equipment would be used if remote handling of munitions was not possible during processing.

On-Post Workers and Residents and Off-Post Population. Lack of design completeness hinders a site-specific health risk analysis for any of the alternatives proposed for the BGAD. Operating experience has been obtained, however, for two chemical destruction incinerators which have processed the same materials that are present at BGAD. This experience and the data accumulated during testing of those facilities provided the basis for the development of site-specific health risk analyses for four different sites for both adults and children. The most recent and applicable of these analyses was at the Anniston, Alabama site (U.S. Army 2001). The baseline health risk analysis for Anniston, which included subsistence farming at the most exposed location, resulted in lifetime cancer risks of less than the EPA target of 1×10^{-5}. Lifetime risks were actually less than 10^{-6}. The EPA target can be interpreted that if 100,000 persons were exposed at the maximum locations, between zero and one person might contract a fatal cancer.

For non-cancer endpoints, the baseline scenario produced results that were higher than the target criterion. In this case no removal of mercury was credited to the pollution abatement system carbon filtration system. Each of two alternative scenarios (modification of operational time or application of theoretical removal efficiency for mercury) produced results at or below target criteria.

The proposed incineration facility would be materially the same as the two operating facilities from which the emission data is derived, but would have improvements to the pollution abatement equipment. The proposed BGAD incinerator would be even more similar to the Anniston facility, including the same munitions and agents, but substantially fewer total munitions are present at BGAD. Thus, similar risk and hazard estimates would be anticipated in a BGAD site-specific health risk assessment which will be performed during RCRA license application process. A more detailed presentation of findings from the health risk assessment at Anniston, Alabama and a discussion of some destruction by-products is found in Appendix E.

In addition to the above line of evidence, the proposed agent incinerator would be required to operate under the ruling of the EPA's Resource Conservation and Recovery Act permitting process for hazardous waste incinerators (*FR* 64 No. 189, Sept. 30, 1999). These new standards were derived after an exhaustive analysis of existing hazardous waste incinerators (in the U.S.) for their emissions and the demographic characteristics of population as a function of location and land use. These sets of information were aggregated and a series of hypothetical analyses performed to identify continuous emission limits for mercury, dioxins/furans, particulate matter, semivolatile metals, low volatile metals, hydrochloric acid/chlorine gas, hydrocarbons and destruction and removal efficiency for each specific organic hazardous constituent that would be protective of the most sensitive population groups. These limits are set to insure that lifetime chronic risks for cancer are below the EPA target of 1×10^{-5} , and that non cancer hazard indices are within acceptable levels for the protection of the health of the most sensitive population groups.

A site-specific assessment of human health risks is a strongly recommended part of the Resource Conservation and Recovery Act (RCRA) permitting process for hazardous waste incinerators (*FR* 64 No. 189, Sept. 30, 1999). The Army will prepare a site specific quantitative health risk assessment for the selected technology prior to the onset of construction. This assessment will include subsistence farmers, subsistence fishermen, children, and adults at the sites of highest potential exposure and will include all pathways for exposure.

4.9.3.4 Impacts of neutralization and electrochemical oxidation alternatives

The results from the Army experience including design, construction and operations of one or more pilot test facilities are presented in this section. Test results for the neutralization options include information from only portions of the facilities and processes that would be required at BGAD. Demonstration testing was not conducted for each system component (e.g., for baseline reverse assembly). Furthermore, in some instances, demonstration configurations differed significantly from the likely configuration of a full-scale unit, so certain demonstration test data were not considered useful in predicting emissions for specific process components (e.g., fluid abrasive cutting and fluid mining; projectile rotary hydrolyzer and dunnage shredder/hydropulper system for Neut/SCWO [Mitretek 2001b]. This is unlike the results discussed in the above section (Sect. 4.9.3.3) which are based on actual operating experience with the types of munitions and agents to be destroyed at BGAD, and which use operational regulatory limits for source terms in risk estimates.

Facility Workers. There is some potential for workers to experience exposure to agent or to some byproduct of the neutralization process. Experience at incinerators would suggest a very small likelihood of this type of event. Identifying inhalation exposures and risks for workers would depend in large part on detailed facility designs that are not yet available. However, the workplace environment would be monitored to ensure that airborne chemical concentrations were below applicable occupational exposure limits. Health risks from occupational exposure through all pathways would be minimized because operations would be enclosed to the maximum extent possible and because protective equipment would be used if remote handling of munitions was not possible during processing.

On-post Workers and Residents and Off-post Population. Routine operations of the facility and minor fluctuations might expose workers or the public to small quantities of hazardous materials and the facility would be engineered to limit such exposures to the greatest degree possible. Estimated maximum on-post and off-post concentrations of air pollutants from the alternative ACWA technologies are discussed in Appendix C of the ACWA (2001) report. These concentrations were converted to estimates of cancer risk and hazard index based on toxicity relationships. All alternative technologies yielded cancer risk levels significantly below the EPA level of concern (cancer lifetime risk of 1×10^{-6}) for carcinogens and non carcinogens (hazard index of 1).

While these risk estimates were significantly below levels of concern, large uncertainties exist because of many factors associated with the lack of maturity of the technologies and the lack of toxicity factors for a significant proportion of the identified byproducts for the different technologies (ACWA 2001). It is most likely that the alternative technologies can be engineered to yield low public health risk estimates to both workers and to members of the public, however, it is not possible at this time to use current measures of health risk to distinguish between the alternative technologies themselves or between any one of them and incineration.

4.9.4 Impacts of No Action

Small, but well understood risks to workers are associated with maintenance of the stockpile. Army procedures are designed to ensure the safety of the stockpile workers; therefore no significant adverse impacts to human health are likely during continued storage under normal conditions. The major issue with continued storage is the risk of some type of accident. Accidents are discussed in Sect. 4.2.2.

4.9.5 Cumulative Impacts

There are no past, present or reasonably foreseeable on-post actions that would combine with any of the five alternatives to cause cumulative adverse health impacts to either the on-post workers and residents, or the off-post population.

4.10 NOISE

The Noise Control Act of 1972, along with its subsequent amendments (Quiet Communities Act of 1978, *United States Code*, Title 42, Parts 4901-4918), delegates to the states the authority to regulate environmental noise and directs government agencies to comply with local community noise statues and regulations. The Commonwealth of Kentucky and Madison County, where BGAD is located, have no quantitative noise-limit regulations.

Sound typically occurs over a wide spectrum of frequencies. For many types of sound measurement, these frequencies are weighted (some count more, some count less) to determine the decibel level. The so-called A weighting was developed to approximate the way in which the human ear responds to sound, and this weighting, expressed as dB(A), applies to the values given below. The EPA guideline recommends a day-night sound level of 55 dB(A) or less to protect the public from activity interference and annoyance in typically quiet outdoor and residential areas (EPA 1974). Maintaining relatively continuous noise below this level will also protect against hearing loss, although less stringent requirements are typically set for that purpose.

Two different sound-level measures of day-night sound level (DNL or Ldn) are used by the U.S. Army for noise impact assessments: A-weighted DNL (ADNL) and C-weighted DNL (CDNL). ADNL is a descriptor used to evaluate the environmental noise impact on the general population, and CDNL is a descriptor used to evaluate the risk of hearing damage produced by impulsive noise. For the Army's regulatory purposes, these measures are both used to define three land-use classifications. Table 4.29 presents these ADNL and CDNL noise-limit criteria for each of three zone classifications (Zones I, II, and III) and the corresponding percent of highly annoyed population (U.S. Army 1997a).

Table 4.29. Noise criteria for noise-sensitive land use classifications noise limit

Noise Zone[a]	ADNL (dBA)	CDNL (dBC)	Population Highly Annoyed(%)
Zone I	< 65	< 62	< 15
Zone II	65–75	62–70	15–39
Zone III	> 75	> 70	> 39

[a]ADNL and CDNL = A-weighted and C-weighted day-night sound levels. dBA and dBC=A-weighted and C-weighted decibels.

Source: ACWA DEIS 2001, Table 7.8-1 [using U.S. Army (1997a)].

The EPA has recommended a maximum noise level of 70 dBA as DNL to protect against permanent hearing loss and a maximum noise level of 55 dBA as DNL to protect against outdoor activity interference and annoyance (EPA 1974). These levels are not regulatory goals, but are "intentionally conservative to protect the most sensitive portion of the American population" with "an additional margin of safety." For protection against hearing loss in the general population from nonimpulsive noise, the EPA guideline recommends an Leq of 70 dBA or less over a 40-year period.

DNL is the time-weighted 24-hour average sound level with a 10 decibel (dB) penalty added to the nighttime levels (2200 to 0700 hours). dBA is a unit of weighted sound-pressure level, measured by the use of the metering characteristics and the A-weighting specified in ANSI SI.4-1983 (the American National Standards Institute specification for sound level meters) and in ANSI SI.4A-1985, the amendment to ANSI SI.4-1983 (Acoustical Society of America 1983, 1985). Leq is the equivalent steady sound level that, if continuous during a specific time period, would contain the same total energy as the actual time-varying sound. For example, Leq (1-h) is the 1-hour equivalent sound level.

Loudness is related to the magnitude of the pressure fluctuations, or sound pressure level (SPL), which is measured in units of Bels, after Alexander Graham Bell who did pioneering research on sound propagation. Because the Bel is a rather large quantity, it is conventional to measure SPL in tenths of a Bel, or decibels (dB). The threshold of human hearing is, by definition, zero dB; background levels at a recording studio are, ideally, around 5 dB; conversational speech is around 60-65 dB at the location of the listener, and a jet takeoff can be in the 120 dB range at a distance of about 100 ft from the runway. The threshold of pain, where the brain receives a definite signal to reduce the SPL or run the risk of damage to the auditory system, begins at around 130 dB for most individuals. Because SPL is reduced by about 6 dB for each doubling of distance from a source, it is important to specify the distance from the source at which a measurement of SPL is made. It is also important to specify an averaging method in order to differentiate between relatively constant noise and occasional or impulsive noise. Noise from construction activity is reasonably continuous over an 8-9 hour work day; therefore, the measures of impact would apply to long-term (day-night) averages. The values used in this assessment correspond to day-night sound pressure (loudness) levels (DNL).

4.10.1 Existing Environment

BGAD is located just southeast of Richmond, Kentucky, in Madison County (Figure 2.1). It is bordered by U.S. Highway (US) 421/25 to the west, US 52 to the north, State Route (SR) 374 to the east, and SR 499 to the south. The major off-post noise sources are US 421/25 and the CSX freight railroad, which borders BGAD to the west. The primary noise- producing activity within BGAD is open detonation at the munitions detonation area located in the southeastern part of the depot, approximately 3.7 mi directly south of the alternative neutralization facility (Fig. 4.5). The open detonation generates loud (but sporadic) noise. The area within about 0.5 mi of the center of the detonation ground area is classified as Zone III. The area between approximately 0.5 and 1.0 mi from the detonation site is classified as Zone II. All other locations within the depot boundary are classified as Zone I. Noise-sensitive land uses, such as housing, schools, and medical facilities, are considered incompatible with noise environments in Zone III, normally incompatible in Zone II, and compatible in Zone I (U.S. Army 1997a).

Ambient sound level measurements in the BGAD site are not currently available. The location of the proposed facility is in the northern section of the depot, in the Zone I area, about 2.5 mi from the nearest part of the Zone II area (Fig. 4.6). This location is in a fairly quiet area (comparable to a wooded subdivision near a small town) where noise levels are typically below 40 dBA (Chang et al. 2000). The residence nearest to the site is located about 1.6 mi north of the site and the 5.3 mi north of munition-detonation ground area. The nearest residential communities are the towns of Reeds Crossing, Moberly, and Speedwell, at distances of approximately 2, 2.5, and 4 mi, respectively, from the proposed sites for an incineration/ neutralization facility. The nearest school (Clark Moore Middle School) is more than 3 mi to

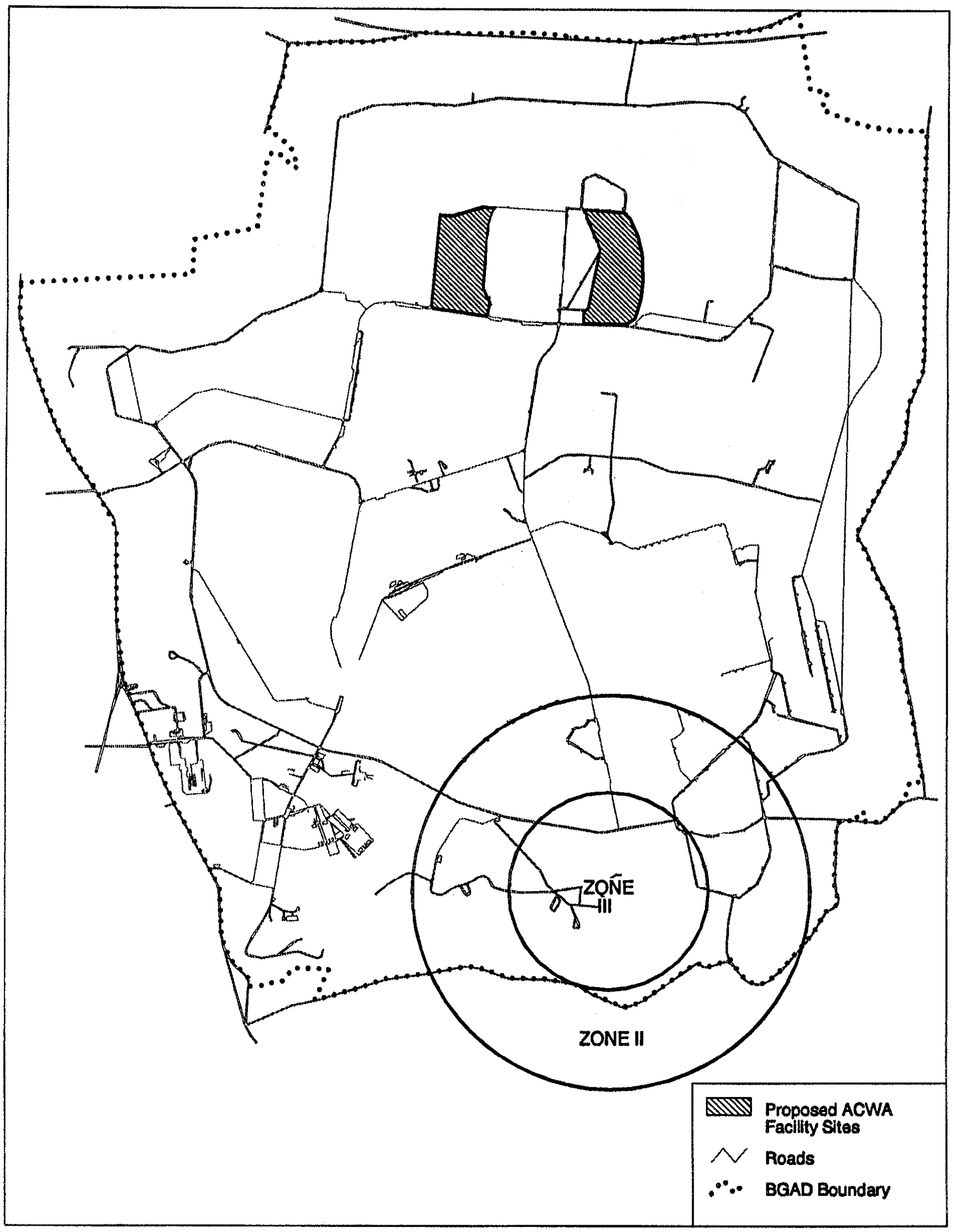

Figure 4.6. Noise-sensitive zones and noise sources and receptors in and around BGAD. ***Source:*** ACWA DEIS 2001, Fig. 7.8-1.

the west-northwest, and the nearest hospital (Pattie A. Clay Memorial Hospital) is located about 5 mi west-northwest of the proposed sites. The region has rolling terrain, scattered woods, and a few small lakes both within BGAD and in the surrounding area.

4.10.2 Noise Sources

Standard commercial and industrial practices for moving earth and erecting concrete and steel structures would be followed to construct an incineration or a neutralization pilot test facility. Noise levels generated from these activities would be comparable to those from any construction site of similar size. Facility operations would involve a variety of equipment that would generate noise. Some equipment, such as fans and pumps for conveying and handling treatment residues (e.g., pollution abatement systems), heating and air conditioning units, electrical transformers, and in-plant public address systems, might be located outside the buildings. However, most of the equipment used in pilot testing operations would be housed inside buildings designed to prevent the release of chemical agents and contain potential explosions. The walls, ceiling, and roofing materials used in these buildings would attenuate the noise generated by the activities inside the buildings.

During both construction and operation, the commuter and delivery vehicle traffic in and around the proposed facility would also generate noise. However, the contribution of noise from these intermittent sources would be minor in comparison to that from the continuous noise sources during construction or operation. As it was for the air quality modeling presented in Section 4.7.4, proposed Area B, which is located closer to the installation boundary and neighboring communities, was selected as the receptor for analysis of potential noise impacts. Regardless of the technology selected, it is assumed that noise levels from both construction and operations would be similar. Detailed information on noise from construction and operational activities associated with a pilot facility were not available at the time of this analysis.

4.10.3 Impacts of Construction

The noise impacts of construction would not be significantly different among any of the evaluated alternatives. Construction and associated activities would result in the generation of noise due to the operation of vehicles and heavy equipment. Such equipment typically generate noise levels in the range of 77 to 90 dB(A) at a distance of about 50 ft from the source (EPA 1978). Sound energy attenuates as it spreads over an ever-increasing area while moving away from its source, leading to a decrease in sound pressure levels of 6 dB for each doubling of distance from the source (EPA 1978).

Thus, construction activities for any of the evaluated alternatives would result in maximum estimated noise levels of about 48 dBA at the BGAD boundary closest to alternative site B, about 1.2 mi north of the facility. At residences located further away from the northern site boundary, the noise level would be substantially lower than 48 dBA. This 48-dBA estimate is likely to be an upper bound because it does not account for other types of attenuation, such as air absorption and ground effects due to terrain and vegetation. This level is below the EPA guidelines of 55 dBA for residential zones and is in the range found within atypical residential community at night (Corbitt 1990). If other attenuation mechanisms were considered, noise levels at the nearest residence would decrease to near or below background levels of about

40 dBA. In particular, tall vegetation between the proposed facility and the site boundary would contribute to additional attenuation. Thus, potential noise impacts from construction activities at the pilot test facility location are expected to be minor to negligible at the nearest residence. The resulting noise levels would be well within the EPA guidelines, which were established to prevent activity interference, annoyance, and hearing impairment.

4.10.4 Impacts of Operation

The noise impacts related to operation of any of the evaluated alternatives would not be significantly different. Operation of a chemical munition destruction facility would result in the generation of noise. The only operating incineration facility of the kind proposed for BGAD, with a non- workforce surrounding population, is located at Deseret Chemical Depot near Tooele, Utah; sound measurements at and near that facility indicated levels as high as 68 dB(A) (see description of dB(A) in Sect. 4.10.1) at a distance of 245 ft from the pollution abatement system (EG&G Defense Materials, Inc. 1997). However, measurements from other locations indicated that much of that sound energy was absorbed by nearby buildings before propagating much further. Absorption of sound energy by buildings and other structures within a facility greatly reduces noise levels beyond the facility. Experience from the baseline incineration facility near Tooele indicates that heating, ventilation, and air conditioning (HVAC) equipment and generators that are located outdoors (i.e., not enclosed) can be a major noise source, especially if the pieces of equipment involved are arranged in a straight line and located near the outside edge of the facility. Sound pressure levels as high as 57 dB(A) were measured as far as 820 ft from the Tooele facility. Assuming the same noise level 820 ft from the proposed location of an incineration or neutralization facility located at BGAD, the noise level at the nearest site boundary would be less than 45 dB(A). This is well below the 55 dB(A) level which, if not exceeded, would prevent activity interference and annoyance (EPA 1978). Therefore, noise levels from operation of a destruction facility would not be expected to impact any off-site location. At the nearest residence, the maximum outdoor noise level expected would be less than 40 dB(A), which may or may not be audible, and would not be expected to have any impact in terms of activity interference and annoyance, or on hearing ability.

In the event that increased throughput is required to meet treaty obligations, additional noise would mostly be generated by vehicles transporting agent containers. The major fixed noise sources would change very little, and since they are the dominant source of noise, little change is expected due to increased throughput.

Nighttime noise. Because of the greater interest in quiet during the night, annoyance can take place at lower levels during the night than during day-time. Much of the noise is expected to arise from operation of outdoor equipment such as heating, ventilation, air conditioning, and generators. The capacities of these will not increase during the night and may decrease. Given that the noise level at the nearest boundary will be less than 40 dB(A), it is unlikely, except during insect-free nights, that anyone could hear noise from the facility since nighttime background noise is rarely below 35-40dB(A).

4.10.5 Impacts of No Action

If no action is taken, sound levels would be expected to remain at their present low levels. Near the northeastern part of the site boundary, noise levels have been typical of outdoor environments far from any concentrated human activity, such as population centers or roads. In such environments, sounds are typically dominated by insects, birds, and interaction of wind with local vegetation. Typical SPLs would be expected to be in the 30 to 40 dB(A); these levels are lower than those of a typical library [around 45 dB(A)].

The levels of noise generated by current stockpile maintenance activities are part of the current background noise levels, which reflect the operations of the installation. These levels would not be expected to change under the no action alternative; therefore, the conditions described in Section 4.10.1 would continue to exist.

4.10.6 Cumulative Impacts

With Other On-post Actions. Typically, SPLs decrease at a rate of about 6 dB (regardless of frequency weighting) for each doubling of distance from the source. Therefore two facilities would have to be in close proximity for their cumulative noise impacts to be substantially greater than either of their individual impacts; however, this is likely to be the case if two agent-destruction facilities operate simultaneously near G Block. The SPLs from several noise sources are not linearly additive; instead, SPL increases by 3 dB (regardless of frequency weighting) for each doubling of sound energy. The physics of sound dictates that sounds are dominated by the loudest source. If other on-post actions are sufficient to double the sound energy, the corresponding increase of 3 dB(A) would have little effect on the noise perceived at any off-site location.

With Other Off-post Actions. The distance between the proposed facility (or facilities) and any appreciable off-post source is sufficient that the 6 dB reduction of SPL with distance from any such source would reduce its SPL to a level that would be small compared with that from the proposed facility (or facilities). Therefore, the contribution of such sources to cumulative effects would not be appreciable. This reasoning also applies to locations near any off-post noise source, which would be far from any of the incineration or neutralization facilities being considered for BGAD.

4.11 AESTHETICS

4.11.1 Existing Environment

BGAD is a military/industrial facility that contains many storage igloos and a number of buildings. Due to the large size of the Depot, its rolling terrain, and the placement of wooded and pastured buffer areas, many of the manmade features are largely hidden from the view of off-site residents and travelers using the roadways surrounding BGAD. The most visible structures are the administrative buildings near the main entrance and the guard posts and gates at other entrances (ACWA DEIS 2001). The structures that are visible are largely consistent, aesthetically speaking, with the mixed-use nature of the surrounding area, which hosts industrial, commercial, agricultural, and low-density residential uses.

4.11.2 Visual Character of the Chemical Agent Destruction Facilities

From off-site, it is possible that several changes could be observed as a result of construction and operation of a chemical agent destruction facility. These would include a new entrance gate, a parking area immediately inside the Depot's perimeter fence, and an open corridor along a new access road in a currently-wooded area inside the BGAD property. It is also possible that portions of the proposed facility could be visible from certain off-site locations. The proposed facility would cover an area of approximately 25 acres and would consist of a collection of industrial-type buildings. There would be eight stacks associated with the baseline incineration technology, ranging in height from 40 ft to 140 ft. Only three of these stacks would be 100 ft or greater in height, and the largest stack diameter would be 7.2 ft. The non-incineration alternatives would have a similar number of stacks, only one of which would be greater than 100 feet in height. The number and parameters of stacks for each alternative are described in Sect. 4.7.2.2.

4.11.3 Impacts of Construction

Changes observable during construction would include the addition of an entrance gate, parking area, and open access corridor. It is possible that the facility could be glimpsed from off site while being built, but it might be constructed in an area blocked from view by hills or trees. The potential changes made on-site would not make the appearance of BGAD inconsistent with the existing visual character of the Depot and surrounding area. Visibility in the project area could be temporarily reduced as a result of dust generated by construction activities and increased traffic.

4.11.4 Impacts of Operation

During operations, the new entrance gate, parking area, and access corridor would continue to be visible from off site. Depending on the precise location of the facility and the extent of tree removal during construction, the facility could be visible from certain off-site locations, although much of the facility would be hidden from sight. There could also be a small steam plume visible beyond the Depot's perimeter. The industrial appearance of any visible buildings, stacks, or plumes would be consistent with the existing visual character of the Depot and surrounding area.

4.11.5 Impacts of No Action

There would be no change to the aesthetic character of BGAD and the surrounding area as a result of the no action alternative.

4.11.6 Cumulative Impacts

The proposed project is not expected to contribute in any substantial manner to cumulative impacts to the aesthetic character of the area.

4.12 GEOLOGY AND SOILS

4.12.1 Existing Conditions

BGAD is located in the Outer Blue Grass Subdivision of the Blue Grass Physiographic Region. The topography of the Outer Blue Grass Subdivision is characterized by moderately undulating to gently rolling hills that steepen near major streams. The topography of the BGAD facility is generally typical of the Outer Blue Grass physiography (URS 2000). The uppermost units underlying BGAD consist of unconsolidated silts, clays, and loams that resulted from weathering of the underlying bedrock. Bedrock in the vicinity is made up of nearly horizontally bedded dolomite, shale, and limestone units. The uppermost bedrock units across most of BGAD are mapped as belonging to the Ordovician-aged Drakes and Ashlock Formations (Hall and Palmquist 1960; Greene 1968). Fine-grained alluvium is present in the surface water drainages. At the proposed sites for the ACWA pilot facility, the uppermost bedrock unit is the Drakes Formation (Greene 1968). The depth to bedrock across BGAD ranges from 4 to 12 ft on uplands and 0 to 3 ft on hillsides (URS 2000).

No economic mineral deposits have been mapped at BGAD (Anderson and Dever 1998). The nearest economic deposit of Quaternary sand and gravel is approximately 4 mi northeast of BGAD. Mineral occurrence has been noted in a core collected about 2 mi northeast of the BGAD. In this core, copper and fluorite were present in a sample correlating to the Cambrian-Ordovician-aged Knoxville Group. The possible economic value of these minerals at this location is uncertain. No other exploratory borehole results have been mapped within 7 mi of BGAD.

Seismicity. BGAD is located in a tectonic domain generally referred to as the Kentucky River Fault System. No faults in the region are known to have displaced geologically younger materials (Pleistocene and Holocene Ages), even though a number of older faults have displaced Paleozoic Era (400 million years ago) formations. Additionally, there are no indications of faults that are capable or potentially capable in the region (Blume 1987).

Two other major fault systems in the vicinity of BGAD are the Lexington Fault System and the Irvine-Paint Creek Fault System. The Irvine-Paint Creek Fault System is approximately 6 mi away and is the closest to BGAD. Minor faults near BGAD are Tate Creek Fault, which is about 0.5 mi south of BGAD, and Moberly Fault, which is about 1 mi to the northeast of BGAD. These fault systems were active during Paleozoic times, but there are no indications of recent seismic activity (Blume 1987).

One of the largest earthquakes in the eastern United States was about 25 mi northeast of BGAD at Sharpsburg, Kentucky in 1980. The focus of the earthquake was at a depth of about 10 mi and had a maximum modified Mercalli intensity of VII in the epicenter region. An earthquake of this intensity produces some damage to masonry and causes difficulty in standing. This earthquake was felt over an area of about 260,000 mi^2 (Mauk et al. 1982). Four other earthquakes have been recorded within 50 mi of BGAD, all of which were smaller in magnitude.

The estimated peak ground acceleration at BGAD that would be generated by an earthquake having a modified Mercalli intensity equal to VIII. An earthquake of this intensity would generate an estimated peak ground acceleration of 0.18 g with an estimated duration of 15 seconds (Blume 1987). A modified Mercalli intensity VIII earthquake would cause damage to masonry and some collapse of buildings.

A probabilistic seismic analysis was recently performed for BGAD (Weston 1996). The results of this analysis indicated an earthquake with a peak horizontal acceleration of 0.08 g would occur at BGAD once in 1,000 years. An earthquake with a peak horizontal acceleration of 0.2 g was estimated to occur once in 10,000 years, and 0.4 g was estimated to occur once in 100,000 years. Seismic hazard curves prepared for nuclear power stations in the eastern United States place BGAD in Seismic Probability Zone 1. Within this zone, minor earthquake damage is expected to occur at least once in 500 years (10% probability of occurrence in 50 years). The peak ground acceleration for this event is estimated to be 0.075 g.

Soils. Soils at BGAD are the result of weathering of the parent bedrock, with soil thickness ranging from 4-12 ft on uplands and 0-3 ft on hillsides. Soils at the proposed site primarily belong to the Lawrence-Mercer-Robertsville association and include the Shelbyville-Mercer-Nicholson association (Fig. 4.7). These soil associations are composed of silt loams at the surface trending to silty clay loams at depth. Both soil associations are underlain by fragipan in some locations, which tends to rupture under pressure. Drainage properties of these soil associations are variable, with the soil permeability typically less than 2 inches/hour. Similarly, the water capacity and erosion properties of the soils are variable.

4.12.2 Impacting Factors

The proposed action entails shallow excavation and the application of standard building practices for industrial facilities, which are not associated with significant impacts to geologic resources or soils in the vicinity of BGAD. Potential impacts from construction and operation of the proposed facility could occur from the variable properties of the soils and underlying bedrock in the vicinity of the proposed site, or releases of a variety of hazardous materials, including chemical agents. Potential impacts from construction and operation of the proposed facility are discussed in the following sections and potential impacts from accidents involving chemical agents are discussed in Sect. 4.22.

4.12.3 Impacts from Construction

Approximately 25 acres of land would be affected to some degree from the construction of the proposed facility or one of the alternatives, wastewater treatment plant and new substations at either proposed Area A or B. As much as an additional 70 acres of land would also be disturbed from development of the site infrastructure (e.g., electric transmission lines, communication lines, gas and water pipelines, parking lots and access roads) for either proposed site. Soil disturbance could result in increased erosion, which would impact surface water quality and biological resources. Best management practices during construction (e.g., sedimentation basin, soil fences, berms, liners, revegetation of disturbed land following construction) will be employed to minimize the potential for increased soil erosion.

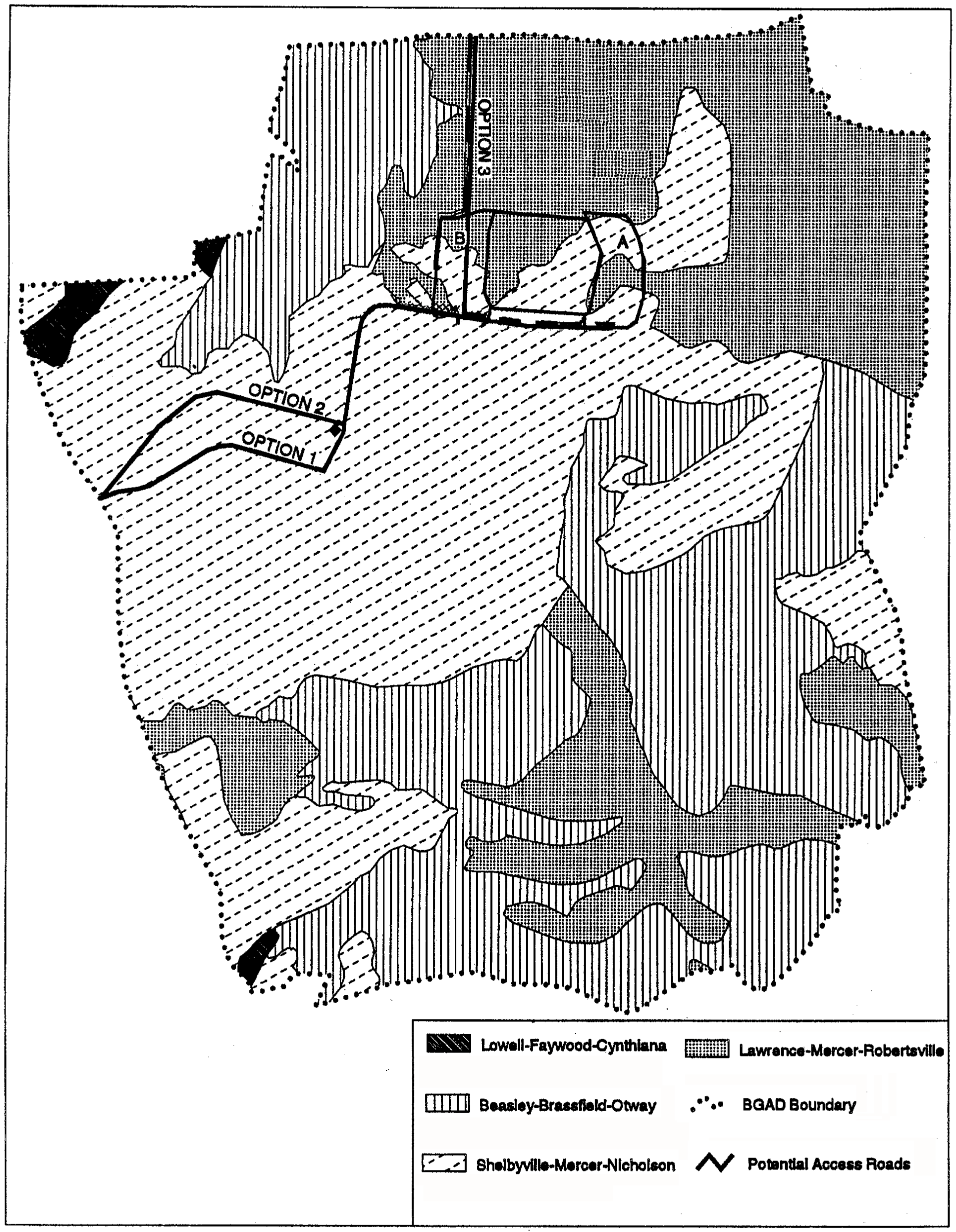

Figure 4.7. Soil associations at BGAD.
Source: ACWA DEIS 2001, Fig. 7.10-1.

4.12.4 Impacts of Operations

Impacts on soils from operation of the proposed facility or alternatives could result from the atmospheric transport and deposition of a variety of contaminants. However, the concentrations of the contaminants in the emissions from facility operations are anticipated to be so low that no significant impacts to surface soils are anticipated. There are no significant differences between the alternative technologies being considered for destruction of the chemical agent at BGAD. No detectable soil contamination is expected form normal operations.

4.12.5 Impacts of No Action

Under the no action alternative for BGAD, potential impacts to soils would be limited primarily to spills of petroleum-based products from vehicles associated with the continued maintenance of the BGAD stockpile. Releases of other hazardous materials, including chemical agent, would be very unlikely, given the nature of chemical stockpile maintenance activities. Impacts associated with future destruction of the chemical agent stored at BGAD are discussed in the cumulative assessment in the following section.

4.12.6 Cumulative Impacts

Cumulative impacts associated with other construction activities in the vicinity of the proposed Areas A and B would increase soil erosion and the potential for accidental spills and releases. These are the same types of impacts as those associated with the construction of the proposed facility or the alternatives. These impacts would be temporary and minor, if best management practices are followed at the other construction activities.

Cumulative impacts associated with other operations in the vicinity of the proposed Areas A and B are not expected to be significant to soils. The proposed facility and its alternatives are anticipated to have very low emissions from operations and other operations at BGAD are also anticipated to have very low emissions from operations. Additionally, other operations at BGAD with the potential for emissions would be located in the southern portion of the depot, away from proposed Areas A and B. Potential sources of impact located off-site from BGAD that are known or anticipated have very low emissions and are far enough from proposed Area A and B to preclude any significant deposition on surface soils.

Cumulative impacts from operation of the proposed facility with other facilities at BGAD or off-site on surface soils are not likely to be significant and would be present only in the vicinity of the proposed Area A and B, because of the distances between the proposed facility and other facilities at BGAD.

4.13 GROUNDWATER

4.13.1 Existing Conditions

4.13.1.1 Geohydrology

Groundwater is present in the near surface alluvium associated with Muddy Creek and its tributaries and in the Drake and Ashlock formations. The Quaternary alluvium is a thin deposit ranging from 0-20 ft found along creeks and in valleys. Underlying the alluvium are dolomite deposits that yield little to no water. The Drakes and Ashlock formations are water bearing with an overall thickness of about 210 ft. The water in these formations is in the carbonate deposits associated with the formations and is typically very hard, becoming mineralized at depth. Infiltration of precipitation is low due to the fine-grained residuum soils at BGAD.

The Drakes and Ashlock formations are associated with the karstification, which includes the development of caves, and the appearance of springs and sinkholes on the land surface. These features are formed from the dissolution of limestone and dolomite in the bedrock. While there are 27 known caves in Madison County (George 1985), the observed discharges at springs from the Drakes formation are at the soil/bedrock interface, where the weathering of parent rock occurs. This observation suggests the flow of groundwater in the Drakes formation is predominantly within cracks and fissures, instead of enlarged cavities within the formation (URS 2000). Approximately 60% of the Drakes formation is composed of shale, which contributes to the development of weathered surfaces rather than dissolution enlarged cavities. The Ashlock formation is composed of 50 % shale and is more likely to have karst development leading to solution cavities, which have larger yields (Hendrickson and Krieger 1964).

In the vicinity of proposed Areas A and B, the Drakes Formation is near the surface. Reconnaissance and field surveys of the sites did not identify karst features (URS 2000). The development of any karst features in the future is uncertain, but the likelihood of karst feature development is increased by the disturbance of soils and construction activities.

4.13.1.2 Groundwater quantity

Groundwater yield from the Quaternary alluvium is too small for use, and the alluvium deposits are thin, which reduces the sustainable yield further. The Ordovician limestone aquifers in the Drakes and Ashlock formations also have low yields. Wells placed in valleys and along streams that are screened in the alluvium yield from100-500 gpd. Wells located in the Ashlock formation can yield up to 500 gpd, providing the wells are screened in the drainage networks and solution channels within the limestone. Wells placed in upland areas typically yield less than 100 gpd. Water levels in the aquifers underlying BGAD fluctuate considerably as a result of precipitation, infiltration, evaporation, and water use. These variations lead to springs and wells becoming dry during late summer or droughts. The groundwater resources associated with BGAD are barely sufficient to provide for an individual household, which requires at least 100 gpd, but are insufficient to serve the proposed facility or its alternatives (Hall and Palmquist 1960, Palmquist and Hall 1961).

4.13.1.3 Groundwater quality

Groundwater in the uppermost aquifers is of the calcium-magnesium-bicarbonate type. The groundwater tends to be very hard and becomes more mineralized with depth. Uncontaminated groundwater can be used without treatment, but treatment is often performed by individuals using groundwater in the vicinity of the BGAD to reduce hardness.

Quarterly groundwater sampling of monitoring wells at BGAD was performed from 1997 to 1999 (IT Corp. 2000). Annual sampling was initiated in FY 2000. The closest monitoring locations to the proposed Area A and alternative Area B are the New Landfill, which is about 3,000 ft east of proposed Area B, and the Old TNT Washout Lagoons, which are about 4,000 ft south of the proposed Areas A and B. Samples from the New Landfill were analyzed for VOCs, semivolatile organic compounds (SVOCs), pesticides/PCBs, total metals, dissolved metals, cyanide, and chloride/sulfate. Sampling of 11 wells was planned, but two wells were dry and three wells had insufficient yield for completing all analyses. The results indicated five VOCs present in one well, one SVOC in one well, one pesticide in one well, and arsenic in one well. Samples from the Old TNT Lagoon were analyzed for explosives, total metals and dissolved metals. Sampling of 12 wells was planned, but four wells were dry and two wells had insufficient yield for completing all analyses. The results indicated explosives were present in three wells. Lead, arsenic, selenium, and silver were detected in at least one well.

No known spills of contaminants have occurred at the proposed Area A and alternative Area B. However, there are no monitoring data available to confirm the existing groundwater conditions at the proposed Area A and alternative Area B.

Groundwater in the formations underlying BGAD is generally hard and may contain salts of hydrogen sulfide at depths greater that 100 ft. Hardness values typically exceed 150 mg/L. Sulfates, nitrates, and total dissolved solids are typically within drinking water standards for groundwater withdrawn from shallow formations. Groundwater withdrawn from wells at depths of 50-200 ft below the base of local creeks has total dissolved solids exceeding 1,000 mg/L. The primary constituent in the deeper groundwater is sodium chloride but hydrogen sulfide is also likely to be present (Hendrickson and Krieger1964).

4.13.1.4 Historical and current water use

Groundwater resources are not currently used at BGAD. Historically, groundwater has not been used at BGAD. Any groundwater use in the proposed A and alternative B Areas preceded the establishment of BGAD.

4.13.1.5 Current and historic water treatment

Groundwater is currently untreated at BGAD. Historically, groundwater was not treated at BGAD.

4.13.2 Impacting Factors

Groundwater resources are not proposed for use with the proposed facility or any of the alternatives. No process water would be released to the environment from the proposed facility or any of the alternatives. Potential impacts to groundwater could result from the generation of sanitary sewage that could infiltrate and contaminate groundwater from leaks. Other contamination of groundwater may result from spills of hazardous materials that could infiltrate and contaminate groundwater. Projected sanitary sewage generation from the proposed facility and its alternatives range from 320,000-4,600,000 gal/y.

4.13.3 Impacts of Construction

The impacts of construction to groundwater would be negligible. During incident-free construction, no contamination of groundwater would occur. Berms and other controls used during construction to control surface water runoff, which are standard practice, will reduce the potential for any groundwater contamination. If spills or leaks of hazardous materials occur, procedures for recovering these materials would be applied to minimize the potential for groundwater contamination.

4.13.4 Impacts of Operations

4.13.4.1 Baseline incineration alternative

The impacts of operation of the baseline incineration alternative on groundwater would be negligible. No process liquids are to be released to the environment, which reduces the potential for the contamination of groundwater. No groundwater is to be used for the baseline incinerator alternative. The only potential for impacts to groundwater would be from spills of hazardous materials during normal operations that might infiltrate and contaminate groundwater. If spills or leaks of hazardous materials occur, procedures for recovering these materials would be applied to minimize the potential for groundwater contamination.

4.13.4.2 Neutralization and electrochemical oxidation alternatives

The impacts of operation of the neutralization/SCWO, neutralization/SCWO-GPCR, and the electrochemical oxidation alternatives to groundwater are essentially the same as the impacts of operation of the baseline incinerator alternative discussed in Sect. 4.13.4.1.

4.13.5 Impacts of No Action

Continued storage of chemical weapons at BGAD would not adversely impact groundwater. Procedures are in place to minimize the potential for chemical spills and address any spills that might occur.

4.13.6 Cumulative Impacts

The proposed facility and alternative facilities would not use groundwater or discharge liquids that could contaminate groundwater during normal construction activities or normal operations. Standard precautions are to be followed for the prevention of leaks and spills during refueling and other activities, which include the construction and operation of the proposed facility or alternative facilities. Procedures are to be used to minimize the potential for spills or leaks of hazardous materials and to recover any hazardous materials that might be spilled from other activities. These practices will ensure that cumulative impacts to groundwater from construction and operation of the proposed facility or its alternatives and all other related on-post activities would be negligible. The destruction facility is designed to avoid any contact of explosives with groundwater. Other foreseeable on-post activities would have negligible or no impacts on groundwater.

4.14 SURFACE WATER

BGAD is located within the Kentucky River watershed. The Kentucky River is 5 miles north of BGAD, and is controlled by a system of locks and dams. Lock and dam number 10 is located at Boonesboro north of BGAD. The average daily mean discharge at lock and dam number 10 from 1983-1999 was 5,600 cfs. The maximum and minimum daily discharges of record were 78,000 cfs and 50 cfs, respectively (USGS 2000). Adjacent watersheds, within 62 miles of BGAD, are the Green and Cumberland River watersheds, as well as the Salt River and Licking River basins.

Water supplies for Richmond, Lexington, and Frankfurt, Kentucky are derived from the Kentucky River downstream of BGAD. Most of the potable water supply in Madison County is derived from surface water.

4.14.1 Existing Conditions

Proposed Area A and alternative Area B are located within the Muddy Creek drainage, which drains the largest portion of the BGAD. All treated wastewater and storm water runoff from BGAD facilities is discharged to Muddy Creek, Hayes Fork, and an unnamed tributary of Otter Creek. Figure 4.2 shows the surface waters of BGAD.

Three major impoundments are located within BGAD. Lake Vega is a 135 ac impoundment of Little Muddy Creek in the central portion of BGAD upstream of proposed Area A and alternative Area B. Lake Vega has a storage capacity of approximately 140 acre-feet and serves as the water supply for BGAD. Elevations at proposed Area A and alternative Area B coincide with the crest of the earthen dam forming Lake Vega. The two other major impoundments are Lakes Buck and Gem on Hays Fork.

Other impoundments at BGAD include Lake Henron and Area A Lake and Area B Quarry Lake (not to be confused with proposed Area A or alternative Area B considered for this proposed action). These surface water impoundments are outside the Muddy Creek drainage and are not used as water supplies. Major off-post surface water impoundments include Wilgreen Lake, located about 5 miles west of BGAD, which is used for fishing and contact recreation, and Herrington Lake located about 25 miles west of BGAD. The Lexington Water Company Reservoir is located about 20 miles northwest of BGAD. Neither Herrington Lake nor the Lexington Water Company Reservoir receive any runoff directly from the proposed Area A and alternative Area B. Runoff from BGAD could reach the Lexington water supply via water pumped from the Kentucky River. Lake Reba is an impoundment located northwest of BGAD that receives the drainage from the northwest portion of BGAD. Lake Reba is used for recreation and irrigation. Lake Reba does not receive any runoff from the proposed Area A and alternative Area B (URS 2000).

4.14.1.1 Floodplains

The 100-year flood of the Kentucky River at lock and dam number 10 is 604.5 ft, assuming no flow regulation by the system of dams (U. S. Army 1966). The highest water level recorded between 1908 - 1960 at lock and dam number 10 occurred on March 29, 1913, when the Kentucky River crested at 592.5 ft. Land elevations at BGAD range from 850 ft to 1040 ft, which is well above the 100-year floodplain and flood of record for the Kentucky River.

The 100-year flood of Muddy Creek is estimated to be 885.3 ft (EBASCO 1990).This flood elevation was estimated by comparison to the Silver Creek watershed, which is similar to Muddy Creek. Discharge data for Muddy Creek are limited and insufficient to establish an accurate determination of the 100-year flood for Muddy Creek. The estimated flood elevation is more than 14 ft below the elevation of the proposed Area A and alternative Area B facility elevations.

4.14.1.2 Water quality and treatment

The water quality of Muddy Creek and its tributaries, including Lake Vega, is good and meets all water quality standards except hardness (U. S. Army 1984). Water from Lake Vega is withdrawn and treated at the BGAD water treatment facility, which has a capacity of 720,000 gpd. The existing water treatment plant is sufficient to meet the needs of the proposed action and alternatives. However, additional storage capacity would be required to meet peak demands and ensure an adequate supply of water in the event of a fire or other emergency. Water supply is discussed further in Sect. 4.3.

4.14.2 Releases to Surface Water

No releases of liquid process effluents would occur from the proposed facility or alternatives. The only effluents released to surface water would be the result of sanitary wastewater treatment. Two sewage treatment plants exist at BGAD and discharge treated effluent to Muddy Creek. Muddy Creek is regulated at the BGAD boundary by Kentucky Pollution Discharge Elimination System (KPDES) Permit KY0020737. The existing sewage treatment infrastructure is not capable of supporting the demand of the proposed facility or any of the alternatives and the continuing BGAD operations. A new sewage treatment facility is included in the proposed action and the alternatives to treat the additional wastes. This new facility would discharge treated effluent to Muddy Creek or pumped to the existing infrastructure in Richmond. Additional discussion of the sewage treatment facilities is presented in Sect. 4.6.

4.14.3 Impacts of Construction

Water use during construction is estimated to about 20 acre-ft over approximately three years (Kimmel 2001). This is less than 1% of the capacity of water treatment plant at BGAD and an even smaller percentage of the capacity of Lake Vega. Consequently, water use during construction would have a limited impact on surface water. Construction activities are estimated to generate about 4.5 million gal of sanitary waste over the same time period. This wastewater would be treated and the treated effluent discharged to Muddy Creek within the requirements of KPDES Permit KY0020737. The release of this additional treated effluent would have a negligible impact on Muddy Creek.

The potential for construction-related impacts on the water quality of Muddy Creek from sediments would be reduced by the use of berms, silt fences, hay bales and other standard construction practices to reduce runoff and control sediment transport. Standard precautions would be taken during construction fueling and maintenance and other activities to prevent spills and leaks. Procedures for recovery of materials spilled would be used to minimize the potential for impacts to surface water. Any impacts that would occur to surface water from any spills would be temporary and limited in extent. No releases of contaminants to surface water would result from incident-free construction. No impacts to surface water outside the BGAD boundary would occur from incident-free construction activities.

4.14.4 Impacts from Operations

4.14.4.1 Baseline incineration alternative

No process related effluents would be released to surface water from incident-free operations of the baseline incineration alternative. Sanitary waste generated during facility operation would be treated prior to discharge to Muddy Creek or would be pumped to the existing infrastructure in Richmond. The estimated sanitary waste annual demand for the baseline incineration alternative is 6.4 million gal. The additional sewage disposal treatment plant would ensure adequate treatment capacity for the facility and the requirements of KYPDES Permit 0020737 would be met. The estimated water use (potable and process water) from operation of the baseline incineration alternative is about 24.4 million gal. The increased demand for water would be supplied by Lake Vega. The existing capacity of Lake Vega is sufficient to meet the demand of the proposed facility and the additional storage tank will ensure sufficient water is available to meet peak demands or the possibility of a fire. This additional demand would not significantly affect Lake Vega or other surface waters. No impacts to surface water off-post would result from incident-free operations.

4.14.4.2 Neutralization and electrochemical oxidation alternatives

The neutralization and electrochemical oxidation alternatives would be expected to have impacts to surface water that are similar to those of the baseline incineration alternative discussed in Sect. 4.14.4.1. Since these alternatives use less water than the baseline incineration alternative, the impacts to surface water would be less. Consequently, impacts to surface water from incident-free operations of these alternatives would be negligible.

4.14.5 Impacts of No Action

Continued storage of chemical weapons at BGAD would not adversely affect surface water. Controls are in place to minimize soil erosion, although some erosion would be expected to occur in areas kept clear of vegetation for security purposes and in dirt roadways within the storage block. A facility exists to treat sanitary waste, and procedures are in place to preclude chemical spills from impacting surface water and address chemical spills if they do occur.

4.14.6 Cumulative Impacts

Construction of the proposed facility or the alternatives would result in impacts to be expected from the construction of a industrial facility. The use of standard construction practices to minimize erosion, control the transport of sediment, and prevent spills of hazardous materials will minimize the impacts of construction activities. Procedures for recovering any hazardous materials that might be spilled would further reduce any potential impacts to surface water. Increased demand for water and additional wastewater loadings would not have a significant affect on surface water. Overall cumulative impacts to surface water from all construction and operation activities would be negligible.

4.15 TERRESTRIAL HABITATS AND WILDLIFE

4.15.1 Affected Environment

BGAD encompasses approximately 14,600 acres in Madison County, Kentucky, located southeast of Richmond (see Fig. 2.1). BGAD and the immediate vicinity are within the Outer Blue Grass Subdivision, which is an area of high biodiversity. Ecological information for BGAD is based largely on data presented in the integrated natural resources management plan (BGAD 2000b). Observations made during team site visits in July 2000, and May 2001, also provided background information on BGAD and the proposed locations for a PMCD agent destruction facility.

4.15.1.1 Vegetation at alternative chemical agent destruction facility plant locations

Eastern Kentucky vegetation is transitional in nature from grassland species to forest trees representative of the Cumberland Mountains. Most of the land area of BGAD is maintained as fescue-dominated pasture interspersed with shrubs and trees that are periodically mowed. Vegetation on most of the installation has been adversely affected by cattle grazing.

Forest stands occur on roughly 2,900 acres of BGAD. Approximately 75% of forested areas have experienced some damage from cattle grazing and deer browsing (BGAD 2000b). Three general forest types can be distinguished on the basis of local topography and soil conditions: upland forest, riparian forest, and flatwood forest. In general, the forest types are characteristic of soil type, moisture, and aspect at BGAD. Well-drained upland locations include bluegrass mesophytic cane forest, bluegrass savanna woodland, and forests on calcareous soils. Riparian forests occur in bottomlands along Muddy Creek, Viny Creek, tributaries of Little Muddy Creek, and the headwaters of Otter Creek. Flatwood forest (bottomland hardwoods) occurs on poorly drained soils on the northern portion of BGAD. Table 4.30 provides a list of the dominant canopy trees and common understory species at BGAD. The major vegetative types occurring at BGAD are shown in Fig. 4.8.

The ongoing forest management program is described in the integrated natural resources management plan and environmental assessment for BGAD (BGAD 2000b). Oak trees are planted to provide valuable food and cover for many wildlife species. Between 1968 and 1974, timber was harvested at BGAD. Forest management activities are designed to improve forest

Table 4.30. Dominant trees and common understory plant species of forests at BGAD

	Dominant/common species	
Forest Type	Common name	Scientific name
Upland forest	Black walnut	*Juglans nigra*
	Ohio buckeye	*Aesculus glabra*
	Bur oak	*Quercus macrocarpa*
	Chinkapin oak	*Quercus muhlenbergii*
	Shumard oak	*Quercus shumardii*
	White oak	*Quercus alba*
	Pignut hickory	*Carya glabra*
	Shagbark hickory	*Carya ovata*
	Hackberry	*Celtis occidentalis*
	Honey locust	*Gleditsia triacanthos*
	Sugar maple	*Acre saccharum*
	White ash	*Fraxinus americana*
	Coralberry	*Symphoricarpos orbiculatus*
	Scorpion grass	*Microstegium vimeneum*
Riparian forest	American elm	*Ulmus americana*
	Green ash	*Fraxinus pennsylvanica*
	Hackberry	*Celtis occidentalis*
	Boxelder	*Acer negundo*
	American sycamore	*Plantanus occidentalis*
	Wingstem	*Verbesina alternifolia*
	Crownbeard	*Verbesina occidentails*
	Scorpion grass	*Microstegium vimineum*
Flatwood forest	Southern red oak	*Quercus falcata*
	Post oak	*Quercus stellata*
	Shingle oak	*Quercus imbricaria*
	Red maple	*Acer rubrum*

Source: ACWA DEIS 2001, Table 7.13-1.

stand quality and wildlife habitat. They include reforestation, tree thinning, and timber stand improvement. Timber stand improvement involves the selective removal of certain trees and the enhancement of openings for tree regeneration, thus benefitting stand species composition and overall quality.

Prescribed burning is being used in grassland areas to maintain or improve the quality of warm-season grasses and prevent the invasion of undesirable species. Burning is planned as a tool to maintain prairie savanna habitat at BGAD (BGAD 2000b). Ongoing surveys at BGAD have identified several natural areas that should be protected from further disturbance (BGAD 2000b). These areas vary in size from less than one acre to several hundred acres. They represent plant communities that are either rare in the Blue Grass Physiographic Region of Kentucky or are in a relatively undisturbed condition when compared with other similar areas in the region.

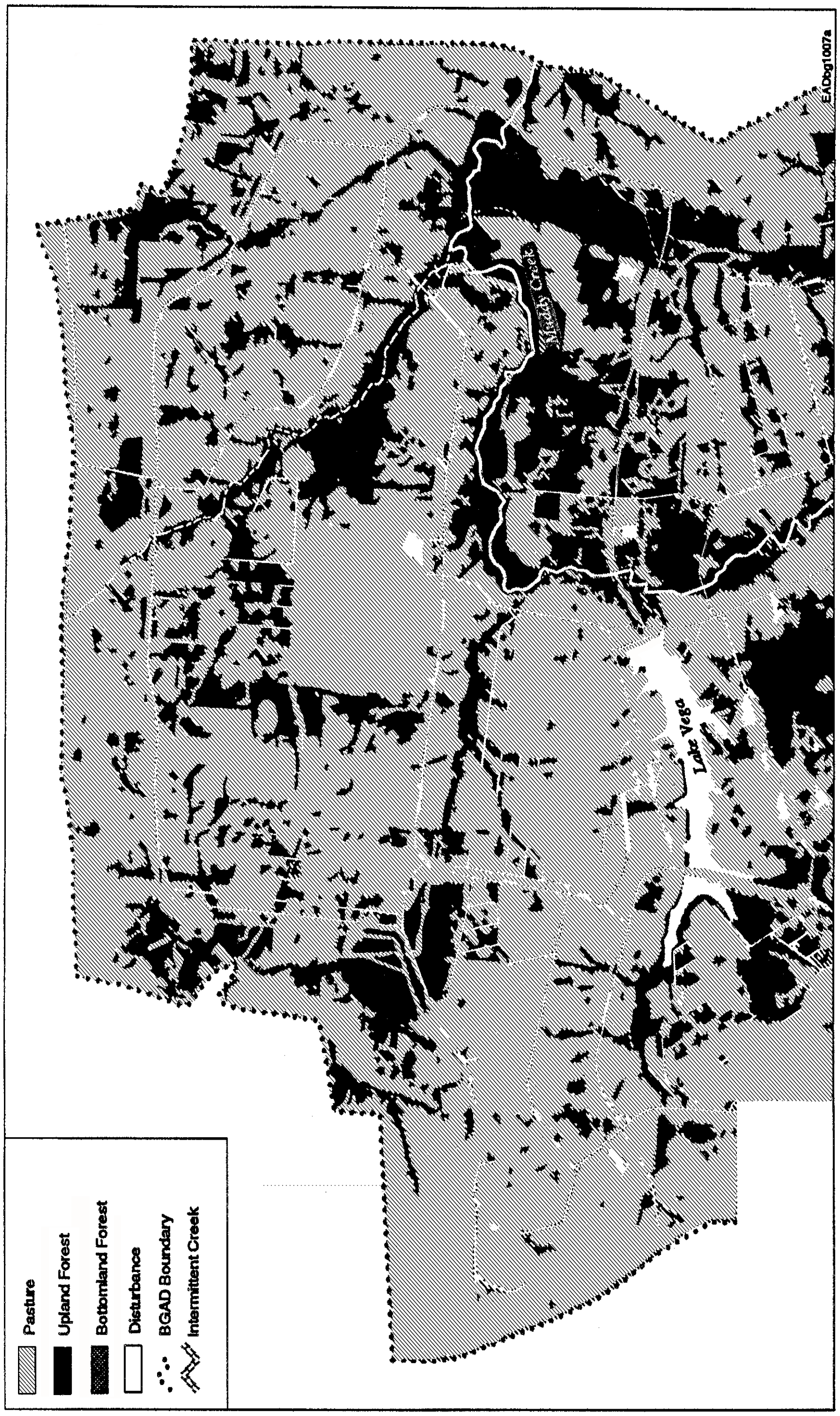

Figure 4.8. Vegetation at BGAD.
Source: ACWA DEIS 2001, Fig. 7.13-1.

Vegetation in proposed Area A located east of the Chemical Limited Area is composed of a mixture of grasses and forbs. A few American sycamore trees occur along the western perimeter of the area and along the southern end of the area. Upland forest occurs east and southeast of proposed Area A, and forested wetlands and an associated canebrake are located in the southeast portion of the area (see Fig. 4.8). Upland forest is also present north of proposed Area A and north of the Chemical Limited Area. Alternative Area B is grass-covered in the eastern portions and tree-covered in the western half. Upland forest covers the western portion of alternative Area B. No quantitative data were available on vegetation or wildlife in either proposed Area A or alternative Area B.

4.15.1.2 Wildlife

Wildlife habitat at BGAD has been adversely affected by livestock grazing. The diversity of ground nesting birds, amphibians, and reptiles is relatively low when BGAD habitat is compared with similar, undisturbed habitats of eastern Kentucky. The wildlife species that occur in grazed areas are those that are generally tolerant of disturbed areas (BGAD 2000b).

Amphibians and Reptiles. Many herpetofaunal species occur in the BGAD region because of the overlap of many northern, southern, and southeastern species that reach distributional limits in eastern Kentucky (Barbour 1971). No quantitative data have been collected on amphibians and reptiles at BGAD. Fifteen reptile and 20 amphibian species are known to occur on BGAD (BGAD 2000b). Amphibians of mesic, forested habitats include the Jefferson's salamander (*Ambystoma jeffersonianum*), marbled salamander (*A. opacum*), and spotted salamander (*A. maculatum*). Common frogs and toads include the Fowler's toad (*Bufo woodhousii fowleri*), green frog (*Rana clamitans*), bullfrog (*R. catesbeiana*), spring peeper (*Pseudacris crucifer*), upland chorus frog (*Pseudacris triseriata*), and cricket frog (*Acris crepitans*). Salamanders occurring in stream habitats and rock outcrops in riparian areas include the southern two-lined salamander (*Eurycea cirrgeria*), cave salamander (*E. lucifuga*), and longtail salamander (*E. longicauda*).

Reptiles of forested habitats at BGAD include the rough green snake (*Opheodrys aestivus*), black rat snake (*Elaphe o. obsoleta*), milk snake (*Lampropeltis triangulum*), and black kingsnake (*Lampropeltis getulus niger*). Aquatic habitats support four turtle species. The most common species are the common snapping turtle (*Chelydra serpentina*) and red-eared slider (*Trachemys scripta elegans*). The eastern garter snake (*Thamnophis sirtalis*) and black racer (*Coluber constrictor*) are the most frequently observed snake species in grassland habitats and pastures at BGAD. Although not included in the species list for BGAD (BGAD 2000b), the timber rattlesnake (*Crotalus horridus*), northern copperhead (*Agkistrodon contortrix*), and several lizard species may occur in upland forest habitats at BGAD (BGAD 1984; Conant and Collins 1998).

Birds. Eastern Kentucky University researchers observed 170 bird species over several decades of monitoring at BGAD (BGAD 2000b). Numerous waterfowl, shorebird, and warbler species visit BGAD only during the spring and fall migration periods. A survey of nongame resident and migratory bird species conducted during 1993 and 1994 documented the presence of 52 species in a variety of habitats (Duguay and Elliott 1994). Bird species frequently observed in upland forests and forest edge habitat during the summer breeding season were the indigo bunting (*Passerina cyanea*), eastern wood pewee (*Contopus virens*), common grackle (*Quiscalus quiscula*), blue jay (*Cyanocitta cristata*), and common yellowthroat (*Geothlypis trichas*). The most common species found in bottomland hardwood forests included the blue jay (*Cyanocitta cristata*), northern cardinal (*Cardinalis cardinalis*), indigo bunting (*Passerina cyanea*), and common yellowthroat (*Geothlypis trichas*). The red-winged blackbird (*Agelaius phoeniceus*), eastern meadowlark (*Sturnella magna*), common yellowthroat (*Geothlypis trichas*), American robin (*Turdus migratorius*), field sparrow (*Spizella pusilla*), and European starling (*Sturnus vulgaris*) were the most frequently observed species in grassland/pasture habitats. Resident birds of prey at BGAD that hunt in grassland areas included the red-tailed hawk (*Buteo jamaicensis*), northern harrier (*Circus cyaneus*), and kestrel (*Falco sparverius*). Game species important in this region of Kentucky that were observed at BGAD included wild turkey (*Meleagris gallopavo*), northern bobwhite (*Colinus virgianianus*), and mourning dove (*Zenaida macroura*) (BGAD 2000b).

Mammals. Terrestrial vertebrate surveys have documented the presence of mammalian species at BGAD (Table 4.31). The most important game species on BGAD is the white-tailed deer. Deer populations vary between 700 and 800 individuals in any given year (BGAD 2000b) and are being maintained at that level by setting annual harvest limits for hunters. Both deer hunting and small game hunting are allowed on BGAD. Furbearers are not trapped or hunted on BGAD. Ongoing monitoring studies during the period of 1999–2004 will assist land management personnel in determining whether carrying capacities are being exceeded to the point of warranting the establishment of a trapping season.

Common species found in forested habitats include the eastern chipmunk, eastern fox squirrel, gray squirrel, and raccoon. The meadow vole, prairie vole, and several shrew species are the most representative small mammals occurring in a variety of habitats. The eastern cottontail occurs in grasslands throughout BGAD. Muskrat, beaver, and mink occur in various wetlands throughout the installation.

4.15.2 Impacting Factors

It is expected that impacts from construction on vegetation and wildlife would be the same regardless of the alternative selected, given the similarity in space requirements, construction activities, and time requirements for constructing any of the agent destruction facilities. Routine agent destruction operations would generate emissions that would be deposited on vegetation downwind of the facility. Operational impacts on wildlife could be related to emissions from routine operations, noise, and the presence of the work force.

Factors associated with a PMCD agent destruction facility that would affect vegetation and wildlife would include construction activities, releases and spills, and accidents. These factors could occur during construction of the facility complex itself and during the installation of utilities, communication cables, and other support areas (such as parking lots and material lay-down areas). Increased activity from the presence of workers and increases in vehicle traffic might also affect wildlife.

Table 4.31. Mammalian species occurring at BGAD[a]

Species	Habitat[b]			
	Grass-land	Upland Forest	Bottomland Forest	Marsh
Eastern fox squirrel (*Sciurus niger)*		X	X	
Gray squirrel *(Sciurus carolinensis)*		X	X	
Southern flying squirrel *(Glaucomy volans)*		X	X	
White-tailed deer *(Odocoileus virginianus)*	X	X	X	
Raccoon *(Procyon lotor)*		X	X	
Red fox *(Vulpes vulpes)*	X	X		
Gray fox *(Urocyon cinereoargeneus)*		X		
Coyote *(Canis latrans)*	X			
Woodchuck *(Marmota monax)*	X	X		
Striped-skunk *(Mephitis mephitis)*	X	X	X	
Muskrat *(Ondatra zibethicus)*				X
Mink *(Mustela vison)*				X
Beaver *(Castor canadensis)*			X	X
Bobcat *(Lynx rufus)*		X	X	
Eastern chipmunk *(Tamias striatus)*		X	X	
Eastern cottontail *(Sylvilagus floridanus)*	X			
Opossum *(Didelphis virginiana)*		X	X	
Meadow vole *(Microtus pennsylvanicus)*	X			
Prairie vole *(Microtus ochrogaster)*	X			
Woodland vole *(Microtus pinetorum)*	X	X		
Southeastern shrew *(Sorex longirostris)*	X	X	X	
Short-tailed shrew *(Blarina carolinensis)*	X	X	X	
Least shrew *(Cryptotis parva)*	X			X
White-footed mouse *(Peromyscus leucopus)*		X	X	
House mouse *(Mus musculus)*	X	X		
Eastern harvest mouse *(Reithrodontomys humulis)*	X			
Meadow jumping mouse *(Zapus hudsonius)*	X		X	
Eastern mole *(Scalopus aquaticus)*	X			
Southern bog lemming *(Synaptomys copperi)*	X		X	
Big brown bat *(Eptesicus fuscus)*		X	X	
Red bat *(Lasiurus borealis)*		X	X	
Northern long-eared bat *(Myotis septentrionalis)*		X	X	
Eastern pipistrelle *(Pipistrellus subflavus)*		X	X	

[a]BGAD (2000b).
[b]Brown (1997).
Source: Adapted from ACWA DEIS 2001, Table 7.13-2.

4.15.3 Impacts of Construction

The locations of the potential sites and utility corridors are described in Section 4.3, 4.4, and 4.5 and summarized in Table 2.4. The construction of a PMCD agent destruction facility would disturb about 25 acres for the site complex and another 70 acres for the site infrastructure. The total area likely to be disturbed during construction is shown in Table 2.4.

4.15.3.1 Vegetation

The impacts from construction on vegetation would be approximately the same for each of the four alternatives being considered. The land requirements for facilities and infrastructure were assumed to be the same for all technologies.

If proposed Area A were chosen as the preferred location, 22 acres of a fescue-dominated grassland community would be affected. A few shrubs and isolated trees would be cleared if the facilities were constructed along the eastern or southeastern portions of proposed Area A. A 1.4-acre sedimentation pond is planned in proposed Area A which would overlap with and displace the forested wetland and associated canebrake in the southeast portion of the area.

Construction at alternative Area B would remove upland forest and grassland communities just beyond the west boundary of the Chemical Limited Area. Vegetation would also have to be removed to allow for a 60-ft-wide access road that would extend from the north side of BGAD.

Some clearing or trimming of trees would be required to install the 69-kV transmission line along a right-of-way to either proposed Area A or alternative Area B. The installation of gas and water supply lines would likely disturb vegetation along road rights-of-way, but this vegetation would have already been disturbed during roadway construction. Grass cover along some rights-of-way near proposed Area A and alternative Area B would continue to be maintained by periodic mowing.

4.15.3.2 Wildlife

Loss of habitat, increased human activity in the Chemical Limited Area, increased traffic on local roads, and noise would be the most important factors that would affect wildlife species. The presence of construction crews and increased traffic would cause some wildlife species to avoid areas next to the construction site during the 32- to 36-month construction period. Wildlife inhabiting the area rely on native shrubs and grasses for food, cover, and nesting and would be affected by vegetation clearing. Burrowing and less mobile species such as amphibians, some reptiles, and small mammals would be killed during vegetation clearing and other site preparation activities. The loss of grassland habitat would displace small mammals and songbirds from the construction areas. The loss of about 95 acres of shrub, upland forest, and grassland habitat during construction would not be expected to eliminate any wildlife species from BGAD since similar habitat is relatively common near the Chemical Limited Area and elsewhere on the installation. Mammalian species that would be likely to be affected by loss of grassland and shrub habitat would include the meadow vole, the white-footed mouse, three shrew species, and the eastern cottontail.

The wildlife species that would be most affected by construction in proposed Area B would be the mammals and birds that are typical of the upland forest, forest edge and shrub habitats at BGAD. Some wildlife habitat would be lost from the intermittent stream that traverses the southern portion of alternative Area B, and similar habitat would be lost in the southern portion of Area A. Species typical of riparian habitat at BGAD include the green frog, chorus frog, cricket frog, and the three salamander species that inhabit rock outcrops and rocky stream beds. The 69-kV transmission line should be built to span sensitive riparian habitats and highly erodible slopes, and construction vehicles should not be used in such areas whenever possible. The tributaries to Muddy Creek along the proposed transmission line and portions of alternative Area B should not be disturbed to protect a relatively rich herbaceous layer (Bloom et al. 1995) in the floodplain riparian community that provides habitat for amphibians and reptiles.

Noise levels generated by construction equipment would be expected to range from 77 to 90 dBA at a proposed PMCD agent destruction facility (see Section 4.10.3). Levels would diminish to background levels at the northern and northeast boundaries of BGAD. Published results from numerous studies indicate that small mammals might be adversely affected by the maximum noise levels produced by construction equipment (Manci et al. 1988; Luz and Smith 1976; Brattstrom and Bondello 1983). In Manci et al. (1988), an article on the effects of noise on wildlife and domestic animals, it is reported that sudden sonic booms of 80-90 dB startled seabirds, causing them to temporarily abandon nest locations. The startle response of birds to abrupt noise and continuous noise and ability to acclimate seems to vary with species (Manci et al. 1988). Some songbirds within about 330 ft of construction equipment might abandon existing habitat because of noise levels. Also, white-tailed deer and other larger mammals would not use areas near the PMCD site during construction because of noise and the presence of workers. No long-term impacts on the hearing ability of wildlife species would be expected from construction-generated noise.

Some unavoidable impacts on wildlife would occur as a result of increased vehicular traffic. Construction traffic along the new access road and existing roads from the west entrance of BGAD to alternative Area B would increase the potential for roadkills for species such as the eastern cottontail, gray and eastern fox squirrels, opossum, and eastern chipmunk.

Birds of prey at BGAD would probably not be adversely affected by the loss of prey base that would be associated with the clearing of about 95 acres of vegetation, but they might not forage in areas next to construction sites because of increased human activity. Species such as the red-tailed hawk and kestrel might benefit from using the single wooden poles built for the transmission line as perch sites.

Electrocution of raptors from simultaneous wing contact with two conductors or a conductor and ground wire on a 69-kV transmission line would not be expected if appropriate design features were incorporated into the system. The red-tailed hawk, the largest raptor occurring at BGAD, has a maximum wing span of 54 in. If conductors were not properly shielded and if the wings of a red-tailed hawk made simultaneous contact with two conductors or with a conductor and ground wire as the bird attempted to land, it would be electrocuted. Electrocution could occur at a transmission pole regardless of whether a crossarm design or a single-pole design without a crossarm was used. Also, cases have been reported in which a single-pole structure was built to support 69-kV conductors, and raptors were electrocuted when they landed on an insulator and made simultaneous contact with a conductor and ground wire (Avian Power Line Interaction Committee 1996). To avoid raptor electrocution, suggested practices for raptor protection would be followed in designing the 69-kV transmission line (Avian Power Line Interaction Committee 1996).

4.15.4 Impacts of Operations

The impacts on wildlife and vegetation from air emissions due to routine operations would be negligible for all four alternatives being considered. Projections of air emissions were evaluated to determine ecological impacts that could result from normal (i.e., incident-free) operations of each of the four agent destruction systems. Air pollutant concentrations resulting from destruction operations are expected to be well below applicable standards for criteria pollutants and chemical agents (see Sects. 4.7 and 4.8 and Appendix I). For the criteria pollutants SO_2, NO_x, CO, PM_{10}, and $PM_{2.5}$, emissions would be less than 3% of the applicable NAAQS. Less than 1% of the allowable concentrations of chemical agent would be emitted (CDC 1988). Trace elements or organic compounds would be dispersed over a large geographic area, resulting in deposition amounts that would be nondetectable or below levels known to be harmful to wildlife and vegetation. Therefore, no significant deposition of these pollutants should occur that would affect vegetation and wildlife in the vicinity of BGAD.

Atmospheric releases of trace metals would total less than 1×10^{-10} lb/d (45 ng/d) if the neutralization and supercritical water oxidation system was used to treat mustard agent and nerve agent (see Kimmell et al. 2001). If neutralization followed by SCWO and gas phase chemical reduction was used, total emissions of all trace metals from processing the entire inventory of chemical agents at BGAD would be less than 1×10^{-2} lb (less than 4.5 g) for mustard, GB, or VX. Emissions of organic compounds released during processing would be less than 1×10^{-4} lb/h. If the electrochemical oxidation technology was used, releases of organic compounds considered toxic air pollutants would be less than 1×10^{-8} lb/d during normal operations. Emissions of barium, cadmium, chromium, copper, lead, and mercury would be less than 0.6 lb/yr. Such emission levels for neutralization followed by SCWO and gas phase chemical reduction and the electrochemical oxidation technology would be far below levels that would adversely affect vegetation at BGAD, and would be expected to be well below levels that would affect ecosystems through biouptake and biomagnification in the food chain.

Previous health risk assessments conducted as part of the RCRA permitting process for other U.S. Army chemical destruction facilities have also included screening level risk assessments (SLERAs). These SLERAs have included screening level pathway analyses of the potential impacts from facility emissions upon ecological communities. That is, previous SLERAs have attempted to determine if ambient concentrations of airborne and deposited constituents (as emitted from the proposed facilities) pose a threat to ecological communities, as opposed to specific individuals of any species. SLERAs will be conducted for the agent destruction facilities associated with the technology alternative selected for destruction of the BGAD stockpile. It is anticipated that these analyses will demonstrate, as have the previous SLERAs conducted for other U.S. Army chemical demilitarization facilities, that ambient concentrations of airborne and deposited constituents (as emitted from the proposed facilities) pose little threat to ecological communities. The results of two such SLERAs are summarized in this section, along with the findings of a site-specific environmental impact risk analysis (EIRA) for the proposed incineration facility at PBA, and information from a study of bird populations at the JACADS facility.

for the proposed incineration facility at PBA, and information from a study of bird populations at the JACADS facility.

Ecological Risks at the DCD Incinerator at the Tooele, Utah, Facility. An ecological evaluation was included in the health risk assessment (A.T. Kearney, Inc. 1996) for the Tooele DCD Facility. This evaluation was used as the basis for two additional studies of ecological risk at Tooele (ChemRisk 1996a; Chambers Group, Inc. 1996a). These two studies focused on emissions of mercury, dioxin, and PCBs, three chemicals known to bioaccumulate. The receptors included the threatened and endangered species near the facility: bald eagle, and peregrine falcon. The receptor locations were taken as the points of maximum concentration as determined in the health risk assessment. A direct and indirect exposure analysis was conducted. The results indicate that it is unlikely that adverse effects would occur to either species.

Screening-Level Ecological Risk Assessment for the Umatilla, Oregon, Facility. The draft health risk assessment (Ecology and Environment 1996) for the Umatilla Chemical Demilitarization Facility included a SLERA in conformance with suggestions by the EPA. The receptor locations were generally the same as those for hypothetical human receptors. The constituents of potential environmental concern (COPECs) were a subset of those used in the human health risk assessment. The SLERA concludes that there is little or no potential for the COPECs to negatively impact terrestrial vegetation or soil invertebrates. The potential effects of mercury on soil macroinvertebrates represented the only hazard quotient that exceeded 1.0; however, this was predicted to occur only in the area of highest impact--about 328 ft. downwind of the facility--well within depot boundaries.

Environmental Impact Risk Analysis for the Proposed Pine Bluff, Arkansas, Facility. USACHPPM has completed an EIRA for the proposed PBA facility (USACHPPM 1997). A portion of the analysis involved an evaluation of risks to sensitive ecological resources and ecosystems from routine, daily emissions from the proposed facility. The COPECs were a subset of those used in the human health portion of the risk analysis. The end point receptors included soil fauna and flora, plant communities, small mammals, and passerine birds. A multi-pathway exposure analysis was conducted, including consideration of bioaccumulation of certain chemicals through the food web. The EIRA concludes that there is little or no potential for the COPECs to negatively impact the terrestrial resources. In conjunction with the EIRA, three additional studies of ecological risk focusing on federally listed threatened or endangered species at PBA were conducted (ChemRisk 1996b; Chambers Group, Inc. 1996b; Zimmerman 1997). The effects of daily emissions on three terrestrial species--bald eagle, red-cockaded woodpecker, and interior least tern--were evaluated in some detail because of their potential occurrence near the proposed facility. The estimates of potential risk to these species associated with the modeled concentrations of mercury, dioxins, and PCBs (Zimmerman 1997) indicate that no adverse effects from projected daily incinerator emissions are anticipated.

Potential Ecological Effects of Emissions at JACADS. On-going studies of bird populations at Johnston Atoll have been conducted by Schreiber (1996) since 1984, six years before the JACADS facility became operational. In other studies, several species of birds nesting near JACADS have shown sensitivity to accumulations of biotoxins, and have therefore been considered to be indicators of whether impacts are occurring at JACADS. The Johnston Atoll studies indicate that as of July 1996, there have been no measurable effects on the birds of Johnston Atoll from the JACADS chemical incineration process (Schreiber 1996).

A SLERA has not yet been performed for the BGAD site. Due to differences in facility operation and design, local meteorological conditions, topography, receptor communities, and other additional factors, there is some uncertainty in predicting site-specific effects at one facility based on a study of other facilities at some distance away. However, the above multiple assessment results for similar facilities, in conjunction with the low atmospheric emission rates for the incineration and other alternatives presented in Sections 4.7 and 4.8 suggest that vegetation and wildlife in the vicinity of BGAD would not receive sufficient deposition of emission contaminants to be adversely affected.

4.15.5 Impacts of No Action

Continuing to store chemical agent at BGAD would not adversely affect plant communities in the Chemical Limited Area during normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas. Periodic mowing of vegetation between the bunkers has precluded establishment of shrub species. This type of vegetative control would likely continue in the future.

No impacts on wildlife species would occur from continued storage of chemical weapons at BGAD. Maintaining the grass cover in the Chemical Limited Area would provide habitat for small mammals and birds that are typical in grassland communities of the Blue Grass Physiographic Province.

4.15.6 Cumulative Impacts

Vegetation. Section 4.15.3 describes the impacts on terrestrial habitats and vegetation that might result from disturbing up to 95 acres of land while constructing an agent destruction facility and associated infrastructure. Construction of other on-post facilities would increase the loss of vegetation as sites would be cleared. The area involved would be smaller than the area disturbed for an agent destruction facility alone, but the acreage is not known exactly. Using standard erosion and runoff controls could mitigate impacts on vegetation that could result from sedimentation and erosion. Emissions from an agent destruction facility (Section 4.8) and other reasonably foreseeable on-post actions would be small and would not have adverse impacts on terrestrial habitats and vegetation.

Impacts on terrestrial habitats and vegetation associated with off-post facilities would be related to the size of the developments and the land area occupied. No new, large industrial facilities were identified. Other reasonably foreseeable actions, including highway and residential construction near BGAD, would have localized impacts that would add to the impacts of actions at BGAD. The impacts of off-post actions could not be quantified but are expected to be temporary or minor.

Wildlife. Section 4.15.3.2 describes the impacts on wildlife that might result from disturbing up to 95 acres of land while constructing an agent destruction facility. Each new on-post construction activity would affect wildlife by increasing loss of habitat and increasing human activity and construction traffic. Cumulatively, these increases would cause additional deaths among burrowing and less mobile species (such as amphibians, some reptiles, and small mammals) and displace additional small mammals and songbirds. If possible, construction disturbance to the tributaries to Muddy Creek and portions of proposed Area A and alternative

Area B should be avoided to protect floodplain riparian community that provides habitat for amphibians and reptiles.

Additional operations on post would increase the number of workers and deliveries. Roadkills would increase as a result of the consequent increase in traffic. The nearby Site Security Control Center would result in some increased noise from traffic, but even with other on-post actions, there would be no appreciable cumulative increase in noise levels. Emissions from an agent destruction facility (Section 4.8) and other reasonably foreseeable on-post actions would be small and would not have adverse impacts on wildlife.

Cumulative impacts on wildlife associated with the off-post trend of increasing urbanization would be negligible. Impacts associated with off-post facilities would be related to the size of the developments and the land area occupied. No new, large industrial facilities were identified. Other reasonably foreseeable actions, including highway and residential construction near BGAD, would have localized impacts that would add to the impacts of actions at BGAD. The impacts of off-post actions could not be quantified but are expected to be temporary or minor.

Additional workers and deliveries would be required for the construction and operation of a baseline incinerator, resulting in a consequent increase in worker traffic. This additional traffic would result in an increase in roadkills.

Impacts on wildlife associated with off-post facilities would be related to the size of the developments and the land area occupied. No new, large industrial facilities were identified. Other reasonably foreseeable actions, including highway and residential construction near BGAD, would have localized impacts that would add to the impacts of actions at BGAD. The impacts of off-post actions could not be quantified but are expected to be temporary or minor.

4.16 AQUATIC HABITATS AND FISH

This section describes the aquatic ecological resources of the existing environment and assesses the impacts on these resources from the construction and operation of the four agent destruction system alternatives(1) baseline incineration; (2) neutralization with SCWO; (3) neutralization followed by SCWO and gas phase chemical reduction (GPCR); and (4) electrochemical oxidation. Few differences in environmental impacts to ecological resources were identified among the four agent destruction systems considered.

4.16.1 Affected Environment

The area of eastern Kentucky within a 30-mi radius of BGAD is rich in surface water resources. Although natural lakes are uncommon, several man-made impoundments are present within the project area. Rivers and streams in the project area provide habitat for several warm-water fish species that could be attractive to recreational anglers. Some cold-water streams in the project area provide cold-water fisheries. The most common game fish in rivers and streams within the 30-mi radius of BGAD are largemouth bass, walleye, sauger, rock bass, bluegill, sunfish, and catfish (Commonwealth of Kentucky, Department of Fish and Wildlife Resources 1983, 1996).

The most visible disturbance of on-post streams, that is, stream bank and stream bed erosion and increased suspended sediments, was attributed to cattle entering these streams. This is almost certainly true for accessible ponds as well.

Twenty-four fish species are reported from four BGAD reservoirs and Muddy Creek located immediately outside BGAD (Bloom et al. 1995). Black bullhead, yellow bullhead, channel catfish, bluegill, red-ear sunfish, largemouth bass, and white crappie are known to occur in BGAD reservoirs from surveys conducted in 1992 and 1993 (Bloom et al. 1995). The most common fish species in the three streams on-site are creek chub*(Semotilus atromaculatu*s), bluntnose minnow *(Pimephales notatu*s), central stoneroller*(Campostoma anomalu*m), and striped shiner *(Luxilus chrysocephalu*s) in Muddy Creek; creek chub, fathead minnow *(P. promela*s), mosquitofish *(Gambusia affini*s), and green sunfish *(Lepomis cyanellu*s) in Otter Creek tributaries; and bluegill *(L. machrochiru*s), mosquitofish, bluntnose minnow, and central stoneroller in Silver Creek tributaries.

Three mussel species, four fingernail clam species, two snail species, and three crustacean (crayfish) species were detected in surveys of BGAD streams and areas around the reservoirs. Freshwater clams, snails, crayfish, and fish species occurring on BGAD are common in streams of the Kentucky River drainage and regionally in eastern Kentucky (Bloom et al. 1995).

4.16.2 Impacting Factors

Impacting factors can arise from construction activities (e.g., , accidental spills and erosion resulting in entry of sediment and contaminant-laden runoff into on-post surface waters), normal operations (e.g., emissions and effluents resulting in deposition or discharge of contaminants into area waters and a very slight, temporary [up to 22 months or so] reduction in surface water volume or flow from surface water withdrawals), and accidents (i.e., the bounding case accidental release of chemical agents by the crash of an airplane into a storage facility followed by a fire).

4.16.3 Impacts of Construction

It is expected that impacts from construction on aquatic habitats and fish would be essentially the same for all alternative technologies, given the similarity in space requirements, siting, construction activities, and time requirements for constructing the facilities.

Direct and indirect construction impacts of the proposed baseline incineration alternative or any of the other alternative chemical destruction facilities on aquatic ecological resources would not differ materially, i.e., impacts on aquatic biota would be of little or no consequence given implementation of best-management practices for erosion control and spill response. Aquatic habitats and fish species would not likely be affected by construction activities if appropriate measures (best-management practices) for minimization of sediment- or contaminant-laden runoff into Muddy Creek are implemented. A sedimentation pond designed to contain runoff during construction of any one of the alternatives would eliminate potential impacts from sediment input to tributaries of Muddy Creek. Siltation fencing or other mechanical erosion control measures would be used during construction of water and gas pipelines and communication cables to control runoff at points where surface disturbance could otherwise affect aquatic habitats.

4.16.4 Impacts of Operations

4.16.4.1 Baseline incineration alternative

Generally, the principal means by which routine operations of a facility of this nature could possibly adversely impact aquatic ecosystems are (1) deposition of atmospheric pollutants, and (2) discharges of pollutant-laden effluents directly or indirectly into nearby surface waters.

Previous screening level ecological risk assessments (SLERAs) conducted as part of the RCRA permitting process for the Tooele, Utah (A. T. Kearney, Inc. 1996), Umatilla, Oregon (Ecology and Environment 1996), and Anniston, Alabama (USACHPPM 1996) chemical demilitarization facilities concluded that adverse effects of atmospheric pollutant deposition on nearby aquatic ecosystems were, for the most part, unlikely. The total hazard index for emissions from the Umatilla facility, however, indicated a slight potential for effects on aquatic species in wetlands about four miles from the facility boundary.

Similarly, an environmental impact risk analysis for the proposed Pine Bluff, Arkansas chemical munitions destruction facility, which is under construction, concluded that emissions would not adversely affect aquatic organisms of nearby water bodies (USACHPPM 1997). A SLERA has yet to be performed for the BGAD site. Due to differences in facility operation and design, local climate and meteorology, topography, receptor communities, and so forth, there is some uncertainty attached to the prediction of site-specific effects at one facility based on the study of another facility some distance away. However, the above multiple assessment results for several similar facilities, in concert with the low atmospheric emission rates for the proposed incineration alternative presented in Sections 4.7 and 4.8, strongly suggest that small streams and ponds downwind of the proposed facility would not receive sufficient deposition of emission contaminants to adversely affect aquatic species during the period of operations. All of the alternative chemical destruction systems would be expected to release even lower quantities of contaminants to the atmosphere, hence no measurable impacts on aquatic ecosystems would be expected to occur.

Once an alternative chemical destruction technology is selected, and before the selected alternative can be granted a RCRA permit, a site-specific SLERA will be performed in accordance with the new draft SLERA Protocol developed by the EPA (1999) in support of RCRA permitting for hazardous waste combustion facilities.

Neither baseline incineration nor any of the other three alternative chemical destruction systems would release process-related liquid effluents to surface waters on- or off-post. Any of the four alternative systems would contribute small quantities of effluent to the sanitary waste treatment plant, which, in turn, would discharge the treated effluent to Muddy Creek. The treatment plant effluent from baseline incineration or any of the alternatives would be required to satisfy the water quality and discharge rates of an NPDES permit, and would be unlikely to result in substantive adverse effects on the aquatic life of Muddy Creek.

As with on-post effects described above, small streams and ponds off-post and downwind of the proposed facility would be unlikely to receive sufficient deposition of emission contaminants to adversely affect aquatic life.

4.16.4.2 Neutralization and electrochemical oxidation alternatives

Impacts of routine operation of the two neutralization alternatives and the electrochemical oxidation alternatives on aquatic communities would be comparable to, or slightly less than the temporary, modest to negligible impacts that would likely result from operation of the baseline incineration alternative.

4.16.5 Impacts of No Action

Continued storage of chemical weapons at BGAD would not adversely affect aquatic habitats or resident fish species.

4.16.6 Cumulative Impacts: Aquatic Habitats and Fish

Adequate measures to control erosion and runoff would minimize to acceptable levels adverse cumulative impacts on aquatic habitats and fish from construction of a chemical agent destruction facility and other on-post facilities and off-post road construction.

Routine operations of the chemical agent destruction facility would have modest to negligible adverse effects on fish, other aquatic organisms, and their habitats. Given the small emissions and deposition potential of other reasonably foreseeable on-post actions and their distance from the agent destruction facility, cumulative impacts on aquatic habitats and fish during routine operations would also be modest to negligible.

In the event two alternative technologies for agent destruction were implemented, adverse impacts from construction would essentially double, but adverse impacts on aquatic habitats and fish would still be minimal if measures to control erosion and runoff are taken for all facilities. Likewise, adverse cumulative impacts during construction of roads in the vicinity of BGAD would be minimized if standard erosion and runoff control measures are implemented.

During routine operations, the emissions and deposition potential of a baseline incinerator would be low (U.S. Army 1991, 1997b; Raytheon 1996). In addition, the total stockpile to be demilitarized is fixed; if another chemical agent facility were to be built and operated as well, fewer munitions would be demilitarized in the incinerator facility, thereby reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions or their distance from the baseline incinerator facility, cumulative impacts on aquatic habitats and fish from a baseline incinerator, another chemical agent destruction facility, and other potential facilities during routine operations would be negligible.

4.17 PROTECTED SPECIES

4.17.1 Affected Environment

The U.S. Fish and Wildlife Service (USFWS) has identified seven federally-listed endangered species (Barclay 2000) as occurring within 30 mi of BGAD (see Table 4.32): three mussel species, three bat species, and one plant species. Another endangered species,

Table 4.32. Federal listed threatened, endangered, and candidate species occurring within 50 km (30 mi) of BGAD

Species	Status[a]
Mammals	
Gray bat *(Myotis grisescens)*	E
Indiana bat *(Myotis sodalis)*	E
Virginia big-eared bat *(Corynorhinus townsendii virginianus)*	E
Birds	
Kirtland's warbler *(Dendroica kirtlandii)*	E
Bald eagle *(Hilaeetus leucocephalus)*	T
Fish	
Blackside dace *(Phoxius cumberlandensis)*	T
Mussels	
Cumberland bean *(Villosa trabalis)*	E
Cumberland elktoe *(Alasmidonta atropurpurea)*	E
Little-wing pearly mussel *(Pegias fabula)*	E
Fluted kidneyshell *(Ptychobranchus subtentum)*	C
Plants	
Running buffalo clover *(Trifolium stoloniferum)*	E
Virginia spirea *(Spiraea virginiana)*	T
Eggert's sunflower *(Helianthus eggertii)*	T
White-haired goldenrod *(Solidago albopilosai)*	T
Short's badderpod *(Lesquerella globosa)*	C
White fringeless orchid *(Plantathera integrilabia)*	C

[a]E = endangered, T = threatened, C= candidate.
Source: ACWA DEIS (2001), Table 7.16-1; Barclay (2000); USFWS (2001).

Kirtland's warbler (*Dendroica kirtlandii*), might visit the installation during migration between its wintering grounds in the Bahamas and its summer breeding area in Michigan. Five federally-listed threatened species and three candidate species for listing are also known to occur within this area.

Of the listed species, only the bald eagle (*Hiliaeetus leucocephalus*) and running buffalo clover (*Trifolium stoloniferum*) are known to occur at BGAD. The bald eagle probably occurs as a winter migrant, being attracted to Lake Vega and other water bodies on post and in the region. Researchers have identified 145 patches of running buffalo clover on BGAD. The clover occurs most commonly on rich soils in habitats with filtered light such as open woodlands, savannas, floodplains, and mesic stream terraces on well-drained sites (BGAD 2000a; Bloom et al. 1995). It typically grows on sites periodically disturbed by mowing, grazing, or trampling. A complete treatment of running buffalo clover is included in the biological assessment covering the project area presented in Appendix F. Mist net surveys for bats at caves on BGAD and along Muddy

Creek in 1993 failed to document the presence of any endangered bat species on BGAD (Bloom et al. 1995). No suitable riverine habitat occurs at BGAD to support any of the endangered mussel species.

The Kentucky State Nature Preserves Commission (KSNPC), in conjunction with the Kentucky Natural Heritage Program (KYNHP), maintains a database of species classified as endangered, threatened, or of special concern on the basis of their rarity of occurrence or a lack of recent records documenting their occurrence (KSNPC 2001). A search on this database of the 20 counties located either totally or partially within a 30-mi radius of BGAD showed that there are 65 endangered species, 77 threatened species, and 61 species of special concern. Also, 18 sensitive plant communities occur within this area. These communities typically occupy a limited area of habitat because of factors such as past human disturbance, topography, aspect, or soil conditions. Remnants of two sensitive plant communities, the bluegrass mesophytic cane forest and the calcareous mesophytic forest, occur on BGAD, as does a plant species of special concern, the spinulose wood fern (*Dryopteris carthusiana*).

Three endangered mussel species, the Cumberland bean *(Villosa trabali*s), Cumberland elktoe *(Alasmidonta atropurpurea*) and little-wing pearly mussel *(Pegias fabul*a), are known to occur within 30 mi of BGAD (Barclay 2000), but all three species are found in the Cumberland River basin to the south of the proposed site, not in the upper Kentucky River basin in which the proposed site lies. Further consideration, therefore, is limited to potential effects of a major accident on these species.

4.17.2 Impacting Factors

It is expected that impacts from construction on protected species would be the same regardless of the alternative being evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the agent destruction facilities. Impacts on protected species might result from the clearing of vegetation during construction of an agent destruction facility and associated infrastructure. Increased human activity from the presence of the on-post work force during both construction and operations and increases in vehicle traffic might also affect federal- and state-protected or sensitive species.

4.17.3 Impacts of Construction

Construction of an agent destruction facility in either proposed Area A or alternative Area B could adversely affect running buffalo clover (RBC), a federally-listed endangered species known to occur at 145 locations on BGAD. Potential habitat for RBC occurs near both areas and along possible construction transportation routes. Direct disturbance or loss of individual plants in patches along the proposed 69-kV transmission line could occur unless concerted efforts to protect them are made by conducting clearance surveys, marking patches that are discovered, and avoiding patches when placing towers and erecting conductors. A detailed evaluation of the impacts that could occur to RBC at BGAD from the construction and operation of and ACWA pilot test facility, which are the same as those of a PMCD agent destruction facility, is provided in the biological assessment covering the project area (see Appendix F). No other federal endangered species are known to inhabit or visit BGAD.

The bald eagle (*Haliaeetus leucocephalus*), a federal listed threatened species, has been observed as a winter visitor at BGAD (Elliott 1994). Construction activities and increased human presence could have a minor impact on individual bald eagles feeding on fish in Lake Vega, located about 0.8 mi south of the Chemical Limited Area. This route would receive increased traffic during construction. At peak construction periods, eagles would be likely to abandon foraging areas in and around Lake Vega and move to other water bodies in the BGAD area.

4.17.4 Impacts of Operations

As discussed in Sections 4.15.4 and 4.16.4, wildlife, vegetation, and aquatic species in the BGAD area would not receive sufficient deposition of emission contaminants to be adversely affected from routine operations of an agent destruction facility. Thus, any protected species in the BGAD area should not be affected due to emissions from routine operations. It is unlikely that any protected species would be in close enough proximity on a frequent enough basis to be affected by increase in road traffic or noise associated with routine facility operations.

RBC, although present within the BGAD facility boundaries, would not be expected to be impacted due to emissions from routine operations. As discussed, levels of emission contaminants from routine operations would be low and dispersed over a wide area. Deposition of these contaminants directly onto the foliage of RBC would be further limited by interception from canopy species present in association with RBC.

4.17.5 Impacts of No Action

No impacts on protected species would occur from continued storage of chemical weapons at BGAD. Ongoing surveys for RBC (*Trifolium stoloniferum*) at BGAD would identify any patches within the Chemical Limited Area. These patches would be marked with signs to prevent disturbance during mowing or other surface activity between the bunkers.

4.17.6 Cumulative Impacts

Construction associated with on-post actions, including an agent destruction facility in either proposed Area A or alternative Area B, could have adverse cumulative impacts on RBC, a federally listed endangered species. The clover typically grows in disturbed areas. Some of this habitat would be disturbed during construction. Surveying for RBC and marking and avoiding patches during construction would reduce potential impacts.

Cumulative impacts on the bald eagle, a federally listed threatened species, would be minor, since it might inhabit BGAD only periodically during the winter months or as a transient species during migration between wintering areas and its breeding range in the northern United States and Canada.

Because the amount of emissions would be small, adverse impacts on protected species would not be expected from routine operations of an agent destruction facility (Section 4.17.4). Emissions from other reasonably foreseeable on-post sources would also be small or emitted far enough away from proposed Areas A and alternative Area B so as to contribute only negligible amounts to overall deposition. Reasonably foreseeable future off-post actions could affect the same overall populations as on-post actions at BGAD. These impacts could not be quantified but are expected to be minor. Cumulative impacts on protected species from atmospheric emissions would be negligible.

4.18 WETLANDS

4.18.1 Affected Environment

One of the goals of the integrated natural resources management plan (BGAD 2000b) is to map the wetlands and compare their extent with national wetland inventory maps prepared by the USFWS. A wetland inventory of BGAD was conducted in 1999 and 2000, but was unavailable for review for this EIS.

Wetlands on BGAD occur around streams and large surface water bodies. In general, they are scattered throughout the installation. Some of the intermittent streams support limited stands of emergent vegetation, including cattail, bulrush, sedges, and duckweed. Small tracts of forested wetlands are dominated by boxelder, American sycamore, and green ash in the canopy and by various sedges, forbs, and emergent aquatic vegetation (Libby 1995). A map showing wetlands identified on the USFWS National Wetland Inventory maps is included as Fig. 4.9. Wetlands were created east of Lake Vega and about 1 mi south of the Chemical Limited Area at BGAD (BGAD 2000b) by a dam improvement project. It resulted in the establishment of semipermanently flooded, emergent, herbaceous vegetation. Wetlands also occur along a tributary to Big Muddy Creek located about 0.5 mi south of proposed Area A. Small wetland areas of less than 1 acre occur along intermittent drainage ways in proposed Areas A and B.

4.18.2 Impacting Factors

It is expected that impacts from construction on wetlands would be essentially the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing any of the alternative facilities. Factors that often govern the type and magnitude of impacts include construction activities (e.g., accidental spills and erosion resulting in entry of sediment and contaminant-laden runoff into wetlands, and direct destruction or alteration of wetland), normal operations (e.g., emissions and effluents resulting in deposition or discharge of contaminants into area wetlands), and accidents.

4.18.3 Impacts of Construction

Areas likely to be disturbed by construction of a chemical destruction facility and associated infrastructure were compared with known wetland locations identified in USFWS national wetland inventory maps. Potential impacts on wetlands were determined on the basis of this comparison and observations made during site visits in June 2000 and May 2001. Figure 4.10 shows locations of wetlands and potential routes for access roads and gas, water, communications, and electric power lines. Construction of the proposed or alternative facilities could affect one or more of five small riverine wetlands (i.e., wetlands associated with intermittent and ephemeral streams) located in the project area. One small wetland of less than 1 acre would be directly destroyed by construction within the 25-acre site needed for the proposed or alternative facilities in proposed Area A. Alternative Area B includes three small (each less than 0.5 acre) wetlands that could be adversely affected by construction of the access road and proposed facilities. Runoff from the construction sites would be directed to a sedimentation pond, thereby reducing the potential for impacts on wetlands located along tributaries to Muddy Creek.

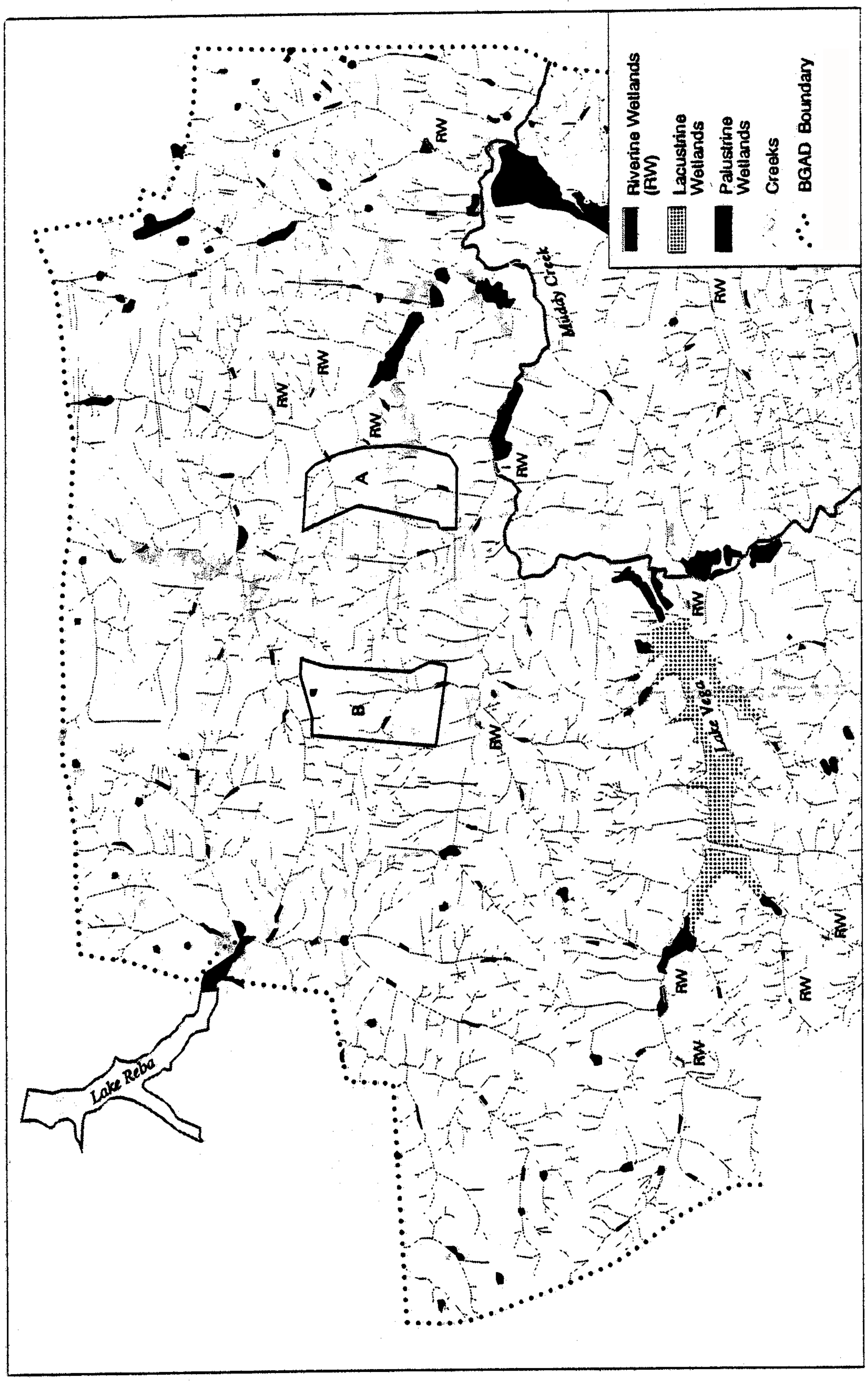

Figure 4.9. Wetlands at BGAD as identified in U.S. Fish and Wildlife Service National Wetland Inventory Maps.
Source: ACWA DEIS 2001, Fig. 7.17-1.

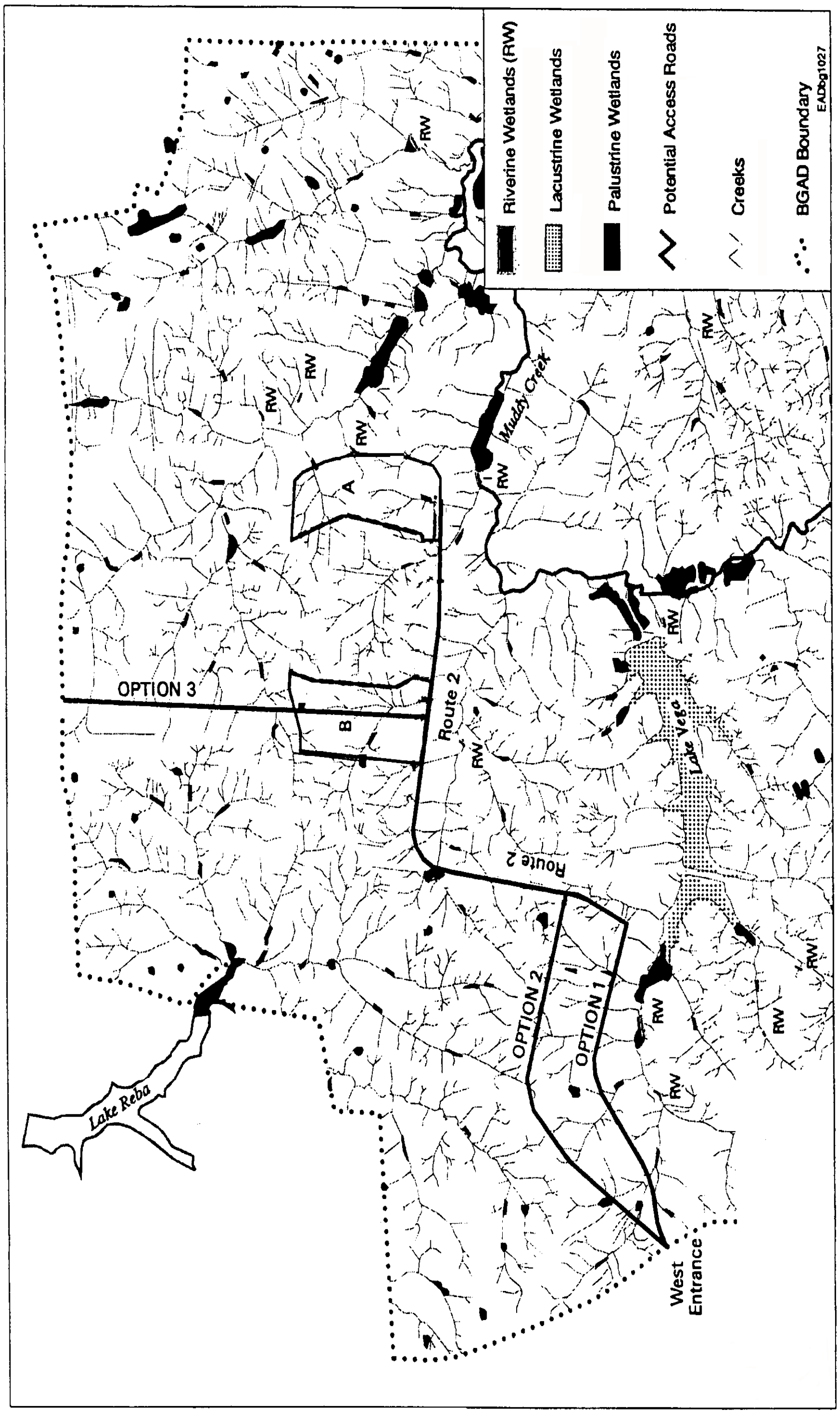

Figure 4.10. Wetlands and potential routes for utility corridors and access roads at BGAD.
Source: ACWA DEIS 2001, Fig. 7.18-2.

There are three options for access roads to be used to deliver construction materials and workers. Some road widening would be needed if existing roads were selected as access roads (Option 1). Option 2 would require new road construction for a distance of about 4,500 ft north of the west entrance to BGAD before turning east and connecting with Route 2. A wetland area of 1.5 to 2 acres in size located immediately north of Route 2 could be affected if road widening were necessary.

Fiber-optic communication cables would probably be buried by using a truck-mounted trenching device. A right-of-way up to 15 ft wide would probably be added along previously disturbed road rights-of-way. Avoidance of wetlands should be possible by limiting cable placement to road rights-of-way and by using siltation fences or straw bales at sensitive areas next to wetland vegetation.

The poles for the 69-kV power line should be able to be placed to avoid disturbing three small wetlands east and northeast of proposed Area A. Impacts of the power line on wetlands near proposed Area A or alternative Area B would be minimal if appropriate locations for poles and conductor strings were chosen prior to construction.

The following mitigation measures would reduce or eliminate construction-related impacts on wetlands beyond the immediate area of the proposed or alternative facilities:

- Routing of pipelines and power lines to avoid existing wetlands,
- Use of siltation fences or straw bales in areas where runoff is likely,
- Revegetation of disturbed areas as soon as possible after construction, and
- Proper design of a sedimentation pond on the 25-acre proposed facility site.

4.18.4 Impacts of Operations

4.18.4.1 Baseline incineration alternative

The impacts of routine operations on wetlands would be similar for the four technology alternatives. As with the effects of operations on aquatic communities addressed in Sect. 4.16.4 above, routine operations of a baseline incineration facility would have at most a slight adverse effect on nearby downwind wetlands and their biota via the atmospheric deposition of minute quantities of pollutants. Some new wetland habitat could be created below the outfall from the sanitary waste treatment facility. Treated discharge from the facility would average approximately 90,000 gal/day, i.e., a discharge flow rate of about 0.1 cfs. Although this is a low flow rate, such a flow could result in continually wet ground that would support the establishment of new wetland vegetation in a small area (perhaps a few tenths of an acre) between the outfall and Muddy Creek.

4.18.4.2 Neutralization and electrochemical oxidation alternatives

Impacts of routine operation of the two neutralization and electrochemical oxidation alternatives on wetlands and their biotic resources would be comparable to, or slightly less than the temporary, modest to negligible impacts that would likely result from operation of the baseline incineration alternative.

4.18.5 Impacts of No Action

No impacts on wetlands would occur from continued storage of chemical munitions at BGAD.

4.18.6 Cumulative Impacts

Cumulative Impacts with Other Actions. One small wetland would be directly destroyed by construction of any of the alternative technology facilities in proposed Area A. Construction in alternative Area B could affect three small wetlands. Any potential wetland impacts could be mitigated by using the measures listed in Section 4.26.7. The Army will begin formal consultation with the U.S. Fish and Wildlife Service following final site selection. The locations of the detonation facility and the molten salt operation facility avoid wetlands (U.S. Army 1998a,b). Locations of other reasonably foreseeable on-post actions would also avoid wetlands. Local off-post road construction would not affect wetlands on BGAD if standard erosion and runoff control measures are taken.

Because the amount of emissions from any of the alternatives would be small, adverse impacts on wetland vegetation and associated wildlife from the routine operation of a baseline incinerator facility would be minimal. Emissions from other reasonably foreseeable on-post sources would also be small or emitted far enough away from the incinerator site so as to contribute only negligible amounts to overall deposition. Discharge from the new sanitary waste treatment facility for any of the alternative chemical agent destruction technologies could create a small area of new wetland.

In the event two alternative technologies for agent destruction were implemented, adverse impacts from construction would essentially double, but adverse impacts on wetlands would be minimal if measures to control erosion and runoff are taken for all facilities. Likewise, adverse cumulative impacts during construction of roads in the vicinity of BGAD would be minimized if standard erosion and runoff control measures are implemented. During construction, a baseline incinerator would likely use the same gate, parking area, and access road as those used by any other alternative agent destruction facility. One small wetland in proposed Area A would be destroyed outright by construction of the sediment retention basin. Constructing a baseline incinerator in alternative Area B could adversely affect the three small wetlands located there. Depending on the corridors chosen for utility infrastructure, construction of any other alternative agent destruction facility could increase the cumulative impacts on wetlands over those associated with a baseline incinerator alone. Any potential wetland impacts could be mitigated by taking the measures listed in Section 4.26.7. The detonation facility and the molten salt operation facility have avoided wetlands. Locations of other reasonably foreseeable on-post actions would also avoid wetlands. Local off-post road construction would not affect wetlands on BGAD if standard erosion and runoff control measures were taken.

During routine operations, the emissions and deposition potential of a baseline incinerator would be low (U.S. Army 1991, 1997b; Raytheon 1996). In addition, the total stockpile to be demilitarized is fixed; if any other agent destruction alternative were implemented, fewer munitions would be demilitarized in a baseline incinerator facility, thereby reducing its overall emissions and deposition. Given the low emissions potential of other reasonably foreseeable actions or their distance from the proposed action, cumulative impacts on wetland vegetation and wildlife from a baseline incinerator, any other agent destruction alternative, and other potential facilities would be negligible to modest during routine operations.

4.19 CULTURAL RESOURCES

4.19.1 Affected Environment

4.19.1.1 Archaeological resources

Approximately one percent of BGAD's land area has been surveyed for archaeological resources. These surveys revealed 39 archaeological sites: 25 prehistoric sites, 10 historic sites, and 6 multi-component sites containing both historic and prehistoric elements. An additional 11 prehistoric and one historic isolated finds have been identified on the Depot property. Currently, none of the sites or isolated finds is listed on the National Register of Historic Places (NRHP). However, 16 of the prehistoric sites, 8 of the historic sites, and 5 of the multi-component sites are considered potentially eligible for the NRHP but require additional investigation (ACWA DEIS 2001). Figure 4.11 shows all surveyed areas and areas with a high potential for archaeological sites at BGAD. Appendix F in the ACWA DEIS (2001) presents a more detailed discussion of cultural resources at BGAD and in the surrounding area.

Two alternative locations (proposed Areas A and alternative Area B) are under consideration to be the site of the proposed facility. To date, only the southwestern portion of proposed Area A has been surveyed for archaeological resources. That survey, documented in 1983, revealed no archaeological sites. However, the southern portion of alternative Area B has been designated as having high potential for containing archaeological resources. Although no archaeological finds have been made at the precise locations where the proposed facility could be built, there are nine sites and three isolated finds recorded in the vicinity of the project area, where access road and utility line corridors could be located. Three other archaeological sites and one isolated find have been recorded north of the proposed facility sites, near possible access road or transmission line corridors. In addition, 18 historic site locations, such as farmsteads and cemeteries, were identified in the vicinity of the project area through a review of old maps (ACWA DEIS 2001).

4.19.1.2 Traditional cultural properties

The definition of a traditional cultural property is one that is eligible for inclusion in the National Register of Historic Places "because of its association with cultural practices or beliefs of a living community that 1) are rooted in the history of a community, and 2) are important to maintaining the continuity of that community's traditional beliefs and practices" (Parker, P., 1993. "Traditional Cultural Properties: What You Do and How We Think," Special Issue of *Cultural Resources Management*, Vol. 16). No traditional cultural properties are known to exist within the proposed project area. However, potentially interested Native American governments have been consulted regarding the proposed action (ACWA DEIS 2001).

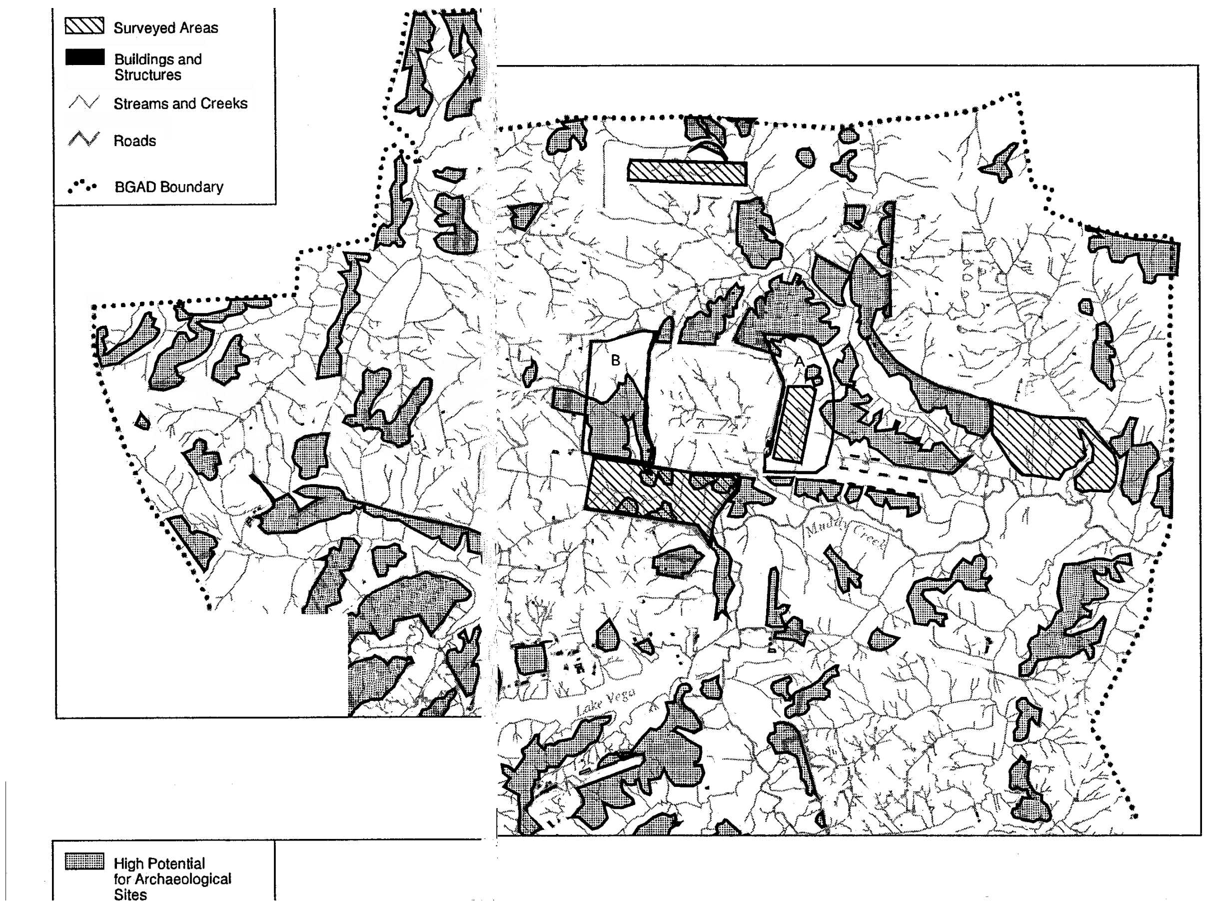

Figure 4.11. Surveyed areas and areas with a high potential for archaeological sites at BGAD.
Source: ACWA DEIS 2001, Fig. 7.18-1.

4.19.1.3 Historic structures

Because of its history as a World War II supply and storage depot, BGAD could be considered historically significant. Accordingly, the storage igloos located in the project area are considered to be potentially eligible for the NRHP (ACWA DEIS 2001).

4.19.2 Impacts of Construction

Archaeological Resources. The potential locations for the proposed facility have not been fully surveyed for archaeological resources, nor have the proposed utility and access road corridors been thoroughly examined. Findings from past archaeological surveys conducted on BGAD property indicate the potential for archaeological sites that are eligible for listing on the NRHP to be located in the proposed project area. Because of its designation as having a high potential for containing archaeological resources, the southern half of alternative Area B is more likely than other areas in BGAD to experience adverse effects as a result of the proposed project. Archaeological surveys of the previously unsurveyed portions of the selected facility, access road, and utility corridor locations are required prior to the start of any project activities, and a report documenting this investigation must be submitted to the State Historic Preservation Officer (David L. Morgan, Kentucky State Historic Preservation officer, written communication to Joe Elliott, U.S. Department of the Army, Blue Grass Army Depot, July 17, 2001). Initial steps in the consultation process have begun (see Appendix F). Upon completion of these surveys and submission of the reports, the State Historic Preservation Officer must concur with a finding of no adverse effect before construction could commence. If any sites that are eligible for the NRHP are discovered, mitigation of potential adverse effects would have to be completed before ground-breaking could begin (ACWA DEIS 2001).

Traditional Cultural Properties. Because no traditional cultural properties are known to exist within the proposed project area, no impact to such resources is anticipated. A letter sent to a dozen representatives of Native American governments soliciting input regarding any concerns or issues they might have with the proposed project yielded only one response. That respondent stated that he was not currently aware of any "culturally sensitive or sacred sites" in the project area (Jefferson Keel, Lieutenant Governor, the Chickasaw Nation, written communication to Joe Elliott, U.S. Army, Blue Grass Army Depot, May 25, 2001). However, the respondent stipulated that any inadvertent discoveries of cultural resources should be brought to the attention of approved Native American officials and result in a cessation of construction activities according to applicable laws.

Historic Structures. The structures currently located in the proposed project area are potentially eligible to be part of a BGAD historic district. However, none of those structures would be destroyed or modified during project construction. Accordingly, no adverse impact to those resources is expected.

4.19.3 Impacts of Operations

Archaeological Resources. Because routine operation of a disposal facility would not involve ground-disturbing activities, no adverse impacts on archaeological resources in the project area are expected.

Traditional Cultural Properties. Because no traditional cultural properties are known to exist within the proposed project area, no impact to such resources is anticipated.

Historic Structures. No adverse impacts to historic structures are expected, because routine operations would not affect the integrity of existing buildings.

4.19.4 Impacts of No Action

Absent an accident, continued storage of the existing weapons would have no direct affect on archaeological resources or historic structures. Because no traditional cultural properties are known to exist within the proposed project area, no impact to such resources is anticipated.

4.19.5 Cumulative Impacts

Construction and operation of the proposed project is not expected to contribute in any substantial manner to cumulative impacts on cultural resources.

4.20 SOCIOECONOMICS

4.20.1 Affected Environment

For several of the topics covered under Socioeconomics, the affected environment is a four-county region of influence (ROI) surrounding the Blue Grass Army Depot (BGAD). The four counties are Clark, Estill, Fayette, and Madison (Fig. 4.12) which, among them, house almost 70% of the current BGAD workforce. For other subjects, information is provided only for Madison County, in which BGAD is located, and its two largest municipalities, Richmond and Berea. These jurisdictions receive special attention because they are closest to the site of the proposed project and, accordingly, are expected to receive the largest share of any inmigration that might occur as a result of the proposed project. Because an accidental release of chemical agent could potentially affect agricultural activity up to 30 mi from BGAD, agricultural information is provided for all counties located entirely or partially within 30 mi of the facility.

Population. In 2000, the population of the four-county ROI was 379,835 (Table 4.33). Of this total, 70,872 (18.7%) resided in Madison County (U.S. Bureau of the Census 2001, *Profile of General Demographic Characteristics: 2000*). Richmond was home to 27,152 of the county's residents, and another 9,851 lived in Berea. During the 1980s, the population of the ROI grew at an annual average rate of 0.9%, with every county showing some increase in population. Within Madison County, Berea grew at an annual rate of 0.6%, but Richmond's population declined at the rate of 0.3% per year. From 1990 to 2000, population in the ROI grew at a much greater rate than in the 1980s, with an annual average growth rate of 1.5%. The annual growth rate for Berea was 0.8%, while Richmond reversed its decline of the previous decade and increased its population at the rate of 2.5% annually. During that same period, population for the entire Commonwealth of Kentucky grew at an annual rate of 0.9%.

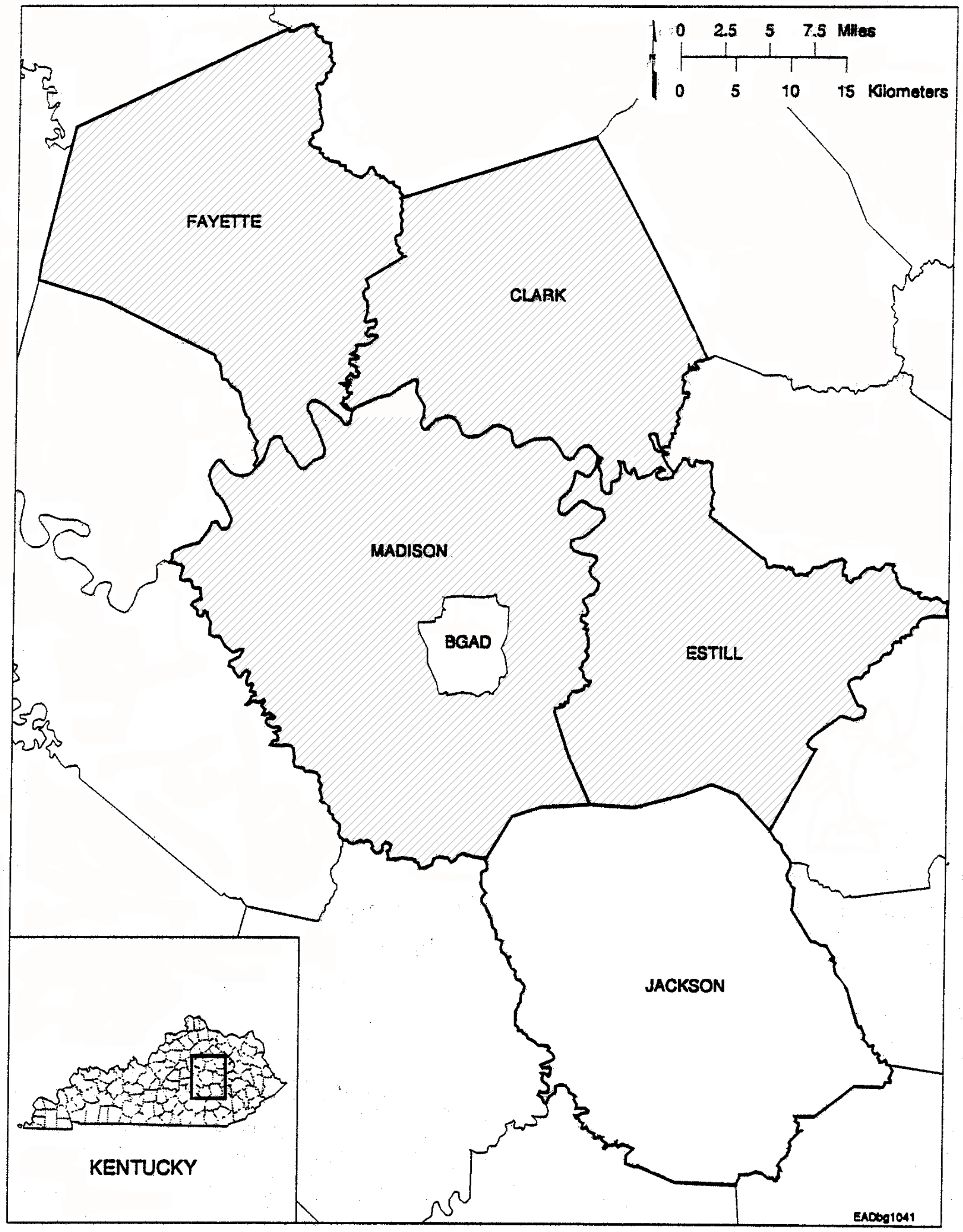

Figure 4.12. BGAD Region of Influence.
Source: Adapted from ACWA DEIS 2001, Fig. 7.19-1.

Table 4.33. Population in four-county region of influence in selected years

Location	1980	1990	Average annual growth rate (%) 1980–1990	2000[a]	Average annual growth rate (%) 1990–2000
City of Richmond	21,708	21,155	-0.3	27,152	2.5
City of Berea	8,602	9,126	0.6	9,851	0.8
Madison County	53,352	57,508	0.8	70,872	2.1
Clark County	28,322	29,496	0.4	33,144	1.2
Estill County	14,495	14,614	0.1	15,307	0.5
Fayette County	204,165	225,366	1.0	260,512	1.5
ROI total	300,334	326,984	0.9	379,835	1.5
Kentucky	3,660,324	3,685,296	0.1	4,041,769	0.9

[a] U.S. Bureau of the Census, 2001, *Census 2000 Redistricting Data (Public Law 94-171) Summary File.*

Source:; ACWA DEIS 2001, Table 7.19-1 and U.S. Bureau of the Census, 2001, *Census 2000 Redistricting Data (Public Law 94-171) Summary file*.

Employment. The resident labor force in Madison County was 37,204 in 2000. Of this number, 36, 201 were working and 1,003 were unemployed, for an average annual unemployment rate of 2.7% (Table 4.34). For the entire ROI, 202,044 residents of the four counties were employed and 4,483 were classified as unemployed, yielding a total resident labor force of 206,527 and an unemployment rate of 2.2%. The 4,483 unemployed individuals residing in the four-county area represent a labor pool that could be used to fill new jobs that would be created by the proposed project. Statewide, the average unemployment rate was 4.1% in 2000, which is higher than the rate in Madison County and the ROI as a whole.

In 2000, 28,982 persons were working at jobs located in Madison County. As shown in Table 4.35, 24.0% of these workers were employed in wholesale and retail trade, 21.4% were engaged in manufacturing, 20.6% worked for service businesses, and 19.6% had jobs in government and education. Among them, these four sectors accounted for over 85% of the jobs in Madison County. For the ROI as a whole, the economy was dominated by services (26.5%) and wholesale and retail trade (23.7%), with substantial numbers of workers also engaged in government and education (17.3%) and manufacturing (13.6%). It is also relevant to note that 11,290 workers (5.1% of all workers employed in the four county region) worked in construction.

Table 4.34. Resident labor force in four-county region of influence, 2000

Jurisdiction	Resident Labor Force	Number Employed	Number unemployed	Unemployment Rate
Kentucky	1,981,868	1,900,116	81,752	4.1%
Clark County	16,941	16,426	515	3.0%
Estill County	5,679	5,425	254	4.5%
Fayette County	146,703	143,992	2,711	1.8%
Madison County	37,204	36,201	1,003	2.7%
Total for ROI	206,527	202,044	4,483	2.2%

***Source*:** Kentucky Cabinet for Workforce Development, 2001, *Kentucky Labor Force Estimates, Annual Averages 2000*.

Currently, approximately 400 civilians are employed at BGAD, and approximately 50 work at the BGCA. Five military personnel also work at the site, either for the depot or for tenant organizations. In addition, a number of commercial and industrial tenants have moved onto the Depot in the last decade, and these enterprises employ approximately 300 civilian workers (ACWA DEIS 2001).

Personal Income. In 1999, the latest year for which data are available, per capita income in Madison County was $20,803, which represents a 5.6% annual growth rate from 1990. For the four-county ROI as a whole, per capita income was $28,279 in 1999, an annual increase of 5.5% since 1990. These figures, along with total income for all residents, are shown in Table 4.36.

Housing. The bulk of any in-moving workers are likely to settle in Madison County because of its proximity to the proposed project. Therefore, this section focuses on the availability of housing units in Madison County and its two largest municipalities, Richmond and Berea.

As shown in Table 4.37, there were approximately 400 vacant housing units for sale and 1,130 vacant units for rent in Madison County in 2000. About half of the vacant units that were for sale were located in Madison County's two largest municipalities, and over four-fifths of the vacant rental units were located in those two jurisdictions. In Richmond, approximately 140 vacant units were for sale and 675 vacant units were for rent. In Berea, there were 50 vacant units awaiting sale and 255 vacant rental units. The approximate numbers of vacant units reported above were calculated from the precise numbers of occupied units and vacancy rates contained in the Census Bureau's *Profile of General Demographic Characteristics: 2000.*

Schools. This section focuses on Madison County because that is where most in-moving workers, and any school-age children accompanying them, are expected to settle. There are 19 public schools in the Madison County School District. They include one preschool, 10 elementary schools (preschool - fifth grade), 4 middle schools (grades 6-8), 3 high schools (grades 9-12), and one day treatment center. Together they have an estimated enrollment of 9,114 students and employ 489 teachers, for a pupil:teacher ratio of 18.6 to 1 (Table 4.38). There are also three private schools in Madison County: Harvest Christian Academy, Richmond

Table 4.35. Employment in four-county region of influence by industry, 2000

	Clark County		Fayette County		Estill County		Madison County		Total for ROI	
	Number of employees	Percent of total	Number of employees	Percent of total	Number of employees	Percent of total	Number of employees	Percent of total	Number of employees	Percent of total
Mining and quarrying	N/D	—	129	0.1	51	1.7	N/D	—	N/D	—
Construction	660	4.4	9,801	5.6	45	1.5	784	2.7	11,290	5.1
Manufacturing	4,577	30.9	18,959	10.8	467	15.4	6,215	21.4	30,218	13.6
Transportation, communications, and public utilities	966	6.5	8,129	4.6	72	2.4	602	2.1	9,769	4.4
Wholesale and retail trade	3,274	22.1	41,665	23.8	669	22.0	6,949	24.0	52,557	23.7
Finance, insurance, and real estate	273	1.8	7,650	4.4	96	3.2	646	2.2	8,665	3.9
Services	2,475	16.7	49,987	28.6	359	11.8	5,970	20.6	58,791	26.5
Government and education	1,502	10.1	30,418	17.4	743	24.5	5,637	19.5	38,300	17.3
Agriculture (full-time)	482	3.2	2,283	1.3	129	4.3	635	2.2	3,529	1.6
Self-employed and unpaid family workers	621	4.2	5,995	3.4	404	13.3	1,534	5.3	8,554	3.9
Total jobs	14,835	100.0	175,016	100.0	3,035	100.0	28,982	100.0	221,868	100.0

N/D means data cannot be disclosed because one firm comprises a large part of the industry or there are too few firms.

Source: Kentucky Cabinet for Workforce Development, 2001, *Labor Market Information, 2000 Annual Averages.*

Table. 4.36. Personal income in Madison County and Four-County region of influence, 1990 and 1999

	Madison County		Four-County Region of Influence	
	Per capita income ($)	Total income (million $)	Per capita income ($)	Total income (million $)
1990	12,732	732	17,410	5,693
1999	20,803	1,408	28,279	10,165
Avg annual growth rate, 1990-1999 (%)	5.6	7.5	5.5	6.7

Source**:** U.S. Bureau of the Census 1994. *County City Data Book: 1994.* Washington, D.C., U.S. Government Printing Office; U.S. Department of Commerce 2000. *Local Area Personal Income*, http://www.bea.doc.gov/bea/regional/reis;U.S. Burea of the Census 2001. *County Population Estimates for July 1, 1999 and Population Change*, July 1, 1998 to July 1, 1999. Http://www.census.gov/population/www/estimates/co_99_1.html

Table 4.37. Housing availability in Madison County and its largest municipalities, 2000

	Madison County	Richmond	Berea
Total no. housing units	29,595	11,857	4,115
Owner-occupied units	16,219	3,802	2,125
Renter-occupied units	10,933	6,993	1,568
Homeowner vacancy rate (percent)	2.4	3.5	2.3
Rental vacancy rate (percent)	9.4	8.8	14.0
Approx no. vacant units for sale	400	140	50
Approx. no. vacant units for rent	1,130	675	255

Source**:** U.S. Bureau of the Census, 2001, *Profile of General Demographic Characteristics: 2000.*

Table 4.38. Description of school systems in Madison County and Kentucky

School System	No. of schools	Est. enrollment	No. of teachers	Pupil:teacher ratio
Madison County Public Schools[a]	19	9,114	489	18.6:1
Private schools in Madison County[a]	2	310	20	15.5:1
Berea Independent School District[a]	3	1,024	68	15.1:1
Kentucky public schools, statewide[b]	1,290	615,893	40,068	15.4:1

[a]Provides estimates for 2000-2001 school year.
[b]Describes 1999-2000 school year.
Source: Kentucky Department of Education, 2000, *2000-2001 Kentucky Schools Directory;* Kentucky Department of Education, 2000, *Kentucky Education Facts;* Dennis Grant, Director of Pupil Personnel, Berea Independent School District, personal communication with Martin Schweitzer, ORNL, June 5, 2001.

Christian Academy, which serves preschool through fifth grade, and St. Mark elementary, serving preschool through eight grade. In combination, these two schools have an enrollment of 310 students and employ 20 teachers, for a pupil:teacher ratio of 15.5 to 1. Finally, the Berea Independent School District has an elementary school (preschool-5), a middle school (grades 6-8), and a high school (grades 9-12). There are 1,024 students and 68 teachers in the district, for a pupil:teacher ratio of 15.1:1. Statewide, the pupil:teacher ratio is approximately 15.4 to 1. All the ratios reported above are much better than Kentucky's maximum allowable class sizes of 24 for K-3, 28-29 for grades 4-6, and 31 for grades 7-12 (Kentucky Department of Education, 2000, *Maximum Class Size, Answers to commonly-asked questions*).

Public Services. There are two public water systems that serve the citizens of Madison County. One is operated by the Richmond Water, Gas, and Sewerage Works and the other one is run by the Berea College Water Department. As shown in Table 4.39, average use of both systems is well below design capacity. However, *peak* use of the Richmond system exceeds 95% of existing capacity. The city of Richmond plans to expand its water treatment plant by 2005 to allow it to treat 12.0 million gallons per day (MGD). An additional expansion is envisioned, probably between 2015 and 2018, to allow the treatment of 15.0 MGD (Herschel Sparks, Richmond Water Gas, and Sewerage Works, personal communication with Martin Schweitzer, ORNL, June 6, 2001).

Sewage treatment in Madison County is provided by the Richmond Water, Gas, and Sewerage Works and the City of Berea. Richmond currently operates two separate plants, while Berea has a single sewage treatment facility. The two Richmond plants have an average discharge flow that is substantially below design capacity, but both exceed that capacity during periods of maximum discharge (Table 4.40). Maximum discharge occurs during wet weather, due to infiltration and inflow into the sewer lines. A third sewage treatment facility for Richmond, the Silver Creek Wastewater Treatment Plant, is expected to begin operation in the summer of 2001, increasing the design capacity of the entire system by 1.0 MGD (Herschel Sparks, Richmond Water Gas, and Sewerage Works, personal communication with Martin Schweitzer, ORNL, June 6, 2001). The Berea Sewage Treatment Plant operates at 99.9% of

Table 4.39. Public water supply in Madison County[a]

Utility	Treatment Plant	Design Capacity (MGD)	Peak Use (MGD)	Average Use (MGD)
Richmond Water, Gas, and Sewerage Works	Kentucky River Water Treatment Plant	9.0	8.64	5.699
Berea College Water Department	Berea College Water Treatment Plant	4.0	3.167	2.406

[a]Covers 12 month period ending February 2001.
Source: Kentucky Division of Water/Drinking Water Branch, 2001, *Kentucky Safe Drinking Water Information System*, Frankfort, Kentucky, March.

Table 4.40. Public sewage treatment facilities in Madison County[a]

Utility	Treatment Plant	Design Capacity (MGD)	Maximum Discharge Flow (MGD)	Average Discharge Flow (MGD)
Richmond Water, Gas, and Sewerage Works	Tates Creek Plant	3.0	3.94	1.854
Richmond Water, Gas, and Sewerage Works	Richmond Dreaming Creek Plant	3.65	4.0	2.325
City of Berea	Berea Sewage Treatment Plant	2.34	4.556	2.337

[a]Information is current as of the first quarter of 2001
Source: Bruce Scott, Kentucky Division of Water, Permits Branch, personal communication with Martin Schweitzer, ORNL, April 19, 2001.

design capacity even under average discharge conditions, and peak flow is nearly double the plant's design capacity. Currently, the City of Berea is working on the preliminary design for an expanded sewage treatment facility that will increase the capacity of the existing treatment plant to 4.5 MGD. The current plan is for the expansion to be completed by 2005 (Donald Blackburn, Berea Sewer Commission, personal communication with Martin Schweitzer, ORNL, April 23, 2001).

Table 4.41 shows the number of police and fire personnel employed in Madison County and its major municipalities. It also depicts the number of police and fire department employees per 1,000 residents for local jurisdictions as well as for the state as a whole. The cities of Richmond and Berea both have substantially more police and fire personnel per capita than does the state as a whole, while the non-municipal sections of the county lag behind the state, especially in terms of police protection.

Madison County has two hospitals. Berea Hospital has 167 beds and an average occupancy rate of 15%. The Pattie A. Clay Regional Medical Center, located in Richmond, has 97 beds and a typical occupancy rate of 46%. County-wide there are 98 physicians, amounting to approximately 1.5 doctors per 1,000 residents. This ratio is lower than for Kentucky as a whole, which has 2.2 physicians per 1,000 persons (ACWA DEIS 2001).

Public Finances. Major sources of revenue and categories of expenditure for the governments of Madison County, Richmond, and Berea are shown in Table 4.42. The other counties in the larger ROI are not discussed here because any need for those jurisdictions to provide public services as a result of the proposed project is expected to be minimal. The City of Richmond has by far the highest revenue and expenditure levels, followed by Berea and Madison County. The greatest source of revenues for the two municipalities is licenses and permits, while most of the county government's funding comes from taxes. The largest single category of expenditures for both Madison County and Richmond is general government, followed by public safety. In Berea, the biggest expenditure item is public safety, followed by general government and "other."

Traffic. This section focuses on those roadways in the immediate vicinity of BGAD that are expected to receive the greatest share of project-induced traffic and that have the greatest potential for experiencing adverse impacts as a result. A map of this potentially-impacted area is presented in Fig. 4.13.

Access to BGAD is afforded by U.S. 25/421, which runs north and south along the western edge of the Depot. Near Terrill, U.S. 25/421 splits into US 25, which goes to the southwest and accesses Berea, and US 421, which goes to the southeast and continues to border BGAD. The Depot's primary entrance is from US 421, on the southwest corner of the site. Another entrance is located further north, along the western boundary of BGAD on US 25/421, very near the point where Duncanon Road runs into US 25/421. One alternative under consideration is for this to be the major entrance used by workers during the construction period. Another important road in this area is Kentucky 52, which runs east and west along the northern boundary of the Depot. An alternative that has been suggested is for a new BGAD entrance to be built from KY 52 and for this to be the major construction-period access point to the proposed facility. Other roads that would probably experience increased traffic as a result of the proposed project are KY 876, which connects Interstate 75 to US 25/421, and the section of US 25 known as the Eastern Bypass, which encircles the central city of Richmond.

Table 4.43 shows existing peak hour traffic on nine key road segments and the corresponding Level of Service (LOS) of each. The table shows that current conditions during peak morning and afternoon hours are poor on many important road segments in the vicinity of BGAD. In the afternoon, the two-mile segment of US 25/421 running from Duncannon Lane (near one possible construction-period entrance to the Depot) north to Marsha Kay Drive operates at a Level of Service (LOS) of E, at which traffic is at or near capacity, causing low speeds and extremely difficult maneuvering. At LOS E, any disruption can lead to flow breakdown and severe congestion (LOS F). KY 52 along the northern border of BGAD also

Table 4.41. Police and fire personnel in Madison County and Kentucky

	Madison County		Richmond		Berea		Kentucky
Service Category	Number employed	Employees per 1,000 population	Number employed	Employees per 1,000 population	Number employed	Employees per 1,000 population	Employees per 1,000 population
Police protection	20	0.7	57	2.2	26	2.6	1.7
Fire Protection	17	0.6	52	2.0	15	1.5	0.7

Source: Adapted from ACWA DEIS, Table 7.19-7.

Table 4.42. Local government finances in Madison County

	Madison County[a]	Richmond[b]	Berea[b]
Revenues (in million $)			
Taxes	2.3	1.3	0.2
Licenses and permits	0	9.5	4.8
Intergovernmental	0.3	1.0	0.2
Charges for services	0	1.2	0.3
Fines and forfeits	0	0.1	0
Miscellaneous	0.5	0.5	0.3
Total	3.1	13.6	5.7
Expenditures (in million $)			
General government	1.8	5.2	0.7
Public safety	0.9	4.9	1.8
Highways and streets	0	0.7	0.3
Health, welfare, and sanitation	0.2	0.9	0.5
Culture and recreation	0	1.8	0.5
Debt service	0.1	0	0
Intergovernmental	0	0	0
Other	0.3	0	0.7
Total	3.2	13.5	4.5

[a]For fiscal year ended June 30,1998
[b]For fiscal year ended June 30, 1999
Source: Adapted from ACWA DEIS 2001, Table G.4.

operates at LOS E during the morning rush hour and at LOS E or D (depending on the particular segment) during the afternoon peak. LOS D is characterized by high-density stable flow in which maneuverability is severely restricted. The worst road segment in the immediate area is the segment of US 25/421 just south of its junction with the Eastern Bypass. This short segment, which nearly all project-related traffic would have to use if the main entrance were located on US 25/421 near Duncannon Lane, experiences severe congestion (LOS F) during morning and afternoon peak travel periods. Traffic along KY 876 just to the west of US 25/421 also is highly congested (mostly LOS E). In contrast, key segments of the Eastern Bypass operate at LOS C (at or near the posted speed but with maneuverability noticeably restricted) or D during peak periods (LOS definitions from Transportation Research Board 1994, *Highway Capacity Manual, Special Report 209*, 3rd ed., National Research Council, Washington, DC).

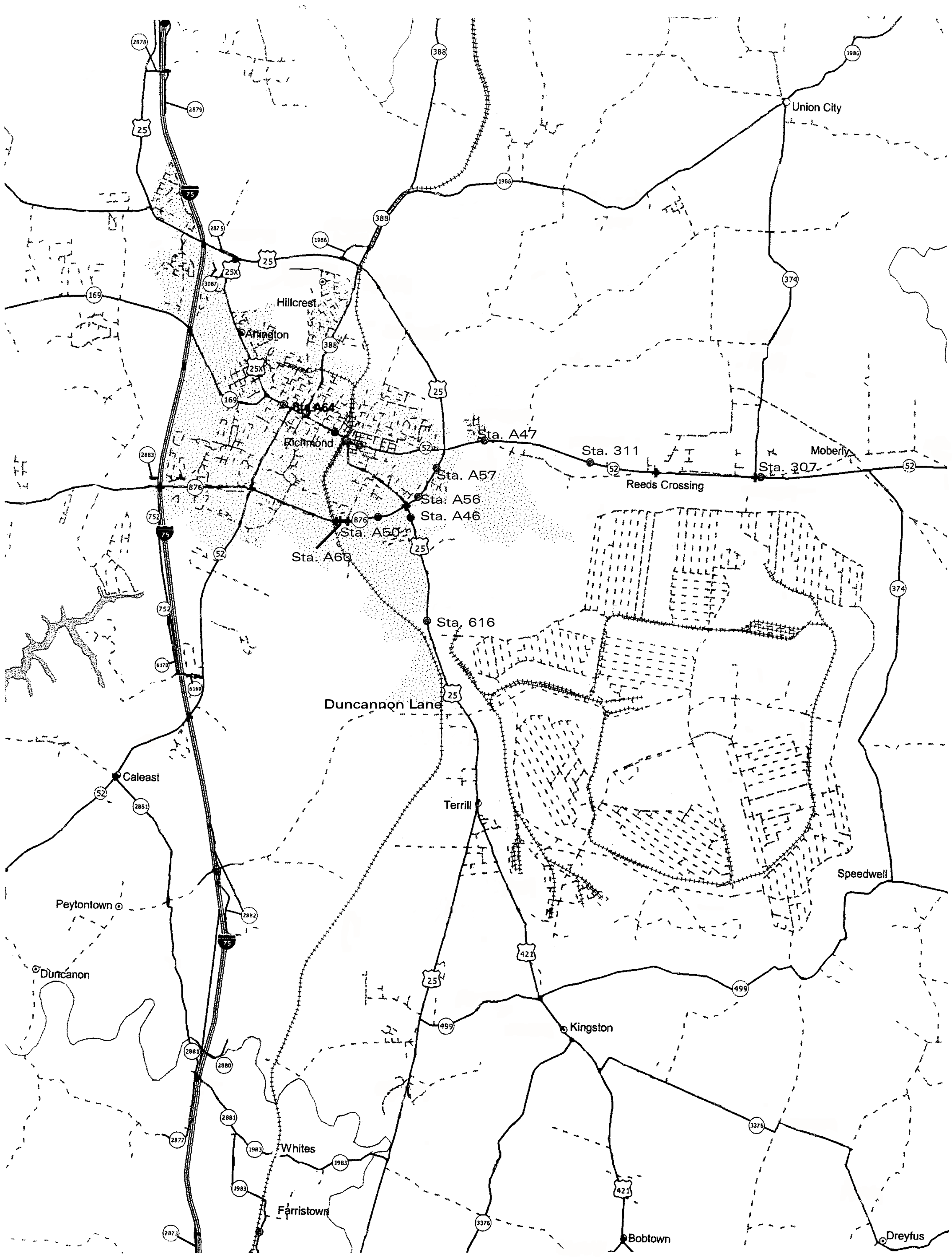

Fig. 4.13. Roadways in the immediate vicinity of BGAD.
Source: Kentucky Transportation Cabinet, March 2000.

Table 4.43. Peak hourly traffic and level of service for key road segments

Road Segment	Traffic Count Station	Morning Peak Hour Traffic Volume	Morning Level of Service	Afternoon Peak Hour Traffic Volume	Afternoon Level of Service
US 25/421, from mi. 13.073 (Duncannon Lane) to mi. 15.199 (Marsha Kay Dr.)	616	740	D	1140	E
US 25/421, from mi. 15.199 (Marsha Kay Dr.) to mi. 15.5 (Eastern Bypass)	A46	1620	F	1760	F
US 25 (Eastern Bypass), from mi. 15.5 (US 25/421) to mi. 15.824 (Commercial Dr.)	A56	1720	D	2490	C
US 25 (Eastern Bypass), from mi. 15.824 (Commercial Dr.) to mi. 16.257 (KY 52)	A57	1960	C	2230	D
KY 876, from mi. 9.169 (railroad underpass) to mi. 9.301 (Boggs Lane)	A68	1580	F	2810	E
KY 876, from mi. 9.301 (Boggs Lane) to mi. 9.998 (US 25/421)	A50	1500	E	2360	E
KY 52, from mi. 12.97 (Eastern Bypass) to mi. 13.891 (Reba Road)	A47	1520	E	1540	E
KY 52, from mi. 13.891 (Reba Road) to mi. 15.4 (Moberly)	311	1420	E	1620	D
KY 52, from mi. 15.4 (Moberly) to mi. 17.775 (KY 374)	307	1220	E	1230	D

Source: Kentucky Transportation Cabinet-Department of Highways, 2000, *Portable Traffic Recorder Report*; Transportation Research Board, 2000, *Highway Capacity Manual*, National Research Council, Washington, DC.

The Commonwealth of Kentucky is planning several expansions and improvements to key roadways in the near future. Construction of a new interchange at I-75 and Duncannon Lane is likely to begin in mid to late 2003 and to be completed in late 2005. In a related improvement, Duncannon Lane is scheduled to be widened from the new interchange to US 25. The improved roadway will be four lanes for much of its length and five lanes in the section closest to US 25. Construction is likely to begin in late 2003 or early 2004 and to last until mid 2006. In conjunction with the new interchange, the wider Duncannon Lane would provide direct access from I-75 to the Depot. Another important planned improvement is the widening of KY 52 from the Eastern Bypass to about 0.3 mile east of KY 374. The road would be widened to five lanes and would have two lanes running in each direction and a turn lane in the center. Construction is expected to begin in late 2002 and to last about two years, with an expected completion date of late 2004. Finally, there are long-range plans to widen US 25/421 to four lanes from Terrill, where it splits into two separate roads, northward to KY 876. However, the design phase for that project would not begin until 2006, and construction would not start for another three or four years after that (Robert Nunley, Kentucky Transportation Cabinet, District 7, personal communication with Martin Schweitzer, ORNL, May 30, 2002).

Agriculture. As explained earlier, the area within 30 mi of BGAD could experience agricultural effects due to an accidental release of chemical agent. Accordingly, the area described in this section consists of all those counties located entirely or in part within 30 mi of BGAD. Within this large region, there are 2.39 million acres of land in farms. Of this, 1.49 million acres are classified as cropland. The chief crops harvested are hay (approximately 435 thousand acres), tobacco (about 71,000 acres), corn (about 66,000 acres), and beans (25,000 acres). In 1997, sales of livestock amounted to $488.4 million in this area and sales of harvested crops totaled $263.3 million (ACWA DEIS 2001).

4.20.2 Destruction Impacting Factors

The primary factor that could lead to the occurrence of socioeconomic impacts in the project area is the direct employment of workers for construction and operation of the proposed facility. These direct workers receive income from the project and spend some part of it in the local economy, which creates indirect employment and income. Some portion of the construction and operation work forces are expected to move into the local area, and this typically increases the demand for housing, schools, and public services such as water and sewage treatment. In addition, all direct employees, regardless of place of residence, would use local roadways to go to and from BGAD—typically during peak travel hours—and this could adversely affect local traffic conditions. An overview of projected employment, income, and inmigration for all five destruction alternatives is provided in Table 4.44.

4.20.3 Impacts of Construction

4.20.3.1 Baseline incineration alternative

Population. It is expected that 1100 construction workers would be on site during the peak construction period. This analysis is based on the conservative estimate that 50% of these workers would move into the local area from elsewhere and that 50% of these inmovers would

Table 4.44. Projected employment, income, and inmigration resulting from project construction and operation

	Baseline Incineration		Neut/SCWO		Neut/SCWO/ GPCR		Electrochemical oxidation	
	Const	Ops	Const	Ops	Const	Ops	Const	Ops
Direct jobs	1100	720	960	720	1110	720	1260	720
Indirect jobs	825	680	710	730	810	640	900	720
Total jobs	1925	1400	1670	1450	1920	1360	2160	1440
Direct income ($ million)	36.5	33.8	31.8	33.8	36.8	33.8	41.6	33.8
Indirect income ($ million)	36.9	32.2	31.6	34.9	36.1	30	40.5	34.3
Total income ($ million)	73.4	66	63.4	68.7	72.9	63.8	82.1	68.1
New households	550	540	480	540	555	540	630	540
Total inmovers	1092	1338	953	1338	1102	1338	1251	1338
New school age children	229	281	200	281	231	281	263	281

Source: Adapted from ACWA DEIS 2001, Table 7.19-14.

bring families with them. This analysis further assumes that the average size of the inmoving family households would be 2.97 persons, the same as the average family size for Kentucky according to the 2000 Census. Indirect jobs would also be created (see below) but all of the required workers are expected to come from the local area. Accordingly, it is projected that a total of 1092 people in 550 households would move into the project area during the peak construction period. If all these new residents settled in Richmond, it would represent an increase of 4.0% over the 2000 population. For Madison County as a whole, this would amount to an increase of 1.5% and, for the four county Region of Influence, 1092 persons would represent growth of only 0.3%.

Employment. Based on the analysis performed for the ACWA DEIS (2001), this document assumes that there would be approximately 0.75 indirect jobs created for each direct one, with the exact numbers varying slightly by disposal technology. For baseline incineration, this would mean the creation of 825 indirect jobs, all of which are expected to be filled by residents of Madison County and the surrounding Region of Influence. Together with direct construction employment, this would amount to a total of 1925 new jobs. This is equal to 5.2% of the resident work force of Madison County and 0.9% of the resident work force of the four county Region of Influence. Seen another way, the number of new jobs created by the proposed project would represent 6.6% of the existing jobs located in Madison County.

Personal Income. Based on the analysis performed for the ACWA DEIS (2001), it is expected that total income generated by the proposed project as a result of direct and indirect employment would total $73.4 million. That amounts to 5.2% of the 1999 total personal income in Madison County and 0.7% of total income in the four county Region of Influence.

Housing. Each inmoving worker is expected to require one housing unit, regardless of whether or not he or she is accompanied by family members. Furthermore, it is expected that most construction workers would seek rental units, due to the relatively short-term nature of their employment. The 550 new housing units required by construction workers amounts to 81.5% of the vacant rental units in Richmond and 48.7% of the vacant rental units available throughout Madison County. Because the number of vacant rental units exceeds the projected demand, no adverse housing impacts are expected as a result of construction. If every inmoving construction worker sought to buy a house, which is extremely unlikely, the resulting demand would exceed the supply of vacant houses that are currently for sale in Madison County.

Schools. For this analysis, it is assumed that 21.0% of the total inmoving population would be school age children because that proportion of the total Kentucky population was aged 5-19 in 2000. Based on this assumption, it is projected that 229 new school-aged children would move into the area during the peak construction period. This represents 2.2 % of current total enrollment in all schools in Madison County. If all of the new students attended the Richmond County Public Schools (excluding the county's private schools and the Berea Independent School District), it would raise the average number of pupils per teacher in that school system from 18.6 to 19.1, still far below the maximum number allowed by the state. Accordingly, no adverse impacts are expected. If the decision were made to keep the pupil:teacher ratio at the previous level, it would require the hiring of 12 new teachers.

Public Services. At current rates of consumption, the addition of 1092 new residents to Madison County would increase average water usage by 0.125 million gallons per day (MGD) and would boost peak use by 0.182 MGD. This does not exceed the current capacity of Madison County's water treatment plants, even during peak periods, so no adverse impact is expected.

The project-induced population increase described above would raise average discharge flow to sewage treatment facilities in Madison County by 0.1 MGD and would increase maximum discharge flow by 0.193 MGD. This amount of average discharge could be easily accommodated by existing sewage treatment facilities in Richmond, but it would exceed current capacity in Berea. However, Berea has plans to add approximately another 2.2 MGD to its sewage treatment capacity by 2005, part-way through the construction period. In all of Madison County's sewage treatment facilities, design capacity is occasionally exceeded during maximum flow conditions, but this is a fairly common occurrence in many areas. Because average discharge associated with project-induced population growth could be easily handled by existing or expected sewage treatment facilities, no lasting adverse impacts are expected to result from project construction. However, if large numbers of inmovers were to settle in Berea before planned improvements are made, there could be temporary adverse impacts on the city's already-strained sewage treatment system.

If all 1092 new residents settled in rural Madison County, one additional police officer would be needed to maintain the existing service level of 0.7 officers per 1,000 county residents. If these inmovers all settled in the city of Richmond, where the existing service level is considerably higher (2.2 police officers per 1,000 residents), two new officers would be required to maintain existing levels of protection. Similarly, one new fire fighter would be needed in rural Madison County or two in Richmond to maintain existing levels of fire protection (0.6 fire fighters per 1,000 residents in rural Madison County and 2.0 per 1,000 persons in Richmond). To maintain the existing ratio of physicians to county residents (1.5 per 1,000 population), two new physicians would be needed in Madison County.

Public Finances. Because relatively few new public service employees would be required to maintain existing service levels in the local area, and because the additional service needs would be relatively short-lived, any impact on public finances is expected to be minimal.

Traffic. As shown in Section 4.20.1, existing traffic conditions are already poor along US 25/421, KY 52, and KY 876 in the vicinity of BGAD during peak travel hours. Adding substantial numbers of construction workers to those road segments during morning and afternoon rush hours would make those conditions worse. For this analysis, it was assumed that 900 additional passenger vehicles would be added to local roadways during peak periods. That number is slightly less than the 1100 construction workers projected for peak construction to reflect the possibility that some of those workers might car pool or would not access the plant from the same direction as most of the construction work force. The finding of the traffic analysis is that all key segments of US 25/421, KY 52, and KY 876 shown in Table 4.33 would experience Levels of Service of F (severe congestion) during the afternoon peak period and most of those segments would have LOS F during the morning rush hour as well.

In addition to the traffic associated with construction workers commuting to and from the proposed project, a certain number of trips by trucks bringing in construction materials and other supplies and removing waste materials would be required. Projections made for a proposed chemical demilitarization facility at the Pueblo Chemical Depot in Colorado indicated that a total of 80 daily trips (40 round trips) by trucks of various sizes would occur during the construction period (*Pueblo Chemical Demilitarization Facility Transportation Assessment*, May 24, 2001, by SAIC for Program Manager for Chemical Demilitarization). A similar number of truck trips are likely to occur at BGAD. It is expected that most of those trips would probably take place at times other than during peak morning and afternoon commuting periods and therefore would not add appreciably to the road congestion described in the previous paragraph.

The traffic analysis described above indicates that under current road conditions, adverse impacts would be significant as a result of construction-period traffic, regardless of which entrance to BGAD was used. However, the planned expansion of KY 52 to five lanes is scheduled for completion by late 2004, at the same approximate time that construction would begin at BGAD. If that road improvement project proceeds as scheduled, the adverse traffic impacts described above would not occur provided that all construction-period traffic accesses BGAD via KY 52. Under such circumstances, it is likely that a traffic signal would be needed on KY 52 at the plant entrance, and it is recommended that the state study this situation and install a light prior to the beginning of project construction, if needed.

The construction of a new I-75 interchange at Duncannon Lane and the widening of Duncannon Lane from I-75 to US 25/421 would provide an alternative route to BGAD that would also avoid the adverse impacts associated with current road conditions. However, the Duncannon Lane expansion is not scheduled for completion until mid 2006, about one and a half years after construction of the proposed disposal facility would begin. Therefore, it is recommended that KY 52 serve as the primary access point to BGAD during project construction, provided that the improvements described above proceed according to schedule.

Agriculture. No adverse effect on area agricultural resources are expected to occur as a result of project construction.

4.20.3.2 Neutralization/SCWO alternative

It is expected that 960 construction workers would be on site during the peak construction period. Using the same assumptions described in Section 4.20.3.1, it is projected that a total of 953 people in 480 households would move into the project area. If all of those new residents settled in Richmond, it would represent an increase of 3.5% over the 2000 population. That would amount to an increase of 1.3% for all of Madison County and 0.3% for the four county Region of Influence. It is further expected that a total of 1670 new jobs would be created, which equals 4.5% of the resident workforce of Madison County, 0.8% of the resident workforce of the four-county ROI, and 5.8% of the existing jobs located in Madison County. Total personal income generated by the proposed project would be $63.4 million, which equals 4.5% of the 1999 total personal income in Madison County and 0.6% of total income in the entire ROI.

Four hundred eighty new housing units would be required during the peak construction period, amounting to 71.1 % of the vacant rental units in Richmond and 42.5% of the vacant rental units available throughout Madison County. No adverse housing impacts are expected because the number of available rental units exceeds projected demand. Because the projected numbers of total inmovers and school age children are similar to those described in Section 4.20.3.1 for Baseline Incineration, it is expected that the impacts associated with Neutralization/SCWO will be basically the same, meaning that no adverse impacts to schools, public services, public finances, or agriculture are anticipated, with the exception of a possible temporary adverse effect on Berea’s currently-strained sewage treatment system. Regarding local traffic, adverse impacts would be significant under current road conditions. However, the planned widening of KY 52, along with the use of that road as the primary construction-period access point to BGAD and the possible placement of a traffic light at the plant entrance, is expected to prevent significant adverse impacts from occurring.

Because there is substantial uncertainty associated with the construction workforce projection for this technology, a bounding analysis was conducted to examine how socioeconomic impacts would vary if the number of workers was approximately 35% more or less than the number used in the above analysis. At the lower bound (600 peak-period construction workers), it is expected that no adverse impacts to housing, schools, public finances, or agriculture would occur, as described above. Even with this reduced workforce, there could still be a possible temporary adverse effect to Berea’s sewage treatment system, but no other adverse public service impacts are expected. Significant adverse impacts to traffic are still expected under current road conditions, but those impacts could be prevented by the timely widening of KY 52 , using that road as the primary construction-period access point to BGAD, and possibly placing a traffic light at the new plant entrance. At the upper bound (1300 workers), impacts are expected to be largely the same as those described for 960 workers, except that the temporary impacts to Berea’s sewage treatment system and the adverse traffic impacts would be somewhat greater. Once again, those traffic impacts could be prevented by implementation of the measures described above.

4.20.3.3 Chemical neutralization followed by SCWO and gas phase chemical reduction (GPCR)

It is expected that 1110 construction workers would be on site during the peak construction period. Using the same assumptions described in Section 4.20.3.1, it is projected that a total of 1102 people in 555 households would move into the project area. If all of those new residents settled in Richmond, it would represent an increase of 4.1% over the 2000 population. That would amount to an increase of 1.6% for all of Madison County and 0.3% for the four county Region of Influence. It is further expected that a total of 1920 new jobs would be created, which equals 5.2% of the resident workforce of Madison County, 0.9% of the resident workforce of the four-county ROI, and 6.6% of the existing jobs located in Madison County. Total personal income generated by the proposed project would be $72.9 million, which equals 5.2% of the 1999 total personal income in Madison County and 0.7% of total income in the entire ROI.

Five hundred fifty-five new housing units would be required during the peak construction period, amounting to 82.2% of the vacant rental units in Richmond and 49.1% of the vacant rental units available throughout Madison County. No adverse housing impacts are expected because the number of available rental units exceeds projected demand. Because the projected numbers of total inmovers and school age children are very similar to those described in Section 4.20.3.1 for Baseline Incineration, it is expected that the impacts associated with Neutralization/SCWO/GPCR will be basically the same, meaning that no adverse impacts to schools, public services, public finances, or agriculture are anticipated, with the exception of a possible temporary adverse effect on Berea’s currently-strained sewage treatment system. Regarding local traffic, adverse impacts would be significant under current road conditions. However, the planned widening of KY 52, along with the use of that road as the primary construction-period access point to BGAD and the possible placement of a traffic light at the plant entrance, is expected to prevent significant adverse impacts from occurring.

Because there is substantial uncertainty associated with the construction workforce projection for this technology, a bounding analysis was conducted to examine how socioeconomic impacts would vary if the number of workers was approximately 35% more or less than the number used in the above analysis. At the lower bound (700 peak-period construction workers), it is expected that no adverse impacts to housing, schools, public finances, or agriculture would occur, as described above. Even with this reduced workforce, there could still be a possible temporary adverse effect to Berea’s sewage treatment system, but no other adverse public service impacts are expected. Significant adverse impacts to traffic are still expected under current road conditions, but those impacts could be prevented by the timely widening of KY 52 , using that road as the primary construction-period access point to BGAD, and possibly placing a traffic light at the new plant entrance. At the upper bound (1500 workers), impacts are expected to be largely the same as those described for 1110 workers, except that the number of housing units required (about 750) would slightly exceed the number of vacant rental units available in Richmond (675). However, there are still plenty of vacant rental units in Madison County as a whole (1130) to accommodate the increased demand. The temporary impacts to Berea’s sewage treatment system and the adverse traffic impacts would be somewhat greater than with 1110 workers, but significant traffic impacts could be prevented by implementation of the measures described above.

4.20.3.4 Electrochemical oxidation technology

It is expected that 1260 construction workers would be on site during the peak construction period. Using the same assumptions described in Section 4.20.3.1, it is projected that a total of 1251 people in 630 households would move into the project area. If all of those new residents settled in Richmond, it would represent an increase of 4.6% over the 2000 population. That would amount to an increase of 1.8% for all of Madison County and 0.3% for the four county Region of Influence. It is further expected that a total of 2160 new jobs would be created, which equals 5.8% of the resident workforce of Madison County, 1.0% of the resident workforce of the four-county ROI, and 7.5% of the existing jobs located in Madison County. Total personal income generated by the proposed project would be $82.1 million, which equals 5.8% of the 1999 total personal income in Madison County and 0.8% of total income in the entire ROI.

Six hundred thirty new housing units would be required during the peak construction period, amounting to 93.3 % of the vacant rental units in Richmond and 55.6% of the vacant rental units available throughout Madison County. No adverse housing impacts are expected because the number of available rental units exceeds projected demand. Because the projected numbers of total inmovers and school age children are similar to those described in Section 4.20.3.1 for Baseline Incineration, it is expected that the impacts associated with the electrochemical oxidation technology will be basically the same, meaning that no adverse impacts to schools, public services, public finances, or agriculture are anticipated, with the exception of a possible temporary adverse effect on Berea’s currently-strained sewage treatment system. Regarding local traffic, adverse impacts would be significant under current road conditions. However, the planned widening of KY 52, along with the use of that road as the primary construction-period access point to BGAD and the possible placement of a traffic light at the plant entrance, is expected to prevent significant adverse impacts from occurring.

Because there is substantial uncertainty associated with the construction workforce projection for this technology, a bounding analysis was conducted to examine how socioeconomic impacts would vary if the number of workers was approximately 35% more or less than the number used in the above analysis. At the lower bound (800 peak-period construction workers), it is expected that no adverse impacts to housing, schools, public finances, or agriculture would occur, as described above. Even with this reduced workforce, there could still be a possible temporary adverse effect to Berea’s sewage treatment system, but no other adverse public service impacts are expected. Significant adverse impacts to traffic are still expected under current road conditions, but those impacts could be prevented by the timely widening of KY 52 , using that road as the primary construction-period access point to BGAD, and possibly placing a traffic light at the new plant entrance. At the upper bound (1700 workers), impacts are expected to be largely the same as those described for 1260 workers, except that the number of housing units required (about 850) would exceed the number of vacant rental units available in Richmond (675). However, there are still plenty of vacant rental units in Madison County as a whole (1130) to accommodate the increased demand. The temporary impacts to Berea’s sewage treatment system and the adverse traffic impacts would be somewhat greater than with 1260 workers, but significant traffic impacts could be prevented by implementation of the measures described above.

4.20.4 Impacts of Operation

The impacts of that would be expected as a result of constructing any of the destruction technology alternatives would disappear at the conclusion of construction. These impacts, however, would be replaced by impacts resulting from operating the selected technology alternatives. This section identifies those impacts.

4.20.4.1 Baseline incineration alternative

Population. It is expected that 720 workers would be required to operate the proposed facility. This analysis is based on the conservative estimate that 75% of these workers would move into the local area from elsewhere. This number is higher than was assumed for project construction, because plant operator jobs are highly specialized and it is expected that many of the operators would come from outside the local area. It is further assumed that 75% of the inmovers would bring families with them. Again, this is higher than for construction, due to the fact that most operations jobs are expected to last longer than the typical construction position. As was the case for construction, this analysis assumes that the average size of each inmoving family household would be 2.97 persons, the same as the average family size for Kentucky. Indirect jobs would also be created (see below) but all of the required workers for those positions are expected to come from the local area. Accordingly, it is projected that a total of 1338 people in 540 households would move into the project area during the operations period. If all of these new residents settled in Richmond, it would represent an increase of 4.9% over the 2000 population. For Madison County as a whole, this would amount to an increase of 1.9%. Compared to the entire population of the four county Region of Influence, an additional 1338 persons would represent population growth of only 0.4%.

Employment. Based on the analysis performed for the ACWA DEIS (2001), this document assumes that there would be approximately 0.95 indirect jobs created for each direct one, with the exact numbers varying slightly by disposal technology. For baseline incineration, this would mean the creation of 680 indirect jobs, all of which are expected to be filled by residents of Madison County and the surrounding Region of Influence. Together with direct construction employment, this would amount to a total of 1400 new jobs. This is equal to 3.8% of the resident work force of Madison County and 0.7% of the resident work force of the four-county Region of Influence. Presented another way, the number of new jobs created by the proposed project would represent 4.8% of the existing jobs located in Madison County.

Personal Income. Based on the analysis performed for the ACWA DEIS(2001), it is expected that total income generated by the proposed project as a result of direct and indirect employment would total $66.0 million. That amounts to 4.7% of the 1999 total personal income in Madison County and 0.6% of total income in the four-county Region of Influence.

Housing. Each inmoving worker is expected to require one housing unit, regardless of family status. Because operations workers would tend to stay in the area longer than construction workers, it is likely that they would be more inclined to buy a house than would construction workers, but many of them are also likely to rent. Therefore, a mix of both rental and owned units would be sought. The 540 new housing units required by operations workers amounts to 80.0% of the vacant rental units in Richmond and 47.8% of the vacant rental units available throughout Madison County. Clearly, there are enough rental units in Richmond and Madison County to accommodate all inmoving workers. However, if a sizable majority of the inmoving workforce (75% or more) sought to buy houses, there would not be enough units available in Madison County. Such a situation could lead to limited choices and higher prices for buyers or encourage them to locate outside of Madison County.

Schools. For this analysis, it is assumed that 21.0% of the total inmoving population would be school age children because that proportion of the Kentucky population was aged 5-19 in 2000. Based on this assumption, it is projected that 281 new school-aged children would move into the area during the operations period. This represents 2.7% of current total enrollment in all schools in Madison County. If all of the new students attended the Madison County Public Schools (which do not include the Berea Independent School District or the county's parochial schools) it would raise the average number of pupils per teacher from 18.6 to 19.2, which is still far below the maximum number allowed by the state. Accordingly, no adverse impacts are expected. If the decision were made to keep the pupil:teacher ratio at the previous level, it would require the hiring of 15 new teachers.

Public Services. At current rates of consumption, the addition of 1338 people to the Madison County population would increase average water usage by 0.153 million MGD and would boost peak use by 0.223 MGD. This does not exceed the current capacity of Madison County's water treatment plants, even during peak periods, so no adverse impact is expected.

The project-induced population increase described above would raise average discharge flow to sewage treatment facilities in Madison County by 0.123 MGD and would increase maximum discharge flow by 0.236 MGD. This amount of average discharge could be easily accommodated by existing sewage treatment facilities in Richmond, but it would exceed current capacity in Berea. However, as explained in Sect. 4.20.3, Berea has plans to add approximately another 2.2 MGD to its sewage treatment capacity by 2005, well before project operations are scheduled to begin. Because average discharge associated with project-induced population growth could be easily handled by a combination of existing and expected sewage treatment facilities, no adverse impacts are expected provided that planned improvements are made to the Berea plant before the onset of project operations.

If all 1338 new residents settled in rural Madison County, one additional police officer would be needed to maintain the existing service level of 0.7 officers per 1,000 county residents. If these inmovers all settled in the city of Richmond, where the existing service level is considerably higher (2.2 police officers per 1,000 residents), three new officers would be required to maintain existing levels of protection. Similarly, one new fire fighter would be needed in rural Madison County or three in Richmond to maintain existing levels of fire protection (0.6 fire fighters per 1,000 residents in rural Madison County and 2.0 per 1,000 persons in Richmond). To maintain the existing ratio of physicians to county residents (1.5 per 1,000 population), two new physicians would be needed in Madison County.

Public Finances. Because relatively few new public service employees would be required to maintain existing service levels in the local area, and because the additional service needs are likely to cease at the end of plant operations, any impact on public finances is expected to be minimal.

Traffic. As explained in Section 4.20.3.1, levels of service are currently poor along US 25/421, KY 52, and KY 876 during peak travel hours and adding substantial numbers of commuting workers under existing road conditions would make things worse. The number of truck trips required during the operation period for the removal of waste products would average less than two per day and would not add appreciably to road congestion. By the time that project operations begin, KY 52 is expected to have been expanded to five lanes, which should alleviate the adverse impacts from project-related passenger vehicles, that would otherwise be expected. In addition, the expected completion of a new interchange on I-75 and the associated expansion of Duncannon Lane would provide a good alternative route to BGAD. Provided that one or both of those planned improvements are completed prior to the onset of operations, that an appropriate entrance point to the Depot is used, and that a traffic signal is provided on KY 52 if needed, no substantial impacts are expected. However, in the unlikely event that the planned improvements are not made on time, adverse impacts could be significant as a result of operations-period traffic.

Agriculture. No adverse effects on area agricultural resources are expected to occur as a result of operations.

4.20.4.2 Neutralization and electrochemical oxidation alternatives

The number of direct operations workers needed for these alternatives is the same as for Baseline Incineration. The number of indirect workers would vary slightly among alternative disposal technologies, but all indirect workers are expected to come from the local labor pool and would not result in any inmigration to the area. Accordingly, the expected effects on population, housing, schools, public services, public finances, traffic, and agriculture are expected to be the same for this alternative as for Baseline Incineration (Section 4.20.4.1).

A total of 1450 new jobs (direct plus indirect) would be created as a result of the neutralization/SCWO alternative. This amounts to 3.9% of the resident workforce of Madison County, 0.7% of the resident workforce of the four-county ROI, and 5.0% of the existing jobs located in Madison County. Total income generated by the proposed project would be $68.7 million, which equals 4.9% of the 1999 total personal income in Madison County and 0.6% of total income in the entire ROI.

A total of 1360 new jobs (direct plus indirect) would be created as a result of the neutralization/SCWO-GPCR alternative. This amounts to 3.7% of the resident workforce of Madison County, 0.7% of the resident workforce of the four-county ROI, and 4.7% of the existing jobs located in Madison County. Total income generated by the proposed project would be $63.8 million, which equals 4.5% of the 1999 total personal income in Madison County and 0.6% of total income in the entire ROI.

A total of 1440 new jobs (direct plus indirect) would be created as a result of the electrochemical oxidation alternative. This amounts to 3.9% of the resident workforce of Madison County, 0.7% of the resident workforce of the four-county ROI, and 5.0% of the existing jobs located in Madison County. Total income generated by the proposed project would be $68.1 million, which equals 4.8% of the 1999 total personal income in Madison County and 0.7% of total income in the entire ROI.

4.20.5 Impacts of No Action

Under the no action alternative, current baseline conditions described in Sect. 4.20.1 are expected to continue largely unchanged. None of the potential impacts identified in Sections 4.20.3 and 4.20.4 are expected to occur in the absence of project construction and operations.

4.20.6 Cumulative Impacts

Construction and operation of the proposed project could combine with other actions taken in the local area to create cumulative socioeconomic impacts. The major off-post actions that could lead to cumulative socioeconomic impacts are road construction in the nearby area and the expansion of industrial facilities located west of BGAD in the vicinity of Duncannon Lane. Should the planned widening of KY 52 be delayed, causing construction of the proposed facility at BGAD to commence before the completion of road construction, significant adverse traffic impacts could occur. Such adverse impacts would be due to the need to accommodate substantial numbers of project-related vehicles on KY 52 during a period when road capacity could actually be diminished as a result of ongoing road construction activities. Additional industrial activity to the west of BGAD could add to the congestion on US25/421 as greater numbers of workers attempt to use road segments that are already heavily traveled. If additional workers are attracted to Madison County from outside the local area in response to off-post industrial expansion, the possible temporary adverse impacts to Berea's sewage treatment capacity could be exacerbated. In addition, the competition for housing would increase, which could further limit choices and/or raise prices for would-be buyers. On the positive side, additional industrial activity in the local area would add to local employment and increase overall personal income.

4.21 ENVIRONMENTAL JUSTICE

Executive Order 12898 (*Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*) was issued by President Clinton on February 11, 1994. It directs all federal agencies to consider environmental justice issues so that its actions will not have "disproportionately high and adverse human health or environmental effects on minority and low income populations."

The impact area for the environmental justice analysis is defined as the entire area within 30 mi of the proposed site, to correspond to the analysis of potential health and safety impacts. This area encompasses all or part of 20 counties: Bourbon, Boyle, Clark, Estill, Fayette, Garrard, Jackson, Jessamine, Laurel, Lee, Lincoln, Madison, Menifee, Mercer, Owsley, Powell, Pulaski, Rockcastle, Wolfe, and Woodford. The racial/ethnic and income characteristics of each of those counties is examined. To provide a finer level of detail, this document also provides information by census tracts, which are relatively permanent statistical subdivisions of counties that typically contain between 2,500 and 8,000 residents.

Census tracts with disproportionate numbers of minority or low-income populations are identified by comparing them to the proportions of minority and low-income populations in the Commonwealth of Kentucky as a whole. According to the 2000 Census, 10.7% of the state's residents classified themselves as belonging to a minority group or being Hispanic [U.S. Census Bureau, 2001, *Census 2000 Redistricting Data (Public Law 94-171) Summary file)]*. Because income data are not yet available from the 2000 census, data from the 1990 Census are used for that analysis. Low-income people are defined as all members of a household whose annual income fell below the federally-defined poverty threshold. In Kentucky as a whole, 19.0% of the population fell below that level (U.S. Census Bureau, 1992, *1990 Summary Tape File 3 (STF3) - Sample Data)*. For this analysis, a census tract is considered to have a disproportionate number of minority or low-income residents if the percentage of these groups is 20 percentage points or more above the state average. In other words, a census tract with 30.7% or more minority residents would be considered to have a disproportionately high minority population. Similarly, a tract with 39.0% or more of its residents living below the poverty level would be classified as being disproportionately low-income.

4.21.1 Existing Conditions

4.21.1.1 Minority populations

Data for this analysis come from the 2000 Census, in which respondents were asked to indicate which race or races they considered themselves to be. Minorities are defined in this document as those people reporting themselves as being a member of a racial minority or an Hispanic of any race. For this analysis, racial minorities consist of people identifying themselves as belonging to any of the following groups: Black or African American only, American Indian or Alaska Native only, Asian only, Native Hawaiian and Other Pacific Islander only, some other race only, or two or more races (i.e., all categories except White only). A detailed description of the racial and ethnic characteristics of residents of Madison County is provided in Table 4.45. It shows that 7.6% of the county’s residents identify themselves as Hispanic or as members of a racial minority. By far the largest racial minority group is Black/African American (4.4%), followed by “two or more races” (1.1%) and Asian (0.7%). One percent of the county’s population reported themselves as being Hispanic or Latino (any race).

Table 4.46 shows the number and percentage of minority populations in each of the 20 counties listed above. The county with the highest minority population is Fayette (20.8%), in which the city of Lexington is located. Other counties with relatively high minority populations are Boyle (13.0%), located to the southwest of Madison County, and Bourbon (10.7%) and Woodford (9.8%), which are adjacent to Fayette County.

Table 4.47 and Fig. 4.14 show that 12 census tracts (out of 167 Census Tracts listed for the 20 counties in the 2000 Census) have disproportionately large percentages of minority residents. All of these census tracts are located in Fayette County and, with one exception (tract 37) they are located entirely or in large part within the city limits of Lexington.

4.21.1.2 Low income populations

Data for this analysis come from the 1990 Census and describe conditions in 1989, because income data from the 2000 census are not yet available at the census tract level. As mentioned earlier, low-income people are defined as all members of a household whose annual income fell below the federally-defined poverty threshold. The precise number varies based on family size and the ages of individuals in the family. For a family of four, the average poverty threshold annual income in 1989 was $12,674 (U.S. Census Bureau, 2001, *Current Populations Survey).*

Table 4.45. Detailed racial and ethnic description of Madison County, 2000

	Number of People	Percent of Total Population
Total Population	70,872	100.0
Non-Hispanic		
White	65,484	92.4
Black or African American	3,138	4.4
American Indian or Alaska Native	187	0.3
Asian	505	0.7
Native Hawaiian or other Pacific islander	14	0.02
Some other race	69	0.1
Two or more races	790	1.1
Hispanic or Latino (any race)	685	1.0
Total Minority Population (all non-Hispanic racial minorities plus Hispanic/Latino)	5,388	7.6

U.S. Census Bureau, 2001, *Census 2000 Redistricting Data (Public Law 94-171) Summary file).*

Table 4.48 shows the number and percentage of low-income populations in 1989 for each of the 20 counties listed above. The county with the highest percentage of low-income residents is Owsley (52.1%), a sparsely populated county located well to the southeast of BGAD. Other counties with relatively high low-income populations are Wolfe (44.3%), Jackson (38.2%), Menifee (35.0%), Lee (33.3%), and Rockcastle (30.7%).

Table 4.46. Minority population of Kentucky and 20 county area, 2000

	Total Population	Minority Population	Percent Minority
Kentucky	4,041,769	433,756	10.7
Bourbon Co.	19,360	2,075	10.7
Boyle Co.	27,697	3,611	13.0
Clark Co.	33,14	2,312	7.0
Estill Co.	15,307	205	1.4
Fayette Co.	260,512	54338	20.9
Garrard Co.	14,792	745	5.0
Jackson Co.	13,495	173	1.3
Jessamine Co.	39,041	2337	6.0
Laurel Co.	52,715	1461	2.8
Lee Co.	7,916	539	6.8
Lincoln Co.	23,361	1012	4.3
Madison Co.	70,872	5388	7.6
Menifee Co.	6,556	200	3.1
Mercer Co.	20,817	1369	6.6
Owsley Co.	4,858	73	1.5
Powell Co.	13,237	268	2.0
Pulaski Co.	56,217	1760	3.1
Rockcastle Co.	16,582	281	1.7
Wolfe Co.	7,065	84	1.2
Woodford Co.	23,208	2264	9.8

U.S. Census Bureau, 2001, Census 2000 Redistricting Data (Public Law 94-171) Summary file

Table 4.47. Census tracts with disproportionate minority populations, 2000

	Total Population	Minority Population	Percent Minority
Fayette County			
Census Tract 1	4894	1741	35.6
Census Tract 2	3828	1811	47.3
Census Tract 3	3341	2402	71.9
Census Tract 4	2383	1575	66.1
Census Tract 10	1071	381	35.6
Census Tract 11	4254	2848	66.9
Census Tract 13	1839	619	33.7
Census Tract 20	7809	2942	37.7
Census Tract 31.02	2695	1357	50.4
Census Tract 37	5662	2082	36.8
Census Tract 38.01	7198	5764	80.1
Census Tract 39.01	5684	1961	34.5

U.S. Census Bureau, 2001, *Census 2000 Redistricting Data (Public Law 94-171) Summary file.*

County-level income data for 1999 have just become available from the 2000 Census. These data indicate that the proportion of low-income residents has fallen slightly for the State of Kentucky and for each of the 20 counties listed above. Statewide, the number of people falling below the poverty threshold declined by about three percentage points. In the 20 county impact area, the decline in the poverty rate ranged from less than one percentage point in Woodford County to about eight percentage points in Jackson County. Most of the counties saw their poverty rates fall by between two and five percentage points. This means that the 1989 data presented below are probably conservative, and could slightly overstate the current number of disproportionately low-income census tracts in the impact area.

Table 4.49 and Fig. 4.15 show that 14 census tracts (out of 160 census tracts listed for the 20 counties in the 1990 Census) had disproportionately large percentages of low-income residents in 1989. Four of these census tracts are located in Fayette County. Most of the others are located in three sparsely-populated rural counties to the east and southeast of BGAD: Jackson, Owsley, and Wolfe Counties. The remaining two of the disproportionately low-income census tracts are located in Madison County, roughly in the center of the city of Richmond. It should be noted that the city of Richmond has an extremely high percentage of 20-24 year olds, with 23.4% of Richmond’s population falling into that age group as compared to only 7.0% for

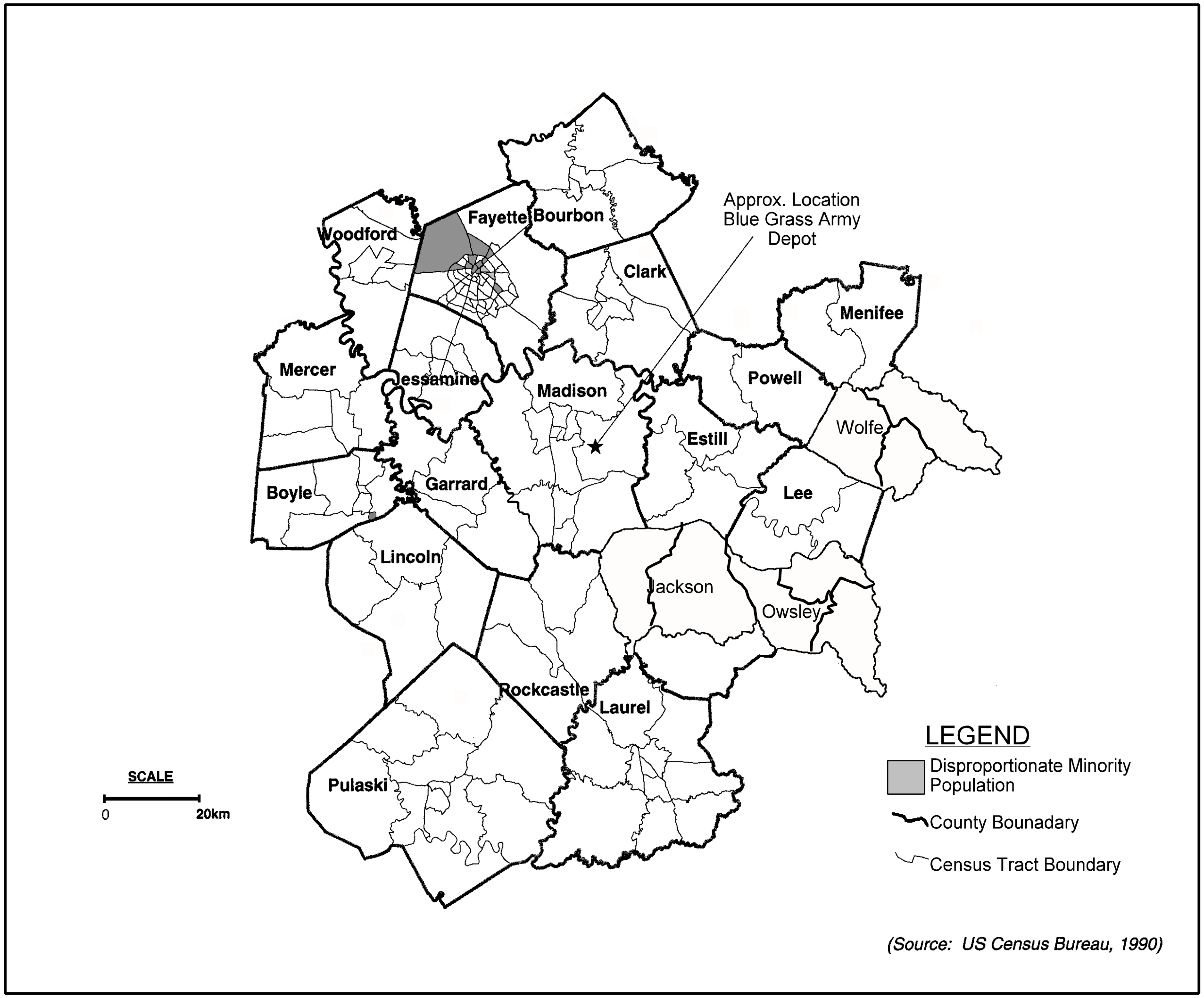

Fig. 4.14. Census tracts with disproportionate minority population within 50 km of the Blue Grass Army Dept.

Table 4.48. Low-income population of Kentucky and 20 county area, 1989

	Total Population for which Poverty Status is Determined	Low-Income Population	Percent Low-Income
Kentucky	3,582,459	681,827	19.0
Bourbon Co.	18,982	3330	17.5
Boyle Co.	23,637	4043	17.1
Clark Co.	29,119	5142	17.6
Estill Co.	14,465	4199	29.0
Fayette Co.	209,896	30,108	14.3
Garrard Co.	11,498	2076	18.1
Jackson Co.	11,884	4544	38.2
Jessamine Co.	29,257	3848	13.2
Laurel Co.	42,921	10,630	24.8
Lee Co.	7229	2704	33.3
Lincoln Co.	19,789	5375	27.2
Madison Co.	51,209	10,859	21.2
Menifee Co.	5070	1776	35.0
Mercer Co.	18,982	3167	16.7
Owsley Co.	4930	2570	52.1
Powell Co.	11,557	3032	26.2
Pulaski Co.	48,277	10,954	22.7
Rockcastle Co.	14,637	4498	30.7
Wolfe Co.	6403	2835	44.3
Woodford Co.	19,588	1538	7.9

Source: U.S. Census Bureau, 1992, *1990 Summary Tape File 3 (STF 3)-Sample Data.*

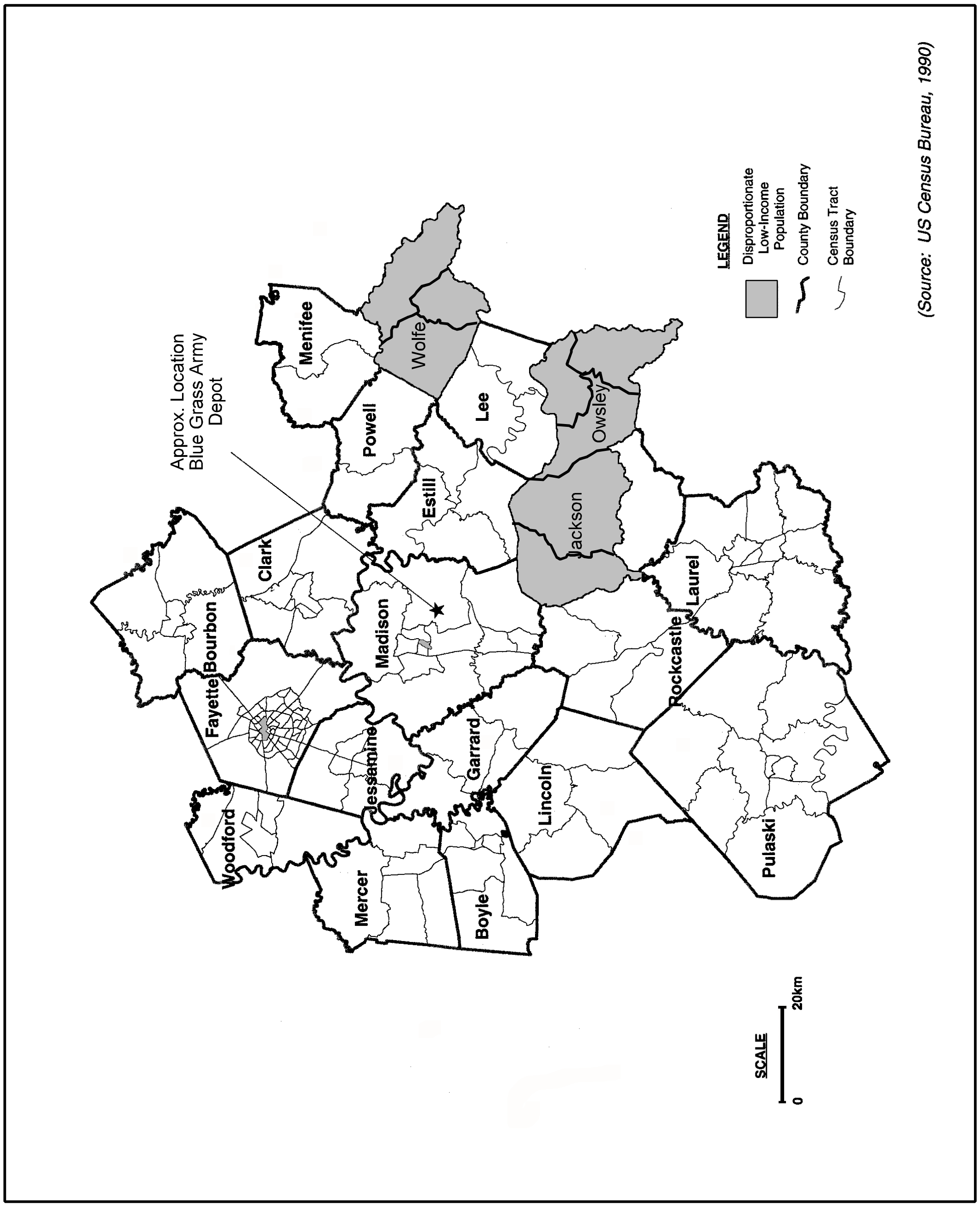

Fig. 4.15. Census tracts with disproportionate low-income population within 50 km of the Blue Grass Army Depot.

Table 4.49. Census tracts with disproportionate low-income populations, 1989

	Total Population for which Poverty Status is Determined	Low-Income Population	Percent Low-Income
	Fayette County		
Census Tract 1	4579	1879	41.0
Census Tract 3	3410	1357	39.8
Census Tract 4	3245	2071	63.8
Census Tract 9	2212	906	41.0
	Jackson County		
Census Tract 9601	4968	2112	42.5
Census Tract 9602	2758	1094	39.7
	Madison County		
Census Tract 104	1988	828	41.7
Census Tract 105	692	293	42.3
	Owsley County		
Census Tract 9901	2900	1565	54.0
Census Tract 9902	1287	542	42.1
Census Tract 9903	743	463	62.3
	Wolfe County		
Census Tract 9901	2060	858	41.7
Census Tract 9902	3322	1413	42.5
Census Tract 9903	1021	564	55.2

Source: U.S. Census Bureau, 1992, *1990 Summary Tape File 3(STF3)-Sample Data.*

Kentucky as a whole. Accordingly, it is likely that the disproportionate number of low-income persons in the two Madison County census tracts is due, at least in part, to a high concentration of Eastern Kentucky University students, whose low-income status tends to be temporary rather than chronic.

4.21.2 Destruction Impacting Factors

Significant environmental justice impacts would only occur in those cases where a high and adverse impact takes place *and* where the affected area has a disproportionately high number of minority and/or low-income persons.

4.21.3 Impacts of Construction

The only high and adverse construction-period impact to human populations identified in this document involves the possible worsening of traffic conditions on KY 52 and US 25/421 in the immediate vicinity of BGAD. This impact would occur only if planned improvements to KY 52 do not take place as scheduled. In that event, the affected populations would be all those residents and visitors who use the roadways in question during morning and afternoon peak travel periods. The only census tracts within 30 mi of BGAD whose residents have disproportionately high minority populations are located in Fayette County, relatively far from the roadways in question. Of the 14 census tracts within 30 mi of BGAD that have disproportionately high populations of low-income residents, only two are in Madison County. Those two low-income census tracts contain only about 5% of Madison County’s total population and are not even the closest tracts to BGAD. Accordingly, it appears that any high and adverse impacts accompanying project construction would *not* disproportionately affect minority or low-income populations. Construction of any of the technology alternatives could provide jobs and income to minority and/or low-income individuals.

4.21.4 Impacts of Operations

During normal operations, the only high and adverse impact to human populations identified in this document involves worsening traffic conditions, but this is considered very unlikely to occur in light of the scheduled completion dates for local road improvements. However, even if such an impact were to occur, it would not disproportionately affect minority or low-income populations, for the same reasons given in Section 4.21.4. Construction of any of the technology alternatives could provide jobs and income to minority and/or low-income individuals.

4.21.5 No Action Alternative

In the absence of an accident, no high and adverse impacts are anticipated as a result of the no action alternative. Accordingly, no environmental justice effects are anticipated.

4.21.6 Cumulative Impacts

The only potentially high and adverse cumulative impact to human populations identified in this document involves traffic along roadways in the immediate vicinity of BGAD. As explained in Sect. 4.21.3, such impacts would *not* disproportionately affect minority or low-income populations.

4.22 IMPACTS OF POTENTIAL ACCIDENTS

Measures would be employed to reduce the potential for an accident during the operation of a chemical munitions destruction facility at BGAD, regardless of whether an incineration or neutralization technology is selected for implementation. Additional measures would be in place to contain any contamination in the unlikely event that an accident involving chemical warfare agents should occur, and to clean up contaminated facilities and resources in the even more remote possibility that an accident should result in external contamination. Measures to avoid a potential accident include: (1) intensive training of personnel in monitoring and assessing facility conditions, and in using proper operational and contingency procedures; and (2) design of the facility to include many monitoring and fail-safe features to automatically shut down operations should abnormal conditions arise. In the event that an accident should occur during operations, redundant containment features (e.g., multiple containment barriers and negative air pressure HVAC) would be designed into the facility to reduce the likelihood that agent could escape into the environment. Finally, if a release of agent involving a spill or down-wind deposition of agent were to occur, the Army would have in place procedures, equipment, and trained personnel for addressing the situation quickly in order to contain contamination and clean up affected areas.

The above measures would control and contain within the facility virtually all the foreseeable, accident scenarios associated with destruction operations at BGAD. Thus, the probability that any accident might affect the public is extremely low (see Appendix H). However, the impacts of such an unlikely worst-case event involving a lightning strike or a severe earthquake followed by a fire could be very serious.

This section provides information concerning the potential impacts to surrounding environmental resources and human health if an accident involving release of agent were to occur. The analysis of hazards and accident scenarios in this EIS is solely intended to provide estimates of the extent and magnitude of potential impact from hypothetical accidents at BGAD. As such, the accident analysis presented in this EIS should not be considered to be a detailed safety assessment or a substitute for a detailed risk analysis.

As discussed in Appendix H, a worst-case bounding accident is used in this section to describe the potential impacts that could create lethal airborne concentrations of chemical warfare agent at distances up to 31 miles from the accident. This accident would be associated with the continued storage of the munitions at BGAD and would involve a lightning strike to a storage igloo. Accidents during destruction operations would be smaller events (as measured by their potential downwind lethal distances, as well as the size of the potentially affected area) as described in detail in Appendix H of this EIS; however, these non-storage accidents are not used in the assessment of potential impacts in this EIS. Instead, the impacts of the 31-mile bounding accident are described in the following sections.

4.22.1 Land Use

Spills. Accidents associated with the proposed action (i.e., munition destruction activities) could involve a spill of chemical agent onto the land surface at the existing storage area, along the on-site transportation route, or at the site of the destruction facility. Spills, in turn, could result in a release of chemical agent into the atmosphere by evaporation. An accidental spill of chemical warfare agent would likely be limited to a small area of land in the vicinity of the accident, but could result in a high level of contamination of soils in the immediate vicinity of the spill. As a result of such a spill, only a small area of land would be affected.

Because only a small area contained within the site would be affected, and because of rapid response and decontamination at the spill site in accordance with an approved spill prevention, control, and countermeasures plan, off-site environmental impacts to land use would be small, except possibly during periods of heavy precipitation or snowmelt following a spill. Rapid response and decontamination also would minimize runoff and seepage of any chemical agent that was spilled. Larger areas could be impacted if heavy precipitation or snowmelt mobilized the spilled agent prior to its cleanup. The bleach solution typically used in the decontamination process could adversely impact vegetation in the immediate vicinity of the spill.

Deposition of Airborne Agent. An accidental release of chemical warfare agent into the atmosphere could affect a larger area of BGAD than could a spill. Such an accident would have significant impacts to on-post land use, as the contamination of on-post buildings and facilities would preclude (at least temporarily) use of the affected portions of the installation.

Off-post land areas downwind from BGAD could also be adversely affected by the deposition of chemical agent onto vegetation and/or soils. The size of the impacted area would depend on the size of the release and meteorological conditions at the time (see Appendix H). Grazing of livestock off-post and downwind from BGAD would be precluded until the contamination declined to levels at which animals could safely graze. The use of land for growing crops within contaminated areas and the consumption of crops produced also would have to be temporarily discontinued. Agricultural crops contaminated with chemical agent resulting from direct deposition would not be suitable for consumption by either humans or animals.

The length of time during which grazing and crop growing would be precluded following an atmospheric release depends on the amount of agent deposited and upon the persistence of the deposited agent. Available evidence indicates that the effects of soil contamination on vegetation and animals would be negligible after a few weeks in the case of nerve agent GB, and after one year in the case of nerve agent VX (U.S. Army 1988; Vol. 3, Appendix O). Land contaminated with mustard agent (H) could be unusable for crops or grazing for relatively long periods of time (perhaps measured in years). Mustard agent and its breakdown products have been found in soils decades after being deposited or buried (Epstein et al. 1973; Small 1983). The chronic effects of relatively low, non-lethal levels of mustard agent in soil on plants, animals, and humans are not well understood, particularly if exposures occur on a long-term, continual basis.

4.22.2 Utilities

The accidental release of chemical warfare agent, whether through a direct spill or emission to the atmosphere, could affect on-post and off-post availability of water, electricity, and natural gas by diverting the available capacities from routine uses (including chemical agent destruction) to emergency response activities.

4.22.3 Waste Management

An undeterminable amount of contaminated wastes could be produced by clean-up activities following a spill of chemical warfare agent or an accident involving the airborne dispersion of agent. Spill and emergency response plans and resources would be in place to contain, clean-up, decontaminate, and dispose of wastes according to existing standards and regulations. See also the discussion of contaminated soils in Sect. 4.22.6 of this EIS.

4.22.4 Air Quality

Relatively short-term, but very significant, effects to air quality would result from an accidental release of chemical warfare agent to the atmosphere. A large atmospheric release, such as might occur during the 31-mile bounding accident, could have serious environmental and human health impacts. These impacts are addressed in the following sections of this EIS (see, for example, the discussion of human health impacts in Sect. 4.22.5 and impacts to ecological resources in Sects. 4.22.9 to 4.22.11). In Appendix H, the transport and dispersion of hypothetical atmospheric plumes of chemical warfare agent are evaluated by modeling the accidental release of agent under different meteorological conditions.

4.22.5 Human Health and Safety

Existing Conditions. Currently, the Army has a health and safety plan, which includes standard operating procedures and training, to prepare on-post workers and residents for a potential accidental release of agent. In addition, the Kentucky Disaster and Emergency Services's Chemical Stockpile Emergency Preparedness Program (CSEPP) office has been assisting, and would continue to assist the off-post population in planning, prepare, and training for a potential accidental release of agent.

Potential Accidental Releases of Agent. This section is applicable to all the destruction alternatives under consideration at BGAD. Human health impacts from exposure to accidentally released chemical warfare agent can be categorized as either lethal effects or sublethal effects. In this EIS, sublethal effects have not been quantified because of their great variation depending on exposure concentrations, the duration of exposure, and the number of people exposed. Estimates of potential fatalities in this EIS are based on the downwind no-deaths distance as computed with the Army's D2PCw atmospheric dispersion model (as discussed in Appendix H). The fatality estimates presented here are those that could result if the wind were to blow in the most unfavorable direction (usually toward the largest concentration of population). The assumed meteorological conditions are those that would disperse chemical warfare agent in a manner that would produce the largest downwind extent of a lethal atmospheric plume.

To provide an upper bound on the potential number of fatalities that might result from the most severe accidents, it can be assumed that lethal concentrations of chemical warfare agent would extend to distances up to 31 miles from the accident, as discussed in Appendix H. The worst-case storage accident is used in this EIS to bound the potential impacts. This accident involves a lightning strike to a storage igloo followed by fire (see Appendix H). As described in detail in Appendix H, if this accident were to occur under the most unfavorable meteorological conditions, it could potentially cause up to 5,900 fatalities among the residential population around BGAD. The estimated number of potential fatalities for this accident under more typical meteorological conditions could be up to 2,200.

Appendix H also evaluates the consequences from a "worst-case" accident at the baseline incineration facility. Because the number of munitions (and hence the quantity of chemical warfare agent) inside the facility would be similar among the destruction alternatives (due to the similarity of munition throughput rates and targeted completion dates), the consequences of the incineration accident from Appendix H can be used as a surrogate for any of the destruction alternatives. Appendix H shows that, if the "worst-case" facility accident were to occur under the most unfavorable meteorological conditions, it could potentially cause up to 2,300 fatalities among the residential population around BGAD. The estimated number of potential fatalities for this accident under more typical meteorological conditions could be up to 180.

The dose-exposure values used in the above estimations are applicable to healthy adult males. If young and old persons were more susceptible to exposure to chemical warfare agent than healthy adult males, the number of potential fatalities could be higher than estimated above. Executive Order 13045 (*Protecting Children from Environmental Health Risks and Safety Risks,* April 1997) requires Federal agencies "to identify and assess environmental health risks and safety risks that may disproportionately affect children." Appendix H presents a sensitivity analysis that considers the increased susceptibility of the young and the old to chemical agent exposure. The results are summarized below.

About 33% of the population around BGAD is older than 65 or younger than 15. The analysis in Appendix H (see Sect. I.4) indicates that if old and young people were 5 to 10 times more sensitive to agent than healthy adults, the overall number of estimated off-post fatalities would probably be about twice the estimates reported above. Thus, children and older adults could be disproportionately affected by an accidental release of chemical warfare agent. However, the potential for adverse impacts, disproportionate or otherwise, would be smaller for the proposed destruction activities than for continued storage at BGAD, because the largest hypothetical accidents during continued storage could create a lethal hazard that would cover a greater downwind area than would the largest such accidents under either of the destruction alternatives (i.e., neutralization or incineration facilities).

The above estimates of potential fatalities are based on residential population statistics and thus are more closely associated with nighttime distributions of population than with daytime distributions. Daytime activities lead to different distributions of population and possibly different estimates of potential fatalities. However, the meteorological conditions needed to propagate lethal doses of chemical warfare agent 31 miles from BGAD can be associated almost exclusively with nighttime hours.

Other Process-Related Hazards. The Neut/SCWO process would use five major process chemicals: sodium hydroxide, phosphoric acid, kerosene, liquid oxygen, and liquid nitrogen (ACWA DEIS 2001). The Neut/GPCR/TW-SCWO process would use several hazardous chemicals, including sodium hydroxide, liquid oxygen, hydrogen, and kerosene (ACWA DEIS 2001). The Elchem Ox process would use sodium hydroxide, nitric acid, sodium hypochlorite, hydrochloric acid, calcium oxide, silver nitrate, and liquid oxygen (ACWA DEIS 2001). Several of these chemicals are flammable or reactive (e.g., sodium hydroxide, sulfuric acid, kerosene) and exhibit irritant properties when inhaled or touched. However, all are common industrial chemicals with well-established handling procedures and safety standards. According to the ACWA Draft EIS (ACWA DEIS 2001), "the risk from gaseous emissions of these chemicals is minimal, but more work is needed to demonstrate the effectiveness of the containment design in the event of an accidental ignition of energetics during processing." The containment requirements are being further addressed in engineering design studies for the ACWA program.

4.22.6 Soils

Under the bounding accident scenario at BGAD, contamination of surface soils could extend over an area beyond the installation boundaries. Given the nature of the accidents, it is assumed that chemical agent would be widely deposited downwind on surface soils as fine particles or as droplets. Degradation rates for fine particles of agent are slightly faster for nerve agents than for mustard agent. The degradation of chemical warfare agents over time is discussed in Sect. 4.22.1.

Pools or particles of chemical warfare agent located near the accident on-post would be removed during cleanup operations. However, accidental spills of chemical warfare occurring either during handling or while in transit to the facility could infiltrate surface soils before cleanup operations could begin. These soils, too, would be removed during cleanup.

In the very unlikely event of a large accidental release of chemical warfare agent into the atmosphere, soils could be contaminated several miles downwind from the accident. However, the contamination would be expected to degrade as described above, and clean-up activities would also occur. For all cases, no long-term impacts to surface soils would be expected to occur.

Any contaminated soils that were cleaned up would be disposed of in accordance with applicable regulations. The ACWA Draft EIS (ACWA DEIS 2001) contains the information in the following paragraphs regarding the nature of such contaminated wastes.

Mustard agent and nerve agents GB and VX are N-listed wastes in the Kentucky hazardous waste regulations (Kentucky listed wastes N001, N002, and N003). In the case of an accident that involves a listed hazardous waste, any contaminated residue, soil, water, or other debris resulting from the cleanup of that agent must also be characterized as a listed hazardous waste (401 KAR 31:010, Section 3(3) (b)(1)).

Pursuant to Kentucky hazardous waste regulations, debris contaminated with a listed hazardous waste may be exempt from regulation as hazardous waste if a demonstration test shows that the waste does not exhibit any hazardous characteristics or if the Cabinet determines, considering the extent of contamination, that the debris is no longer contaminated with hazardous waste (401 KAR 31:010). "Debris" is defined as solid material exceeding a 60-mm particle size; it includes manufactured objects, plant or animal matter, and natural geologic material. A mixture of debris and other material is subject to regulation as debris if a visual inspection indicates that the mixture is composed primarily of debris, by volume.

4.22.7 Surface Water

Spills of chemical agent in munitions handling areas within the disposal facility would be contained by curbed concrete slabs. Such spills would therefore not be expected to impact surface water. Spills occurring outside the facility during loading, transportation, or unloading of the chemical munitions that escaped containment measures could impact surface water. The severity of the impact on water resources would depend on the details of the accident, and particularly on how much chemical agent was involved in the spill. Consequences of the chemical agent interacting with water (hydrolysis) would vary by the type of chemical agent, the solubility of the agent, the turbulence (mixing) of the receiving water, and receiving water temperature and pH and could include the formation of various hydrolysis products that, while hazardous, are not as toxic as the original agent (see Appendix B, U.S. Army 1988). Containment procedures and decontamination measures enacted after the accidental spill had taken place would minimize any impacts to surface water.

An accident releasing large amounts of chemical agent into the air could have significant impacts on water resources in the vicinity of BGAD. Agent released into the atmosphere could be deposited onto nearby surface waters. Deposition would be greater close to the accident site. Agent deposited onto land could be carried to surface waters by runoff following a pre-cleanup rain or during snowmelt.

In the event that surface water were to become contaminated, dilution from other uncontaminated flows and mixing in the receiving waterbody would reduce the concentration of agent in that waterbody. In addition, the turbulence of surface water flows would encourage the agent to dissolve. Once dissolved, the chemical warfare agents would hydrolyze and degrade; hence, they would not be expected to persist in water.

Surface water resources located potentially downwind from the bounding accident at BGAD include the Kentucky River; Drowning, Muddy (also known as the Big Muddy), Otter, Calloway, Hines, Tate, Silver, Paint Lick, and Red Lick creeks; Little Muddy Creek, Viny Fork, and many other smaller unnamed Muddy Creek tributaries; and Lakes Vega (also known as Ordnance Lake), Buck, Gem, and Reba. The Kentucky River as well as Lakes Vega and Reba would be precluded as drinking water supplies after a large release of agent into the atmosphere. Water treatment would be required to remove chemical agent prior to human consumption. Agent might hydrolyze in Lakes Vega and Reba so slowly that water treatment would be required for extended periods. Precipitation events would slowly flush accumulated chemical agent further downstream from affected portions of the Kentucky River watershed. The use of all surface water resources within the downwind area defined by the dispersing plume of chemical agent might have to be restricted until monitoring demonstrated that the water was safe for intended applications.

4.22.8 Groundwater

It is very unlikely that, after an accident, conditions would exist to allow significant impacts to groundwater resources. Groundwater might be affected in an accident by infiltration of surface waters contaminated by the mechanisms described in Sect. 4.22.7. Also, in the unlikely event that cleanup activities were delayed, accidentally spilled chemical warfare agent might infiltrate to groundwater. That is, seepage of chemical agent into the groundwater could occur if not arrested in time by clean-up or decontamination activities.

The potential impacts to groundwater would be minimal because the source of the agent contamination would not be expected to last for significant periods (due to clean-up efforts, etc.), and because any agent contamination in water would degrade as the water moved downward through the soil toward groundwater. In addition, once in the groundwater, degradation would continue and dilution would occur in the receiving groundwater. Transportation of chemical agents by subsurface flow would be minimal.

4.22.9 Terrestrial Habitats and Wildlife

Ecological impacts from the bounding accident in this EIS were assessed on the basis of deposition and atmospheric concentration estimates by using the D2PCw model (as described in Appendix H). This model takes into account meteorological conditions and incorporates detailed information on the type of accident, agent involved, and type of release when it estimates atmospheric dispersion and deposition.

The prevailing winds that would accompany the bounding accident at BGAD would generally blow from the southwest. Therefore, ecological resources located northeast of BGAD would have a higher probability of being affected if such an accident were to occur. However, the accident could presumably affect ecosystems in any direction, depending upon the direction and speed of the wind at the time of the accident.

Vegetation. No data were found on the exposure of native vegetation to chemical agents under field conditions. The nerve agents GB and VX function primarily by interfering with neurotransmission in animals and would therefore not be likely to affect vegetation. No data were found on the uptake of agent H through ingestion under field conditions. Hydrolysis of agent H would likely occur during the first one or two days after the accident; it would result in various degradation products. A recent article that reviews the toxicity of chemical warfare agent degradation products suggested that thiodiglycol (TDG), a breakdown product of agent H, could persist in soils following an accidental release (Munro et al. 1999). Even if all of the agent H within this area degraded to the TDG (low likelihood of occurrence), it would be highly unlikely that an herbivore would receive a dose through the food pathway that would be above the levels of concern reported for laboratory rats (Munro et. al. 1999).

The long-term impacts on terrestrial ecosystems from an accident releasing chemical warfare agent would likely be minimal. Due to the relatively low sensitivity (i.e., high tolerance) of plants to chemical warfare agent, it is expected that impacts on the growth of vegetation beyond the immediate vicinity of the accident would generally not be significant. However, evidence suggesting that plants absorb chemical agents and their breakdown products indicates that vegetation contaminated with chemical agent could be harmful to grazing livestock and wildlife over an extended period of time (U.S. Army 1988, Vol. 3, Appendix O). Soil contamination effects of chemical warfare agents, from a spill or deposition following an accidental release, could for quite some time if the contamination were not removed by clean-up activities (see Sect. 4.22.1).

Wildlife. No data were found on the exposure of wildlife to chemical agents under field conditions. However, wildlife downwind of an accidental release could be injured or could die from direct inhalation of chemical agents. Injuries caused by mustard agent could include respiratory damage, eye injuries, burns, or long-term carcinogenic effects. Birds and insects may be particularly sensitive to the effects of these agents (U.S. Army 1988, Vol. 3, Appendix O).

If the bounding accident were to occur at BGAD, the distance beyond which no human deaths would occur would be 31 miles. Because certain animal species are more sensitive than humans to chemical agent exposure, fatalities among animals could occur at much greater distances than those for humans. Acute effects to wildlife from an accidental release would occur quickly after exposure. Some deaths could occur among exposed wildlife located in areas closest to the site of the accident, particularly less mobile species with small home ranges (e.g., small mammals, reptiles, and amphibians) since they would likely remain in the hazardous plume during the accident. Mammals and birds within this distance that did survive could suffer from blistering skin, irritation to the respiratory system, eye irritation, and other chronic effects known to affect humans and laboratory animals (U. S. Army 1988).

Some chemical agent deposited on vegetation or in surface waters, particularly in areas closest to the point of release, could be ingested by wildlife during the first few days after the accident. Herbivores such as deer and rabbits not directly affected by inhalation of agent would be the species most likely affected by ingestion of agent deposited on the surface of vegetation. The consequences of such exposures would depend upon the level of agent contamination and the quantities ingested; however, wildlife could be adverse impacted by such exposures.

4.22.10 Aquatic Habitats and Fish.

Aquatic habitats and fish in Lake Vega and other water bodies at BGAD might be affected by a release of mustard following an aircraft crash into the CHB followed by a fire. Impacts would be relatively short term, but some fish mortality could occur within a few minutes of deposition of mustard on the water surface. Dilution would occur rather quickly, and hydrolysis of mustard into its degradation products of relatively low toxicity soon would tend to reduce mortality of fish from this agent.

VX is more environmentally persistent than GB. VX is moderately to highly soluble in water, with a solubility of 30 g/L at 77°F (Munro et al. 1999). The persistence of VX in aquatic environments varies with temperature and pH. Its half-life ranges from 17 to 42 days at a temperature of 77 °F and pH of 7. One of its degradation products, EA2192, moreover, may exhibit toxicities of the same order of magnitude as its parent compound. Depending on the concentrations of VX reaching surface waters, fish, amphibians, and reptiles would be likely to die if their responses were similar to those of mammals under laboratory conditions (Munro et al. 1999). Analyses of the effects from potential accidental releases of VX on fish and other aquatic organisms (U.S. Army 1998c) indicate that the impacts at BGAD could be severe. Aquatic organisms in Lake Vega, Muddy Creek, and intermittent and ephemeral streams at BGAD would be killed from exposure to VX following an aircraft crash into the CHB during VX processing. Aquatic species in surface waters located downwind (generally to the northeast of BGAD) would also be affected by accidental release concentrations projected by the D2PC model. (The D2PC model uses very conservative input parameters and assumptions; its use is described in Appendix H of this EIS.)

An analysis was conducted to determine potential impacts on aquatic organisms. Hazard quotients were determined on the basis of benchmark values for exposures of striped bass to VX (U.S. Army 1988). On the basis of D2PC model results, mean deposition values within the 1% human lethality, no lethality, and no human health effects contours were used to determine water concentrations for pools that are 4 in. and 3.3 ft deep. For the sake of analysis, these concentrations were chosen because they are very conservative given that moving water in a stream would probably result in faster agent dilution rates and lower concentrations of VX than would standing pools in intermittent streams or shallow ponds. Hazard quotients determinations for exposures within the three contours suggest that fish at locations downwind of the accident would probably be severely affected, depending on the stream's flow rate and depth. Fish LT50s would be longer than the times projected for pools or streams that are 4-in. and 3.3-ft deep with high flow rates and turbulence. Thus, fewer than 50% of the resident fish might be injured or die. Impacts on aquatic species would probably be most severe in small, shallow ponds and streams.

Exposure of aquatic organisms to VX would also increase after the first rainfall event, resulting in runoff of VX into surface waters. Impacts on aquatic organisms from exposure to GB would be likely to be short-term, since dilution in the water column would cause GB to break down by hydrolysis.

4.22.11 Protected Species

No federal listed threatened or endangered species would be adversely affect at BGAD from the release of a chemical agent after an aircraft crash into a CHB and a fire. The only federal endangered species occurring on BGAD—running buffalo clover (*Trifolium stoloniferum)*— could experience a buildup of chemical agent deposited on leaf surfaces from fallout after an accident. The amount of deposition on the leaves would vary, depending on the degree of canopy closure provided by the trees above individual plants. Existing toxicity data for root uptake of agent by vascular plants indicate that effects would occur only at levels much higher (on the order of 100 to 1,000 times higher) than levels of agent estimated to occur in soil, even in the >50% human-effect isopleth (U.S. Army 1988, Vol. 3, Appendix O). No studies suggesting that chemical agent would adversely affect RBC were found.

Three endangered mussel species, the Cumberland bean *(Villosa trabali*s), Cumberland elktoe *(Alasmidonta atropurpurea*) and little-wing pearly mussel *(Pegias fabul*a), are known to occur within 30 mi of BGAD (Barclay 2000). Under D-3 meteorological conditions, mussels in shallow perennial or intermittent streams could be exposed to relatively high concentrations of VX within the 1% human lethality, no human deaths, and no human health effects contours, at distances of 5.6 mi, 7.6 mi, and more than 30 mi, respectively, downwind from the accident release site. The persistence of VX in aquatic environments varies with temperature and pH. The half-life of VX generally ranges from 17 to 42 days at a temperature of 77°F and a pH of 7 (Appendix A). One of its degradation products, EA2192, moreover, may exhibit toxicities of the same order of magnitude as its parent compound. Given the sedentary nature of mussels, individuals would be exposed to the entire aliquot of water containing agent deposited from the vapor plume following an accident. The toxicity of VX and its degradation products on these endangered mussels is unknown, but if toxicities happen to be comparable to that for striped bass, water concentrations both within and beyond the 30 mi contour could be high enough to result in mortality of the Cumberland bean, Cumberland elktoe, and little-winged pearly mussel. Mussels surviving the accident exposure would likely bioaccumulate VX in their soft tissues.

4.22.12 Wetlands

Wetlands near the site of the aircraft crash into the CHB would be exposed to mustard with consequent adverse effects on the biotic communities supported by these wetlands. The limited amount of data available on known impacts on plants suggests that some absorption of VX would occur (U.S. Army 1988). VX and its breakdown products would be harmful and potentially lethal to aquatic and amphibious life in the water column, and to any animals ingesting contaminated plant material. Plant species exposed to mustard and GB downwind of the accident site would not be likely to become contaminated to a large extent because of the tendency of both compounds to break down relatively quickly by hydrolysis.

4.22.13 Cultural Resources

An accident involving the release of chemical warfare agent could result in impacts to both the on-post and off-post cultural resources located downwind of the accident. Exposed surfaces of archaeological sites, TCPs, or historic structures could become contaminated. At a minimum, public access to these cultural resources would be temporarily denied until contamination was degraded by exposure to light and moisture or by active decontamination efforts. For the 31-mile bounding accident, only temporary impacts (i.e., access restrictions) would be expected on cultural resources. Access restrictions could last for a few days or longer, depending on the degree of contamination and the length of time required to certify that access could again be permitted. It is expected that low levels of agent contamination would degrade in a few hours under certain conditions, while larger quantities might take considerably longer. Those properties located nearest to the accident would have a greater potential for contamination than those farther away.

Historic properties located within 31 miles of the accident could be affected by temporary but extended restriction periods until the contaminant was sufficiently degraded. If the contaminant were to be deposited as a liquid, the Army might require that the properties of concern undergo various decontamination procedures before being released for access by the public. These decontamination procedures could potentially damage the property. However, deposition of liquid agent in quantities that would require decontamination procedures that could damage or destroy cultural resources would most likely be confined close to the point of the accident and within the BGAD boundaries. Extended public access restrictions lasting until the contaminant dissipated would be the most likely measure for preserving significant properties.

4.22.14 Socioeconomics

An accidental release of chemical warfare agent into the atmosphere could have catastrophic impacts on socioeconomic resources in Madison County and surrounding counties. The bounding case accident could result in loss of life and negative economic impacts from the contamination of the environment, including water, food supplies, and structures. Furthermore, the economic activity of the local area would be immediately reduced because of the inability to use the existing infrastructure and resources currently available. At the same time, economic resources would be directed toward recovery and restoration. As in other events involving hazardous chemicals, the length of time for restoration would depend on the amount of agent released, the size of the contaminated area, and the time needed to decontaminate.

Impacts to Agriculture. The effect of an accidental release on agricultural resources would depend primarily on two factors: (1) the spatial extent of agent dispersal and (2) the protective actions taken. The precautions taken to protect agricultural resources and to prevent the public from consuming affected agricultural products would help avoid some of the direct impacts of an accident. The grazing of livestock downwind from the accident would be precluded until the contamination declined to levels at which animals could safely graze without experiencing adverse effects, and at which time their meat or milk products would be safe for human consumption. The use of land within contaminated areas for growing crops and the consumption of crops produced by affected soils also would be temporarily discontinued. Agricultural crops contaminated with chemical agent resulting from direct deposition would not be suitable for human consumption. The length of time during which grazing and crop growing would be precluded following an atmospheric release depends on the amount deposited and the persistence of the chemical warfare agent.

Although the potential impacts of a release on agricultural resources around BGAD would be temporary, they could be significant. It is difficult to estimate the economic losses that would be associated with such impacts to agriculture. Such an analysis was presented in the ACWA Draft EIS (ACWA DEIS 2001). The ACWA analysis determined that the most significant impact would occur if all the crops and livestock produced in a single season were to be quarantined (either voluntarily or by federal or state requirements) as a result of the accident and removed from the marketplace. If the equivalent of half of the affected area's annual agricultural production were to be affected, losses from livestock and crop sales could be as high as $480 million. In addition, this estimate of economic losses could be low if an accidental release were to result in the "stigmatization" of Madison County and surrounding county livestock and crops, wherein sales might suffer from the buyers' perceptions about the undesirability of agricultural products from the affected area long after actual contamination is no longer an issue.

Impacts to Businesses. Evacuation of nearby businesses might accompany an accident at BGAD. Although such an evacuation would likely be only temporary, disruption of the economy in the evacuated area could be significant. An analysis of the potential magnitude of the economic impacts that would likely accompany an accident was presented in the ACWA Draft EIS (ACWA DEIS 2001). The ACWA analysis determined that if an evacuation were to affect 50% of the economic activity in the area, the single-day losses would be $6 million in sales and $4 million in income, as well as impacts to 16,000 affected employees.

Other Socioeconomic Impacts. In the event of a major accidental release, it is likely that some areas and structures would have to be abandoned temporarily. If the affected areas and structures were in a heavily-populated area with many houses or in a heavily-developed commercial or industrial site, there would be adverse impacts to quality of life, including effects related to mental health and well-being, social structure, and well-being of the affected communities (U.S. Army 1988).

4.23 SUMMARY OF CUMULATIVE IMPACTS

This section summarizes the key points from the assessments of cumulative impacts presented in the previous sections addressing each environmental resource area. For the purpose of identifying pertinent data concerning potentially affected environmental resources for this FEIS, numerous regional private and government organizations have been contacted, particularly from the Commonwealth of Kentucky and Madison County. During these contacts, information was also sought concerning past, present, and reasonably foreseeable future activities that, in combination with the proposed action, might result in cumulative impacts within the depot or in the surrounding area.

The assessment of the gathered information resulted in findings that, for the most part, impacts would be temporary and would not be expected to be significant. The notable exceptions are traffic disruptions along KY 52 and US25/421 and possible adverse impacts to sewage treatment capacity in Berea and to housing in the local area (see Sect. 4.20). There would also be exceedances of NAAQS levels for particulates ($PM_{2.5}$) during construction of the proposed facility. The background level for $PM_{2.5}$ as noted below, already exceeds NAAQS levels of 15g/m^3. Cumulative air quality impacts from criteria pollutants during operations would be less than those from construction for all alternatives, although concentrations of $PM_{2.5}$ would continue to exceed the NAAQS level (see Sect. 4.7). On the positive side, additional industrial activity in the local area would add to local employment and increase overall personal income (see Sect. 4.20).

If construction of the proposed facility occurs simultaneously with road construction activities along these corridors and/or the expansion of industrial facilities located west of BGAD in the vicinity of Duncannon Lane, significant adverse traffic impacts could occur. These impacts to traffic would vary with the size of the construction work force for each of the destruction technologies evaluated. Since the construction work forces for the evaluated alternatives range from a low of 960 for neutralization with SCWO to a high of 1260 for electrochemical oxidation, the magnitude of potential cumulative traffic impacts varies accordingly. The size of the operations work forces are identical for all alternatives and therefore do not result in different traffic impacts. In addition, if additional workers are attracted to Madison County from outside the local area in response to off-post industrial expansion, the possible temporary adverse impacts to Berea's sewage treatment capacity could be exacerbated. Finally, the competition for housing would increase, which could further limit choices and/or raise prices for would-be buyers.

During construction, PM10 and PM2.5 from fugitive emissions would be the pollutants of principal concern. When current on-post and off-post sources are taken into account (the background levels), total PM10 concentrations would be less than 83% of the NAAQS levels. The total 24-hour PM2.5 concentration would be 95% of the NAAQS level, and the total annual PM2.5 concentration of 17.4 g/m^3 would exceed the NAAQS level. However, even without the proposed facility or any other reasonably foreseeable on-post or off-post actions, annual levels of PM2.5 are already 114% of the NAAQS level of 15 g/m^3. (Annual background concentrations of PM2.5 throughout Kentucky tend to be higher than the NAAQS level.) Construction of the proposed facility would contribute another 0.3 g/m^3.

Other than activities associated with the construction of the destruction facility (e.g., utility upgrades), there are no activities on the installation with the potential to contribute to cumulative impacts. Construction of the Site Security Control Center, laundry/change house, warehouse, and the vehicle storage facility area and operation of a molten salt operation facility and an explosive detonation chamber for the destruction of conventional munitions simultaneously with the construction and operation of the proposed facility would increase off-post particulate concentrations but would not result in cumulative impacts since these facilities are far enough away from proposed Sites A and B to preclude significant interactions. Likewise, local road construction, including the widening of Duncannon Lane and construction of a new interchange at I-75 and Ducannon Lane, would be too far away to cause significant particulate concentrations in the areas receiving the greatest impacts from the proposed facility. Utility upgrades associated with the destruction facility construction could improve utility services for other users on the installation. The off-post areas near the installation are primarily in agricultural, industrial, or residential use.

4.24 OTHER IMPACTS

4.24.1 Irretrievable and Irreversible Commitment of Resources

In implementing the proposed action or the no-action alternative, some of the resource commitments would be irreversible and irretrievable; in other words, the resources would be neither renewable nor recoverable for further use. Generally, resources that may be irreversibly or irretrievably committed by construction and operation of the proposed destruction facilities include construction materials that could not be recovered or recycled and energy sources or materials consumed or reduced to unrecoverable forms of waste. In addition, biota may be destroyed in the vicinity of the site, and wildlife may be affected by the loss of habitat, increased human activity in the construction area, increased traffic on local roads, and noise. Less mobile and burrowing species (such as amphibians, some reptiles, and small mammals) could be killed during vegetation clearing and other site preparation activities. Running buffalo clover (RBC), a federal endangered species, could be affected by habitat disturbance or loss of individual plants in patches along the proposed 69-kV transmission line. Protection measures, as outlined in the biological assessment (Appendix F), would be implemented to minimize potential losses.

Resources used during construction of the destruction facilities would include cement, gravel, ore used for steel, natural gas, diesel fuel, gasoline, and water. Construction activities and destruction operations require a commitment of human and financial resources. Commitments of machinery, vehicles, and fossil fuels also would be required during the project. None of these resources are in short supply relative to the size and location of the proposed action.

In accordance with Pub. L. 99-145, equipment and structures comprising the destruction facility would have to be dismantled and disposed of following destruction of the chemical stockpile at BGAD. However, in November 1989, the House and Senate Appropriations Committee of Conferees in Title VI of the 1990 DAC Report 101-345, entitled Chemical Agents and Munitions Destruction, Defense, directed the Army to investigate and report on the feasibility and desirability of using chemical weapons destruction facilities for other purposes after destruction of the stockpile. Reuse of these facilities, however, is currently precluded by Pub. L. 99-145, which requires the demilitarization facilities to be used for the sole purpose of destroying the chemical stockpile and to be decommissioned following the completion of that mission. The land on which the proposed destruction facility would be constructed could be reused by other U.S. Army functions after completion of decommissioning.

The no-action alternative (continued storage) would also require commitment of resources for maintenance of the stockpile. However, fewer resources would be irreversibly and irretrievably committed than under on-site destruction.

4.24.2 Long-term Impacts vs. Short-term Use

The proposed action would involve a short-term use of land and resources, as well as minor, short-term increases in suspended particulates and plant emissions associated with construction and operation of the destruction facility. These would be more than offset by the elimination of the risks of continuing to store the chemical agents at BGAD. The greatest potential adverse effects of continued storage would be primarily those associated with accident conditions and would be concerned with threats to human health, ecology, and agriculture. Elimination of the chemical agent stockpile would eliminate these risks and would also provide additional area within the BGAD installation for other uses.

Potential environmental impacts from construction, normal operation, and possible accidents associated with the estimated 6-year duration of the proposed action would be generally less severe than the potential risks and adverse impacts from continued storage.

The Army would generate scrap metal resulting from operation of the proposed destruction facility. This material—formerly the bodies of munitions—would be recycled if the Commonwealth of Kentucky agrees to their delisting following decontamination into the scrap metal market and could offset the potentially adverse environmental effects, as well as reduce the energy requirements, of mining and smelting virgin ores.

4.25 CLOSURE AND DECOMMISSIONING

With passage of Public Law 99-145 in 1986, Congress directed the Army to destroy the U.S. Stockpile of chemical munitions, and mandated the dismantling and destruction of the demilitarization equipment and buildings upon completion of the stockpile destruction activities. Subsequently, in 1989, Congress issued the 1990 Defense Appropriations Conference (DAC) Report, 101-345, in which it directed investigation and reporting on the feasibility and desirability of using the destruction facilities for other purposes after the stockpile is destroyed. At that time the proposed incineration facilities were found to be not well suited for many of the possible uses that were investigated , and no recommendation for future use was made (Goldfarb et al. 1991). Nevertheless, with passage of the DOD Appropriations Act, 2000 (Public Law 106-79) in October 1999, Congress modified federal law to remove the mandate for dismantling the destruction facility, if the administration of the state in which it is located so chooses. This has become known as the "Right of First Refusal".

As a result of Public Law 106-79, the Army is now studying the feasibility and cost-effectiveness of using the chemical munitions destruction facilities to destroy the Non-stockpile Chemical Materiel (NSCM) that is stored at the same locations. Nevertheless, the Army currently intends to dismantle and close the BGAD facility upon completion of the stockpile destruction activities (including destruction of the four non-stockpile items). That intent is the motivation for providing the following discussion of potential impacts of closure and decommissioning of the destruction facility eventually constructed at BGAD.

To date, a closure plan has not been developed that presents plans and methods for closure of the chemical munitions destruction facility at BGAD. Closure plans have not been developed for chemical weapons destruction facilities within the continental United States. The non-incineration technologies have not advanced to the stage of having developed closure plans. JACADS is the only such chemical weapons destruction facility to have completed its mission and to have developed a closure plan. Although the JACADS plan (U.S. Army 2000) would not be directly applicable to BGAD, for purposes of this assessment, it is assumed that the JACADS plan would bear some similarities to closure plans for incineration facilities in the U.S. Therefore, it provides the best basis for the discussion of the potential impacts of closure and decommissioning presented in this section. Some of the key points are summarized below.

Engineering Changes and RCRA. The JACADS facility will be closed through an integrated sequence of partial closures and changes in function. JACADS decommissioning activities are planned, engineered, and implemented through the use of Engineering Change Proposals. For example, it was anticipated that before the chemical demilitarization operations were completed on Johnston Island, portions of the storage area would undergo a change in function from munitions storage to a hazardous waste storage area. The affected bunkers will be used for storage of certain process and non-process wastes awaiting incineration (e.g. carbon filters, demilitarization protective ensembles, etc.). Additionally, the spent decontamination solution storage tanks and all associated equipment will be dismantled and thermally treated in the MPF. Prior to decontamination/ dismantlement of the existing exhaust system, a new system will be installed for the MPF, LIC, and other areas in the MDB to process final emissions.

Use of Furnaces. The existing JACADS furnaces will be utilized during the closure campaign. Large quantities of closure waste will be generated as a result of the dismantlement of decommissioned equipment in the MDB. Most of this closure waste will be processed through the MPF in order to reach the level of decontamination required by permit. In the case of baseline incineration, the MPF may be used to co-process waste (primarily metals) associated with the munitions machinery while the LIC continues to process munitions and agent.

Closure Assessment. During the JACADS closure campaign, a final closure investigation/assessment will be performed to determine the nature and extent of any potential release of hazardous waste and/or hazardous constituents from the hazardous and solid waste management units.

Decontamination. Cleanliness criteria have been established for the JACADS buildings, structures, and associated equipment for demilitarization operations. The Army has also developed specific decontamination criteria to ensure safe usage of the equipment and buildings associated with agent management. These same criteria will be used during the closure campaign.

Although the Army will examine and use the most efficient, up-to-date, and environmentally benign decontamination methods and solutions available, decontamination methods for agent contaminated areas will involve the following techniques, as appropriate for each situation:

- Chemical decontamination
- Decontamination solution [sodium hydroxide (NaOH) and sodium hypochlorite (NaOCl) or other as appropriate]
- Caustic or bleach mixed with surfactants
- Pressurized hot water
- Pressurized hot water mixed with caustic or bleach
- Epoxy spray painting
- Concrete surface layer removal
- Concrete curb removal

Decontamination methods for non-agent contaminated areas will address hazardous contaminants other than agent. Cleaning areas of loose debris should be sufficient in most cases, with other measures to be used as necessary including physical methods (e.g., grit blasting or hydroblasting) and liquid method (e.g., washing, steam cleaning, and use of cleaning solutions).

All decontamination solutions and residues will be collected, containerized, and disposed of in accordance with existing standards and requirements. Furthermore, a detailed description of the steps needed to accomplish closure will be prepared in accordance with existing site decontamination procedures or with recommendations made following closure sampling and evaluation of data. The partial and final closure activities to be described include removal or decontamination of all contaminated hazardous waste residues, containment system components, equipment, structures, and soils (U.S. Army 2000).

4.25.1 Site and Facilities

Complete destruction of the BGAD chemical munitions stockpile followed by closure and dismantling of the destruction facility would free up the site and surrounding facilities for reuse.

4.25.2 Land use

Closure and decommissioning of chemical demilitarization facilities at BGAD, whether they be incineration or neutralization or electrochemical oxidation facilities, would likely have positive effects on both on-post and off-post land use. For on-post, closure and decommissioning would make more land available for various other uses. For both on- post and off-post, closure and decommissioning would mean that the single largest threat to existing and proposed land uses (i.e., the accidental release of mustard agent into the atmosphere during either continued storage or destruction) would be removed.

4.25.3 Water Supply and Use

The water supply infrastructure is entirely within the boundary of the BGAD and any impacts during construction and operation would be limited to the installation. Closure and decommissioning would thus likely have positive effects only on on-post water supply and use. First, it would end the diversion of water to chemical agent destruction from other on-post uses, making more water available for various on-post land uses. Second, closure and decommissioning would eliminate the potential impacts to water of an accidental release of mustard agent during either continued storage or destruction.

4.25.4 Electrical Power Supply

Closure and decommissioning would likely have positive effects on the electrical power supply by providing additional power and infrastructure to the north central portion of the installation. This would make more electrical power available for other on-post land uses.

4.25.5 Natural Gas Supply

Closure and decommissioning would likely have positive effects on the natural gas supply by providing the infrastructure (e.g., pipelines) and natural gas, as needed, to other potential uses in the north central portion of the installation.

4.25.6 Waste Management

A closure and decommissioning plan has been developed for JACADS. Table 4.50 presents the waste categories and estimated quantities from the JACADS closure and decommissioning plan. Approximately 90% of the wastes listed in the table, 5.4 million lb, would be hazardous wastes. There would be approximately 545 thousand lb of nonhazardous wastes. There has not been a detailed analysis of the wastes that may be generated from the closure and decommissioning of an incineration or a neutralization or electrochemical oxidation facility.

It is likely that the quantities of wastes coming from closure and decommissioning of the BGAD facility would be at least as large as the quantities of similar wastes coming from JACADS. It is expected that the ratio of nonhazardous to hazardous wastes from closure and decommissioning would be similar for JACADS and the BGAD facility.

The impacts from disposing of the nonhazardous wastes at permitted offsite landfills would not be large. However, treating and disposing of roughly 10 times as much hazardous waste could challenge the capacity of permitted, offsite TSDFs. To adequately assess waste management impacts, more detailed information is needed concerning waste amounts and capacities of the TSDFs to be used.

4.25.7 Air Quality-Criteria Pollutants

Closure and decommissioning would generate fugitive dust in quantities similar to those involved in site construction; these impacts were analyzed in Sect. 4.7. It is not expected that any health-based air-quality standards for criteria pollutants would be exceeded.

4.25.8 Air Quality-Hazardous and Toxic Materials

Closure and decommissioning would not be expected to occur until toxic and hazardous substances have been removed from the site; therefore, no air quality impacts of toxic and hazardous substances would be expected.

4.25.9 Human Health and Safety

The types of impacts that may occur during decommissioning would be similar to those that accompanied the initial construction of the facility. These construction impacts are discussed in Sects. 4.9.2 and 4.10.3. There would be no significant adverse health impacts for the closure and decommissioning of this facility to the on-post workers and residents and the off-post population.

Table 4.50. JACADS waste stream summary

Waste feed designation	Munitions Campaign			Co-processing (lbs)	Closure Campaign		Total weight (lbs) of the waste feed
	Stored as of April 00 (lbs)	End predicted increase (lbs)	USACAP waste Inventory (lbs)		SSOs (lbs)	Secondary (lbs)	
Inert bulk solid waste-bulk equipment	510,800	53,400	6,400	32,600	930,200	204,200	1,737,600
Inert bulk waste-piping & fittings	0	0	0	1,600	26,500	0	56,100
Inert bulk solid waste-structural steel & ripping/cond supports	0	0	0	100	134,300	0	134,300
Inert bulk solid waste 2" foam Core panels	0	0	0	0	173,800	0	173,800
Inert bulk solid waste-concrete	0	0	0	0	118,500	0	118,500
Inert bulk solid waste-valves & metal parts <=5% plastics	27,600	6,900	0	1,600	256,500	0	292,600
Inert bulk solid waste-aluminum	700	140	0	1,000	900	280	3,020
Combustible bulk waste-electrical parts/ instruments>5% plastics	1,200	240	0	1,600	38,00	480	41,520
Combustible bulk solid waste Non-halogenated plastics, wood doors	49,000	11,100	400	3,700	74,600	23,600	162,400

Table 4.50. (continued)

Waste feed designation	Munitions Campaign: Stored as of April 00 (lbs)	Munitions Campaign: End predicted increase (lbs)	Munitions Campaign: USACAP waste Inventory (lbs)	Co-processing (lbs)	Closure Campaign: SSOs (lbs)	Closure Campaign: Secondary (lbs)	Total weight (lbs) of the waste feed
Halogenated waste-cable/conduits	34,300	6,900	0	3,500	54,200	13,700	112,600
Halogenated waste-piping, fittings, valves and misc.	44,400	7,500	0	200	74,100	17,050	143,250
Halogenated waste-DPE Suits	173,000	34,600	0	0	0	41,000	248,600
Polystyrene &Polyethylene	22,600	3,700	8,400	0	0	8,600	43,300
Spent HEPA & prefilters	6,000	0	1,500	0	2,600	0	10,100
MDB sludge	6,000	1,200	0	0	0	2,400	9,600
SDS	220	50	0	0	0	2,300,000	2,300,270
Agent contaminated spent hydraulic fluid	4,000	800	0	0	11,000	1,600	17,400
Agent contaminated charcoal	208,600	0	39,000	0	0	72,700	320,300
Total	1,088,420	126,530	55,700	45,900	1,955,200	2,686,610	5,957,360

Notes: 1. Based on 4000 lbs/tray of metal.
2. Based on 400 lbs/tray of DPE suits.

4.25.10 Noise

Closure and decommissioning would not be expected to generate appreciable continuous noise. However, the proposed structures are designed to withstand considerable stresses without great damage, which complicates disassembly and decommissioning. Sporadic noise from saws, jackhammers, etc. may lead to sound pressure levels as high as 95 dB(A) at a distance of 15 m. Moreover, it is possible that explosives would be used to demolish some structures. The resulting noise would be expected to be audible at the site boundary, and, in some cases, would be audible, and possibly temporarily distracting, at outdoor locations around the nearest residence.

4.25.11 Visual Resources

Closure and decommissioning would have a positive effect on visual resources by removing the chemical agent destruction facilities and restoring them to their prior condition, including the re-creation of wildlife habitat.

4.25.12 Geology and Soils

No adverse impacts would be expected to the soils or mineral resources from facility closure and decommissioning. Negligible to no soil disturbance would be associated with the closure activities. Economic geologic resources would be either spread to the existing terrain or could be used for other purposes at BGAD.

4.25.13 Groundwater

No adverse impacts would be expected to the groundwater resource from facility closure and decommissioning. Groundwater would not be affected by closure.

4.25.14 Surface Water

No adverse impacts would be expected to the surface water resource from facility closure and decommissioning. Negligible to no soil disturbance would be associated with the closure activities that could potentially degrade surface water.

4.25.15 Terrestrial Habitats and Wildlife

If the facility were to be removed from the site then approximately 95 acres of terrestrial habitat would become available to undergo the natural successional sequence from grassland to forest.

4.25.16 Aquatic Ecology and Wetlands

Impacts of closure and decommissioning activities would be expected to be comparable to those encountered as a result of construction of any of the incineration or neutralization or electrochemical oxidation alternatives. With respect to wetlands and aquatic biota, therefore, adverse impacts on area wetlands, streams, and ponds would be negligible if best- management practices are used to minimize sediment- or contaminant-laden runoff into Muddy Creek.

4.25.17 Protected Species

If the facility were to be removed from the site then approximately 95 acres of terrestrial habitat would become available to undergo the natural successional sequence from grassland to forest thereby potentially benefitting any protected or listed species associated with forests.

4.25.18 Cultural Resources

Closure and decommissioning would likely have positive effects on cultural resources by removing the potential impacts of an accidental release of mustard agent into the atmosphere during either continued storage or destruction.

4.25.19 Socioeconomics

Closure and decommissioning would have both adverse and beneficial effects on socioeconomic resources in Madison County. Adverse effects would result primarily from losing the operations-related jobs, income, and public revenues described in Sect. 4.20.4. Beneficial effects would result primarily from the land and utilities that would be made available for other productive uses on the installation and from decreased traffic on US 25/421, KY 52 and KY 876. Also, closure and decommissioning would have the beneficial effect of removing a potential threat to the area's socioeconomic resources (i.e., the accidental release of mustard agent into the atmosphere during either continued storage or destruction).

4.25.20 Environmental Justice

Activities associated with decommissioning and closure of the destruction facility would be carried out in compliance with accepted environmental and occupational standards. Therefore, decommissioning and closure activities would not cause adverse human health or environmental effects on minority or lower-income populations.

4.26 MITIGATION AND MONITORING

Mitigation measures and monitoring (which can be considered a mitigation measure) help ensure that storage, handling, and destruction of the chemical munitions are carried out in a safe and efficient manner. Similarly, destruction facility permitting (Sect. 4.27) can be considered part of the mitigation measures. The permitting process requires advance consideration of potential health, ecological, and agricultural risks, and proof of capability to operate within limits that have been studied and set conservatively by regulatory agencies to provide an adequate margin of safety for the protection of workers, the public, and the environment.

4.26.1 Environmental and Safety Enhancements

The PMCD FPEIS (U.S. Army 1988a) identifies mitigation measures and safety enhancements that would reduce the probability and consequences of potential accidents. The performance of JACADS and DCD (incineration) and APG and NECD (neutralization with biotreatment and neutralization with SCWO, respectively) have resulted in further safety enhancements in designs. Implementation of lessons learned at these facilities is an important mitigation measure for reducing risk from destruction operations.

4.26.2 Personnel Reliability

Good hiring practices, training programs, and oversight of workers' performance contribute to overall personnel reliability which would be necessary to mitigate accidents that could result from human error. Accidents resulting from human error have been assessed through risk analysis. Planned screening procedures, hiring practices, and training procedures are outlined below.

4.26.2.1 Hiring practices and screening of employees

Operations and maintenance personnel expected to have access to agent would be required to enter the Army's Chemical Personnel Reliability Program (CPRP). This controlled access program provides a means of assessing the reliability and acceptability of individuals being considered for and assigned to chemical duties. Qualifying factors include competence, dependability, emotional stability, and positive attitude toward assigned duties and the objectives of the CSDP, CPRP, and ACWA programs. Disqualifying factors include alcohol abuse, drug abuse, negligence or delinquency in performance of duty, conviction for a serious offense by a military or civil court, any physical or mental condition that compromises the performance of an assigned duty, poor attitude, or inability to wear required protective clothing. Personnel security investigations that involve national agency checks by the Federal Bureau of Investigation would be conducted as part of this program. This could also involve written inquiries to listed references. The individuals would be interviewed by the certifying official, and all medical records would be reviewed by qualified medical personnel.

The operating and maintenance contractor would be required to establish a random drug testing program. Employees could be subject to verification by functional test, urine screening, search, or other action following guidelines of the Food and Drug Administration.

4.26.2.2 Training program

An integrated training program has been implemented to ensure that all facilities are operated in a uniform and consistent manner that provides protection to human health and the environment both on and off the facility site and to minimize factors that degrade human performance or increase the likelihood of human error. A central Chemical Demilitarization Training Facility (CDTF) has been constructed at APG. This facility is being used to provide initial and refresher training to operating and maintenance personnel from all the CONUS facilities. CDTF contains classrooms; a non-agent laboratory for sampling, analytical, and monitoring activities; an equipment area with major pieces of munition/bulk disassembly equipment; a control room with simulation capability; and a fully equipped DPE support area where personnel undergo rigorous training that includes classroom instruction and actual hands-on experience with simulated chemical agent. Personnel are graded for their response to simulated failures and emergencies. After their training is completed at CDTF, the operators would undergo additional hands-on training at the BGAD facility. Prior to the start of operations, operators are required to demonstrate competence in performing their assigned duties through written and oral exams and by performing exercises (under normal and emergency situations) while being observed by a certifying official.

4.26.2.3 Human-initiated accident scenarios

Human error plays a role in a few of the accident scenarios considered in the assessment of potential impacts in this FEIS; consequently, mitigation to reduce the probability and/or consequences of accidents involving human error would help to reduce the overall risk associated with the proposed action. Of principal interest are those accidents with lethal plumes traveling past BGAD boundaries (i.e., those credible events with no-deaths distances exceeding 1.2 mile) and that are initiated by human error.

A review of the accident database for BGAD (see Appendix H) shows that there are a number of accidents initiated by human error that could travel beyond installation boundaries under unfavorable meteorological conditions and several accidents that could travel beyond installation boundaries under most likely meteorological conditions. The characteristic accidents include several that are common to all technological alternatives (e.g., dropping a munition or a munition pallet, a forklift collision, and a vehicle accident) and some that may be unique to a particular technological alternative (e.g., feeding a munition into the dunnage incinerator rather than the deactivation furnace for the baseline incineration alternative).

A number of mitigation measures are planned, and others are under study in various risk management studies, that would reduce the probabilities and consequences of these accidents.

4.26.3 Emergency Preparedness

Effective emergency planning and management through the Chemical Stockpile Emergency Planning Program could mitigate the consequences of accidental chemical agent releases for the population living near BGAD. Emergency planning and response capabilities have been upgraded in the BGAD vicinity, with Army assistance; consequently, emergency planning and preparedness would mitigate impacts from accidents during continued storage (no action), as well as from accidents during operation of the proposed destruction facility. The proposed action of on-site destruction would have little, if any, impact on the planning and implementation of upgrades, and the emergency response program for BGAD under the proposed action would resemble that under no action. The upgrades to emergency preparedness and response comprise a beneficial impact of the proposed action.

4.26.4 On-Site Medical Support

A medical facility with the latest supplies and equipment for diagnosing and treating occupational illnesses and injuries and for treating and decontaminating chemical casualties would be located on-site. This medical facility would have sufficient beds to support the most probable event (MPE). The MPE is the worst potential mishap most likely to occur during routine handling, storage, maintenance, surveillance, or demilitarization operations that could result in the release of agent and personnel exposure. The medical facilities would be government-owned but operated by contract medical personnel in accordance with applicable Department of the Army and Joint Commission on Accreditation of Health Care Organizations publications.

4.26.5 Monitoring

The ability to detect very small quantities of agents GB, VX, and HD (agent monitoring) is crucial to assuring the continued health and safety of BGAD workers and the public.

4.26.5.1 Agent monitoring

Standards and procedures for monitoring chemical agent are summarized in this section.

4.26.5.2 Standards for agent exposure

The U.S. Department of Defense (DOD) airborne exposure limits for the agents of interest are presented in Table 4.28. These safety standards have been established by DOD and in some cases DHHS to serve as guidelines for monitoring within the chemical demilitarization plant, within the storage areas, during transport activities, and on the perimeter of the installation. The airborne exposure limits are set conservatively to provide an adequate safety margin to protect workers and public health. The exposure limits (see Table 4.28) are defined as follows:

- *Time-weighted average (TWA).* The TWA is the allowable unmasked worker exposure limit established by the Army and approved by DHHS for an 8-hr/day exposure averaged throughout a maximum of five consecutive work periods for an indefinite time.
- *General population limit (GPL).* The GPL is the allowable TWA agent exposure limit established for the general public for a 72-hr time period.
- *Source emission limit (SEL).* The SEL is the maximum allowable concentration of agent that can be emitted at the stack. Emissions meeting the SEL should be (1) avoided by a well-designed, -constructed, and -operated incineration facility; (2) an early indication of process fluctuations; and (3) measurable in an accurate and timely manner. Air dispersion modeling has demonstrated that the allowable GPL and TWA limits would not be exceeded as a consequence of emissions at SEL.

4.26.5.3 Instrumentation

Air monitors currently in use and available for the facility include rapid-response detectors and delayed-response samplers for both high and low levels (concentrations) of agents. Air monitors for GB, VX, and mustard are well-developed and have been subjected to extensive precision and accuracy testing in actual monitoring environments. Monitoring systems would include an automatic continuous air monitoring system (ACAMS) and a depot area air monitoring system (DAAMS), each of which can detect low and high levels of agent. ACAMS primarily produces audible alarms in the presence of high or low levels of agent, whereas DAAMS provides a continuous record of low as well as high agent levels. Both systems would use gas chromatography.

The ACAMS is an automated gas chromatograph that can be configured to detect GB, VX, or mustard at TWA, SEL, IDLH, GLD, or MPL agent levels. The chromatogram is recorded on a strip chart, and an alarm is provided that would be wired to a remote control center. The M8A1 and M8 alarms are portable field instruments for detection of high levels of GB or VX and can provide a local annunciation or be wired to a remote control center. The response times for the above detectors range from 1 to 3 min for high-level detection to 3 to 5 min for low-level detection.

The DAAMS has a sampler consisting of a solid sorbent tube through which air is aspirated for a predetermined period of time. Samplers are used to obtain time-dependent average concentrations at low detection levels for historical documentation. Gas chromatography is employed because it is the only method with the sensitivity to detect low levels represented by GPL. Sampling times are about 1, 2, and 12 hr for SEL, TWA, and GPL respectively; the analysis time is about 1 hr.

Sampling for the presence of high levels of GB, VX, or mustard during routine surveillance activities can be performed with chemical agent field detector kits. These kits can include a hand-operated aspirator bulb, detector tickets, detector tubes, detector paper, and reagents. Air is drawn through a detector ticket or tube, and when the ticket or tube has been treated with reagent solution, an immediate color change is observed if agent vapor is present. For liquid sampling, the detector paper is put in direct contact with the unknown liquid. A specific and immediate color change is used to confirm the presence of agent.

4.26.5.4 Storage monitoring

Monitoring is performed to detect chemical agent leakage from defective chemical weapons. Most leaks are vapor leaks from pin-sized holes, although liquid leaks from weld cracks or serious corrosion penetrations are also detected. Monitoring results are used to define the level of protective equipment needed and to verify the safety of workers performing surveillance and maintenance. Procedures to monitor storage areas have been implemented and validated during the past several decades.

4.26.5.5 Handling and on-site transport monitoring

Before any igloos would be opened for transferring the munitions, monitoring would be performed in accordance with site-specific safety plans. The workers would then remove munitions from the igloo or storage area, load them into MAVs (incineration) or ONCs (neutralization or electrochemical oxidation), and check the integrity of the seals. The munitions would be transported to the CHB. Because of the short transport distance from the CHB to the MDB and the containment provided by the ONC, monitoring would not be conducted during this movement.

At the CHB, low- and high-level monitors and samplers would be placed to detect and document the presence of any agent vapor. The CHB would be equipped with agent monitors, detector tubes, and detector paper. These items would be employed in response to an accidental spill during handling or transport and in verifying cleanup.

4.26.5.6 Destruction plant monitoring

A network of chemical agent alarms and samplers would be used in the demilitarization plants

1. to verify compliance with applicable work area and stack-emission standards,
2. to detect process fluctuations so that corrective actions could be taken before a hazardous situation could develop, and
3. to verify the safety of the operation.

The instruments that would be used include ACAMS and DAAMS. The ACAMS would serve as the chemical agent alarms, notifying plant operators of process fluctuations as well as potentially hazardous conditions. DAAMS would be used to provide a historical record of agent concentrations and to confirm ACAMS alarms.

If agent were detected, ACAMS would provide a local alarm, and a signal would be transmitted from most stations to activate a visible and audible alarm in the control room. Stations used at airlocks and some other areas are not usually linked to the control room since agent may be present there as part of normal operations. The local alarm would alert outside operators to wear their protective masks and take proper action as outlined in the Army protocol. A permanent record of the date, time, and location of any linked alarm would be recorded automatically on a computer. PAS would be used to scrub acidic and particulate material from the exhaust gases.

For the baseline incineration alternative, the incinerator and building ventilation exhaust stacks would be the two main disposal plant sources for agent emission to the atmosphere. The stacks would be monitored to verify that the incinerators and filters were performing as designed and to provide information if excessive agent were emitted.

The LIC, MPF, and DFS would share a common exhaust stack that would be monitored continuously by low-level ACAMS and DAAMS to serve the purposes listed above. In addition, the individual exhaust ducts from each furnace to the common stack would be monitored by low-level ACAMS. These monitors would be used to determine which incinerator/furnace was causing an upset condition if an upset alarm were to occur at the common stack. All ACAMS alarms would be transmitted to the control room. If an alarm in this monitoring system were triggered, waste feed to the incinerator would cease immediately. Corrective actions would be taken and verified before waste feed would be resumed.

All MDB building ventilation exhaust air would flow through charcoal filters to remove any chemical agent contamination from the air before being released through a stack. The filter exhaust stack would be monitored continuously by low-level ACAMS and DAAMS. In addition, the space between the carbon filter banks would be monitored continuously by a low-level ACAMS. If an alarm occurred at this monitor, the filter bank would be temporarily taken off line (replaced by a back-up filter bank), and its carbon beds would be replaced. The monitor between the banks would show when the first bed is loaded and should be replaced.

For the non-incineration alternatives, monitoring would be prescribed in environmental permits issued under RCRA. They would be similar to those planned for the baseline incineration alternative, as appropriate.

4.26.6 Perimeter Monitoring

The purpose of the perimeter monitoring stations would be to provide a historical record of any potential major agent release. The monitoring system is not intended to control destruction activities nor to provide an early warning of an accidental release. This kind of information has been used in the past to prove the historical safety of destruction operations. The destruction facility ventilation system and furnace stacks would be monitored for agent continuously to provide early warning signs of an accidental release.

Current plans are to install the perimeter monitoring stations at BGAD prior to the commencement of destruction operations such that adequate baseline monitoring can be completed. The number and location of these stations are being considered. The Army Center for Health Promotion and Preventive Medicine, which has been involved in developing or reviewing the perimeter monitoring systems at DCD and JACADS, has been asked to initiate a study that reviews site specific characteristics and to provide a recommendation on the number and location of these monitoring stations at BGAD. The perimeter monitoring plan would be coordinated with DHHS prior to finalization.

4.26.7 Ecological Mitigation

Construction could affect as much as 95 acres of terrestrial, aquatic, and wetland habitat. The following measures would minimize impacts from construction and operations on all ecological resources:

- A berm would surround the facilities to contain any potential releases from spills or fluctuating operations. The facilities would be designed with many safety features (e.g., detection devices, automatic shutoff) to prevent migration of spills from an operational accident.
- Construction of pipelines and the 69-kV transmission line would be planned to (1) avoid sensitive riparian habitats and highly erodible slopes by spanning such areas and (2) preclude the use of construction vehicles where possible.
- In designing the 69-kV transmission line, suggested practices for raptor protection would be followed in order to prevent raptor electrocution.
- Disturbance to the tributaries to Muddy Creek along the proposed transmission line and portions of Proposed Areas A or B would be avoided to protect a relatively rich herbaceous layer in the floodplain riparian community that provides habitat for amphibians and reptiles.
- The sedimentation pond would be designed and placed to avoid impacts on vegetation and wetlands from soil erosion and runoff during construction, including potential impacts from sediment input to tributaries of Muddy Creek.
- Siltation fencing or other mechanical erosion control measures would be employed during construction to control runoff in areas where surface disturbance could affect aquatic species or wetlands.

- The Army would conduct clearance surveys for RBC, mark patches discovered, and avoid patches when placing electrical towers and erecting the conductors.
- Construction workers would be briefed on sensitive ecological resources and mitigation measures.
- Disturbed areas would be revegetated as soon as possible after construction was completed.

The following mitigation measures would reduce or eliminate construction-related impacts on wetlands:

- Routing of pipelines and power lines to avoid existing wetlands,
- Use of siltation fences or straw bales in areas where runoff is likely,
- Revegetation of disturbed areas as soon as possible after construction,
- Proper design of a sedimentation pond on the 25-acre PMCD facility site, and
- Some new wetland habitat could be created below the outfall from the sanitary waste treatment facility.

4.27 PERMITS

Before implementing the proposed action, the Army would be required to coordinate its actions with various federal, Commonwealth of Kentucky, and local legal and regulatory authorities. This section summarizes the permits, approvals, and consultations required by these authorities.

4.27.1 Permits and Approvals Required for Construction

Certain reviews, permits, and approvals must be obtained before construction. According to Public Law 91-121 (Armed Forces Appropriations Act of 1970) and Public Law 91-441 (Armed Forces Appropriations Act of 1971), any destruction plan that the Army prepares must be reviewed by DHHS, whose oversight responsibility and authority are normally thought of in terms of its public health and safety functions; DHHS also looks critically at the potential impacts of proposed projects.

Executive Order 12088, *Federal Compliance with Pollution Control Standards*, and other public laws require that all federal agencies comply with all applicable federal, state, and local pollution control standards. Compliance with applicable pollution control standards requires that the Army secure environmental permits in the same manner as do private project sponsors. Department of Army Regulation 200-1 requires that all major permits and approvals for an activity be secured before any construction is begun. A RCRA permit application for the proposed facility will be submitted to the Commonwealth of Kentucky and applications for air emissions source permits will be submitted to the Commonwealth of Kentucky after issuance of the ROD in accordance with the requirements of the Clean Air Act and Commonwealth of Kentucky and local air quality regulations.

The processes for acquiring the RCRA and air permits are very similar, but their technical contents are quite different. The Army submits draft permit applications to the Commonwealth of Kentucky and responds to notices of deficiencies. The state then proposes specific permit terms. At that point, the permits are made available for review and comment by the permittee (the Army) and the public. After reviewing the comments, the commonwealth issues the final permits, and construction may begin. Table 4.51 provides an overview of specific permits that may be required at various phases of the destruction program, from pre-construction through closure.

Letters from FWS in regard to potential impacts to threatened and endangered species, and from the Kentucky State Historic Preservation Officer in regard to potential impacts to historic or archaeologic resources, are presented in Appendix F.

4.27.2 Permits and Approvals Required for Operation

After completing construction, the Army would test the destruction facility. Initial tests would be conducted with agent surrogates; then actual trial burns (for an incineration facility) or pre-operational testing (for non-incineration technologies) would be conducted with agent. Results of the test burns would be submitted to the Commonwealth of Kentucky and federal agencies. If the test burn results were acceptable, the Commonwealth of Kentucky would impose final RCRA operating conditions as necessary. As long as operation of the destruction facility continued, the Army would be subject to a variety of reporting, inspection, notification, and other permit requirements of the Commonwealth of Kentucky. DHHS would continue its oversight role, reviewing data and making appropriate recommendations concerning public health and safety before toxic operations begin. No NPDES permits, other than for sanitary sewage, would be required.

Table 4.51. Commonwealth of Kentucky permits potentially required for the destruction of chemical agent at Blue Grass Army Depot

Phase	Waste	Water	Air
Pre-construction	Permit may be required; must submit itemized list of infrastructure projects for approval prior to construction	• Stormwater Permit • Sanitary Sewer • Construction Permit	If required by emission level, permit must be issued before any infrastructure project.
Construction (of chemical agent destruction facility)	RCRA Permit S Modification to existing storage permit S "Miscellaneous Unit" or incinerator depending on technology selected	• Stormwater Permit • Sanitary Sewer Construction Permit • KPDES Outfall Permit S For direct discharge S Scope technology dependent • Industrial Pre-treatment Permit S For indirect discharge S Richmond Municipal Utilities	• Air Permit S State Origin Permits S Title V Permits S PSD Permits
Operation	No separate permit required; must submit regular compliance reports	Must submit regular compliance reports	No separate permit required; must submit regular compliance reports
Closure	• Implement closure plan in current Permit or modify as necessary • Post-closure care if required	No Permit required	No Permit required

Source: Ralph Collins, Kentucky Department of Environmental Protection, 2001. "The Kentucky Permitting Process: Pre-Construction to Closure: BGAD Chem Demil Facility," presented to Kentucky Environmental Working Integrated Process Team, April 24, 2001, Lexington, KY.

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5. LIST OF PREPARERS

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6. DISTRIBUTION LIST

Note: This list is maintained by the Program Manager for Chemical Demilitarization's Public Affairs Office at (410) 671-3629/1093.

7. INDEX

APPENDIX A

NOTICE OF INTENT

A.1 NOTICE OF INTENT FOR PMCD

[Federal Register: December 4, 2000 (Volume 65, Number 233)]
[Notices]
[Page 75677-75678]
From the Federal Register Online via GPO Access [wais.access.gpo.gov]
[DOCID:fr04de00-50]

DEPARTMENT OF DEFENSE
Department of the Army

Notice of Intent To Prepare an Environmental Impact Statement (EIS) for the Design, Construction, and Operation and Closure of a Facility for the Destruction of Chemical Agents and Munitions at Blue Grass Army Depot (BGAD), Kentucky

AGENCY: Department of the Army, DoD.
ACTION: Notice of Intent.

SUMMARY: This announces the Army's intent to prepare a site-specific EIS on the potential impacts of the design, construction, operation and closure of a facility to destroy all of the chemical agents and munitions currently stored at the BGAD, Kentucky. The EIS will examine potential environmental impacts of the following destruction facility alternatives: a baseline incineration facility; a full-scale facility to pilot test an alternative technology successfully demonstrated by the Assembled Chemical Weapons Assessment (ACWA) Program; and no action (an alternative that will continue the storage of the chemical agent and munitions at the BGAD). If any reasonable alternatives are identified during the environmental analysis process, they will be considered as alternative courses of action.

The United States has a statutory and international treaty obligation to destroy its stockpile of chemical weapons, including those at the BGAD. The technique of using incineration (herein referred to as baseline incineration) has already been tested safely and successfully in full-scale facilities. Alternatives to baseline incineration have been tested at the demonstration level, but not in pilot scale or full-scale facilities. Before additional federal funds can be spent on any alternative technology, sec. 142 of the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999, Pub. L. 105-261, requires that three findings be made. First, an alternative technology would have to be determined to be as safe as and as cost effective as baseline incineration. Second, it must also be capable of completing destruction of the stockpile by the later of either the Chemical Weapons Convention destruction date or the date the

BGAD stockpile would be destroyed if baseline incineration were used. Finally, it must comply with Federal and State health and safety laws.

DATES: Written comments must be received not later than February 2, 2001 in order to be considered in the Draft EIS.

ADDRESSES: Written comments may be forwarded to the Program Manager for Chemical Demilitarization, Public Outreach and Information Office (ATTN: Mr. Gregory Mahall), Building E-4585, Aberdeen Proving Ground, MD 21010-4005.

FOR FURTHER INFORMATION CONTACT: Mr. Gregory Mahall by mail at the above listed address, by phone at 410-436-1093, by fax at 410-436-5122, or by email at gregory.mahall@pmcd.apgea.army.mil. For additional general information or questions on this process, please call 1-800-488-0648 to leave a message.

SUPPLEMENTARY INFORMATION: In compliance with the National Environmental Policy Act (Title 40, CFR, Parts 1500 through 1508), the Army will prepare an EIS to assess the health and environmental impacts of the design, construction, operation and closure of a facility to destroy all of the chemical agents and munitions stored at the BGAD.
Federal law and an international treaty require that the chemical agents and munitions be destroyed. This EIS will analyze the impact of the various methods of destroying the BGAD stockpile. The ACWA Program is currently in the process of programmatically addressing pilot tests for alternative technologies at one or more Army chemical agent stockpile sites (FR 65 20139, April 14, 2000). These two separate and distinct analyses serve complementary but different purposes.

This site-specific EIS continues the process that began when Congress established the Program for Chemical Demilitarization in Pub. L. 99-145 in 1985. The law requires destruction of the chemical weapons stockpile by a deadline established by treaty; that date is April 2007. This requirement still exists, notwithstanding the establishment of the ACWA Program. The Chemical Demilitarization Program published a Programmatic EIS in January 1988. Its Records of Decision (ROD) states that the stockpile of chemical agents and munitions should be destroyed in a safe and environmentally acceptable manner by on-site incineration. Site-specific Environmental Impact Statements that tier off the Programmatic EIS have been prepared for Johnston Atoll Chemical Agent Disposal System, Tooele Chemical Agent Disposal Facility, Anniston Chemical Agent Disposal Facility, Umatilla Chemical Agent Disposal Facility, Pine Bluff Chemical Agent Disposal Facility, Aberdeen Chemical Agent Disposal Facility, and Newport Chemical Agent Disposal Facility. An updated report and Record of Environmental Consideration have also been done on the Tooele Chemical Agent Disposal Facility.

The specific purpose of the current analysis is to determine the environmental impacts of the methods that could accomplish the destruction of the stockpile at the BGAD by the required destruction date on April 2007. The environmental impact analysis will determine whether construction of a full-scale plant operated initially as a pilot facility and using one of the technologies successfully demonstrated in the ACWA Program is capable of destroying the stockpile at the BGAD by the reburied destruction date (or as soon thereafter as could be achieved by constructing a destruction facility using the baseline incineration technology), and if doing so is as safe as the baseline incineration technology. The 1988 Programmatic EIS ROD does not limit or predetermine the results of the selection of a destruction technology for the BGAD, and it does not dictate the decision to be made in the ROD following completion of the EIS for this action at the BGAD. The ACWA Program has already successfully demonstrated and validated neutralization followed by supercritical water oxidation. The ACWA Program is currently evaluating two additional technologies--electrochemical oxidation with nitric acid and neutralization/supercritical water oxidation/gas phase reduction. If one or more of these technologies are later considered to be a reasonable alternative, they will also be considered in this site-specific EIS. The ACWA Program EIS for potential follow-on pilot testing of successful ACWA Program demonstration tests pursuant to the process established by Congress in Pub. L. 104-208 and 105-261 addresses a separate but related purpose. That purpose is to determine if any ACWA Program technologies can be pilot tested, and, if so, at which site or sites. The ACWA Program EIS will be distinct from this site-specific EIS because its emphasis will be on the feasibility of pilot testing one or more of the successfully demonstrated and validated ACWA Program technologies considering the unique characteristics of various sites, where chemical weapons are currently stored, including the BGAD. At the conclusion of both of these Environmental Impact Statements, Records of Decision will be issued.

The Army will hold scoping meetings to aid in determining the significant issues related to the proposed action that will be addressed in the site-specific EIS. The scoping process will include public participation and seek input from Federal, Commonwealth of Kentucky, and local government agencies, as well as residents within the affected environment. The dates, times, and locations of scoping meetings will be announced in appropriate news media at least 15 days prior to these meetings.

Dated: November 28, 2000.

Raymond J. Fatz,
Deputy Assistant Secretary of the Army, (Environment, Safety, and
Occupational Health), OASA(I&E).
[FR Doc. 00-30756 Filed 12-1-00; 8:45 am]
BILLING CODE 3710-08-M

A.2 NOTICE OF INTENT FOR ACWA

Federal Register: April 14, 2000 (Volume 65, Number 73)]
[Notices]
[Page 20139-20140]
From the Federal Register Online via GPO Access [wais.access.gpo.gov]
[DOCID:fr14ap00-55]

DEPARTMENT OF DEFENSE
Department of the Army

Environmental Impact Statement for Follow-On Tests Including Design, Construction and Operation of One or More Pilot Test Facilities for Assembled Chemical Weapon Destruction Technologies at One or More Sites

AGENCY: Program Manager, Assembled Chemical Weapons Assessment, Department of Defense.
ACTION: Notice of intent.

SUMMARY: This announces the Army's intent to prepare an Environmental Impact Statement on the potential impacts of the design, construction and operation of one or more pilot test facilities for assembled chemical weapon destruction technologies at one or more chemical weapons stockpile sites, potentially simultaneously with any existing demilitarization programs and schedules at these sites. The size of the pilot tests and the location of the test facilities will be determined in this process.

DATES: Written comments must be received not later than May 30, 2000 in order to be considered in the Draft Environmental Impact Statement.

ADDRESSES: Written comments may be forwarded to the Program Manager Assembled Chemical Weapons Assessment, Public Affairs, Building E-5101, Room 219, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 21010-5424.

FOR FURTHER INFORMATION CONTACT: Ms. Ann Gallegos at 410-436-4345, by fax at 410-436-5297, or via email at ann.gallegos@sbccom.apgea.army.mil, or Program Manager Assembled Chemical Weapons Assessment, Public Affairs, Building E-5101, Room 212, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 21010-5424.

SUPPLEMENTARY INFORMATION: This proposed action continues the process that began when Congress established the Assembled Chemical Weapons Assessment Program through passage of Public Law 104-208. The authorizing legislation instructed the Department of Defense to identify and demonstrate alternatives to baseline incineration for the destruction of assembled chemical weapons. Baseline incineration is the technology and process in place at the

Johnston Atoll in the Pacific and at Deseret Chemical Depot in Utah. Assembled chemical weapons are munitions containing both chemical agents and explosives that are stored in the United States unitary chemical weapons stockpile. This includes rockets, projectiles, and mines. Unitary agents include chemical blister agents (e.g., the mustard H, HD, and HT) and chemical nerve agents (e.g.,GB (Sarin) and VX).

With the National Defense Appropriations Act for Fiscal Year 1999, Congress directed the Program Manager, Assembled Chemical Weapons Assessment to plan for the pilot testing of alternatives technologies.

While all of the chemical stockpile sites were initially believed to be potential test sites, Edgewood Chemical Activity in Maryland, Newport Chemical Depot in Indiana, and Johnston Atoll in the Pacific Ocean have been eliminated from any consideration. Chemical stockpile sites at Edgewood and Newport will not be considered because no assembled chemical weapons are at those locations. Johnston Atoll will not be considered because all chemical weapons at the site will be destroyed before the National Environmental Policy Act analysis can be completed.

Sites at Anniston Chemical Activity in Alabama, Pine Bluff Chemical Activity in Arkansas, Pueblo Chemical Depot in Colorado, and Blue Grass Chemical Activity in Kentucky are being considered. Deseret Chemical Depot in Utah and Umatilla Chemical Depot in Oregon are not currently being considered because the current schedule for those plants indicates that the assembled chemical weapons will be destroyed prior to the time that a pilot facility would be ready to operate. If new information indicates that assembled chemical weapons in sufficient quantity will remain at these sites, then placement of the pilot facility at those sites will be analyzed.

Technologies under consideration include a variety of processes, such as, chemical neutralization, biological treatment, and supercritical water oxidation. The Program Manager, Assembled Chemical Weapons Assessment pilot tests will not halt or delay the operation or construction of any baseline incineration facility currently in progress. Transportation of assembled chemical weapons between stockpile sites is precluded by public law and will not be considered.

Alternatives that will be considered in the Environmental Impact Statement are: (a) No action, (b) pilot test of chemical neutralization followed by super critical water oxidation, and (c) pilot test of chemical neutralization followed by biological treatment.

There is a second Notice of Intent, entitled “Notice of Intent to Prepare an Environmental Impact Statement for the Design, Construction, and Operation of a Facility for the Destruction of Chemical Agent at Pueblo Chemical Depot, Colorado.” The focus of this complementary Environmental Impact Statement will be specifically on what technology should be used for the destruction of the chemical weapons stockpile at Pueblo Chemical Depot. The focus of the Assembled Chemical Weapons Assessment Environmental Impact Statement is on whether or not pilot testing of any Assembled Chemical Weapons Assessment technology should be conducted, and if so where, but it will leave to the Pueblo Chemical Depot Environment Impact Statement the question whether a full-scale facility operated initially as a pilot facility should be constructed to destroy the stockpile at that location. The emphasis for the Assembled Chemical Weapons Assessment document is to consider Assembled Chemical Weapons Assessment technologies and the various stockpile sites that may be suitable for conducting pilot tests, considering such factors as existing facilities, resource requirements for each technology and the ability of the site to provide those resources, munitions configurations and availability at each site at the time actual testing would begin. At the conclusion of both these Environmental Impact Statements, the same officials will issue The Records of Decision.

During scoping meetings, the Program Manager, Assembled Chemical Weapons Assessment is seeking to identify significant issues related to the proposed action. The Program Manager, Assembled Chemical Weapons Assessment desires information on: (1) The potential chemical weapons stockpile sites and surrounding areas, (2) concerns regarding the testing and/or operation of multiple technologies at these sites, (3) issues regarding the scale of the pilot test facilities, and (4) specific concerns regarding any potential technologies. Individuals or organizations may participate in the scoping process by written comment or by attending public meetings to be held in Alabama, Arkansas, Colorado, Kentucky and the Washington, DC metropolitan area. The dates, times, and locations of these meetings will be provided at least 15 days in advance by public notices in the news media serving the regions where the meeting will be located. The public meeting in Colorado will be held in conjunction with the public meeting on the site-specific Environmental Impact Statement.

Dated: April 10, 2000.
Raymond J. Fatz,
Deputy Assistant Secretary of the Army, (Environment, Safety, and
Occupational Health) OASA (I&E).
[FR Doc. 00-9336 Filed 4-13-00; 8:45 am]
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APPENDIX B

SUMMARY OF SUPPORT STUDIES

The alternatives for disposal of chemical munitions stored at BGAD are supported by numerous studies.

1. GA Technologies, Inc. 1987a, 1987b, and 1987c. *Risk Analysis of the On-Site Disposal of Chemical Munitions, Risk Analysis of the Disposal of Chemical Munitions at National or Regional Sites*, and *Risk Analysis of the Continued Storage of Chemical Munitions*.

A major public concern with disposal of chemical munitions has to do with risks from accidents associated with the various CSDP disposal alternatives. Specific concerns have included comprehensiveness of the risk analysis; potential bias in the analysis; failure to consider site-specific inventories and associated activities, including variation in time-at-risk for different alternatives; treatment of common mode failures and human error in the analysis; and treatment of accidental release source terms. These reports support addressing the concerns and the incorporation of revised operational concepts associated with the various activities needed to implement each programmatic alternative (e.g., packaging, on-site and off-site transportation, and improvements in plant design).

2. Jacobs Engineering Group, Inc., and Schneider EC Planning and Management Services 1987. *Emergency Response Concept Plan for the Chemical Stockpile Disposal Program.*

In response to public concerns that the FPEIS treatment of emergency preparedness was inadequate and insensitive to site-specific differences in inventory and preparedness needs, this study develops a standard approach to be used in implementing site-specific plans. This approach specifically includes development of emergency planning zones based on the site-specific parameters of the CSDP risk analysis and varying potential for taking protective actions. Alternative warning systems and protective actions are considered in the study, and recommendations are made for organizational communication between Army and civilian authorities. The approach also addresses emergency planning and preparedness concepts for fixed-site and transportation corridors. The Army has determined that emergency planning activities are a significant mitigative action associated with the program.

3. The MITRE Corporation 1987a. *Risk Analysis Supporting the Chemical Stockpile Disposal Program (CSDP).*

In response to the need to integrate complex risk analyses of diverse CSDP alternatives, the Army contracted the MITRE Corporation to monitor the risk analyses during their preparation and to prepare an integrated summary of the risk analyses.

4. The MITRE Corporation 1987b. *Transportation of Chemical Agents and Munitions: A Concept Plan.*

Early in the CSDP planning process, public concerns relating to the treatment of stockpile transport included the premature rejection of alternative transport modes (i.e., air and marine) and the lack of detail as to how such movements would take place. Comments also included concerns about the risks and hazards of such movement. As a result of these concerns, the Army sponsored the study and development of a transportation concept plan for on-site and off-site movement. This study, which involved a panel of hazardous material transportation experts, developed preliminary operational plans for movement by truck (on-site only), rail, air, and water. Design-basis recommendations were also made regarding the type of munition packaging to be used during transport.

5. The MITRE Corporation 1987c and 1987d. *Analysis of Existing Hazardous Material Containers for Transporting Chemical Munitions* and *Conceptual Design of a Chemical Munition Transport Packaging System*.

The use of a Chemical Agent Munition Package Transporter (CAMPACT) for off-site movement of stockpile items was proposed. This package was based on a shipping container under development by the U.S. Department of Energy for the movement of radioactive materials. The Army contracted with the MITRE Corporation to reconsider the use of the CAMPACT and develop packaging concepts based on transportation accident thresholds for both on-site and off-site movement (as also identified by the panel of hazardous material transportation experts employed on the above task). Such packages have not been fabricated or tested, but the Army feels that these package concepts are more applicable to CSDP needs than is the CAMPACT. Furthermore, the proposed concepts represent the state of the art in packaging.

6. The MITRE Corporation 1988. *Conceptual Design of a Packaging System for On-Site Transport of Chemical Munitions*.

This report describes a conceptual packaging system to be used for transporting chemical munitions from existing storage areas to a demilitarization building located on the same site. The packaging system concept is based on design criteria for transportation safety and logistics. It also incorporates special features related to thawing frozen mustard agent prior to processing and handling as well as transporting containers with leaking munitions inside. This report describes the package concept and includes quantitative analyses of the basic structural and thermal design features.

The goal for the on-site transport package is the provision of safe and efficient munitions movement from existing on-site storage facilities to an on-site container-handling building to be located adjacent to the munitions demilitarization building. The basic safety criterion is the prevention of chemical agent release into the environment during normal conditions of transport or as the result of an accident during transportation. The basic efficiency criterion requires that the package system support the maximum feed rate of munitions into the destruction equipment in the munitions demilitarization building.

The conceptualized container consists of a cylindrical inner container surrounded by thermal insulation and a cylindrical outer steel shell. Two cylindrical shells provide redundant containment for leaks of agent from munitions. The entire cylindrical assembly is supported on shock-isolating springs within a rectangular support frame. Separate doors seal inner and outer cylinders, and gas sampling ports provide for the remote detection of leaking munitions. The container doors also include sealed power feed-through fixtures to accommodate a modular convection heating unit to be installed as needed for thawing frozen mustard agent munitions in the container.

7. U.S. Army 1987a. *Chemical Stockpile Disposal Program: Monitoring Concept Plan.*

The Army's concept plan addresses the manner in which all activities associated with stockpile disposal would be monitored. Although this study identifies various monitoring technologies, it does not attempt to assign a particular monitor to each location during the process. Rather, it includes the basic concepts and logic relevant to developing detailed monitoring programs for each disposal alternative. The report addresses the monitoring of industrial pollutants as well as chemical agents; it also addresses organizational monitoring, including independent monitoring. The results of this study have been incorporated into the FPEIS.

8. U.S. Army 1987b. *Mitigation of Public Safety Risks of the Chemical Stockpile Disposal Program.*

The Army, with the assistance of the MITRE Corporation, Oak Ridge National Laboratory, the Ralph M. Parsons Company, and GA Technologies, Inc., identified mitigation measures that would reduce the probability and/or magnitude of an accidental release of chemical agent for all CSDP disposal alternatives. Using accident scenarios identified in the CSDP risk analysis (GA Technologies, Inc. 1987a, 1987b, and 1987c) as a baseline, this report screened from consideration those accident sequences with a frequency less than 10^{-8} per year or a lethal downwind release less than 0.5 km (0.3 mile) (for on-site activities only). The sequences remaining were analyzed in detail to identify potential mitigative measures for reducing risk.

9. U.S. Army 1987c. *Chemical Agent and Munition Disposal: Summary of the U.S. Army's Experience.*

In response to comments regarding the insufficient documentation of past experience in destroying chemical agents, the Army prepared a report documenting CSDP-related experience. This report identifies major programs at the Rocky Mountain Arsenal near Denver, Colorado, and the Chemical Agent Munitions Disposal System (CAMDS) at Tooele, Utah. Process effluents associated with each disposal campaign are also identified. Additionally, the report incorporates data on products of incomplete combustion (PICs) and principal organic hazardous constituents (POHCs) for incineration of agent GB. It also describes the currently proposed disposal process, estimated effluents, and future incineration tests at CAMDS, including PICs and POHCs tests for mustard agent and agent VX.

10. Carnes, S. A., et al. 1989. *Emergency Response Concept Plan for Lexington-Blue Grass Army Depot and Vicinity*.

This report develops information and methodologies that bear on two major decisions for the CSDP emergency preparedness program determining emergency planning zones and selecting protective action strategies. A conceptually simple methodology for determining emergency planning zone (EPZ) boundaries is developed and applied to the BGAD stockpile, and a recommended EPZ and set of boundaries are identified. The EPZ consists of two zones, an immediate response zone (IRZ) with a radius of approximately 10 km (6 miles) from the storage area and proposed disposal site and a protective action zone (PAZ) with a radius of approximately 25 km (16 miles) from those locations. Most boundaries are set using natural features of the landscape or other landmarks with which the local populace is familiar (e.g., the Kentucky River, county boundaries, roads, and highways).

The report identifies the advantages and disadvantages of six categories of protective actions (i.e., evacuation, in-place sheltering, respiratory protection, protective clothing, prophylactic drugs, and antidotes) and various options among these categories. Potentially suitable options for the IRZ and PAZ general publics and institutional populations are identified, and preliminary recommendations are made. For the general population in the IRZ, the recommended option is expedient sheltering, although other potentially feasible options for the general population in the IRZ include sealing a house, pressurizing one room or a building, using respirators while sheltering, or mass pressurized sheltering. For institutionalized or impaired persons in the IRZ (e.g., school children and hospitalized patients), positive pressurization of a "safe" room in a house or building is recommended. For the PAZ, evacuation is recommended for all persons.

The viability of the recommended EPZ and the effectiveness of the recommended protective actions depend on the adoption and implementation of appropriate standards for command and control decisions and for alert and notification systems. Given the possibility of rapid onset of accidents at BGAD and the proximity of civilian populations in the IRZ, an overall command and control structure must be able to provide a decision on warning and protective actions in less than five minutes from accident detection. Somewhat more time is available for the PAZ.

11. Blackwell, O., et al. (1987). *Report of the Kentucky Community Study Group*, Eastern Kentucky University, Richmond, KY.

On August 28, 1987, a public hearing was held in Richmond, Kentucky, regarding the DPEIS for CSDP. Among those representing the U.S. Army was Under Secretary James Ambrose. During the question and answer period of the meeting, a local citizen made the following comment to Mr. Ambrose:

> . . . *I would like to make a request of the Army that they fund the Kentucky Resource Council with $100,000 so that we may be able to conduct some of our own studies which we think might be helpful* (Transcript of the CSDP Public Hearing, Thursday, August 28, 1986, p. 88).

Later that evening, Under Secretary Ambrose agreed to sponsor a local citizen study for the Blue Grass Chemical Activity (BGAD) area. Subsequently, the Army also offered local citizens at the seven other sites an opportunity to undertake local studies [Federal Register **(52)**, 4646, Feb. 13, 1987). Citizen representatives from five sites (BGAD, APG, NECD, PBA, and UMCD) were contracted to write community studies. These studies provide another avenue of input for local communities. The community studies generally focused on three objectives: (1) to perform independent evaluation of the DPEIS, (2) to review and comment on ongoing additional studies addressing specific areas of concern, and (3) to perform independent studies as necessary to address areas of concern. The community studies provided this information.

The BGAD community study was completed through a contract with Eastern Kentucky University (Blackwell, et al. 1987). In addition to recommending that the BGAD stockpile be flown to Tooele Army Depot (TEAD) for incineration, the study raised a series of concerns that are addressed in subsequent sections. These concerns dealt with health effects; social, economic, and cultural resources; aircraft activity; the risk analysis; transportation concepts; agent monitoring; mitigation; plant design and operations; and the selection of the preferred alternative. These issues have been incorporated into this EIS as part of the scoping process as discussed in Sect. 1.4.2 of this EIS.

12. NRC (National Research Council) 1994. *Recommendations for the Disposal of Chemical Agents and Munitions*

The Army undertook a study of chemical munitions disposal technologies in the 1970s, including the assessment of incineration and chemical neutralization methods. In 1982, that study culminated in the proposal for the use of incineration technology, which has subsequently been incorporated into the baseline system. In 1984, another NRC committee reviewed the chemical stockpile program and possible disposal technologies, and endorsed incineration as the method of choice. The NRC Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program monitored the construction and Operational Verification Testing of a prototype facility using the baseline technology, JACADS. To address public concern over incineration, Congress, in 1992, directed the Army to evaluate alternative disposal approaches that might be safer and more cost effective than incineration and that could complete the disposal operations within the required time frame. The Army was further directed to report to Congress on potential alternative technologies by the end of 1993 and include the recommendations of NRC. This NRC report provides that information. The NRC committee drew upon its long experience with the disposal program and on the report of the Committee on Alternative Chemical Demilitarization Technologies in the preparation of recommendations. In conducting its assessment, the committee was concerned primarily with the technical aspects of safe disposal operations. However, the committee recognized that other issues would also influence the selection of disposal technologies, including public concerns. A public forum was convened in 1993 to listen to the public and do discuss the criteria for evaluating alternative technologies.

13. NRC (National Research Council) 1999. *Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons*

The U.S. Army is in the process of destroying the United States' stockpile of aging chemical weapons. The Army selected incineration as the preferred "baseline" destructions technology and currently has two operating facilities—one on Johnston Atoll and another at the Deseret Chemical Depot near Tooele, Utah. In response to significant public concern and political opposition to the incineration process, chemical neutralization based processes are being studied as possible alternatives to incineration. The NRC was asked by the Army Program Manager for ACWA (who is responsible for evaluation of the neutralization alternatives) to perform an independent technical review and evaluation of seven neutralization technology packages which had passed the DOD initial screening criteria. The NRC formed the Committee on Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons. This report contains the committee's findings and recommendations and details the factual data, the information supplied by the technology providers, and the analyses and arguments that support the findings and recommendations.

1 4. NRC (National Research Council) 2000. *Evaluation of Demonstration Test Results of the Alternative Technologies for Demilitarization of Assembled Chemical Weapons, a Supplemental Review*

When the NRC's Committee on Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons first report was prepared, the committee did not have the benefit of evaluating the results of neutralization technology demonstrations. Subsequently the Army Program Manager for ACWA requested that the committee evaluate both the technology providers' test reports and the Army's evaluations to determine if the demonstrations changed the committee's earlier findings or recommendations. This report is a supplemental review evaluating the impact of the three demonstrations tests on the committee's original findings and recommendations.

15. NRC (National Research Council) 2001. *Analysis of Engineering Design Studies for Demilitarization of Assembled Chemical Weapons at Pueblo Chemical Depot.*

The Program Manager for Assembled Chemical Weapons Assessment asked the National Research Council (NRC) to assess engineering design studies developed by Parsons/Honeywell and General Atomics for a chemical demilitarization facility to completely dispose of the assembled chemical weapons at the Pueblo Chemical Depot. The NRC formed the Committee on Review and Evaluation of Alternative Technologies for the Demilitarization of Assembled Chemical Weapons: Phase 2 (ACW II Committee). The committee evaluated the engineering design packages proposed by the technology provider and the associated experimental studies that were performed to validate unproven unit operations. A significant part of the testing program involved expanding the technology base for the hydrolysis of energetic materials associated with assembled chemical weapons, a concern expressed by the ACW I Committee in its original report in 1999. In some cases, tests for some of the supporting unit operations were not completed in time for the committee to incorporate results into its evaluation. In those cases, the committee identified and discussed potential problem areas in these operations. Based on its expertise and its aggressive data-gathering activities, the committee was able to conduct a comprehensive review of the test data that had been completed for the overall system design.

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APPENDIX C

MATURITY OF INCINERATION TECHNOLOGY

This appendix provides a status report on the Army's operational experience with incineration technology since the time of the Final Programmatic Environmental Impact Statement (FPEIS) for the Chemical Stockpile Disposal Program (CSDP) (U.S. Army 1988). Appendix D of the FPEIS documents the Army's experience prior to 1987. "Maturity" of the technology refers to the continuing refinement of designs and procedures from the conceptual design to the operation of a destruction facility. The performance and design of the Johnston Atoll Chemical Agent Disposal System (JACADS) the Army's prototype incineration facility, and the Tooele Chemical Agent Disposal Facility (TOCDF) have been refined and improved based upon U.S. Army and U.S. Environmental Protection Agency (EPA) reviews. Regulatory approvals of the design are required from the State of Colorado prior to the start of construction and operation of the proposed BGAD facility.

C.1 BACKGROUND AND SUMMARY

The Army has previously conducted chemical demilitarization operations at former production facilities at Rocky Mountain Arsenal (RMA), located in Denver, Colorado, and at the Chemical Agent Munitions Disposal System (CAMDS) near Tooele, Utah. These operations were in addition to the destruction of munitions and agent at JACADS and TOCDF.

This appendix discusses the performance of JACADS, which completed destruction operations on Johnston Island in the Pacific Ocean on November 29, 2000, and of the operational TOCDF facility. Tables C.1 and C.2 summarize the U.S. Army's experience in industrial scale destruction of lethal chemical agents and munitions before and after the availability of the JACADS and TOCDF facilities.

The FPEIS concluded that no significant human health impacts would be expected during normal plant destruction operations. This conclusion has been supported by operational experience and equipment advancements that have been made since the FPEIS. However, agent has been detected outside the JACADS and TOCDF facilities. Nevertheless, these events posed no serious health threat to nearby personnel.

At the time the FPEIS was published, initial polychlorinated biphenyl (PCB) incineration tests had been conducted at CAMDS. Based on these tests, it was concluded that PCB incineration would result in no significant human health effects. This conclusion is reinforced by Toxic Substances Control Act (TSCA) test burns conducted at JACADS and at TOCDF (see Sects. C.2.1 and C.3.1), PCB emissions from these incinerators were substantially lower than commercial PCB-permitted units within the continental United States.

As discussed below, air quality impacts from emissions during normal operation have been evaluated against standards applicable to criteria pollutants. Hydrogen chloride (HCl), nitrogen oxides (NO_x), particulate matter, and sulfur dioxide (SO_2) emissions were monitored during the Army's JACADS and TOCDF tests and were found to be within EPA regulatory limits (see Sects. C.2.1 and C.3.1).

Table C.1. Summary of U.S. Army's pre-JACADS experience in industrial-scale chemical agent/munitions destruction

Operation	Description	Date	Agent	Site[a]	Process[b]	Quantity (1,000 kg)	Quantity (1,000 lb)
Project Eagle Phase I	Ton containers	July 72–Mar.74	H	R	I	2,008.5	4,428.0
Project Eagle Phase I	Ton containers	July 72–Mar. 74	HD	R	I	777.5	1,714.0
Project Eagle Phase II	M34 cluster bombs	Oct. 73–Nov. 76	GB	R	N/I	1,873.2	4,129.6
Project Eagle Phase II (Expanded)	Underground storage tanks	Sept. 74–Nov. 74	GB	R	N	171.5	378.0
Project Eagle Phase II (Expanded)	Ton containers	May 75–Nov. 75	GB	R	N/I	1,635.0	3,604.5
Project Eagle Phase II (Expanded)	Honest John warhead (M139)	Apr. 75–Nov. 76	GB	R	N/I	34.7	76.5
Chemical Agent Identification Sets Disposal	Chemical agent identification sets	May 31–Dec. 82	(c)	R	I	16.6	36.7
M55 Rocket Disposal		Sept. 79–Apr. 81	GB	C	N/I	58.1	128.0
Agent Injection Incineration Tests		Apr. 81–Jan. 84	GB	C	I	5.1	11.2
Agent Injection Incineration Tests	Ton containers	June 81–Aug. 84	VX	C	I	3.6	7.9
155-mm Projectile Disposal		July 81–July 82	GB	C	N	27.4	60.5
105-mm Projectile Disposal		Mar. 82–July 82	GB	C	N		
In-Situ Agent Incineration		Oct. 82–Dec. 83	GB	C	I	8.0	17.6
M55 Rocket Incineration		Nov. 85–Nov. 86	GB	C	I	1.0	2.3
Liquid Incinerator Test		Aug. 85–Aug. 86	GB	C	I	17.2	37.9
Agent BZ Disposal		May 88–Sept. 89	BZ[d]	P	I	42.6	94.0
Liquid Incinerator Test		Sept. 89–Oct. 89	VX	C	I	18.1	40.0
Total						6,698.1	14,766.7

[a]R refers to Rocky Mountain Arsenal, C refers to Chemical Agent Munitions Disposal System, and P refers to Pine Bluff Arsenal.

[b]N refers to agent neutralization only; I refers to incineration of agent and explosive (and/or metal parts thermal decontamination); N/I refers to agent neutralization and explosive incineration (and/or metal parts thermal decontamination).

[c]Agents include phosgene, chloropicrin, mustard, lewisite, cyanogen chloride, nitrogen mustard, and GB.

[d]The incapacitating agent BZ is not lethal.

Table C.2. Summary of U.S. Army's experience in industrial-scale incineration of chemical agents/munitions at JACADS and TOCDF

Munition type	Agent type	Quantity of agent (1000 kg)	Quantity of agent (1000 lb)
Johnston Atoll Chemical Agent Disposal System (JACADS), Johnston Island, Pacific Ocean[a]			
M55 (115-mm) rockets/M56 warheads	GB	283.4	625.0
MC-1 (750-lb) bombs	GB	304.0	670.3
MK-94 (500-lb) bombs	GB	125.9	277.6
M121/A1 (155-mm) projectiles	GB	316.1	696.8
M426 (8-in.) projectiles	GB	85.6	188.8
M360 (105-mm) cartridges	GB	35.8	79.0
Ton containers	GB	45.1	99.4
M55 (115-mm) rockets/M56 warheads	VX	63.0	138.9
M121/A1 (155-mm) projectiles	VX	116.2	256.1
M426 (8-in.) projectiles	VX	95.5	210.5
M23 land mines	VX	63.4	139.7
Ton containers	VX	44.2	97.4
M60 (105-mm) projectiles	HD	61.4	135.5
M2A1 (4.2-in.) cartridges	HD	118.8	262.0
M104 (155-mm) projectiles	HD	0.6	1.3
M110 (155-mm) projectiles	HD	30.1	66.3
Ton containers	HD	52.4	115.6
JACADS total[b]		1841.5	4059.8
Tooele Chemical Agent Disposal System (TOCDF), Tooele, Utah[b]			
M360 (105-mm) projectiles	GB	433.8	956.4
M55 (115-mm) rockets	GB	127.0	280.1
MC-1 (750-lb) bombs	GB	445.4	981.9
Ton containers	GB	3,356.5	7,339.9
TOCDF total		4,362.7	9,618.3
JACADS and TOCDF total		6,204.3	13,678.0

[a]The JACADS facility was operational from July 1990 through November 2000. All chemical munitions on Johnston Island have been destroyed.

[b]The TOCDF facility became operational in August 1996.

Sources: Derived from "PMCD: At a Glance: Total Munitions Processed, Program Manager for Chemical Demilitarization, U.S. Army, Aberdeen Proving Ground, Md., December 5, 2000, URLs: http://www-pmcd.apgea.army.mil/aag_jacads.asp and http://www-pmcd.apgea.army.mil/aag_tocdf.asp (both accessed February 19, 2001); and "U.S. Chemical Weapons Stockpile Information Declassified," News Release No. 024-96, Office of Assistant Secretary of Defense, Jan. 22, 1996.

C.2 EXPERIENCE IN DISPOSAL OPERATIONS WITH THE JOHNSTON ATOLL CHEMICAL AGENT DISPOSAL SYSTEM

Johnston Atoll is a coral atoll located in the central Pacific Ocean about 1300 km (825 miles) southwest of Honolulu, Hawaii. Johnston Island, the largest island of the atoll, has been a storage site for three types of chemical agents: GB, VX, and mustard (H and HD). These agents were present in a variety of stockpile items, including rockets, mines, projectiles, bombs, and ton containers.

JACADS is located on Johnston Island. This facility, which became operational in June 1990, was the first full-scale plant capable of destroying all types of agents and munitions. JACADS uses the reverse assembly incineration process to meet the environmental and safety requirements for stockpile destruction. Figure C.1 is a representation of the JACADS reverse assembly process—a munition disassembly step followed by incineration of the liquid agents and the munition components in four separate furnaces or incinerators. The JACADS munition disassembly equipment and the incinerators were developed as a result of experience gained with destruction of the stockpile at RMA and more recently at CAMDS.

The Army began constructing JACADS in January 1986. Systemization (i.e., the system-wide operational checkout of all electrical and mechanical equipment prior to operations with actual chemical agents) was completed in June 1990, and chemical agent destruction operations began at that time.

Safety and environmental considerations have always been important in JACADS operations. Since the fall of 1988, an extensive effort has been made to ensure that the JACADS in-plant agent-monitoring systems maintain the necessary precision and accuracy to detect agent at the low agent concentration detection limit (i.e., the parts per trillion level).

Based on a recommendation from the National Research Council (NRC), a perimeter monitoring system (i.e., external to the plant) was implemented at Johnston Island in October 1990. The perimeter monitoring system is designed to provide a historical record of any major release of agent. The perimeter monitoring system consists of eight agent sampling stations, located around the perimeter of the JACADS facility and chemical storage area.

Four meteorological stations collect data that can be used to model a potential agent release. Data for certain criteria pollutants (i.e., pollutants for which ambient standards have been established under the Clean Air Act) are also being collected at these four stations. These criteria pollutants are ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and total suspended particulates. This additional monitoring is not required by regulation; it reflects a voluntary commitment by the Army to check the impact of JACADS emissions on ambient air quality.

Representatives from the U.S. Department of Health and Human Services (DHHS) conducted a February 1990 preoperational review, concentrated in the area of perimeter and workplace monitoring and medical support capabilities. In a letter documenting the results of this visit (PMCD 1990), DHHS made various recommendations but concluded that all possible actions in the engineering field had been taken to ensure the safety of the workers and the island population. The NRC and EPA have also provided oversight for JACADS testing and operations.

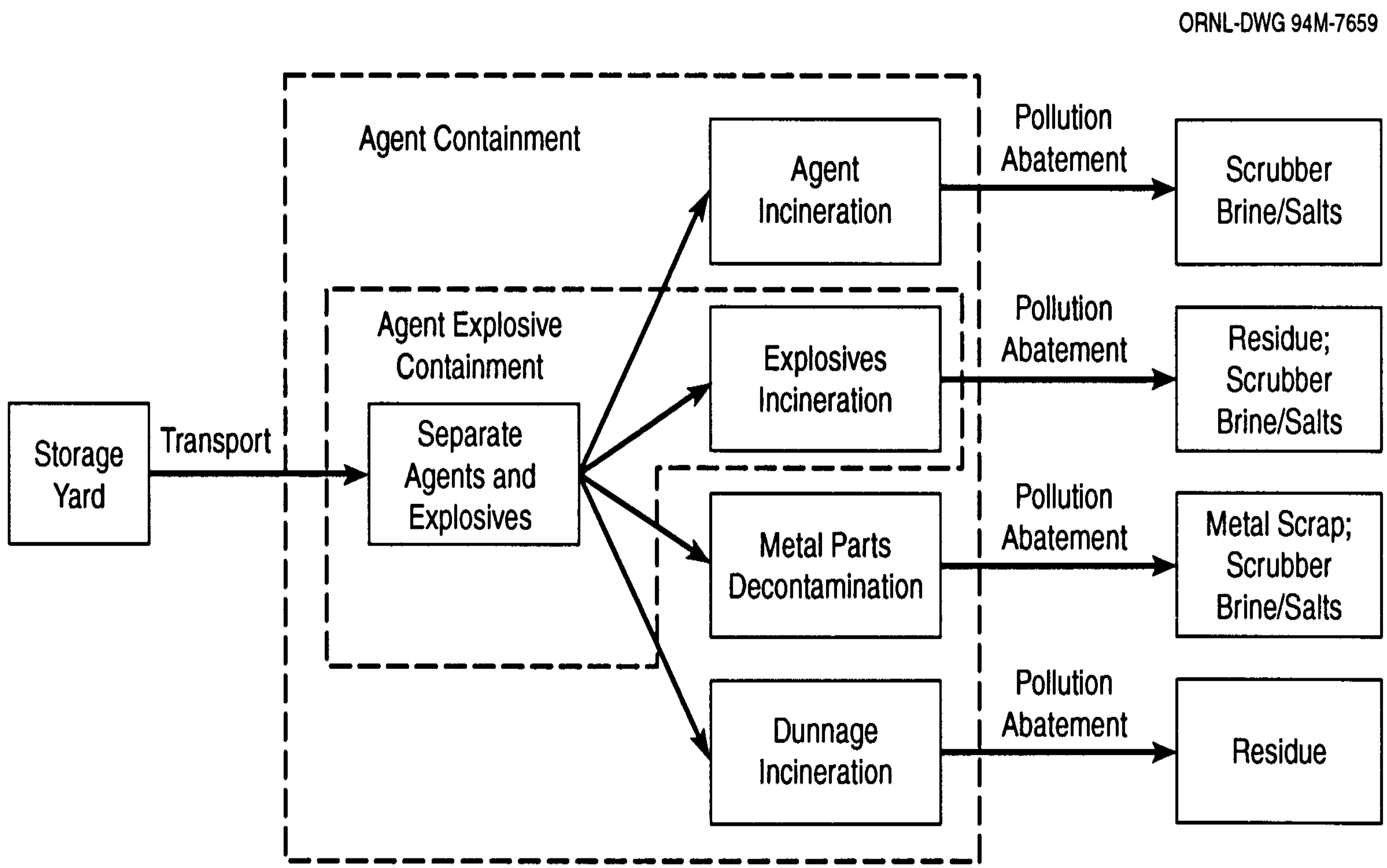

Fig. C.1. Schematic diagram of the incineration process employed at the Johnston Atoll Chemical Agent Disposal System.

C.2.1 Emission and Performance Data from JACADS Facility Tests

C.2.1.1 TSCA trial burns

Trial burns, followed by tests involving actual chemical agent destruction operations, are required by the EPA to obtain a permit to incinerate PCBs. Small amount of PCBs are present in the rocket shipping and firing tubes. Two TSCA trial burns were conducted without agent in the Deactivation Furnace System (DFS) in February 1990; a third TSCA trial burn was conducted with agent GB in October 1990. The trial burns consisted of feeding PCB-contaminated shipping and firing tubes and the complete rocket motor section into the DFS. Representatives from EPA Headquarters witnessed the TSCA trial burns, and the analysis was conducted under EPA guidance. HCl and particulate emissions were below federal regulatory limits. A PCB destruction and removal (DRE) efficiency of 99.9999%, as required by the TSCA regulations, was achieved in all three burns. Dioxins and furans were not detected in the JACADS stack emissions, with the exception of tetrachlorodibenzo-*p*-dioxin (TCDD), which was present in concentrations near the detection limit, well below the proposed EPA standard of 30 ng/dscm.

The highest measured emission rate of PCBs from the JACADS stack during the DFS trial burns was 5.6×10^{-4} g/hr (2×10^{-5} oz/hr) (SRI 1990). Table C.3 provides a comparison of these PCB emissions with three of the largest commercial, EPA-permitted PCB incinerators in the continental United States (CONUS). The PCB emissions monitored from the JACADS DFS were significantly lower than permitted CONUS PCB incinerators.

Table C.3. Comparison of polychlorinated biphenyl (PCB) emissions from the Johnston Atoll Chemical Agent Disposal System (JACADS) with PCB emissions from three commercial PCB incinerators permitted by the Environmental Protection Agency

Incinerator[a]	PCB emission rate
Rollins	0.0181 g/hr (calculated—low value)
ENSCO	0.0548 g/hr (calculated—low value)
SCA	0.0630 g/hr (measured—low value)
JACADS Deactivation Furnace System	0.00056 g/hr (measured—high value)

[a]Rollins = Rollins Environmental Services, Inc., Deer Park, Tx.; ENSCO = Energy Systems Company, El Dorado, Ark.; SCA = SCA Chemical Services, Inc., South Chicago, Ill.

Source: Phase 2, Hazardous Waste Study No. 37-26-1345-86, Assessment of the Occupational Health, Environmental and Regulatory Impact of Polychlorinated Biphenyls Contained in the M441 Shipping and Firing Tube, Chemical Agent Munitions Disposal System, Tooele Army Depot, Tooele, Utah, 17–28 March 1986, U.S. Army, Aberdeen Proving Ground, Md., 1986.

C.2.1.2 RCRA trial burns with chemical agents

RCRA trial burns were conducted at JACADS as part of the operational verification testing (OVT) at that facility. The RCRA trial burns were conducted during incineration operations with actual chemical agents. Stack-gases were monitored from the liquid incinerator (LIC), the DFS, and the metal parts furnace (MPF). The list of air pollutants monitored included over 100 target analytes, depending upon the type of agent being burned. These pollutants may be organized into five broad categories: (1) volatile products of incomplete combustion (PICs), (2) semivolatile PICs, (3) polychlorinated dibenzo-*p*-dioxins and dibenzo furans, (4) metals, and (5) other miscellaneous pollutants, including mustard agent and hydrogen chloride.

Although the Army seeks zero emissions from its operations, it must meet emission standards developed to protect human health and the environment. Emission standards for agents GB, VX, and HD and other pollutants, such as dioxins and hydrogen chloride, as well as air quality standards for the public and workers are provided in Tables C.4 and C.5. Table C.6 provides a summary of JACADS monitoring data for pollutants of major interest. These data were collected during the RCRA and TSCA trial burns using actual chemical agents as the feed materials (AEHA 1992; SRI 1991, 1992a,b; UEC 1992, 1993).

Table C.4. Air emission standards applicable to Johnston Atoll Chemical Agent Disposal System

	Standard[a]	
	Stack gas concentration	Destruction & removal efficiency
Agent GB	300 ng/m^3 [a]	99.99% [b]
Agent VX	300 ng/m^3 [a]	99.99% [b]
Agent HD	30,000 ng/m^3 [a]	99.99% [b]
Polychlorinated biphenyls (PCBs)		99.9999% [c]
Nitroglycerin		99.99% [b]
Dioxins/furans	30 ng/dscm [d]	
Hydrogen chloride		99% [e, f]
Particulate matter	180 mg/dscm [e]	

[a] *Federal Register* 53:8504–8507 (Mar. 15, 1988)
[b] Resource Conservation and Recovery Act (RCRA) permits
[c] Toxic Substances Control Act (TSCA) limit.
[d] *Federal Register* 56:5490 (Feb. 11, 1991); 40 CFR 60:53a (July 1, 1992) (standard for total dioxins/furans from large municipal waste combustors for which construction began after Dec. 20, 1989)
[e] 40 CFR 264.343 (July 1, 1992)
[f] Standard is the larger of 1.8 kg/hr or 99% removal efficiency.

Table C.5. Permitted concentrations of air pollutants in the vicinity of workers and ambient air quality standards for the general public

	Workers		General public	
Pollutant	Standard	Averaging period	Standard	Averaging period
Agent GB	0.1 $\mu g/m^3$ [a]	8 hr	3 ng/m^3 [a]	72 hr
Agent VX	0.01 $\mu g/m^3$ [a]	8 hr	3 ng/m^3 [a]	72 hr
Agent HD	3 $\mu g/m^3$ [a]		100 ng/m^3 [a]	72 hr
Polychlorinated biphenyls (PCBs)				
54% chlorine	500 $\mu g/m^3$ [b]	8 hr		
42% chlorine	1000 $\mu g/m^3$ [b]	8 hr		
Hydrogen chloride	7,000 $\mu g/m^3$ [b]	8 hr		
Sulfur dioxide	13,100 $\mu g/m^3$ (5 ppm) [b]	8 hr	80 $\mu g/m^3$ [c, d] 365 $\mu g/m^3$ [c, d] 1300 $\mu g/m^3$ [c, e]	annual 24 hr 3 hr
Nitrogen dioxide	9,400 $\mu g/m^3$ (5 ppm) [b]	8 hr	100 $\mu g/m^3$ [c]	annual
Carbon monoxide	55,000 $\mu g/m^3$ (50 ppm) [b]	8 hr	10,000 $\mu g/m^3$ [c] 40,000 $\mu g/m^3$ [c]	8 hr 1 hr
Particulate matter (PM_{10})	[f]		50 $\mu g/m^3$ [c, g] 150 $\mu g/m^3$ [c, d, g]	annual 24 hr
Ozone			235 $\mu g/m^3$ [c, d]	1 hr
Lead			1.5 $\mu g/m^3$ [c]	3-month [h]

[a] *Federal Register* **53**:8504–8507 (Mar. 15, 1988).
[b] 29 CFR 1910 (July 1, 1992); updated per *Federal Register* **58**:35338–35351 (June 30, 1993).
[c] National Ambient Air Quality Standards; 40 CFR 50.
[d] Not to be exceeded more than once per year (for ozone and PM_{10}

Table C.6. Monitoring results during the first three Operational Verification Testing campaigns at Johnston Atoll Chemical Agent Disposal System [a]

	OVT1 (GB)	OVT2 (VX)		OVT3 (HD)	
Pollutant	LIC	LIC	DFS	LIC	MPF
Agent					
Max. conc.	ND	ND	ND	ND	ND
Min. DRE	>99.999997%	99.999999%	NC [b]	>99.99995%	>99.9996% [c]
Max. PCDD/PCDF conc.	0.16 ng/dscm	ND	769 pg/dscm [d]	1.08 ng/dscm	1.48 ng/dscm
Max. HCl emission rate	0.035 lb/hr	ND [e]	ND [e]	0.02 lb/hr	0.0497 lb/hr
Max. particulate conc. (@7% O_2)	4.23 mg/dscm	19.1 mg/dscm	4.6 mg/dscm	3.22 mg/dscm	10.92 mg/dscm
Max. CO conc. (@7% O_2)	26 ppm			18.5 mg/m^3	13.0 ppm
Max. lead conc.	16 µg/dscm		55 µg/dscm [d]		
PCBs					
Max. conc.			26 ng/dscm [d]		
Min. DRE			99.99990%		
Nitroglycerin					
Max. conc.			40 µg/dscm [e]		
Min. DRE			99.99884%		

[a] OVT-operational verification testing; ND-not detected; NC-not calculated; DRE-destruction and removal efficiency; PCDD/PCDF-polychlorinated dibenzo-*p*-dioxins/ polychlorinated dibenzofurans; HCl-hydrogen chloride; CO-carbon monoxide; PCBs-polychlorinated biphenyls.

[b] Agent is not fed to DFS.

[c] Proven efficiency is limited by the detection limit for stack gas and the amount of agent in the feed material. The amount of agent in the feed material in this case was very low. It should therefore be emphasized that this figure is a lower bound that was calculated using the detection limit as the assumed stack gas concentration, and no agent was actually detected in the stack gas.

[d] Maximum ambient air concentrations calculated using average Johnston Island meteorological conditions are 43.5 fg/m^3 (PCDD/PCDF), 2.8 ng/m^3 (lead), 1.3 pg/m^3 (PCBs), and 2.1 ng/m^3 (nitroglycerin). To get concentrations for worst-case meteorology, multiply by 1.7.

[e] Detection limit is 0.03 lb/hr (0.014 kg/hr).

Note: Values given represent the highest concentration or lowest from multiple runs during operational verification destruction and removal.

Sources: Results of the RCRA Trial Burn with GB Feed for the Liquid Incinerator at the Johnston Atoll Chemical Agent Disposal System, SRI-APC-91-190-6967-006-F-R4, Southern Research Institute, Birmingham, Ala., 1991; *Results of the RCRA Trial Burn with VX Feed for the Liquid Incinerator at the Johnston Atoll Chemical Agent Disposal System*, SRI-APC-92-384-7530.5.1-I-R3, Southern Research Institute, Birmingham, Ala., 1992; *Results of the RCRA Trial Burn and the TSCA Demonstration Burn of the Deactivation Furnace System with M55 VX Rockets at the Johnston Atoll Chemical Agent Disposal System*, Final Report SRI-APC-92-385-7530.5.1-I-R3, Southern Research Institute, Birmingham, Ala., 1992; and *Inhalation Risk from Incinerator Combustion Byproducts, Johnston Atoll Chemical Agent Disposal System, Health Risk Assessment No. 42-21-MQ49-92,* U.S. Army Environmental Hygiene Agency, Aberdeen Proving Ground, Md., 1992.; *Results of the Demonstration Test Burn for the Thermal Destruction of Agent HD in the Johnston Atoll Chemical Agent Disposal System Liquid Incinerator*, United Engineers and Constructors, Philadelphia, Pa., 1993.; and *RCRA Trial Burn Report for HD—Mustard Ton Containers—Metal Parts Furnace at the Johnston Atoll Chemical Agent Disposal System*, United Engineers and Constructors, Philadelphia, Pa., 1992.

Air emissions of chemical agents. No agent was detected in the exhaust stack during the RCRA and TSCA trial burns. DREs for the LIC were greater than 99.99999% for agents GB and VX, and greater than 99.9999% for agent HD. Feedstock for the MPF contained sufficiently small amounts of agent HD that no agent could be detected in the stack. Nevertheless, from the quantities fed into the MPF and from the stack gas detection limits for agent HD, it was possible to calculate that the DRE was greater than 99.9995%.

Emissions of criteria pollutants. Johnston Island is exempt from National Ambient Air Quality Standards (NAAQS). These standards exist for SO_2, NO_2, carbon monoxide (CO), O_3, lead, and particulate matter small enough to move easily into the lower respiratory tract (particles less than 10 microns in aerodynamic diameter, designated PM_{10}). However, stack gas concentrations of pollutants for which NAAQS exist (except for ozone) were monitored because they are regulated in the continental United States. Formation of ozone, because of the complex chemical reactions required, often takes place too far away from the facility to monitor the ozone formed as a result of combustion.

Stack concentrations were generally below 1.3 g/m^3 for SO_2 and below 0.94 g/m^3 for NO_x (conservatively assumed to consist entirely of NO_2). Assuming that concentrations are diluted by a factor of 10,000 between the stack and the ambient air,[1] the maximum hourly ambient air concentrations are 131 μg/m^3 for SO_2 and 94 μg/m^3 for NO_x. For SO_2, the NAAQS that corresponds most closely to an hourly average is a 3-hr average standard of 1300 μg/m^3, or about 10 times the maximum hourly average obtained above. A 3-hr average, which is always equal to or less than the maximum hourly average, would therefore be expected to be, at most, about 10% of the corresponding NAAQS. The only standard for NO_x is an annual average concentration of 100 μg/m^3. The annual average concentration would be expected to be less than one-tenth of the 94-μg/m^3 maximum permissible hourly concentration at locations in the continental United States. The standards for SO_2 and NO_x should not be exceeded as a result of incineration of chemical agent.

Other non-agent air emissions. During the DFS trial burns, the average DRE for PCBs was greater than 99.9999%, meeting the TSCA standard. The DRE of nitroglycerin in the DFS always exceeded 99.99%, as required by RCRA. Stack-gas concentrations of total dioxins and furans from the LIC ranged from undetectable to 1.48 ng/m^3. No TCDD (considered the most toxic form of dioxin) was detected in the LIC stack.

Stack gas concentrations of hydrogen chloride were within regulatory limits during the trial burns. Atmospheric emissions of target metals were also measured during the OVT campaigns; the metals emissions were either not detectable or were below EPA's established levels of concern.

In 1999, a trial burn of 4.2-inch HD mortar rounds was conducted at JACADS to show compliance with the operating permit of the MPF, which allows for the destruction of agent residue within the munitions, as well as agent-contaminated materials (JACADS 1999). Of all the chemicals of concern that were measured at the stack, only mercury was found to be near or above the emission standards that were in the process of being finalized when the trial burns took place. Stack-gas concentrations of mercury as high as 142 μg/dscm were detected, even though mercury was not detected in the feed samples. The stack gas emissions standard for mercury is

[1]Conservative values of dilution factors were obtained from the EPA screening model SCREEN2, using design stack parameters typical of those for the exhaust stacks. The calculated dilution factor was 0.0008 at 1500 m from the stack (a typical distance from a proposed stack location to the nearest site boundary at U.S. storage depots).

45 μg/dscm (*NESHAPS: Final Standards for Hazardous Air Pollutants for Hazardous Waste Combustors*, 64 FR 52827, September 30, 1999). Any chemical weapons incinerator constructed and operated in the United States will be required to meet the new standards for mercury, dioxins/furans, particulate matter, semivolatile metals, low volatile metals, hydrochloric acid/chlorine gas, hydrocarbons and destruction and removal efficiency for each specific principal organic hazardous constituent. The Army plans to employ enhanced monitoring, design changes, and operational modifications as necessary to maintain the mercury emission rate below these standards.

C.2.2 Incidents and Releases from JACADS

Because the Johnston Island facility serves as the pilot facility for chemical stockpile incineration, accidents and unexpected occurrences are reported, investigated, and analyzed. The investigations are directed to minimizing operational and environmental impacts. Corrective measures are implemented when appropriate.

The Army Program Manager for Chemical Demilitarization (PMCD) has an aggressive accident reporting procedure (PMCD 1994a). The chemical disposal facility operating contractor reports all accidents to the PMCD through the PMCD Field Office. PMCD notifies the Office of the Assistant Secretary of the Army (Installations, Logistics, and Environment), the Office of the Assistant Secretary of the Army (Research, Development and Acquisition), Department of the Army Safety Office, Deputy Chief of Staff for Operations and Plans, and DHHS. If there is a release of agent to the environment, then the procedures for reporting releases to EPA are also implemented.

C.2.2.1 Accidental releases of chemical agent from JACADS

During JACADS operation, there have been three confirmed chemical agent releases from the facility to the environment; the first two releases occurred during periods of equipment maintenance. These three releases occurred while working with nerve agent GB: (1) from the LIC through the PAS and out of the common stack on December 8, 1990, (2) from the LIC through the PAS and out of the common stack on March 23, 1994, and (3) from a charcoal filter unit supporting the Munitions Demilitarization Building (MDB) on March 17, 1995. In each case, an investigation was followed by recommendations for implementing corrective actions (see MITRE 1991; PMCD 1995a; PMCD 1994b; and PMCD 1995b).

C.2.2.2 Other incidents at JACADS

Other unplanned events, which released no agent to the environment, have occurred during JACADS operations. Public concern about these incidents has focused on releases of agent internal to the JACADS facility (Costner 1993a), false-positive monitoring alarms (Costner 1993b), and unintended detonations/fires of munitions during the demilitarization process. None of these incidents jeopardized the health and safety of personnel outside of the JACADS facility. In all cases, the redundancy (e.g., multiple layers of containment, cascading ventilation pathways) designed into the JACADS facility functioned as planed to prevent the release of chemical agent from the facility.

Two serious incidents, involving one injury and one fatality, at JACADS are described below. On March 17, 1993, eight people, in Toxicological Agent Protective Level B clothing, entered JACADS to carry bagged contaminated material from the second floor munitions corridor to the first floor Toxic Maintenance Area (CMDA 1993). The plastic bags contained mustard sludge removed from 105-mm projectiles. One individual on the entry team slung a bag over his shoulder to carry the 23-27 kg (40-60 lb) bag more easily. The slung bag was observed to be leaking liquid onto the back of the worker's calves while he carried it. The monitors did not detect agent contamination during the egress procedure, but the individual observed a 2.5 × 1.2 cm blister on the back of his right calf when reporting to work on the next operating shift. The blister was diagnosed by clinical examination and testing as a minor exposure to mustard. The individual was not physically impaired and was able to perform work in a "light duty" status. In response to the incident, the investigation team recommended corrective actions concerning bagging/containerizing of agent contaminated waste, protective clothing requirements, waste handling procedures, and egress monitoring procedures.

On October 30, 1997, the Army announced that the JACADS's employees had worked more than 3.5 million hours without a lost-time injury. The JACADS accident-free period was broken on November 27, 1997, when a contractor employee was killed while performing planned maintenance during an extended facility shutdown. The employee was servicing a large feed chute when an overhead portion of the chute fell on him. Neither chemical agent nor explosives were involved in the accident (Smart 1998).

C.3 EXPERIENCE IN DESTRUCTION OPERATIONS WITH THE TOOELE CHEMICAL AGENT DISPOSAL FACILITY

In September 1989, the systems contract for the construction and operation of the TOCDF in Tooele, Utah, was awarded to EG&G, Inc., of Falls Church, Virginia. The Tooele facility was the first of eight such facilities initially proposed for construction and operation under the CSDP. Construction of TOCDF was completed in August 1993.

After systemization of the facility, the state of Utah issued final permits and approval for the trial burn in June 1996. Destruction of chemical agents and munitions began at TOCDF on August 22, 1996. Lessons learned during the construction, systemization, and operation of the TOCDF will be applied to the CSDP disposal facilities proposed at other CONUS sites.

The shakedown process began with GB-filled M55 rockets and was followed by GB ton containers. Simultaneous co-processing of both munition types began on March 22, 1997. Processing of the rockets was halted in March 1997 at the end of the trial burns. During the analysis of the DFS trial burn, unanticipated low levels of PCBs were found in the Pollution Abatement System (PAS). Investigation later showed that gaskets in the PAS, not the rockets, was the source of the problem (TOCDF 1998). Corrective measures were taken, and processing of rockets was resumed.

C.3.1 Emission and Performance Data from Tests at TOCDF

Trial burns to establish that TOCDF could meet the TSCA and RCRA requirements were required before TOCDF could begin full operation. Individual incinerators have been brought on line, with the priority given to those needed to destroy the agent and munitions presenting the greatest storage hazard. (The stockpile of GB-filled M55 rockets and ton containers of GB is being destroyed first to produce the greatest reduction in the risk of storage.) Results of the TSCA burn for the DFS (EG&G 1997b, 1999), and the RCRA trial burns with agent GB for the MPF, LIC-1, LIC-2, and DFS are now available (EG&G 1997a, 1998a,b, 1999). The LIC-1, LIC-2, and MPF trial burns have been approved. Because of an equipment problem that might affect the reliability of the data needed for the health risk assessment (TOCDF 1998), the DFS trial burn was repeated in November 1998 (EG&G 1999). Additional trial burns will be conducted with other agents before the destruction campaigns for those agents are initiated.

C.3.1.1 TSCA trial burns

The TSCA test burn was conducted using the DFS in January 1997. This test, conducted by TRC Environmental Corp. for EG&G Defense Materials, Inc., was to demonstrate the capability to incinerate the PCBs found in the M55 rocket shipping and firing tubes. The DFS successfully had previously demonstrated a 99.999947% DRE for PCBs in a “mini-burn” in November 1996 (PMCD 1996). PCB DREs were greater than the required 99.9999% in all three 1997 test runs (EG&G 1997b). The TSCA performance of the DFS was confirmed during the repeat trial burn (see Table C.7). The minimum PCB DRE was 99.999985%. The maximum PCB emission rate, 1.0×10^{-8} g/s or 0.00028 g/hr, is well below that from the commercial PCB incinerators shown earlier in Table C.3. All the measured emissions were below regulatory limits, and the incinerator performance exceeded the requirements (EG&G 1999).

C.3.1.2 RCRA trial burns with chemical agents

Deactivation furnace system. The first agent trial burns with the DFS were also conducted in January 1997. Although the agent is drained from the rockets before they enter the DFS, there is enough residual agent to require that agent destruction be demonstrated. The PCBs in the rocket shipping and firing tubes required that PCB destruction also be demonstrated.

Table C.8 summarizes the results of the agent trial burns for the DFS, LIC-1, and MPF. Note that Table C.8 displays the poorest result from the three runs in each trial burn. Emissions of GB, CO, HCl, and particulates were well within the Utah permit limits. Agent destruction exceeded the RCRA requirement of 99.9999%, with 99.9999972% (EG&G 1999).

Liquid incinerator system 1. The agent trial burn for LIC-1 was conducted in February 1997 to demonstrate the ability to destroy agent GB in compliance with the Utah permit and RCRA regulations. Results of this trial are also found in Table C.8. The minimum DRE for GB from the three runs was 99.99999968%. Emissions of GB, CO, HCl, and particulates were within the established limits (EG&G 1998a).

Liquid incinerator system 2. The agent GB trial burns in the LIC-2 took place in August 1997. The results of the LIC-2 trial burns are summarized in Table C.8. The LIC-2 also exceeded the 99.9999% minimum DRE for agent GB, with a minimum DRE greater than 99.999999973%. The maximum concentrations of GB, particulate matter, and CO were well below the Utah permit limits, as was the maximum HCL emission rate (EC&G 1998b).

Table C.7. Emission and TSCA performance data[a] from the DFS second trial burn at TOCDF

	Regulatory limit/ comparison value	Average of three runs	Maximum. or minimum value
	Exhaust gas emissions		
PCB emission rate	5.39×10^{-7} g/s[b]	8.97×10^{-9} g/s	1.0×10^{-8} g/s
PCDD/PCDF emission rate	5.65×10^{-9} g/s[b]	5.8×10^{-11} g/s	6.0×10^{-11} g/s
Particulate matter emission rate	0.0174 g/s[b]	0.0092 g/s	0.0121 g/s
Particulate concentration (@ 7% O_2)	48.3 mg/dscm[c] 180 mg/dscm[d, e]	2.9 mg/dscm	3.8 mg/dscm
HCl emission rate	4 lb/hr or 1% total HCl prior to PAS[c,d]	0.015 lb/hr	0.0158 lb/hr
NO_x concentration		314.2 ppm	353.3 ppm
CO concentration (@ 7% O_2)	100 ppm[e]	6.5 ppm	7 ppm
CO_2 concentration		6.90% dry	7.1% dry
	Minimum DRE for PCBs and energetic components		
PCB DRE	99.9999%[d]	99.999985%	99.999984%
Nitroglycerine	99.99%[f]	99.99988%	99.99986%
3,4,6-trinitrotoluene (TNT)	99.99%[g]	99.99989%	99.99987%
	Incinerator performance standards		
Afterburner combustion efficiency	99.9%[d]	99.99%	99.99
Afterburner residence time	>2 s[d, e]	3.1 s	2.5S
Afterburner exhaust gas temperature	>2000 °F[d] 2050<T<2350 °F[e]	2150 °F	2143–2159 °F

[a] Data from *Tooele Chemical Agent Disposal Facility (TOCDF), RCRA Agent GB Trial Burn #2 Report for the Deactivation Furnace System*, rev. 0, EG&G Defense Materials, Inc., Tooele, Utah, Feb. 16, 1999, Table 1-1, p. 4 (CO, DREs); Table 3-1, pp. 23–24 (CO, afterburner data), Table 5-4, p. 45 (particulates, CO_2); Table 5-5, p. 46 (HCl); Table 5-11, p. 45 (PCB); Table 5-14, p. 69 (PCDD/PCDF); Table 5-25, p. 93 (NO_x); Table 7-2, p. 110 (PCB DRE); Table 7-3, p. 111 (nitroglycerin, TNT DRE).

[b] Values used in *Tooele Chemical Demilitarization Facility Tooele Army Depot South (EPA I.D. No. UT5210090002), Screening Risk Assessment*, A.T. Kearny, Inc., San Francisco, prepared for State of Utah Department of Environmental Quality, Division of Solid and Hazardous Waste, Salt Lake City, February 1996, Appendix R.

[c] Limit set by Air Approval Order.

[d] Limit set by TSCA.

[e] Limit set by RCRA Permit.

[f] Value set by DFS GB ATB Plan.

Table C.8. Summary of TOCDF RCRA agent GB trial burn reports

		Trial Burn			
	Utah Permit Limit	DFS	LIC-1	LIC-2	MPF
Max. GB concentration [a,b]	0.3 µg/m^3	<0.0028 µg/m^3	<0.0034 µg/m^3	<0.0034 µg/m^3	<0.0046 µg/m^3
Min. GB DRE[b]	99.9999%	>99.9999972%	>99.999999968%	>99.999999972%	>99.99999972%
Max. particulate matter concentration (@ 7% O_2) [c]	48.3 mg/dscm [d] 180 mg/dscm [d]	3.8 mg/dscm	5.3 mg/dscm	4.8 mg/dscm	22.3 mg/dscm
Max. HCl emission rate	4 lb/hr [e]	0.016 lb/hr	0.037 lb/hr	<0.008 lb/hr	<0.015 lb/hr
Max. CO concentration (@ 7% O_2)[f]	100 ppm	7 ppm	74 ppm	50 ppm	12 ppm
Max. dioxin TEQ concentration (@ 7% O_2) [b,g]	<0.2 ng/dscm	<0.0036 ng/dscm		<0.00093 ng/dscm	<0.042 ng/dscm
Max. TEQ emission rate[b,g]		$<1.2 \times 10^{-11}$ g/s	$<3.6 \times 10^{-11}$ g/s[h]	$<5.6 \times 10^{-11}$ g/s [h]	5.7×10^{-11} g/s
Max. total PCDD/PCDF emission rate[b,g]		$<6.0 \times 10^{-11}$ g/s	$<2.0 \times 10^{-10}$ g/s	$<2.9 \times 10^{-10}$ g/s	$<4.4 \times 10^{-9}$ g/s

[a] From analysis of DAAMS sorbent tubes—Station PAS 702 (DFS), Station PAS 704 (LIC-1), Station PAS 705 (LIC-2), Station PAS 703 (MPF).
[b] Maximum concentration or minimum DRE of results for three runs. Limit of quantification value was used because no GB was detected.
[c] Equivalent values in gr/dscf @ 7% O_2: DFS, 0.0017; LIC-1, 0.0023; LIC-2, 0.0016; and MPF, 0.0097.
[d] Smaller limit set by Air Approval Order, equivalent to 0.016 gr/dscf @ 7% O_2; larger limit set by RCRA Permit, equivalent to 0.08 gr/dscf @ 7% O_2.
[e] Alternatively 1% total prior to PAS (LIC-1 and DFS reports) or 1% total organochlorine (MFP report).
[f] Maximum value from 60 min rolling average.
[g] Maximum value calculated from method detection limits.
[h] Calculated from max. PCDD/PCDF emission rates in Table 5-16, p. 72, LIC-1 report; Table 5-16, p. 70, LIC-2 report; and TEF values (App. C, Sect. C-23).

Sources: Compiled from *Tooele Chemical Agent Disposal Facility (TOCDF), RCRA Agent GB Trial Burn #2 Report for the Deactivation Furnace System*, rev. 0, EG&G Defense Materials, Inc., Tooele, Utah, Feb. 16, 1999, (Table 1-1, p. 4; Table 5.4, p. 44; Table 7-1, p. 108); *Tooele Chemical Agent Disposal Facility (TOCDF) RCRA Agent GB Trial Burn Report for the Liquid Incinerator System #1*, rev. 2, EG&G Defense Materials, Inc., Tooele, Utah, July 15, 1998 (Table 1-1, p. 2; Table 5-4, p. 43; and Table 5-16, p. 72); *Tooele Chemical Agent Disposal Facility (TOCDF) RCRA Agent GB Trial Burn Report for the Liquid Incinerator System #2*, rev. 1, EG&G Defense Materials, Inc., Tooele, Utah, June 19, 1998 (Table 1-1, p. 3; Table 5-4, p. 42; and Table 5-16, p. 70); and *Tooele Chemical Agent Disposal Facility (TOCDF) RCRA Agent GB Trial Burn Report for the Metal Parts Furnace*, rev. 0, EG&G Defense Materials, Inc., Tooele, Utah, Aug. 15, 1997 (Table 1-1, p. 3; Table 5-4, p. 42; and Table 5-15, p. 69). TEQ emission/concentration data for DFS from M. J. Rowe and T. A. Ryba, Jr., PMCD, U.S. Army, Aberdeen Proving Ground, Md., letter to H. Dodohara, EPA, Washington, D.C., Feb. 26, 1998.

Metal parts furnace. In April 1997, EG&G conducted the agent trial burn for the MPF. This trial burn was conducted to demonstrate the required DRE for GB, and to demonstrate system performance with respect to compliance parameters, and the ability to control emissions regardless of munition type. Metals were added to the feed materials to represent the maximum feed rates of munitions containing heavy metals.

Results of the trial burn are summarized in Table C.8. Emissions of GB, CO, HCl, and particulates were within the established limits for the MPC. Emission of HCl were not detected; the given rate is the maximum calculated rate. Minimum DRE for GB was 99.99999972%, well above the required 99.9999% (EG&G 1997a).

C.3.2 Incidents and Releases from TOCDF Involving Agent GB

Some unexpected events or operational fluctuations occurred during the early TOCDF operations; investigation of these events has led to improvements in facility operation. These events are discussed below. The events have been grouped arbitrarily into those that involved detection of agent within the facility and other incidents. None of the incidents involved a release of agent outside the facility, and there was never a threat to the public or the environment.

MPF shutdown. The MPF shut down automatically on March 30, 1998, when an incompletely drained MC-1 bomb was fed into the incinerator. The excess GB remaining in the bomb was the result of an improperly positioned drain probe. The increased temperature due to the extra GB triggered automatic shutdown of the furnace. An ACAMS alarm in the MPF duct sounded during the incident, but this is thought to have been due to an interferent material. Neither ACAMS in the main stack alarmed, and no evidence of GB was found when the DAAMS tubes were analyzed (Bauman 1999a,b; DCD 1999) .

Agent spill. About 140 gallons of liquid GB was spilled from an agent strainer assembly on December 13, 1998. The strainer is designed to remove solids that might be present in the liquid agent before the agent is pumped to the LIC. The spill occurred in an environmentally controlled area of the facility, and the agent was captured in a sump designed for that purpose (Israelsen 1998; DCD 1998a). The cause of the spill was an incorrectly installed washer on the strainer assembly, which had been serviced before the incident. Maintenance procedures were revised to correct the problem, and destruction operations resumed on December 16. No employees were exposed to the agent, and no agent was released to the environment (DCD 1998b).

Worker actions. In April 1997, two incidents initiated by worker actions resulted in positive agent readings. On April 21, workers in Level B clothing opened a bag of inadequately labeled waste in the toxic maintenance area and triggered an abnormally high room alarm. On the following day, workers entered the Category A airlock and the toxic maintenance area without authorization, resulting in a 0.4 time-weighted average reading in the airlock (PM-CSD/EG&G 1997).

As a result of these actions, the Site Project Manager limited facility activities under a “Notice to Discontinue for Insufficient Quality” until additional management controls were instituted. The limitation was lifted on April 24, 1997. These incidents, as well as results from an audit of the Quality Assurance Plan Program in the areas of configuration control and criteria for entry-level employees, prompted a joint Program Manager for Chemical Stockpile Disposal-

EG&G review (PMCD 1997; DCD 1997). Their report (PM-CSD/EG&G 1997) focused on staff and management issues and made recommendations for improvements.

Agent detection during unpacking and inspections. Small quantities of agent GB have been detected a number of times during routine monitoring of the interior air of onsite containers (ONCs), used to transport the munitions to the processing facility. The agent was being contained within the identified ONCs until they were unloaded in a controlled area of the facility by workers dressed in protective clothing. Numerous small leaks of GB have been detected recently during the processing of the 105-mm projectiles; these leaks were found when the nose plugs were removed to verify that there was no explosive charge present. The inspections took place in an environmentally contained unpack area. The leaking projectiles were then processed through the incinerator. Although press releases have often been issued, detection of agent in these circumstances was not unexpected, due to the aging of the chemical agent stockpile. The environmental controls and protective clothing have prevented exposure of workers and releases to the environment.

C.4 PAST ASSESSMENTS OF CHEMICAL AGENT INCINERATION TECHNOLOGY

The JACADS experience has been assessed by both PMCD and independent organizations to draw some conclusions about the baseline incineration technology.

PMCD assessment. In 1996, PMCD assessed the JACADS experience (PMCD 1996). It concluded that the JACADS operational experience, though not flawless, has demonstrated that the baseline technology can safely and effectively destroy chemical agent, chemical-filled munitions and bulk chemical storage containers. During the first six years of operation, demilitarization has eliminated the entire stockpile of some munitions. There had been three low-level GB nerve agent releases to the atmosphere that did not pose a worker or public health risk, and there has been only one minor agent exposure to a worker. PMCD felt that the claims from the opposition groups concerning the Army's inability to demonstrate that the chemical disposal facilities can operate without releasing large amounts of nerve agent to the environment and exposing workers to serious health risks had been disproved.

The JACADS industrial accident rates had also been steadily improving since the start of JACADS. The industrial rates for Recordable Incident Rates (RIR) and Cases With Days Away (CWDA) were normally below the average rates for similar industries (CDRA 1995). The PMCD performed an operational readiness evaluation prior to starting agent destruction at JACADS (PMCD 1989). This survey included personnel from outside of the PMCD and from outside of the Department of the Army to add independent reviews of facility readiness. All of the findings identified during the surveys were tracked to completion and agent operations were not allowed to begin until all findings were resolved.

MITRE Corporation. The MITRE OVT Reports (1991, 1992, 1993a,b,c) include the following statement:

> "JACADS met the OVT safety performance goals that were established for it. As expected, there were no injuries or fatalities arising from the processing of agent or munitions. Events did occur that challenged the levels of protection designed into JACADS. While none of these presented (nor could have presented) significant public risk, some of the events increased the probability of agent

exposure or injury to workers. The lack of agent or munition injury demonstrates the importance of having 'safety in depth' incorporated into the facility design and operation."

The National Research Council. Although the Johnston Island facility did experience numerous problems during OVT, the Stockpile Committee of the NRC concluded in 1994 that there were no "show stoppers" in these problems (NRC 1994b). The NRC also stated that no such system can be completely designed without problems, and the baseline system has been properly designed with multiple levels of safety to contain problems before they become hazards to the workers or surrounding communities (NRC 1994b).

The Henry L. Stimson Center. The Henry L. Stimson Center, a nonprofit, nonpartisan institution devoted to public policy research, published a report on the U.S. chemical weapons destruction program in 1994 (Smithson 1994). This report notes that the U.S. Army's monitoring level for nerve agents is 21,000 times stricter than what would be required federally and about 210 times stricter than the tougher emissions standards requested by some states. For mustard, the Army's monitoring levels are 415 times stricter than the federal requirement and four times stricter than the more rigorous state emissions standard. In addition, the Army's incinerators have hundreds more operational checkpoint and safeguards than federal regulations require. These extra alarms give the Army ample information about the incinerator's operation to enable appropriate adjustments to be made to maintain the highest level of combustion efficiency.

The Stimson Report provides a discussion on advocacy science concerning several of the opposition group reports. The Stimson Report includes a review of Greenpeace's *Playing With Fire* (Costner and Thornton 1990). This review states that the Greenpeace report does not appear to have been subjected to the standard peer review process that the scientific community uses; the report omitted large amounts of scientific data that contradicts the data it presents or the conclusion reached; the authors use data selectively and misinterpret it; and authors use out-of-date information. EPA and other regulatory standards are based upon extensive, peer-reviewed research that draws upon all of the data and studies that Greenpeace and other incineration opponents fail to cite, as well as upon data provided by opposition scientists. To date, federal regulators have clearly stated that the Army's program has met or exceeded these standards.

C.5 CONCLUSIONS REGARDING CHEMICAL AGENT INCINERATION TECHNOLOGY

The JACADS operational experience, as continued by the on-going destruction of chemical agents and munitions at TOCDF, has shown that the baseline incineration program can effectively destroy chemical weapons in a safe and environmentally protective manner. The JACADS facility destroyed over 4 million pounds of lethal chemical agent and over 410,000 items/munitions/rounds in its ten years of operation.

An additional 9.6 million pounds have been destroyed from August 1996 through November 2000 in the TOCDF facility in Utah. During JACADS operations, there were three confirmed minor agent releases from the facility to the environment, and several other operational malfunctions leading to fires or accidental detonations of munitions. The design of JACADS and the continually maturing PMCD safety culture insured that none of these processing incidents posed a threat to workers or to the population located near the facility. The safety and operational record of the Army's chemical weapons incinerators enhances the confidence placed in the baseline incineration system by the NRC and other reviewers.

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APPENDIX D

BASELINE INCINERATION TECHNOLOGY DESCRIPTION

D.1 EXISTING FACILITIES AND PROPOSED CHANGES

The baseline incineration technology is based on the systems being used in the Johnston Atoll Chemical Agent Disposal System (JACADS), which has completed destruction of chemical agents and munitions on Johnston Island in the Pacific Ocean, about 1,300 km (825 miles) southwest of Honolulu, Hawaii (U.S. Army 1983). The decision to destroy the chemical agent and munition stockpile by incineration was based on the maturity of the baseline process, the ability to perform operational testing with production-scale facilities at the JACADS plant, and safety and environmental considerations. The performance of the JACADS facility during Operational Verification Testing (OVT) and continuing operations and Tooele Chemical Disposal Facility (TOCDF) during systemization and operations would be reflected in the BGAD design to minimize the risks of destruction operations. The JACADS plant is described in more detail in the FPEIS (U.S. Army 1988).

The baseline incineration destruction process (Fig. D.1), as constructed at JACADS and TOCDF, includes reverse assembly (i.e., disassembly of the chemical munitions) as well as agent destruction by incineration, incineration of components, and incineration of various wastes in four types of primary incinerators (furnaces): (1) a liquid incinerator (LIC)—a stationary liquid injection incinerator; (2) a deactivation furnace system (DFS)—a rotary kiln; (3) a metal parts furnace (MPF)—a roller hearth incinerator; and (4) a dunnage incinerator (DUN)—a stationary bed incinerator. Liquid chemical agent would be drained from munitions bodies and destroyed in the LIC. The LIC would also incinerate spent decontamination fluid. Energetic materials (explosives and propellants) would be segregated from munitions by reverse assembly procedures and destroyed in the DFS. Metal that has been in contact with chemical agent would be decontaminated in the MPF. If constructed, the DUN would be used to burn combustible nonmunition wastes and debris, such as packaging material. However, the DUN has been removed from service at JACADS and TOCDF because of operating difficulties and is not proposed as part of the baseline incineration technology for destruction of chemical munitions stored at BGAD. Combustible, agent–contaminated dunnage would be burned in the MPF or DFS. Uncontaminated dunnage would be sent to an appropriately permitted off-site disposal facility. All incinerators have secondary combustion chambers to destroy any agent not incinerated in the primary furnace. A pollution abatement system (PAS) for each incinerator would be used to control atmospheric emissions. At JACADS and TOCDF there is a brine reduction area (BRA) with its own PAS. The BRA is used to evaporate liquid effluents from the incinerators' PAS to dryness. Although, the BRA has been removed from service at TOCDF because of cost constraints, the BRA is expected to be cost-effective at BGAD. Dried brine salts would be stored and disposed of at an off-site Resource Conservation and Recovery Act (RCRA) treatment, storage, and disposal facility (TSDF).

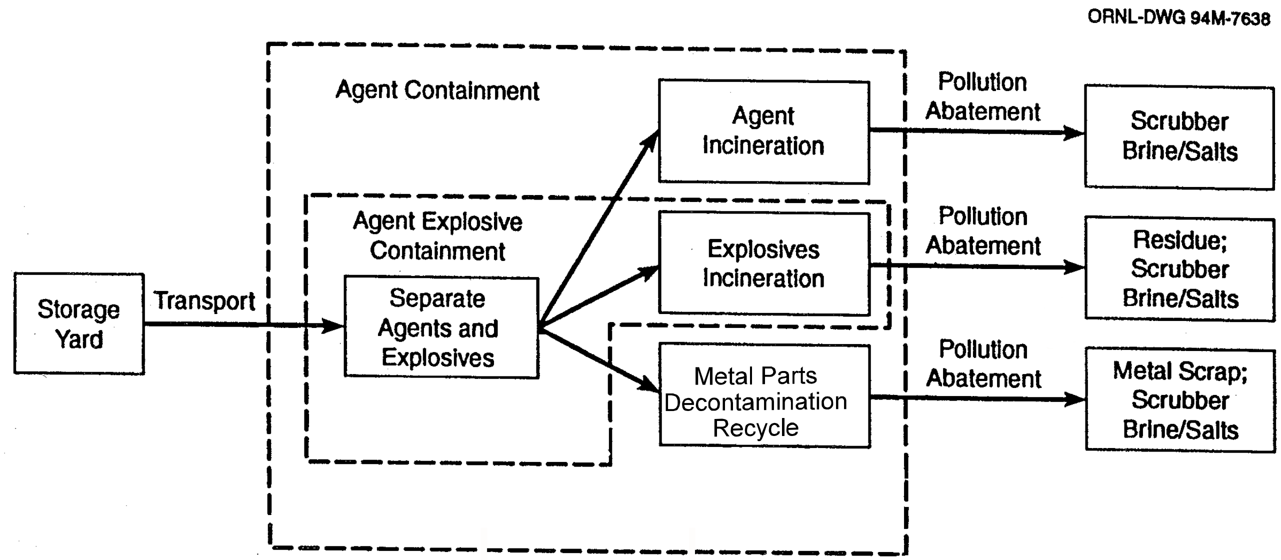

Fig. D.1. Schematic diagram of the baseline incineration process for the proposed BGAD baseline incineration alternative.

D.2 FACILITY DESCRIPTION

The baseline incineration facility for Blue Grass Army Depot (BGAD) would consist of three incinerators, described in Sect. D.1.1, housed within one building, pollution abatement equipment, and several support buildings constructed on a 20-acre site immediately adjacent to the existing chemical agent storage area.

D.2.1 Facility Site

Areas A and B considered for siting the destruction facility are shown in Fig. D.2. Existing security fencing along the perimeter of the chemical agent storage area would be extended to include the proposed site, thereby creating a contiguous fenced area consisting of the storage area and the destruction site. On-post personnel not directly associated with demilitarization operations would be excluded from a buffer area around the destruction site or provision would be made for their protection or evacuation.

The area topography consists of undulating terrain with a maximum slope of 13°. Construction of the proposed destruction facility at BGAD would involve small amounts of excavation and fill work. Leftover construction debris would be transported to a commercial disposal site.

The drainage system would be designed to divert surface runoff from the plant site and prevent erosion and surface water accumulation on the site. Clearing, grubbing, and earthwork would be required.

D.2.2 Primary Process and Process-Support Buildings

The baseline BGAD destruction facility includes a munitions demilitarization building (MDB), which would house the three incinerators, a container handling building (CHB), a PAS, an analytical laboratory, a personnel maintenance building (PMB), a process support building (PSB), a process utilities building (PUB), an entry control facility, and associated support facilities needed for operations and maintenance (Fig. D.3). This is a conceptual design that is not final and would likely evolve further. The descriptions in this FEIS are based on the design criteria documents specific to BGAD as well as 100% design for similar destruction facilities at JACADS and TOCDF. The heart of the destruction plant would be the MDB, a two-story building to house the three incinerators and mechanical processing equipment for preparing the munitions for incineration. The destruction process is described in Sect. D.3.

The MDB structure and ventilation are being designed to control hazardous materials and vapors within the building (see U.S. Army 1988). The process areas in the building would have a negative pressure with respect to the environment and would thus prevent the escape of vapors from the building. Different air-ventilation zones in the MDB would be established according to the degree of agent contamination and would be separated by physical barriers for agent confinement. Pressure differentials between zones would direct airflow from zones of lower potential for agent contamination to zones of higher potential (i.e., a cascading ventilation system). The building ventilation exhaust would be filtered through charcoal filters to remove agent before being discharged to the atmosphere.

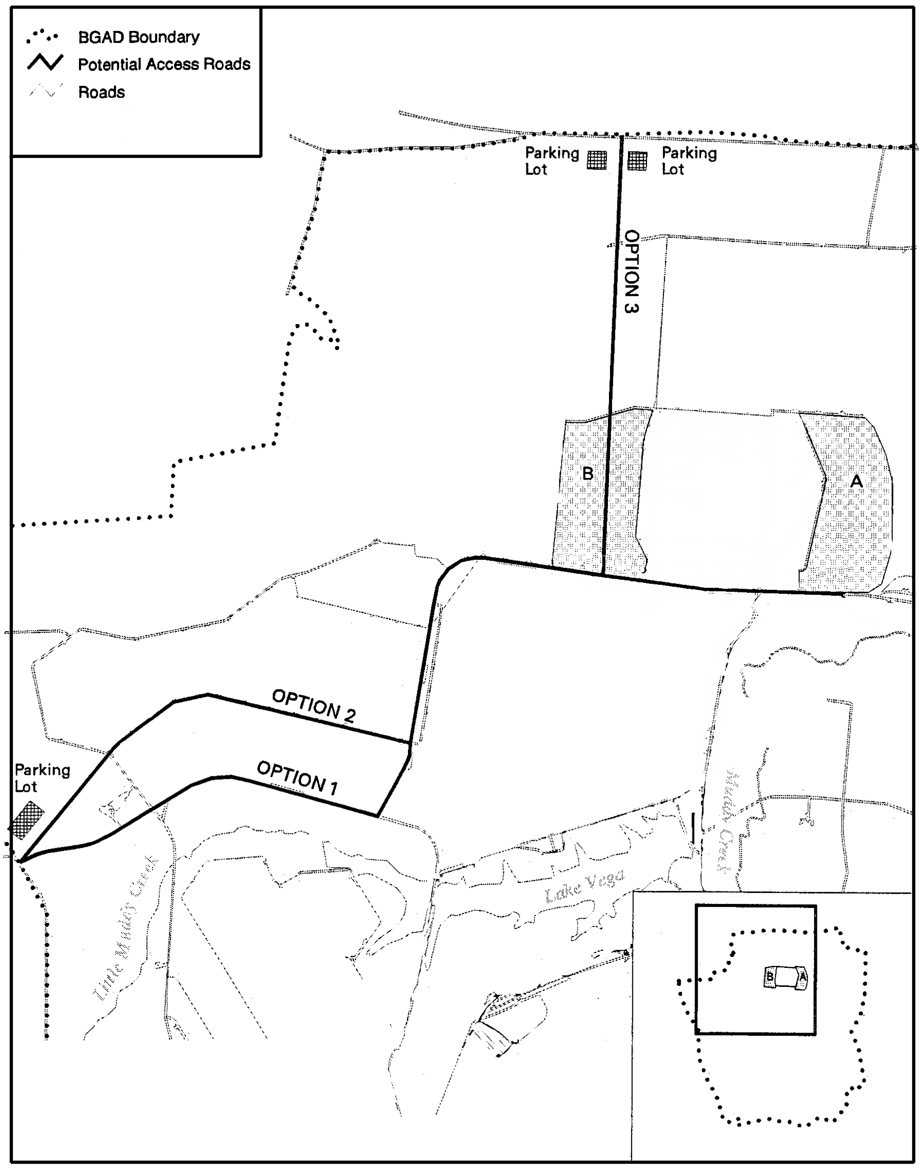

Fig. D.2. Location of alternative sites and road access corridors identified for the proposed chemical weapons destruction facility at the Blue Grass Army Depot. (Adapted from Fig. 7.3-1 of the ACWA DEIS)

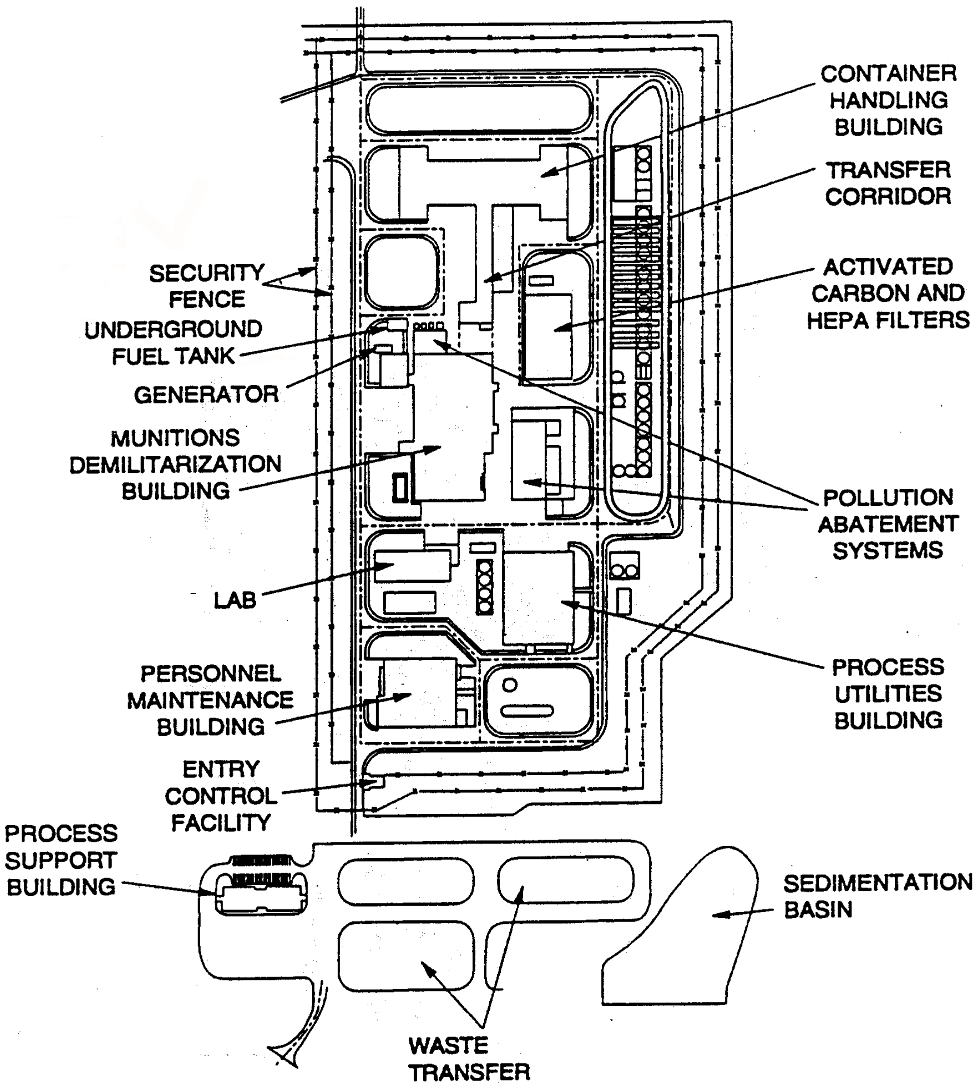

Figure D.3. Site plan for the baseline destruction facility at the Blue Grass Army Depot.

The MDB would include a toxic cubicle (TOX) with two tanks for holding agent drained from munitions until the agent is transferred to the LIC. A 500-gal tank would contain liquid agent during routine operations when agent is being transferred to the LIC. A 1300-gal surge tank would provide for containment of extra agent if the LIC is shut down while agent drained from munitions is being transferred to the TOX. The two tanks would have a total capacity of 1800 gal and would be provided with secondary containment of 2060 gal. The TOX has sufficient secondary containment to accommodate the contents of both the large and small holding tanks. The MDB would include the control room, storage area, maintenance facilities for equipment contaminated with agent, and facilities for washdown and decontamination.

The main PAS would control emissions of acidic gases and particulates in the flue gases from the incinerators. Each of the three incinerators would be served by an independent system in the PAS. The systems for the DFS, MPF, and LIC would each have a quench tower, a venturi scrubber, a packed bed scrubber tower, and a demister vessel. These systems would share a common stack.

As currently proposed, the PUB would house a residue handling area, boilers, a bulk chemical storage and chemical makeup area, and a forklift battery charging station.

The PMB would house a plant medical facility, a support area for personnel wearing the demilitarization protective ensemble (DPE), change rooms, a lunchroom, a maintenance area, and communications facilities. The medical facility would provide support for possible accident events that could occur during handling, storage, maintenance, surveillance, or demilitarization operations. Qualified medical personnel would remain on-site for each operating shift and would be able to treat victims of industrial and chemical agent accidents. A transport van would shuttle DPE-clad crews between this building and the MDB. The laboratory would be equipped to chemically analyze emissions and wastes for chemical agent content and other pollutants. A tank, which would be managed according to all applicable permits, plans, and procedures, would be used to temporarily store liquid chemical wastes until they are transferred to the LIC.

Two different types of agent monitoring systems would be employed at various places to detect any chemical agent that may escape into the air in and around the proposed facility. The systems would be located inside the MDB, in the exhaust stacks from the PAS, in the filtered exhaust from the MDB ventilation system, and at appropriate locations outside the MDB.

The bulk chemical storage area would consist of equipment and tanks enclosed within the PUB. The perimeter of the bulk chemical storage area would be delimited by a berm to provide secondary containment of the chemicals. In addition, tanks containing acids and bases would be segregated and the hydrochloric acid (HCl) tank would be diked separately to maintain separation of incompatible chemicals in the event of a spill. The bulk chemical storage area would contain tanks of decontamination fluid for neutralization of any agent leaks or spills. One tank would contain an 18% (by weight) solution of sodium hydroxide (NaOH) for acid gas neutralization in the PAS. A 10,000-gal tank would contain 12% sodium hypochlorite, which is diluted to 5.5% for mustard decontamination and stored in two separate 5,000-gal decontamination tanks. A 6,000-gal tank would contain 35% HCl for washing equipment in the PAS.

D.2.3 Roads, Utilities, and Support Facilities

Existing BGAD roads would be used for transporting construction equipment to the proposed site; these same roads would be used for removal of solid waste (hazardous and nonhazardous) from the facility. A short, new road would connect the existing chemical munitions storage yard with the proposed destruction site; this road would be designed to withstand the weight of the munition-laden vehicles.

Munition transport convoys would proceed from the storage yard, through a new set of gates in the existing security fences, directly to the destruction facility. Thus, all munitions transport would occur inside the high-security area, and the munition transport distance would be minimal.

Natural gas and electrical power would be provided to the site from sources outside the BGAD installation. Communications would be provided by connections to the existing on-site service. A sanitary waste treatment facility would be constructed adjacent to the proposed destruction facility with treated effluent directed into Muddy Creek. The estimated utility demands are presented in Table D.1. Other support facilities would be small in size and would require only minor construction activity. Following are descriptions of the proposed upgrades to existing utilities and facilities at BGAD.

Table D.1. Annual utility demands for the baseline incineration destruction facility at Blue Grass Army Depot

Utility	Usage
Process water	18 million gal
Potable water	6.4 million gal
Fire water Peak 500,000 gal storage capacity]	 3,000 gal/min
Sanitary sewer	6.3 million gal
Natural gas	550 million ft^3
Fuel oil[b]	45,000 gal
Electricity	22 GWh

1 m^3 = 35.314 ft^3, 1 L= 0.264172 gal, and 1 m^3 = 1000L.
[a]Fire water does not have an annual demand. It is a short-term requirement.
[b]Fuel oil is required for the emergency generators.

Water. Facility requirements for potable and process water would be withdrawn from an existing main and tie in at a point 30 ft from the security fence. The source of fresh water at the installation is Lake Vega. A new, ground-level 500,000-gal water storage tank would be constructed to supply water for personnel, fire fighting, and to supply water during periods of peak facility demand and, thus, minimize peak water withdrawals from the water source.

Natural Gas. Natural gas would be supplied to the facility by a new pipeline to extend from an existing 8-in. main. The existing offsite pipeline runs outside the eastern boundary of the installation. It is estimated that approximately (12 acres of land might be disturbed for construction of onsite gas transmission and service lines. The portions of the pipeline outside of the BGAD boundary would be designed, installed, and maintained by the Delta Natural Gas Company contingent upon the Government purchasing optimum quantities of gas. Distribution piping for natural gas would be installed in the vicinity of the destruction facility and its support facilities. A natural gas metering and regulating station would also be required.

Communications. The existing communication trunk lines serving BGAD do not have adequate spare capacity to support the proposed facility. Therefore, a new trunk line would be installed from a location south of the main entrance at BGAD to the administration area. From the administration area to the facility site, about 3 miles of new underground cable would be installed.

Access Road. A new road would be constructed to transport construction equipment to the selected site, to transport workers between parking areas and the selected site on shuttle buses, and to remove solid waste (hazardous and nonhazardous) from the facility. Three alternative routes for these roads (and parallel utility corridors) have been identified and are assessed in this document. The first two alternative routes (labeled option 1 and option 2 on Fig. D.2) would be constructed running in a west-east direction between U.S. Highway 25 and an existing on-post road (Route 2) and then north and east to the selected site. The third alternative route (labeled option 3 on Fig. D.2) would be approximately 1.5 miles in length and would be constructed running in a north-south direction between Kentucky Highway 52 and Route 2 immediately to the southwest of the existing chemical storage area. Approximately 0.8 mile of roadway would be upgraded and widened to 40 ft, meeting Commonwealth of Kentucky standards, to provide access to and emergency evacuation from the proposed facility. In addition, a short, new road would connect the existing chemical munitions storage yard with the proposed site; this road would be designed to withstand the weight of the munition-laden vehicles. Roads in the chemical agent storage area would be upgraded and widened to support the relatively heavy vehicles required for agent transport. The total land area disturbed for construction of the new access road, the new parking area (see below), and Route 2 upgrades are indicated in Table 2.4.

Electrical Power Substation and Power Lines. The existing electrical distribution system for BGAD does not have the capacity to support the proposed facility. New service connections would be made to existing power lines of the Kentucky Utilities Company, with approximately 1.25 miles of overhead 69 kV power lines. As many as two new electrical substation with redundant transformers would also be constructed. They would connect with a new CSDP plant substation no closer than public traffic route distances to the explosive enclosures. Two 4,160-volt buried power lines would be installed to connect the substation to the proposed facility. Power would also be provided to the parking area, the fire and potable water supply pumphouse, and other equipment located in these areas as well as the PSB. A separate power supply would be furnished to the sewage treatment facility, the vehicle storage facility, the laundry, and the access control building. It is estimated that approximately 20 acres might be disturbed for construction of the electrical substation and associated power lines.

Personnel Support Building. A building would be constructed to house the administrative functions of the facility.

Parking. In addition to an employee/visitor parking lot, with a capacity of 40 automobiles and five buses, that would be constructed adjacent to the proposed process support building and entry control facility on the south side of the site, a larger parking area would be constructed near the new gate to BGAD adjacent to the new access road along either U.S. Highway 25 or Route 52; this parking lot would have a capacity of approximately 440 cars and five buses (see Fig. D.2). Additional parking space would be in the main BGAD administration area.

Waste Transfer Area. A waste transfer area for solid wastes from the proposed facility would be constructed to provide space for dumpsters for RCRA and non-RCRA wastes awaiting transport to an approved disposal location.

Waste Water. A new sewage treatment plant would be constructed near the facility next to Muddy Creek near Route 3 on the installation. The wastewater to this plant would consist of effluent from facilities such as bathrooms, showers, and laundries. The effluents from the sewage treatment plant would be approximately 17,000 gal per day of liquid effluents. The treatment plant would use approximately 1,140 ft^3 per minute from emergency diesel generators while operating if electric power is lost. No hazardous material of any type would be discharged into this system (i.e., the destruction process itself would not produce any wastewater).

Storm water. The site drainage system is being designed to direct storm water to a common point outside the fence surrounding the destruction facility. A storm water retention pond is planned.

D.3 PROCESS DESCRIPTION

The demilitarization process at BGAD would involve five main steps: (1) removal of propellants, (2) transport of munitions from the existing chemical munitions storage yard to the MDB, (3) removal of bursters and fuzes, (4) incineration of munitions, and (5) management of the waste materials that would remain after incineration.

D.3.1 Disassembly

Almost all chemical munitions stored at BGAD contain some form of explosive or energetic component (such as fuzes, bursters, primers, igniters, and propellants). These components would require removal prior to the destruction of the chemical agents. The chemical muntions are all stored on pallets in the igloos.

The disassembly process would involve dismantling of each munition, either manually or through the use of robotic equipment. The munitions exiting this process would be energetically inert but would still contain GB, VX, or mustard agent in the munition cavity sealed by the burster well. The purpose of disassembly is to ensure that only the inert munition containing the chemical agent moves to the next step of the process, which would involve accessing the agent by drilling or cutting into the munition body prior to destruction of the chemical agent. The scrap energetic components resulting from this process would be either disposed of on-site or shipped to an appropriate, approved off-site destruction facility.

Two types of dismantling have been identified: (1) the removal of propulsive components from those rounds stored in a “complete munition” configuration (i.e., the M55 rockets) and (2) the removal of fuzes (if present) and bursters from the warhead portion of each of the stored munitions.

Approximately 68% of the items at BGAD are stored in the “complete munition” configuration. The remaining 32% of the items are stored without propellants, primers, and igniters. All the munitions at BGAD would be subjected to disassembly to remove the remaining explosive components [i.e., fuzes (if present) and bursters].

D.3.1.1 Process disassembly

Munitions would be moved to the disassembly area within the MDB. The energetic components would be separated from the rest of the munition using mechanical, reverse assembly methods. A machine similar to the projectile and mortar disassembly (PMD) machine used in the baseline design at JACADS and TOCDF would be used to separate the energetic components within an Explosion Containment Room (ECR) in the MDB. The actual number of PMDs used would depend on throughput needs. The PMD design would include a nose closure removal station (NCRS), a miscellaneous parts removal station (MPRS), and a burster removal station (BRS). The burster size reduction machine would likely not be used. The components that would be separated would include the lifting plug, fuze well cup, and burster for the 155-mm in. projectiles. For the 155-mm and 8-in. projectiles, the lifting plug would be retained. The M55 rockets would be sheared into sections. The energetics would be removed from the sheared sections.

The munition exiting the PMD would be energetically inert and still contain agent in the munition cavity sealed by the burster well. These munitions would be palletized and moved to the igloos for storage. Alternatively, the munitions would be directly transferred to another portion of the MDB for further processing.

D.3.1.2 Treatment/disposal of energetic components

The energetic components would be treated in the DFS, a rotary kiln-type furnace. The proposed furnace to be used for the BGAD facility would be specifically sized and designed to incinerate energetic components found in the BGAD stockpile [fuze and burster material (tetrytol and compositon B[1])]. The design would include safety features and the means to suppress any pressure waves generated in the event of an explosion. The furnace system and its secondary components would be designed as part of the MDB.

The energetic materials would be fed to the proposed rotary kiln using conveyors and feed chutes. Inside the kiln, the components would be conveyed by rotation of the kiln from the charge end to the discharge end. The explosive material would be ignited by the furnace temperature (approximately 1500°F) and would burn rapidly. Metal parts and ash would be discharged from the kiln. The decontaminated scrap would be disposed off-site.

An afterburner that operates at approximately 2000°F would be used to further ensure complete combustion of agent and other combustion products in the exhaust gas from the rotary kiln. The exhaust gas would then be treated in a PAS and vented to the atmosphere.

D.3.2 Transport and Handling

Transport of the munitions from the existing storage yard to the MDB would be a multistep process designed to ensure safety. As has been the case at TOCDF, munitions at BGAD would be transported in on-site containers (ONCs).

Before opening an igloo to remove munitions to be transported, the igloo air would be sampled for the presence of agent. If no agent is detected, the igloo would be opened and loading

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[1]Composition B is a high explosive composed of 60% cyclotrimethylenetrinitramine (RDX), 39.5% trinitrotoluene (TNT), and 0.5% calcium silicate.

would begin. Monitoring of igloo air would continue during the work-shift cycle. Storage crews would remain at open igloos to accommodate each shipment. Pallets of munitions would be secured to load trays. Transport would be restricted to daylight hours and permissible weather conditions; therefore, multiple igloos might be simultaneously opened to allow transport of enough munitions and other items to support 24-hr operation of the destruction facility.

Loaded ONCs would adhere to 20-mph speed limit. The transport distances from various storage igloos to the proposed destruction facility range from 1000 ft to 1.1 miles. Emergency services would be provided by the operating crew at the igloos with backup from the installation response force.

Once inside the MDB, each load tray would be monitored, unloaded, and its contents moved to the unpacking area. Empty loading trays would be returned to the loading dock for reuse.

In the MDB unpacking area, munitions would be removed from pallets.

D.3.3 Pretreatment and Incineration

Each munition would be treated by a specific procedure.

- Bursters wells would be removed from the projectiles. The projectiles would be drained. The agent would be transferred to the TOX storage tank and then to the LIC, and the remaining projectile parts would be thermally decontaminated in the MPF. Ash and particulates from the DFS would be further monitored. If agent is present, the drum of particulates would be cycled within the MPF to ensure that agent is destroyed. The LIC would also incinerate spent decontamination solution periodically used to clean the system.
- Combustible scrap from packaging material for all munitions, spent charcoal filters, and other agent-contaminated wastes would be sent to the MPF.
- Spent charcoal filters may also be incinerated in the MPF.

D.3.4 Waste Management

Effluents from the proposed facility would include atmospheric emissions and liquid and solid wastes. The primary nonhazardous liquid effluent would be sanitary waste. Most liquids generated by the agent destruction process would be disposed of internally by incineration. Liquid brines, the most abundant potentially hazardous liquid, would be dried to produce brine salts and transported to an appropriately permitted off-site TSDF. Specifics for laboratory waste handling would be developed by the systems contractor in a laboratory hazardous waste management plan. Most likely, hazardous waste would be segregated in the laboratory for off-site disposal at an appropriately permitted TSDF and nonhazardous waste rinse waters would be collected in the laboratory waste tank and would be shipped off-site or disposed of in the LIC.

The BGAD destruction facility operations, including waste management, would comply with all applicable federal, state, local, and Army regulations for air and water quality, solid waste, hazardous waste, and noise. The Commonwealth of Kentucky has been delegated authority to oversee the federal programs for air and water quality and for most hazardous waste management requirements, including those associated with the Hazardous and Solid Waste Amendments of 1984. Kentucky should have full authorization to oversee all aspects of the Hazardous and Solid Waste Amendments of 1984 before the issuance of a permit for destruction of the chemical weapons stockpile stored at BGAD. Kentucky adheres to the National Ambient Air Quality Standards (NAAQS) for the prevention of significant deterioration (PSD) of air quality.

Atmospheric emissions. Atmospheric emissions would originate from (1) PASs for the three incinerators, (2) filtered ventilation from process areas, (3) combustion gases from steam boilers and vehicles, and (4) airborne dust from handling of incinerator residue and from vehicle traffic. One common stack would serve the LIC, MPF, and DFS. Handling and disposal of incinerator residue in accordance with requisite provisions of the RCRA permitting process would result in little potential for significant adverse impacts on air quality and, therefore, is not addressed further. Emissions from vehicles and combustion of natural gas and LPG in boilers would be regulated by EPA and the Kentucky Department of Environmental Protection (KDEP).

The three incinerators with their associated PASs would be required to meet RCRA requirements. The DFS and MPF would be required to destroy agent to a destruction and removal efficiency (DRE) of 99.99% and meet the allowable stack concentrations set by the U.S. Army Surgeon General. The LIC would be operated to destroy agent to a DRE of 99.9999% and meet the agent emission limits established by the U.S. Army Surgeon General. The allowable stack concentrations for all three incinerators have been reviewed and accepted by the U.S. Department of Health and Human Services (DHHS). Emissions of HCl and metals would be regulated in accordance with a RCRA permit. The incinerators would also be required to meet air pollution control requirements for conventional pollutants (e.g., carbon monoxide [CO] and sulfur dioxide [SO_2]) and opacity. Other materials such as dioxins, furans, and small amounts of toxic metals could also be present in incinerator emissions. All stacks would be monitored continuously for agent and periodically for other regulated emissions. Carbon monoxide would be continuously monitored as an indicator of products of incomplete combustion.

Ventilation exhaust air from potentially contaminated areas of the MDB would be filtered extensively before being discharged. In addition, a PAS filtration system has been developed for the incinerator exhaust gases. The PAS filter system consists of six filter units (one each for the LIC and the MPF and two for the DFS, including two shared spares. The DFS would have two filter units in parallel; however, typically, only one unit would be on-line at any one time. Each filter unit consists of a prefilter, a bank of high-efficiency particulate air (HEPA) filters, six 2-in. thick banks of activated charcoal filters in series, and one final bank of HEPA filters. The filter units for the MDB ventilation system have a similar design.

To improve the absorption of the filters, the gas stream would be cooled before it enters the PFS. This would be accomplished by routing brine from the scrubber towers through a series of coolers. The cooled brine would be sprayed into the top of the scrubber, which in turn cools the furnace exhaust. The last conditioning step would be to increase the dew point. This would be done with an in-line natural gas burner. The burner would raise the temperature of the gas stream until the stream is no longer saturated with water. After the exhaust gas has been conditioned, it would pass through the PFS to the induced draft fans and finally to the stack.

Activated carbon filtration is an accepted method of removing hydrocarbon and similar organic chemicals from air and gas streams. It is commonly used in petrochemical industries, and it is the preferred method for treatment of ventilation airflows in chemical weapons facilities. Fixed-bed activated charcoal filters have been used effectively in this capacity by the Chemical Stockpile Disposal Program (CSDP) for several years. Since complete agent destruction would occur during the incineration processes, these activated charcoal filter units are being incorporated as an additional safety feature to further preclude the potential for a chemical agent release.

The ventilation and incinerator exhaust stacks would be monitored continuously for the presence of chemical agent. Charcoal filter replacement would be rigorously controlled to protect the workers and to prevent release of agent. The spent carbon from the filter units would be incinerated in the DFS or MPF. Current plans are to dispose of the incinerated carbon residue in an off-site permitted hazardous waste landfill.

Liquid wastes. The primary liquid discharge from the facility would be domestic sewage, estimated to average about 17,000 gal/day. Peak sewage generation is estimated to be about 35,000 gal/day. No process wastewater or hazardous liquid would be discharged into the sanitary system. Sanitary sewage from the disposal facility would be sent to a new treatment facility that would discharge treated effluent to Muddy Creek.

Solid wastes. Solid process wastes would consist of ash and scrap from the incinerators. Hourly waste generation rates are shown in Table D.2. The total process solid waste expected to be generated during the life of the facility is 3,950 tons, a volume of about 85,200 ft^3. These quantities include approximately 1,600 tons of nonhazardous scrap metal from munition bodies, which would be sold to a scrap dealer or smelter for reuse if possible. However, if a landfill were to be needed due to an inability to sell scrap metal, a permitted off-site landfill would be selected. Currently, there are no plans to dispose of any waste materials from the destruction process in a local landfill. Construction debris and some nonprocess wastes are to be disposed of in a permitted, off-site commercial landfill. Items of salvageable value would be provided to the Defense Reutilization Management Office for recycling. The U.S. Army would be required to comply with all applicable environmental protection regulations governing waste disposal.

Table D.2. Summary of solid process waste for the proposed destruction facility at the Blue Grass Army Depot

		Generation rate[a]
Source	**Type**	**lb/hr**
Metal parts furnace	Metal scrap	10,100
Deactivation furnace	Scrap/ash	1,400
Brine reduction	Brine salts	6,300
Liquid incinerator	Solids	Negligible

[a]Rates are maximal and based on peak-limiting process step. The total solid process wastes (including protective suits and charcoal residue ash, in addition to munition-specific solid waste) that would be generated during the lifetime of the proposed destruction facility are expected to be about 3,950 tons(85,200 ft^3). This quantity does not include munition overpacks, or transport overpacks.

Hazardous solid wastes would consist mainly of ash residue from the furnace systems. Hazardous wastes would be taken to a off-site permitted waste disposal facility. There are facilities located in California, Illinois, Missouri, and Texas that accept the types of wastes anticipated to be generated.

The analysis of ash from the JACADS incineration operations shows that it is categorized as hazardous waste based on measured parts-per-million (ppm) levels of cadmium, lead, and chromium. JACADS brine salts have occasionally shown lead concentrations high enough (>5 ppm) to be classified as hazardous waste. Results of waste analyses also indicate that the wastes would contain no toxic vapors (such as organics or agent). However, the Commonwealth of Kentucky has listed all agent-related wastes as hazardous. The ash residue to be transported from the destruction facility would be dry and without free liquids. Based on the expected characteristics of these wastes, there would be minimal environmental damage from possible accidental spills, of the ash, brine salts, and/or metal parts. Cleanup would be performed according to the BGAD Spill Control Plan.

Transport. The hazardous wastes may be transported off-site by truck. Up to 2 trips could be required on some days, depending on the type of munition being processed. On most days, no more than 1 trip would be required. Waste loads on trucks would be limited to 10 tons.

D.4 ANALYTICAL AND MONITORING PROGRAM

The analytical and monitoring program for the baseline facility would use equipment, standards, and procedures similar to those of the baseline facility at Tooele (TOCDF). The analytical and monitoring program would consist of agent monitoring (vapor phase) for public and worker safety purposes, and analytical characterization of solid and liquid matrices to support treatment and/or off-site disposal. The following paragraphs provide more detail on air monitoring and waste (liquids and solids) characterization.

D.4.1 Air Monitoring (chemical agent)

The concepts for monitoring the modified incineration facility are the same as those identified for a baseline facility.

Standards for agent exposure. Air exposure limits are the same as those used to regulate baseline facilities.

Instrumentation. Instrumentation used to monitor chemical agents would be similar or identical to those used at baseline facilities. Near-real time monitoring devices would be used to monitor for all monitoring standards, with the exception of the General Population Limit (GPL). Depot Area Air Monitoring Systems (DAAMS) would be used as a confirmation and historical monitor, as currently implemented at the baseline facilities.

Storage monitoring. Storage monitoring would be performed in accordance with baseline facility storage monitoring requirements.

Handling and on-site transport monitoring. Monitoring of munitions during handling and transport would be the same as that performed at other baseline facilities such as TOCDF. Since ONCs would be used to transport munitions on site, they would be monitored prior to unloading munitions. Vapor contents of the ammunition vans interior would be monitored remotely at the completion of each transportation activity. Emergency response for a chemical accident/incident would be handled the same as at other chemical agent destruction facilities.

Disposal plant monitoring. Instrumentation described above would be used to provide a comprehensive monitoring system that meets the same stringent monitoring concepts implemented at other chemical agent destruction facilities. Air monitoring would be provided for worker areas, furnace stack(s), filter vent(s), and process areas. Similar to the monitoring system implemented at other chemical agent destruction facilities, monitoring would provide data to decision makers to ensure operations are being conducted safely and in compliance with all regulatory requirements.

Perimeter monitoring. Current plans are to install the perimeter monitoring stations at BGAD prior to the commencement of destruction operations such that adequate baseline monitoring can be completed. The number and location of these stations are being considered. The Army Center for Health Promotion and Preventive Medicine, which has been involved in developing or reviewing the perimeter monitoring systems at DCD and JACADS, has been asked to initiate a study that reviews site specific characteristics and to provide a recommendation on the number and location of these monitoring stations at BGAD. The perimeter monitoring plan would be coordinated with DHHS prior to finalization.

D.4.2 Waste Characterization

Waste generated during the operation of the baseline incineration facility would be analyzed with the purpose of characterizing the waste for regulatory determination (RCRA hazardous waste) and for ensuring that any permit conditions relating to feed rate limits are met. A detailed waste analysis plan would be developed as part of the RCRA permitting process that specifies the individual waste streams, analytical parameters, and the frequency of analyses.

Agent screening. Waste streams that have the potential to be contaminated with chemical agent would be screened to determine the level of contamination, if present.

The process solids that would be disposed off-site would consist of metal parts/ash from furnace treatment of munitions and brine salts from drying liquid brines produced by the PAS. These materials would meet the 5X condition (this condition should destroy chemical agent). However, additional confirmatory agent analysis may be conducted. Ash would be analyzed for agent and RCRA parameters. Other solids that may be generated during the process and that may be contaminated with agent, such as maintenance waste, cleanup waste, etc, would be characterized for agent by monitoring for the purpose of safe handling. These wastes would be incinerated on-site and detailed characterization would not be necessary.

Potentially contaminated liquid waste streams, which include but are not limited to, spent decontamination solution, potentially contaminated laboratory solvents and decontamination solution mixtures, hydraulic fluids and pump oils would be screened for residual agent contamination. Screening would be performed using an analytical method that has an analytically determined method of detection limit at or below the regulated level.

Hazardous constituent analyses. Waste streams that are intended to be shipped off-site would also undergo additional analyses for regulatory characterization. The parameters would consist of RCRA constituents.

Standards for waste characterization. The U.S. Army currently implements the waste control limit (WCL) for determining if a matrix is contaminated with residual agent. Wastes would be characterized to levels that would be specified in permits issued for the incineration facility. Other hazardous constituents (pH, TCLP, etc.) would be regulated in accordance with RCRA and Commonwealth of Kentucky requirements.

Instrumentation. Agent screening instrumentation would be the same as instrumentation implemented at TOCDF. Additional waste characterization parameters would be determined using instrumentation specified by EPA and the Commonwealth of Kentucky.

D.5 REFERENCES

ACWA DEIS (Assembled Chemical Weapons Assessment), 2001. *Draft Environmental Impact Statement for Follow-on Tests Including Design, Construction and Operations of One or More Pilot Test Facilities for Assembled Chemical Weapon Destruction Technologies at One or More Sites*, Program Manager for Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., May.

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APPENDIX E

INFORMATION SUPPORTING HUMAN HEALTH RISK ASSESSMENTS AT AGENT INCINERATION FACILITIES

E.1 SUMMARIES OF HUMAN HEALTH RISK ASSESSMENTS FOR PROPOSED AGENT INCINERATORS

E.1.1 Tooele, Utah

A human health screening risk assessment (A. T. Kearney, Inc. 1996) was completed in 1996 by the state of Utah for the Deseret Chemical Depot (DCD) incinerator. The DCD assessment employed a multi-chemical, multi-pathway analysis that considered human exposures to chemical emissions from the stacks at the DCD facility. The assessment included both direct and indirect exposure pathways for a list of 60 constituents of interest.

The hypothetical receptors for the analysis included (a) an adult residing at the point of maximum off-site concentrations, (b) a child residing at the same point, (c) a subsistence fisher located 40 km (25 miles) from the facility (i.e., at the nearest possible location of an adequate supply of fish), and (d) three different types and locations of farmers, including cattle and vegetable farmers. The exposure pathways included the various applicable combinations of inhalation, soil ingestion, and consumption of vegetables, fish, beef, and milk.

Emissions from the facility were predicted based upon extrapolations from measurements at the Johnston Atoll Chemical Agent Disposal System (JACADS). A modifier was also included in the analysis to account for abnormal combustion conditions that might occur during startup, shutdown, or other production upsets. Emissions during times of nonpeak performance (5% of the time for metals and particulate emissions and 20% of the time for nonmetals emissions) were assumed to be 10 times the level detected during the stack tests.

For the hypothetical adult and child residents, the subsistence fisher, and the three types of farmers, the predicted carcinogenic risks were found to be at or below the level established by U.S. Environmental Protection Agency (EPA) screening risk assessment guidelines (i.e., 1×10^{-5}), even for 30 years of incinerator operations at DCD. Similarly, the noncarcinogenic risks met or were below EPA guideline risk levels (i.e., a hazard quotient of 0.25).

E.1.2 Umatilla, Oregon

In April 1996, the state of Oregon issued a pre-trial burn health risk assessment (Ecology and Environment 1996) for the proposed chemical demilitarization facility at the Umatilla Chemical Depot (UMCD). The UMCD health risk assessment included much the same approach and many of the same assumptions as in the DCD health risk assessment. The UMCD assessment considered human exposures to chemical emissions from the stacks at the proposed UMCD facility. The assessment included both direct and indirect exposure pathways for a list of 73 constituents of interest.

The hypothetical receptors for the analysis included: (a) an adult resident, (b) a child resident, (c) a subsistence farmer, and (d) a subsistence fisher. With the exception of the subsistence fisher, the health risks were evaluated at two locations: at the point of maximum concentration and at the nearest downwind fence line. The location of the subsistence fisher was at the maximally impacted water body. The subsistence fisher was assumed to catch fish from the Umatilla River (which is predicted to be more highly impacted than the Columbia River), while residing at the most highly impacted point along the river. This point was determined to be approximately 5 km (3 miles) south of the confluence of the Umatilla and Columbia Rivers.

For the hypothetical residents and the subsistence farmer, the point of maximum concentration was used regardless of whether this location was on-site or outside the UMCD boundaries. The location of maximum airborne concentration rarely coincided with the location of maximum deposition; nevertheless, for the purposes of the health risk assessment, both concentrations were assumed to occur at the same location. Thus, maximum impact was investigated. The exposure pathways included the various applicable combinations of inhalation, soil ingestion, and consumption of above-ground and below-ground produce, fish, beef, and milk.

Emissions from the facility were predicted based upon extrapolations from measurements at JACADS. A modifier was also included in the analysis to account for abnormal combustion conditions that might occur during startup, shutdown, or other production upsets. The numerical value of this modifier was the same as described above for the DCD health risk assessment.

For the hypothetical adult and child residents, the subsistence farmer, and the subsistence fisher, the results of the UMCD health risk assessment indicate that the risks to current populations were less than the regulatory benchmarks established by the Oregon Department of Environmental Quality. At the high-impact location, risks to hypothetical residents and to the subsistence farmer were greater than the benchmarks. However, this location is only about 100 m (328 ft) from the proposed facility, and well inside the nearest depot boundary. None of the other potentially exposed populations in the vicinity of UMCD are expected to be exposed to emissions constituents at levels in excess of regulatory benchmarks.

E.1.3 Pine Bluff, Arkansas

In early 1997, the U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM) issued an environmental impact risk assessment (EIRA [USACHPPM 1997]) for the proposed Pine Bluff Arsenal (PBA) facility and the existing central incineration complex (CIC) at PBA. The EIRA employs a multi-chemical, multi-pathway analysis that considers human exposure to chemical emissions from the stacks of the proposed destruction facility and the existing CIC. The analysis includes both direct and indirect exposure pathways involving inhalation; incidental ingestion of soil; and consumption of beef, milk, fish, chicken, eggs, produce, and drinking water.

Emissions from the proposed PBA facility were predicted based upon extrapolations from measurements of actual emissions at JACADS. Modifiers were also included in the analysis to account for abnormal combustion conditions that might occur during startup, shutdown, or other production upsets. Emissions from two other existing Resource Conservation and Recovery Act (RCRA) sources at the Pine Bluff were also considered in the analysis.

A total of 86 constituents of interest were evaluated. Based on anticipated waste feed stream characteristics, the substances of concern were categorized into six general classes: (1) chemical agents and/or principal organic hazardous constituents, (2) polychlorinated dioxins and furans, (3) products of incomplete combustion, (4) metals, (5) acid gases, and (6) particulate matter.

Potential health effects were determined for four groups of people: a farmer who lives on and consumes food grown on land near PBA, a fisher who consumes fish from bodies of water near PBA, an adult resident who lives near PBA, and a child resident who lives near PBA. The subsistence farmer, adult resident, and child resident were evaluated at the maximally impacted fence line location. The subsistence fishers were assumed to catch fish from the water bodies while residing at the maximally impacted fence line location. Subsistence fishers who fished at the Arkansas River, Saline River, Bayou Bartholomew, Old River Lake, and A & A Fish Farm were assumed to consume 60 g/day of fish. The fishers who fished at Yellow Lake, Tulley Lake, and Duck Reservoirs, were presumed to be recreational fishers who consumed 32 g/day of fish while also residing at the maximally impacted fence line location.

The chronic, carcinogenic and noncarcinogenic risks were calculated for both indirect and direct exposures for the subsistence farmer, five subsistence fishers, three recreational fishers, adult resident, and child resident. Risk estimates represent the incremental probability that an individual will develop cancer over his or her lifetime as a result of exposure to a particular carcinogen. These risks are termed “excess lifetime cancer risks” and represent the additional risk, above the normal background level, of an individual developing cancer. The excess lifetime cancer risks from both indirect and direct exposures are summed and compared to EPA's benchmark value of 1×10^{-5}. An excess lifetime cancer risk of 1×10^{-5} indicates that an individual has a chance of developing cancer from exposure to the carcinogenic substance somewhere in the range from zero to one in 100,000.

Noncarcinogenic hazards are expressed as a hazard index (HI). Hazard indices are the summation of individual hazard quotients (HQ) for substances that exhibit a common systemic health effect on the liver and neurological systems. All noncarcinogenic inhalation HQs were summed for a total inhalation HI, regardless of affected target organ or system. The liver HI, neurological HI, and inhalation HI were compared to a noncarcinogenic health standard of 0.25.

In addition, the fence line resident and a hypothetical on-site worker were subjected to an acute analysis (representing a 1-hr upset condition exposure). The acute analysis collected all maximum on-site concentrations into a single receptor location. The acute hazard quotients for those substances exhibiting the same potential acute toxic endpoint were added together and compared to a benchmark value of 1.0.

The EIRA is based on a screening evaluation (Step 1) that follows the methodologies recommended in EPA's Implementation Guidance (EPA 1994). Since the Step 1 results indicated no adverse human or environmental health effects, a phased demographic specific evaluation (Step 2) was not required. For the Step 1 analysis, the combined risks from the proposed destruction facility and the existing CIC to the subsistence farmer, five subsistence fishers, three recreational fishers, an adult resident, and a child resident were below the benchmark values of 1×10^{-5} for cancer, 0.25 for non-cancer, and 1.0 for acute hazard.

E.1.4 Anniston, Alabama

As part of the licensing process, a draft Resource Conservation and Recovery Act (RCRA) part B Health Hazard Risk Assessment (HHRA) was completed for the Anniston Chemical Agent Disposal Facility (ANCDF) (USACHPPM 2001), and the final is due to be published soon.

The ANCDF HHRA is a multipathway assessment of human health risks that result from stack emissions. The technical approach is designed to provide conservative estimates of human health risk. The HHRA, which included both direct and indirect exposure pathways for a list of 141 constituents of interest, focused primarily on direct and indirect health risks associated with: incinerator/source-specific emissions, startup, shutdown, and upset emissions. In general, direct and indirect human health risks were estimated using USEPA guidance and recommendations. Although the USEPA human health risk assessment protocol was the primary source of methodology, certain approved modifications were made.

Emissions from the facility were estimated based on unit emission factors derived from measurements of input of specific munition/agent combinations and measured air emissions during tests at the JACADS and the Tooele, Utah incineration facility. These unit emission factors were adjusted for differences in operational characteristics. Modifiers were included to account for abnormal combustion conditions that might occur during startup, shutdown, or other production upsets. Emissions during times of nonpeak performance (5% of the time for metals and particulate emissions and 20% of the time for nonmetals emissions were assumed to be 10 times the level detected during the stack tests. For any of the 141 constituents of interest, the maximum unit emission factor was used out of all tests at either facility, thus attempting to provide a conservative assessment.

The following exposure scenarios were addressed in the HHRA: a subsistence farmer, a subsistence farmer’s child, a subsistence fisher, a subsistence fisher’s child, an adult resident, a child resident, and a breast-feeding infant for each adult scenario. For acute inhalation evaluations, an on-site worker and an adult resident with maximum exposures were the individuals selected. An adult subsistence farmer and the child were evaluated for the following pathways: ingestion of soil, homegrown produce, home-produced beef and milk, home-produced pork, home-produced chicken and eggs, drinking water from an impacted surface waterbody, and inhalation of air emissions. An adult subsistence fisher and the child were evaluated for the following pathways: ingestion of incidental soil, homegrown produce, locally caught fish, drinking water from an impacted surface waterbody and inhalation of air emissions. Six different waterbodies were evaluated. An adult resident and child were evaluated for exposures to: ingestion of incidental soil, homegrown produce, drinking water from an impacted surface waterbody and inhalation of air emissions. As recommended by the USEPA, infant exposure to dioxins by ingestion of their mother’s milk was evaluated based on the adult of each of the above scenarios. The breast feeding infant was assumed to ingest maternal milk exclusively; therefore no other exposure pathways were included in this scenario.

The initial modeling was based on all incineration sources (deactivation furnace system, metal parts furnace and the liquid incinerator) operating with maximum hourly feed rates and maximum lifetime hours of operation for 6000 hours per year. The initial exposure modeling produced results that were higher than the target criterion so the risk assessment was based on two operational scenarios: (1) the modified hours scenario permitted the deactivation furnace system to operate 6000 hours per year while the other two operated at 4800 hours per year,

(2) the pollution abatement system carbon filtration system scenario in which a theoretical removal efficiency for mercury emissions is applied while all incinerators are operating at 6000 hours per year. Both operational scenarios produced results that were lower than the target health criteria.

The highest estimated lifetime cancer risk values for any combination of scenarios came from dioxins, furans, mustard agent and 1,2-dibromoethane. All the maximum risk values were less than the EPA target of 1 x 10^{-5} , and also less than 1 x 10^{-6} . Mustard, phosphorus and methyl mercury had the highest estimated non cancer hazards for all scenarios. While most of the estimated hazard indices were less than the criterion of 0.25, for one of the six fisher scenarios the index was equal to the criterion. None of the estimated average daily doses for the breast-feeding infant scenarios were higher than 1% of the average infant background exposure level of 60 pg/kg-day for either of the alternative operational scenarios. For the resident exposure, arsenic, GB and VX had the highest estimated hazards for the acute analysis. For the on-site worker, lead, arsenic and VX had the highest estimated hazards for the acute analysis. For both operational scenarios, the results of lead concentration in the blood level of children aged 0 to 7 years old were less than the target criterion limits. Also for both alternative operational scenarios, calculated lead concentrations in the soil and air were also less than the target criteria for the adult analysis. Air concentrations of particulate matter for all scenarios were lower than the National Ambient Air Quality Standard.

E.1.5 Tooele Utah

In accord with the continuous improvement concept, the State of Utah Department of Environmental Quality moved from its 1996 human health screening risk assessment (A.T. Kearney, Inc. 1996) to provide a quantitatively enhanced analysis. This improved analysis began with the development of a *Health Risk Assessment Protocol* (Tetra Tech EM Inc. 2001). The development of the protocol included a public review and comment period and was intended to establish all of the methods and parameters to be used in the risk assessment. The draft risk assessment, that forms the basis of this discussion, has undergone public comment and is due to be finalized soon (Tetra Tech EM Inc. April 2002, in which references within this section are located). The objectives of this risk assessment are to calculate the cumulative risks and hazards for each exposure scenario specific to each source and specific to each agent campaign. Potential adverse health effects were evaluated separately for each source and each agent, and cumulatively to provide a basis for evaluating the protectiveness of the operating conditions in the RCRA hazardous waste permits. The approach in this human health risk assessment was to evaluate health risks first based on traditional exceedingly conservative assumptions to enable the analysts to winnow through the many ultra low risk scenario/chemical combinations. The few that stand out after this winnowing process receive greater attention in successive steps taken to provide more realism in the analyses. In the end, where there is some question of uncertainty, additional measurements of TOCDF effluents and environmental sampling were deemed to be the methods to resolve the uncertainty. Thus, health risk assessment is a process rather than a single point-in-time event.

The HHRA was completed in accordance with the peer review draft of the U.S. EPA's *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (U.S. EPA 1998), and the errata issued on August 2, 1999 (U.S. EPA 1999). Risk calculations were performed with the Industrial Risk Assessment-Health® software (Lakes Environmental Software 1998), which calculates risk in accordance with the U.S. EPA (1998) guidance.

Chemicals of Potential Concern (COPCs) include (1) any compound that had been a target analyte during trial burn tests at TOCDF, CAMDS, or JACADs (detected or nondetected), and (2) any compound that had been reported as a tentatively identified compound (TIC) during trial burn tests. Of the 393 COPCs identified, 171 were evaluated quantitatively in the risk assessment using either COPC-specific fate, transport, and toxicity data or surrogate data (primarily for dioxins reported as homologue totals). The 122 COPCs that were not evaluated include (1) tentatively identified compounds; (2) volatile and semivolatile organic compounds that are not components of the feed and are not expected as products of incomplete combustion; and (3) metals like aluminum, boron, cobalt, copper, manganese, phosphorous, tin and vanadium that are not usually associated with risk to human health in combustor emissions.

TOCDF emissions evaluated for the HHRA are from the two liquid incinerators, the deactivation furnace, the metal parts furnace, the heating ventilation and air conditioning (HVAC) and the brine reduction area (BRA). The dunnage incinerator is not included because the Army does not intend to operate it. Actual trial burn emission rate data for the emission source are used when available; if not, it is necessary to extrapolate from sources where data is available. When actual emission data becomes available for a given source, that data is compared with the surrogate data. If necessary, this comparison may lead to an update of the risk assessment. For the TOCDF HHRA, trial burn data from trial burns at TOCDF, JACADS, and CAMDS were reviewed to determine appropriate scaling emission rate data for the three agent campaigns. Scaling is based on engineering considerations such as feed rate, combustion unit design and operating conditions, PAS design and operating conditions, stack gas flow rates, and agent-specific times of combustion.

The risk assessment evaluated exposure scenarios for (1) the subsistence rancher adult and child, (2) the resident adult and child, (3) the on-site worker, (4) the recreational adult and child for SunTen water ski lakes and Rush Lake, and (5) the fisher adult and child for Rainbow Reservoir. All exposure pathways recommended by the EPA (1998) were evaluated including:

- inhalation,
- incidental ingestion of soil,
- ingestion of drinking water from surface water sources,
- incidental ingestion of surface water (recreational use of water),
- ingestion of homegrown produce and farm-raised beef, sheep, poultry and eggs,
- ingestion of farm-raised cow's milk and pork,
- ingestion of fish, and
- ingestion of dioxins in breast milk by an infant.

In response to public comments the following additional pathways were evaluated:

- ingestion of mutton as a current exposure,
- ingestion of goat's milk as a potential future exposure,
- ingestion of fish from a second water body (Rainbow Reservoir) as a future scenario, and
- incidental ingestion of surface water at a second source (SunTan water ski lake).

The risk assessment also evaluated the combined risk to a rancher adult who is also an on-site worker.

The risk assessment showed that four effluent materials exceeded EPA targets:

(1) Indeno(1,2,3-cd)pyrene and dibenz(a,h)anthracene for the subsistence rancher exposure scenario;
(2) Di-n-octylphthalate (DNOP) for the subsistence rancher exposure scenario for all agent campaigns, with the highest hazard quotient for the VX campaign, and
(3) Mercury for the recreationalist and subsistence rancher exposure scenarios for all agent campaigns.

With the above results, additional evaluation was decided upon for the four materials to determine what course of action should be taken so that health effects are maintained below the EPA target risk and hazard levels.

Indeno(1,2,3-cd)pyrene and dibenz(a,h)anthracene have never been detected in stack gases at TOCDF, CAMDS, or JACADS. Polycyclic aromatic hydrocarbons (PAHs), like indeno(1,2,3-cd)pyrene and dibenz(a,h)anthracene, have been detected at other types of incinerators and are likely present at some trace concentration below the analytical detection limit. The presence of these PAHs in emissions is uncertain but future testing will evaluate the presence of these two compounds. In addition, they will be monitored in environmental samples.

The majority of hazard from DNOP was attributable to the consumption of contaminated homegrown foods. The Centers for Disease Control and Prevention reports that DNOP is not expected to be a concern in terrestrial food pathways because it is metabolized (ATSDR 1997). Although some phthalates are known to be present in chemical munitions, DNOP has not been identified as a constituent of chemical munitions. DNOP was detected once during the VX rocket test burn at CAMDS in one of four test burns. If this single detection were an artifact, the DNOP HQ would still exceed 0.25, assuming that it is present in stack gas at the analytical detection limit. The presence of DNOP in stack gas emissions is uncertain but future testing will evaluate its presence. In addition, it will be monitored in environmental samples.

The majority of risk for mercury is attributable to the consumption of fish contaminated with methyl mercury. In the HHRA, the brine reduction area accounts for about 93% of the mercury emissions from processing GB. The BRA has only operated for a short time and may never be operated again; if so, the HQ for mercury would be below the target level. As demonstrated during the GB test burns, the effectiveness of the pollution abatement system at TOCDF is limited for removing mercury. Therefore characterization of mercury in the waste feed is critical to operating within EPA health quotient criteria. Wastes containing high concentrations of mercury must be cleaned of most of the mercury prior to incineration to limit effluent quantities. In addition, since the mercury hazard is specific to methyl mercury that may accumulate in fish, samples from the environment, including fish, will be monitored to verify that mercury levels remain acceptable.

E.2 A REVIEW OF THE 1994 DRAFT U.S. ENVIRONMENTAL PROTECTION AGENCY DIOXIN REASSESSMENT AND OTHER INFORMATION AVAILABLE SINCE 1989

This section compares the information base from the 1988–89 time frame—the period of publication of the Final Programmatic Environmental Impact Statement (FPEIS) for the Chemical Stockpile Disposal Project (CSDP)—with more recent studies, focusing on three areas: the improved information on human health effects of dioxin and dioxin-like compounds, new information about ambient levels of dioxin and dioxin-like compounds, and changes in the understanding of the role of incineration in the production of dioxin and dioxin-like compounds.

E.3 HEALTH EFFECTS

E.3.1 Non-Cancer Endpoints Summary

Since the publication of the FPEIS (U.S. Army 1988) in January 1988, new data on non-cancer effects, especially in monkeys and rats, have been published. These data provide evidence that developmental effects on the central nervous system can occur at much lower levels of exposure than the previous animal no observed adverse effects level (NOAEL) of 1 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$. However, no available experimental data clearly indicate how low a new no-effects level should be. During the same period, studies of four groups of human infants have been performed that suggest that 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) and dioxin-like substances may cause persistent adverse effects on the developing nervous system at the high end of environmental exposure levels. However, these studies are not conclusive with respect to the hypothesis that dioxin and related compounds might be the causative agents because of methodological problems as well as concomitant exposures to other potential neurotoxicants in the case of studies which examine infants exposed via maternal fish ingestion (three groups). Other non-cancer effects identified by EPA (1994) from epidemiological studies of highly exposed humans as likely TCDD effects were judged not well-substantiated, especially at or near background levels, by EPA's Science Advisory Board (SAB) (SAB 1995). The EPA was also strongly questioned about the same issues in comments from the public (EPA 1995). Even today, most of these possible effects cannot be ruled out and need further study. A chronological presentation of information from the EPA and SAB documents is highlighted in Exhibit E.1 and summarized in ATTACHMENT E-1.

Information regarding the details of TCDD-induced effects has been gained from animal and *in vitro* studies reported after the EPA Health Assessment Document was published (EPA 1988). The most significant of the new data could support a downward revision of the non-cancer animal NOAEL, probably an order of magnitude or more in view of the 0.125 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$ low observed adverse effects level (LOAEL) for developmental neurotoxicity in Rhesus monkeys (Schantz, Ferguson, and Bowman 1992; Schantz and Bowman 1989) and in view of developmental effects on the male rat reproductive system and its function (Mably et al. 1992) as well as other evidence. More animal data are needed as NOAELs are not available from these studies.

However, the findings of the draft dioxin reassessment document (EPA 1994) on likely effects in humans from epidemiological studies (e.g., alterations in male reproductive hormones, borderline risk for diabetes or prediabetic change, gamma glutamyl transferase (GGT) elevation, effects on the immune system, endrometriosis) associated with elevated TCDD levels are not well-established in the eyes of the SAB. In the case of elevated GGT levels, no convincing case was made for adverse clinical health effects being associated with the observation.

According to the SAB (1995) although it appears that dioxin and related compounds can produce immune effects at some dose level in animals, the dioxin reassessment does not provide convincing evidence to indicate that background or near background exposures have similar effects in humans. This may be due in part to omissions in the types of tests of immune function employed in the epidemiological studies and in part to the long lag time between exposure and assessment of immune system function. Animal studies showing effects at body burdens in the range of human background body burdens need replication before they can be considered well established according to the SAB (1995).

The statements in EPA (1994) regarding there being a smaller margin of exposure than previously thought, and the implication that adverse effects on human health are occurring at or near background levels are judged by the SAB (1995) not to have been convincingly demonstrated in the EPA draft dioxin reassessment report (EPA 1994).

EPA (1994) estimated that if the usual procedures were followed to set a reference dose (RfD) for TCDD, that it would be about 10^{-5} µg/d (10 pg/d), or about 10–100 times below the estimated daily intake of dioxin-like compounds. However, both EPA (1994) and SAB (1995) reject the use of an RfD because TCDD toxic equivalents (TEQs) are not like the substances for which RfDs have been used but are accumulated in the body and background levels are high enough that they need to be taken into account in evaluating the impact of incremental exposures associated with a specific source. The SAB (1995) strongly recommended that EPA develop a method for assessing the non-cancer impacts of incremental exposures.

Human studies of developmental neurotoxicity have been made on four cohorts of infants exposed transplacentally and to breast milk with elevated levels of polychlorinated biphenyls (PCBs) or dioxins, furans, and PCBs. A critical and detailed analysis of the results of all studies on these cohorts—together with the body of animal data—may assist in determining whether exposures to elevated levels of dioxins and related compounds are likely to have adverse health effects on human prenatal and postnatal development and what the quantitative relationship between exposure and effects might be, if any. The results to date are suggestive of incremental effects at each level above background, but do not conclusively implicate the dioxins and related congeners, in part because the exposures are mixed and in several studies are known to include heavy metals and pesticide residues (also potential neurotoxicants).

Exhibit E.1. Non-cancer endpoint position summary

Developmental and reproductive toxicity

EPA 1985: Rat litter survival indices and renal pelvis dilation low observed adverse effects level (LOAEL) = 1 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$ (Murray et al. 1979).
pp. 14-11: LOAEL for rat teratogenic effects greater than or equal to 100 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$.

EPA 1988: 1 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$ taken as a no observed adverse effects level (NOAEL), but with reservations that it may be a LOAEL; considered "highly suspect" as NOAEL (App. C, p. 9); reference dose (RfD), RfD = 1×10^{-5} $\mu g{\cdot}kg^{-1}{\cdot}d^{-1}$ (p. 14); not sufficient evidence to link tetrachlorodibenzo-*p*-dioxin (TCDD) to human developmental toxicity.

EPA 1994: pp. 7-249–50: Male reproductive hormone effects considered causally linked to increased serum TCDD levels, based on two epidemiological studies (Egeland et al. 1994; Roegner et al. 1991).
p. 7-253: Long-term neurological effects not seen (transient effects reported in humans); too little information to determine developmental neurotoxicity.

EPA 1995 In the Summary of Public Comments on the dioxin reassessment, several commentors noted that the study by Egeland et al. (1994) on human male reproductive hormones was technically deficient and of questionable statistical significance (i.e., none of the mean reproductive hormone levels in any of the exposed groups were out of the normal range) and that relevant human data were omitted from discussion.

SAB 1995: p. 59: It would be appropriate to reevaluate NOAEL of 1 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$ [Schantz, Ferguson, and Bowman (1992) and Schantz and Bowman (1989) monkey data: LOAEL = 0.125 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$; Mably et al. (1992) rat frank effects level at estimated body burden of 34 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$ from acute 64 ng/kg per oral on gestation day 15]. Criticized EPA for omitting consideration of evidence for developmental neurotoxicity associated with intrauterine exposure from work of Jacobson, Jacobson, and Humphrey (1990), Gladen et al. (1988), and Rogan et al. (1986); also noted Huisman et al. (1995) report of developmental toxicity.

Immunotoxicity

EPA 1985: No information.

EPA 1988: No unequivocal cases of significant immune function alterations in humans following TCDD exposure; effects in animals seen at levels also producing other pathological and reproductive/developmental effects (App. E, p. 1; pp. 19–20).

EPA 1994: p. 7-261: Too little information to suggest definitively that TCDD, at the levels observed, is an immunotoxin in humans; p. 4-35 points out inconsistencies in human data but also methodological problems that preclude ruling out effects. Table 9-5 shows recent mouse and marmoset data on effects at body burdens equivalent to human background body burden.

EPA 1995 In Summary of Public Comments on the dioxin reassessment, various commentors noted that relevant human data demonstrating no association between serum TCDD levels and diminished immune function had been omitted (e.g., Neubert et al. 1991, Roegner et al. 1991); reliance on host resistance models criticized; use of toxicity equivalent factors (TEFs) based on immunotoxicity data from mice questioned; bias toward Ah-receptor mechanism criticized; and that Chap. 9 overstated immunotoxicity risks observed in epidemiologic studies.

Exhibit E.1. (Continued)

SAB 1995: p. 59: the SAB agreed that sufficient data exist to suggest that immunotoxic effects could occur in humans at some dose levels, but felt (p. 60) EPA had not presented convincing evidence that background or near background exposures cause adverse immunotoxic effects in humans. Human populations have not been studied with appropriate test battery, especially the “gold standard” test for suppression of primary antibody response after immunization.

Other

EPA 1994: p. 7-245: Gamma glutamyl transferase increased in humans; clinical significance unknown; may not be adverse.
p. 7-247: Slight increased risk of diabetes or increased fasting serum glucose in humans.
p. 7-262: Thyroid function: equivocal results in human studies that have looked at endpoint; little information on production workers, none on Seveso residents. Recent small study on infants shows effects on thyroxine, thyroxine binding globulin, and thyroid stimulating hormone related to TCDDs and tetrachlorinated dibenzofurans (TCDFs) in breast milk (Pluim et al. 1993); large study also suggests effects (Sauer et al. 1994).
p. 9-62: Endometriosis: Rier et al. (1993): monkey, 5 ppt in diet/4 years, body burden = 54 ng/kg (NOAEL not established) (Table 9-5); possible cytokine involvement (human in vitro and ex vivo cells) (Rier, Parsons, and Becker 1994; Zarmakoupis et al. 1995).

EPA 1995: Summary of Public Comments (EPA 1995) on animal data presentation was generally supportive; however, the use of the Egeland et al. (1994) results on human male reproductive hormones was criticized by several commentors as being technically deficient and of questionable statistical significance. Relevant human data omitted; reliance on host resistance models criticized; use of TEFs based on immunotoxicity data from mice questioned and additivity a problem; bias toward Ah-receptor mechanism was criticized; several commentors felt Chap. 9 overstated the risks observed in epidemiologic studies.

SAB 1995: p. 78: The SAB judged that EPA has not presented findings adequate to support a conclusion that adverse effects in humans may be occurring near current environmental exposure levels to TCDD and related compounds.

A number of studies have suggested that elevated environmental exposures to PCBs or a combination of PCBs, polychlorinated dibenzofurans (PCDFs), and polychlorinated dibenzo-*p*-dioxins (PCDDs) may cause developmental neurotoxicity in human infants (see Exhibit C-1). Some of these studies (e.g., Jacobson, Jacobson, and Humphrey 1990) were omitted from consideration in the draft dioxin reassessment document (EPA 1994), and some have been published since its release (e.g., Huisman et al. 1995; Lonky et al. 1996). An 11-year follow-up study on the Lake Michigan cohort of children found to have effects on visual memory as infants and effects on verbal and quantitative short-term memory at age 4 (Jacobson, Jacobson, and Humphrey 1990) shows that prenatal exposure to levels of PCBs slightly higher than those for the general population is associated with lower full-scale and verbal intelligence quotient scores after controlling for potentially confounding variables. The strongest effects were related to memory and attention. The Dutch study (Huisman et al. 1995) implicates PCDFs and PCDDs as well as PCBs. Gladen et al. (1988) observed a continuum of effect with increasing transplacental PCB exposure as did Jacobson, Jacobson, and Humphrey (1990). However, the changes seen at birth (Rogan et al. 1986) and in infancy by Gladen et al. (1988) did not persist further nor appear to have adverse effects on mental functioning. Because of the wide variety of chemical pollutants that were likely present in many of these studies including PCBs, mercury, hexachloro-benzene, 1,1-dichloro-2,2-*bis*-(p-chlorophenyl)ethylene (DDE, also known as p,p'-DDE), and mirex, none of the results show an association between any particular chemical and a specific behavioral effect. Several recent comprehensive reviews of the various studies on neurobehavioral effects following environmental exposures to PCBs suggest that due to methodological problems and the inconsistent and conflicting results, further research be undertaken to resolve the uncertainties concerning the risks of perinatal exposure to PCBs (Safe 1994; Schantz 1996).

Recent Dutch studies suggest changes in thyroid hormone status associated with human fetal and postnatal exposure to PCDFs and dioxins (Pluim et al. 1993; Sauer et al. 1994; Koopman-Esseboom et al. 1994; Weisglas-Kuperus et al. 1995). The effects reported in these studies are not in complete agreement for either the infants or mothers, possibly in part because the Pluim et al. (1993) study is for a far smaller group of mother-infant pairs than that of Sauer et al. (1994). The study by Koopman-Esseboom et al. (1994) on thyroid hormone concentrations showed a significant correlation between PCDD, PCDF, and PCB levels in human milk and lower plasma levels of thyroid hormones; however, all of the measurements were within the normal range. The clinical relevance of these small changes in thyroid hormone levels on the developing fetus and infant is unknown; additional research will be needed to determine its significance. However, disruption of thyroid hormone status is one possible route for TCDDs and related compounds to cause developmental neurotoxicity; and it will be important to see whether such observations can be replicated and clarified in future studies. Also, several of the studies suffer from potentially confounding mixed exposures (e.g., to heavy metals and pesticide residues in the diets of contaminated fish eaters). Thus, these studies, while suggestive, may not be conclusive for developmental neurotoxic effects of TCDD or dioxin-like exposures on human infants, particularly at ordinary background levels of exposure in the absence of other elevated toxins. The entire group of studies should be reviewed critically as a whole, together with the body of animal data, for their implications for human developmental toxicity. Such an in-depth review is beyond the scope of this report but ultimately this body of data may provide relevant information with regard to the issue of whether any additional exposure to dioxin-like substances causes adverse human health effects.

E.3.2 Cancer Risk from Dioxin-like Compounds—EPA Evaluations from 1985 to 1995

From 1985 to 1995, EPA made three different assessments of carcinogenesis (EPA 1985, 1988, 1994) focused on TCDD—the 1994 reevaluation was followed by a detailed review by the EPA SAB, which differed from the 1994 draft document on a number of issues (SAB 1995). The 1994 reevaluation concentrated mostly on TCDD but used bioassay-based potency factors given as TCDD toxicity equivalent factors (TEFs) (Sect. E.3.3) which provided an operational basis for conversion of doses of congeners (referred to as dioxin-like compounds) to an 'equivalent' dose of TCDD referred to as TEQs. This summary is focused on aspects of those four efforts that might affect the understanding of the carcinogenic potential in humans over the past decade. The information in Exhibit E.2 suggests that fundamental ideas, data actually used, and conclusions have been very robust over time. The documentation has changed to accommodate new experiments and theory related to the role of the Ah receptor-cytochrome P450 linkage and its linkage with toxicity, but the conclusions are nearly the same. Similarly, the "unit risk" dosage associated with an extrapolated human risk of one-in-a-million per lifetime has tracked from 0.006 $pg{\cdot}kg^{-1}{\cdot}d^{-1}$ (EPA 1985), through 0.1 $pg{\cdot}kg^{-1}{\cdot}d^{-1}$ (EPA 1988), back to 0.01 $pg{\cdot}kg^{-1}{\cdot}d^{-1}$ in EPA 1994. This should come as no major surprise considering that the Kociba et al. (1978) study conducted by Dow Chemical Company comprised data that were used to determine both the 1985 and 1988 estimates. The 1994 effort added an updated evaluation by Sauer et al. (1990) of the animal tumor data from the Kociba et al. (1978) study and a short-term study by Maronpot et al. (1993). The SAB offered strong criticism that more usage was not made of the much greater abundance of animal data and of the data base on human carcinogenesis associated with exposures to dioxin-like compounds.

As described by Silbergeld (1995), risk assessments for dioxins have been done around the world. Each estimate has defined an acceptable level of increased cancer risk as one in a million, and all use the same rat data, yet they differ by orders of magnitude in terms of the exposure associated with that risk. The differences arise from the models used to fill in between high-dose animal data and most measured or anticipated human exposures. This variability results in acceptable daily intakes that range from the EPA value of 0.006 to 10 $pg{\cdot}kg^{-1}{\cdot}d^{-1}$, which has been recommended by the World Health Organization and is used in some European countries (BSM 1992). The following list provides a profile of the carcinogenic properties of TCDD as described in the 1985, 1989, and 1994 EPA evaluations and the 1995 SAB review:

1. *Mutation of cells and genotoxicity*

TCDD seems to induce cancer in animal experiments (see Exhibit B-2), but mutagenic and genotoxic effects are not registered in short-term tests. Thus, in the classical sense, TCDD cannot be considered a complete carcinogen. This issue continues to be a dilemma and carries forward into whether TCDD is a complete multisite carcinogen or simply a promoter of carcinogenesis whose effects are reversible upon termination of exposure.

2. *Animal carcinogenesis*

Considered to be adequate in all evaluations for TCDD and a mixture of two isomers of hexachlorodibenzodioxin; no other PCDDs or PCDFs have been tested for carcinogenicity.

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3. *Metabolism and pharmacokinetic models*

Models and data have improved but cannot provide any practical improvements in risk assessment models.

4. *Mechanisms of carcinogenic action*

From an assessment perspective, there has been no significant change The 1994 reevaluation provided strong assertion for an Ah receptor mediated mechanism of action, but members of SAB noted that the behavior may be simply an association (biomarker of exposure not of deterministic significance) or measure of a cell's attempt to protect itself and that toxicity

Exhibit E.2. Summary of EPA evaluations of dioxin and dioxin-like compounds from 1985 to 1995

Mutagenicity and genotoxicity

EPA 1985: Data on mutagenicity and genotoxicity are controversial and inconclusive. tetrachlorodibenzo-*p*-dioxin (TCDD) initiator in rodent cancers.
EPA 1988: Some bioassays indicate metabolism may produce genotoxic intermediates; probably not genotoxic.
EPA 1994: Probably non-direct initiating activity. Short-term assays may not respond to indirect effects of dioxin-like substances. Not generally considered genotoxic in traditional terms.
SAB 1995: TCDD has no recognized capacity for initiation; it is not a complete carcinogen.

Animal carcinogenicity

EPA 1985: Animal cancer data for oral exposure are adequate.
EPA 1988: Animal cancer data for TCDDs are adequate.
EPA 1994: TCDD is a multi-site carcinogen in animals.
SAB 1995: Animal cancer data are unequivocal.

Metabolism and pharmacokentics

EPA 1985: Metabolism and pharmacokinetic data are insufficient to permit modeling of equivalent human doses.
EPA 1988: Provided an extensive review for use of a hormone-like mechanism.
EPA 1994: Pharmacokinetic data were used to modify multi-stage coefficients.
SAB 1995: EPA estimating 16 coefficients from 4 data points (p. 64).

Carcinogenic mechanisms

EPA 1985: Mechanisms of action should be studied.
EPA 1988: Controversy about carcinogenic mechanisms of TCDD.
EPA 1994: Strong support for use of the Ah receptor as a direct index of effect and/or risk; potent modulators of cell growth and differentiation.
SAB 1995: EPA overstated the case for Ah receptor mechanism—Ah is a marker of exposure but may be just an association. The significance of subtle biochemical and biological changes with TCDD exposure is unknown.

Dose-response model

EPA 1985: Linearized-multistage model.
EPA 1988: Qualified usage of the linearized-multistage model.
EPA 1994: Evaluation is hybrid between curve-fitting and “pure mechanistic modeling” using physiologically based pharmacokinetic and two-stage models.
SAB 1995: It appears that a threshold model would fit data equally well as the linear model.

Exhibit E.2. (Continued)

Animal cancer data used

EPA 1985: Used female rats (combined sites) from Kociba et al. (1978) but average pathology from Kociba et al. (1978) and Squire (1980).
EPA 1988: Used female rats (liver only) from Kociba et al. (1978), but pathology by Squire (1980).
EPA 1994: Used female rats (liver only) from Kociba et al. (1978), but revised tumor incidence data based on Sauer (1990); used focal lesions from gavage study by Maronpot et al. (1993).
SAB 1995: Although there was an abundance of animal data on TCDD, only one study (Maronpot et al. 1993) was added to the analysis.

Adequacy of epidemiological data

EPA 1985: Epidemiological data are inadequate.
EPA 1988: Epidemiological data are inadequate.
EPA 1994: Limited epidemiological data were analyzed, but animal data were chosen for low-dose extrapolations.
SAB 1995: Human data are limited and controversial; few chronic effects observed in humans. The EPA (1994) conclusion that dioxin and related compounds are likely to present a cancer hazard to humans at exposure levels within one or two orders of magnitude above background is not well-supported by the existing human epidemiologic data-base.

Human carcinogenicity

EPA 1985: TCDD and hexachlorodibenzo-*p*-dioxin (HxCDD) are probable human carcinogens.
EPA 1988: TCDD is a probable human carcinogen.
EPA 1994: Dioxin-like compounds are probable human carcinogens.
SAB 1995: Dioxin-like materials are probably carcinogenic to humans.

Characterization of TCDD

EPA 1985: Cellular and biochemical data are inadequate for use in risk assessments.
EPA 1988: Describing TCDD either as a promoter or a complete carcinogen is an oversimplification.
EPA 1994: It appears that humans respond to polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) like test animals with biochemical and molecular similarities.
SAB 1995: All evidence implicates TCDD as a carcinogenic promoter.

Exhibit E.2. (Continued)

Development of scientific opinion on TCDD

EPA 1985: TCDD was analyzed as a complete carcinogen.
EPA 1988: Data on TCDD as a complete carcinogen, but data lacking on direct action.
EPA 1994: TCDD is a potent, complete carcinogen in some experiments.
SAB 1995: TCDD is not a complete carcinogen.

Slope factor

EPA 1985: Slope factor is 156 $\mu g \cdot kg^{-1} \cdot d^{-1}$ for TCDD.
EPA 1988: Slope factor is 10 $\mu g \cdot kg^{-1} \cdot d^{-1}$ for TCDD.
EPA 1994: Slope factor is 100 $\mu g \cdot kg^{-1} \cdot d^{-1}$ for TCDD.
SAB 1995: EPA must consider durability of conclusions—would other reasonable assumptions lead to different risks?

Other cogeners

EPA 1985: Slope is 6.2 $\mu g \cdot kg^{-1} \cdot d^{-1}$ for HxCDD.
EPA 1988: Congeners not analyzed.
EPA 1994: Used toxic equivalent (TEQ)/toxicity equivalent factors (TEF) models for more than 200 chemical congeners. No long-term animal cancer bioassays have been performed except for TCDD and HxCDD.
SAB 1995: SAB supports concept but encourages more validation. It is not obvious how potencies were derived and how vigorously they can be defended.

Unit risk

EPA 1985: Unit risk dose for TCDD is 0.006 $pg \cdot kg^{-1} \cdot d^{-1}$.
EPA 1988: Unit risk dose for TCDD is 0.1 $pg \cdot kg^{-1} \cdot d^{-1}$.
EPA 1994: Unit risk dose for TCDD and TEQ-adjusted congeners is 0.01 $pg \cdot kg^{-1} \cdot d^{-1}$.
SAB 1995: Unit risk is not supported by available data. EPA should have provided a more comprehensive analysis of human data.

Background exposure

EPA 1985: Concentration in foods, air, and water is unknown.
EPA 1988: Upper bound daily intake estimated at 0.04 to 0.51 $pg \cdot kg^{-1} \cdot d^{-1}$.
EPA 1994: From pharmacokinetic model, dietary intake estimates are: TCDD = 0.3 to 0.6 $pg \cdot kg^{-1} \cdot d^{-1}$; including dioxin-like PCDDs and PCDFs, TEQ = 1 to 3 $pg \cdot kg^{-1} \cdot d^{-1}$; with dioxin-like polychlorinated biphenyls (PCBs), TEQ = 3 to 6 $pg \cdot kg^{-1} \cdot d^{-1}$.
SAB 1995: EPA tends to overstate danger. Uncertainties are not identified. Sensitivity analyses needed to estimate solidness of conclusions. Estimates of average exposure are reasonable but have substantial uncertainties—need population distribution data.

events may actually be in a different pathway. Although much is known regarding the Ah receptor and cytochrome P450 linkage, it is highly speculative to link Ah receptor events directly to the mechanisms of carcinogenic action.

5. *Dose-response model*

All EPA cancer risk assessment evaluations used low-dose linearity either from the multistage model or its condensation to a two-stage formulation. However, the SAB criticized the EPA's 1994 draft dioxin reassessment for failing to consider a benchmark or threshold model instead of simply adopting a linear approach.

6. *Animal cancer data used for model evaluation*

The Dow Chemical study has been used constantly throughout the decade, except that individual variations in pathology as reported by Kociba et al. (1978), Squire (1980), and Sauer (1990) have been factors of uncertainty. Additional variation results from choice of pathological site (e.g., whether effects are for combined pathological sites or restricted to certain neoplasms of the liver). The 1994 analysis added one experiment (Maronpot et al. 1993) to the analysis of the Kociba et al. (1978) experiment so that two experiments have now been chosen from many available cancer experiments on several species. As implied, there is a wealth of animal carcinogenesis data that have never been used in the derivation of guidance criteria, for example the male rat data from the Dow study by Kociba et al. (1978).

7. *Interspecies differences*

The SAB noted that interspecies difference in animal studies, range over a factor of 10,000. No single animal model can accurately predict human responses. Based on available data, it is debatable whether the most sensitive species, or the most representative animal species should be used when selecting an animal model to predict TCDD toxicity in humans.

8. *Risk coefficients (i.e., slope factors) and unit risk*

Risk coefficients are used in the sense of "*risk* = *slope* × *dose*" and therefore unit-risk factors and slope factors are inversely related. The 1985 values and the 1994 values are similar within a factor-of-ten; they reflect a less serious hazard than was perceived in 1988—all values are well within the bounds of uncertainty and assumption. The SAB recommended strongly that such sensitivity evaluations be considered, but it is almost certain that the range will span from zero to a very large risk. Also the SAB noted that EPA's preferred dose response model is linear, but "it seems clear that a threshold model would provide an equivalent or nearly equivalent description of the data. This is the most important issue in the dose-response-modeling…"

9. *Background exposure and risk*

In the 1994 reanalysis of the health risk from TCDD and dioxin-like compounds, the EPA has considered PCDD, PCDF, and PCB congeners, with chlorine substitutions in at least the 2, 3, 7, and 8 positions, all converted to isotoxic dose equivalents of TCDD—the best-studied member. One of the most confusing issues arising from the EPA reanalysis is that of choosing a value prudent for protection versus the need for a realistic prediction of risk in human populations hypothetically exposed to a particular dosage. By traditional EPA methods, the two goals have not been distinguished adequately in many cases.

Generally, carcinogenic substances have been analyzed in terms of both their carcinogenic potency and their potential to cause non-carcinogenic but adverse effects according to methods used in classical toxicology. The processes usually include a comparison of the risk specific dose (RSD) (selected on the basis of a risk level of one in a million for some compounds and one in a hundred thousand for others) with a RfD based on a NOAEL, LOAEL, low observed effects level (LOEL), or no observed effects levels (NOEL), modified by a very large safety factor. The most limiting value for either the RSD or the RfD is usually taken for hazard control.

When a slope factor, unit risk dose, or RSD for cancer has been derived from animal data, the intent has been to estimate the 95% upper bound on low-dose risk, and sometimes the RSD was set on a risk of 10^{-5}. In contrast, if the slopes or unit risk doses were based on epidemiological data, the goal was to estimate the most probable values instead of the upper 95% limit and the RSD was often set for a risk of 10^{-6}.

The RfD is based on an experimentally determined estimate of a NOAEL, LOAEL, LOEL, or NOEL [chosen according to availability and relevance] reduced by a composite safety factor. In many of EPA's applications, additional confusion has resulted from the interchangeable use of "safety factors" and "uncertainty factors," and some publications have attempted to demonstrate equivalence of particular interpretation of the two distinct ideas (Dourson and Stara 1983, Dourson et al. 1985). But with the additional confusion regarding the RfD concept for TEF/TEQ models being used to estimate risks associated with normal human background exposure levels and to infer risk increases associated with incremental exposures above normal background for dioxin-like compounds, it is important to remember that statistical uncertainty factors are quite different from the EPA's safety factors and the two should not be equated either in concept or in magnitude.

"Safety factors" as used by the EPA, were devised to estimate a "safe" dose to a hypothetical sensitive human subpopulation when fragmentary data on humans or animals are available. Some chemicals have had very limited testing; other chemicals have been tested more exhaustively. Safety factors help accommodate this situation. For any particular compound, the "permissible exposure" may be safe by a wide but unknown margin, perhaps many orders of magnitude. A disadvantage in this absolute decision-making schema is the inconvenience and expense of usually large, but unknown, margins for safety and the complete lack of correspondence of the RfD concept from compound to compound. Thus, relative comparisons are not relevant. Safety and/or modifying factors that have been used in deriving RFDs include:

- intra-species variability (a factor of 10);
- inter-species variability (a factor of 10);
- subchronic test data when chronic not available (a factor of 10);

- using LOAEL when NOAEL not available (a factor assigned ranging from 1 to 10);
- test data do not reflect the rout of exposure for humans (a factor of 10);
- use of acute test data when chronic data not available (a factor of 10), and
- qualitative professional judgements regarding scientific uncertainties not covered under the standard safety factors, such as the completeness of the data base for a particular chemical and the number of animals in the key study—these considerations are described as a "modifying factor" (a factor of 1 to 10).

Traditionally, EPA has used the first four factors to establish composite safety factors of 10, 100, 1,000, or 5,000 for RfD considerations; however, the last modifying factor may be used to decrease the RfD by up to another order of magnitude.

Although a "possibly safe" dose decreased by additional factors ranging from 10 to 100,000 could, at least in theory, produce a "more safe" dose [assuming that risk is some value greater than zero], it appears that values so derived may distort the reality between protection and risk. Such distortion impedes accurate ranking of chemicals, site/technology prioritization or selection, and a host of other considerations that depend upon reasonably accurate relative comparisons. With respect to the current situation of producing low, or perhaps even trivial, concentrations of dioxin-like compounds during the incineration of chemical warfare agent, the RfD concept seems to imply a risk increment that is unlikely to be detected in any sensitive bioassay or study of sensitive human biomarkers of exposure or risk.

E.3.3 Toxicity Equivalents and Toxicity Equivalent Factors

Dioxins are used to refer to the family of structurally similar compounds comprising TCDD and other 2,3,7,8-substituted dioxins, 2,3,7,8-substituted furans, and those PCB congeners with at least four chlorine atoms which can assume a planar configuration and have dioxin-like activity, including the non ortho, mono ortho, and a few di ortho PCB congeners. EPA (62 FR 24887) provides descriptions of these compounds, their properties, and the common processes that produce them.

The TEF procedure rests empirically upon the ability of TCDD and its various congeners to induce enzyme production via the Ah receptor (Birnbaum and DeVito 1995). Since TCDD is the most potent congener, the TEFs derived for all other congeners are primarily an expression of their ability to induce P-450 enzymes via binding to the Ah receptor relative to TCDD. The TEQ methodology assigns TCDD a TEF value of 1 and all other congeners are assigned TEF values of 0.001 to 0.5 depending on their potency relative to TCDD. Enzyme production is itself not toxic, but is used as a "biological marker" for possible toxic effects. Any connection between this enzyme induction and possible toxic effects has not yet been shown.

The principal identified sources of PCDDs and PCDFs are combustion and incineration of chlorine containing fuels, chemical manufacturing/processing sources as by-products, industrial and municipal processes, such as those involving wood pulp (manufactured using chlorine as a bleaching agent) and reservoir sources which may result in exposures produced by redistribution of material.

The TEF procedure used in the EPA's dioxin reassessment was developed under auspices of the North Atlantic Treaty Organization's Committee on Challenges of Modern Society to promote international consistency in addressing contamination involving PCDDs and PCDFs.

With this TEF methodology, PCDDs and PCDFs with chlorine substituted in the 2,3,7,8 positions are assigned nonzero values (Table E.1). Additionally, the analogous brominated compounds and certain PCBs have been identified as having dioxin-like toxicity and are also included in the definition of dioxin-like compounds. However, EPA has not assigned TEF values for brominated dibenzo-*p*-dioxins, brominated dibenzofurans, and PCBs.

Table E.1. Toxicity equivalent factors (TEF) for polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans

Congener	TEF	Congener	TEF
Tetrachlorodibenzo-*p*-dioxin (TCDD)	1	Tetrachlorodibenzofuran (TCDF)	0.1
Pentachlorodibenzo-*p*-dioxin (PeCDD)	0.5	Pentachlorodibenzofuran (PeCDF)	0.5
Hexachlorodibenzo-*p*-dioxin (HxCDD)	0.1	Hexachlorodibenzofuran (HxCDF)	0.1
Heptachlorodibenzo-*p*-dioxin (HpCDD)	0.01	Heptachlorodibenzofuran (HpCDF)	0.01
Octachlorodibenzo-*p*-dioxin (OCDD)	0.001	Octachlorodibenzofuran (OCDF)	0.001

The procedure relates the toxicity of structurally related PCDD and PCDF congeners and is based on a limited amount of *in vivo* and *in vitro* toxicity testing. In application, the methodology steps include

1. Analytical determination of PCDDs and PCDFs in the sample.
2. Multiplication of congener concentrations in the sample by the TEF for each congener to express the concentration in terms of TCDD equivalents.
3. Summation of the products in Step 2 to obtain the total TEQs in the sample.

The SAB (1995) has reviewed the use of TEFs and TEQs and noted that TEFs are used to address the broad range of dioxin-like compounds having the common property of binding to the Ah receptor and producing related responses in cells and whole animals: “The use of the TEFs as a basis for developing an overall index of public health risk is clearly justifiable, but its practical application depends on the reliability of the TEFs and the availability of representative and reliable exposure data.” Since only about 10% of the total exposure to dioxins is likely to be from TCDD, if TEFs are going to be used, it is obligatory to have good information on distribution, metabolism, and half-lives of other major components.

Since the EPA 1994 analysis, the carcinogenic potential of dioxin-like compounds has raised significant concern—because the slope factors (or unit risk factors) have changed little over the 1985–94 interval. Similarly, the personal “background” dose, although unknown in 1985, was estimated in 1988 and is still quite consistent with estimates proposed in 1994 for TCDD. What has changed is the use of TEQ and TEF models that combine over 200 congeners into a single toxicity index keyed to TCDD. The use of 50% of detection limit for all non-detected congeners ensures that “background” will be an upper bound. This upper bound of exposure is then mated to the dose response model, which itself has a variation of 1,000 fold from country to country. Moreover, another upper limit assumption is added but often overlooked…that hyperplastic foci in rat liver are equivalent to a fatal hepato-carcinoma in humans. Even with this abbreviated discussion, it can be seen that what is presented by EPA as an upper bound is, in effect, a product of multiple upper bound models and assumptions. Hence, it should be expected that highly inflated models of risk and highly inflated models of background body burdens predict small, if any, margins for safety with respect to cancer, or other health effects.

E.4 AMBIENT BACKGROUND

Dioxins are produced in very small quantities (never intentionally in an industrial setting). In 1987 the EPA estimated the cumulative annual releases from known sources to be about 12 kg/year (25 lb/year) in the United States; more recent EPA estimates suggest the present value is about 3 kg/year (EPA 1998). Combustion and incineration sources of dioxins include municipal waste, sewage, medical wastes, metallurgical processes, and burning of coal, wood, petroleum, and used tires. Major contributions to total annual production include medical and municipal incinerators, secondary copper smelters, forest fires, and cement kilns which burn hazardous waste. Motor vehicles, hazardous waste incinerators, industrial wood burning, and other metal smelting are more moderate contributors of dioxin-like compounds, followed by activities involving incineration of sewage waste, and residential wood burning (see EPA 1994, Vol. I, Table II-2, pp. 17–18 for a table of the major emission sources and their airborne emissions in grams of TEQ TCDD per year.) Deposition measurements in Europe and in the United States suggest deposition rates of about 1 ng $TEQ \cdot m^{-2} \cdot year^{-1}$ are typical for remote areas and 2 to 6 ng $TEQ \cdot m^{-2} \cdot year^{-1}$ for populated areas.

Methods and limitations regarding the EPA (1994) exposure assessment for dioxin-like compounds (as described by the SAB) are given in Exhibit E.3. A brief synopsis of exposure as portrayed in the 1988 EPA document is found in Exhibit E.4.

The EPA (1994) stressed that the margin of safety (between background exposures and levels of exposure where effects have been observed in test animals) for dioxin-like compounds is smaller than that which EPA usually accepts for many other compounds. As described in Sect. E.3.3, the new EPA approach, based on TEQ/TEF models and combining the effects of many congeners in a single toxic index seems to be a point of concern when such considerations are further inflated by assumptions regarding upper bounds on dose response models, pathologic equivalences between nodules and cancers and the treatment of concentrations below limits of detection as if they were present at 50% of the detection limit.

The SAB was very concerned that a distinction be made between ordinary background and the high-end levels observed in the studies cited: “There is an inference that humans are at risk from background and near-background exposures. The term background, because of its implications in ordinary discourse, needs to be amplified in the context of the dioxin reassessment. Background typically refers to exposure levels that are not out of the ordinary experience. The populations described by Jacobson et al. (1990b), Gladen et al. (1988), and Huisman et al. (1995), which demonstrate associations between PCB (and in the Huisman study, PCBs and dioxins) exposure and neuro-developmental deficits, would be classified at the high end of the background distribution. This distinction needs to made clear by EPA.”

Exhibit E.3. Methods and limitations regarding the EPA 1994 exposure assessment for dioxin-like compounds (EPA 1994; SAB 1995)

- Uncertainties include detection-point contributions from local versus distant sources: Fraction of exposure cannot be simply associated with fractions of emission.
- Considerable uncertainty exists regarding the accuracy of toxicity equivalent factor (TEF)/toxic equivalent (TEQ) models.
- A background was estimated from the human diet by using 50% of the detection limit for non-detected congeners and central estimates for consumption. TEQ = 119 pg/d of tetrachlorinated dibenzo-*p*-dioxin (TCDD) equivalent, 90% of which is expected from the diet.
- Body-burden data and pharmacokinetic models estimate from 10 to 30 pg/d for TCDD, which is consistent with the preceding value for the TEQ of dioxin-like congeners.
- The EPA estimate for the average is reasonable, but a population distribution is needed.
- EPA describes "background" for sites removed from known contamination (based on general food supply) and expresses concern that "comparison of estimated exposures from a single planned facility to this 'background' might not be adequate if the region already had a higher level of exposure than the 'background' due to the presence of multiple existing sources."
- A site-specific assessment addresses the incremental exposure from a specific source.
- To estimate a "baseline" exposure, (1) default values should be replaced with site-specific data, (2) data from a comparable site should be used if site-specific data are unavailable, and (3) and regional data should be used if comparable site data are unavailable. Use of national background data may be inappropriate for specific sites.
- Because TEQ/TEF models indicate that 10–100 times background poses a risk, more realistic treatments of the congeners that consider "agonist and antagonistic" effects should be attempted.
- EPA: Cancer and other adverse effects may not be detectable until exposure exceeds background by factors of 10 to 100.
- Margins between background and levels that cause detectable effects in humans are considerably smaller than previously estimated.
- Data on subsistence fishermen indicate EPA's estimated body burdens may be 100-fold high.

E.5 INCINERATION AS A MAJOR SOURCE OF DIOXINS

E.5.1 Development of the Science

The question of whether or not incineration is a major source of dioxin dates back to the late 1970s. At that time public and federal agencies concerns about emissions of PCDDs and PCDFs intensified when these compounds were discovered at both municipal and hazardous waste incineration facilities (Travis and Cook 1989, p. 102). Incineration as an important source of these two classes of compounds was generally acknowledged by the early 1980s (EPA 1994 p. 3-64; Brunner 1985, p. 63). In testing a variety of industrial stationary combustion sources during the National Dioxin Study in 1987, the EPA made a series of qualitative observations on the relationship between total chlorine present in the fuel/waste and the magnitude of emissions of PCDDs and PCDFs from the stack of tested facilities (EPA 1987 as reported in EPA 1994, p. 3-72). In general, combustion units with the highest PCDD emission concentrations had greater quantities of chlorine in the fuel/waste, and conversely, sites with the lowest PCDD emission concentrations contained only trace quantities of chlorine in the feed.

Exhibit E.4. U.S. Environmental Protection Agency comments available in 1988 from report EPA (1988), EPA/600/6-88/005A[a]

- Sources considered for human exposures included soil, land disposal, and municipal waste incineration.
- The Centers for Disease Control and Prevention raised concerns if concentrations in soil are above 1 ppb in residential areas.
- Human exposures are likely to result from foods, ingestion or contact with soil, and inhalation of dust and vapors.
- Pathway analysis, bioavailability, absorption, consumption, and bioaccumulation were included. Plant uptake and pharmacokinetics were discussed.
- Scenario-dependent numbers are not applicable to specific sites.
- Highest exposures result from the food chain.
- Reasonable worst case scenarios indicate that tetrachlorinated dibenzo-*p*-dioxin (TCDD) at 1 ppb could cause risk of 10^{-2}; however, careful handling can reduce risk to 10^{-8}. At 1 ppt, risk was about 10^{-5}.
- Pharmacokinetics were used to calculate (from body burden data) an estimate for the upper limit "background" daily intake in the United States.
- Upper limit daily intake ranged from 0.04 to 0.51 $pg{\cdot}kg^{-1}{\cdot}d^{-1}$.

[a] EPA (1985) states that concentrations of TCDD in foods, air, and water are unknown. In 1994, the third EPA reassessment of TCDD describes estimates of human exposures to TCDD at 0.3–0.6 $pg{\cdot}kg^{-1}{\cdot}d^{-1}$, based on pharmacokinetic modeling and dietary considerations. Pharmacokinetic modeling has not been applied to other polychlorinated dibenzo-*p*-dioxins (PCDDs) or polychlorinated dibenzofurans (PCDFs); background toxic equivalent (TEQ) exposures to these materials have been estimated to be 1–3 $pg{\cdot}kg^{-1}{\cdot}d^{-1}$. Adding dioxin-like polychlorinated biphenyls (PCBs) raises background TEQ exposure to 3–6 $pg{\cdot}kg^{-1}{\cdot}d^{-1}$, assuming that diet comprised about 90% of the typical exposure.

At the time of preparation of the CSDP FPEIS in 1986–87, the question of considering inclusion of dioxins and furans as possible combustion products and an analysis of their potential health effects was considered. However, they had not been identified as combustion products of the warfare agents (U.S. Army 1988, pp. B-16,17). Data from agent combustion trials indicated that the design of the incinerators provided sufficiently high temperatures and long residence times such that dioxins and furans were not formed at measurable levels (U.S. Army 1988, pp. B-119–121). The only other source contributing chlorinated molecules would be the dunnage (packing materials including wood and possibly some plastic). Assessment of emissions or health effects from this source was outside the charge to the assessment team.

Since the publication of the original FPEIS (U.S. Army 1988), a measurement program has been carried out on the prototype chemical agent incinerator at JACADS. These measurements supported health risk assessments conducted by the U.S. Army on the incineration of chemical agents during the operational verification testing at JACADS (AEHA 1992). Emissions of dioxins and furans were included in the health risk assessments. However, only extremely small quantities of dioxins and furans were emitted from the JACADS incinerators. The JACADS air emission standard for dioxins and furans was 30 ng/dscm (dry standard cubic meter) total dioxins/furans, based on emission limits from large municipal waste combustors built after December 20, 1989 (Appendix A, Table A.5). The measured TEQ emissions of dioxins and furans from the various incinerators and furnaces at JACADS ranged from

0 to 1.48 ng/m^3 (see Appendix A, Table A.7); this is in the parts-per-trillion range. No TCDD was detected.

The results of the Army's health risk assessment (Appendix A, Table A.8), show that the total cancer risk, the total chronic non-cancer risk, and the total acute non-cancer risk resulting from exposure to air emissions from incineration of the three agents (i.e., GB, VX, and mustard) at JACADS are all less than the EPA-established levels of concern for the general public. In these risk assessments, agents GB, VX, HD, dioxins, and furans were assumed to be present at concentrations equal to one-half of their analytical detection limit, even when the concentration was otherwise undetectable. For carcinogenic chemicals, the concern was for the risk of an individual contracting cancer by being exposed to ambient concentrations of that chemical over the course of a lifetime. The assessment methodology used by the Army was very conservative and protective of human health. These health risk assessment results also indicated a large margin of safety above the acceptance criteria from all three measures of health (cancer, chronic non-cancer, and acute non-cancer).

At the time of preparation of the FPEIS, the understanding with respect to products of incomplete combustion was that "Under the conditions of temperature and residence time proposed for incinerator operation, no chlorinated hydrocarbon releases are expected" (U.S. Army 1988, p. B-157). This perception was supported by the earlier studies on emissions from incineration system tests performed during the 1980s at Tooele Army Depot (now Deseret Chemical Depot) in Utah. The Chemical Agent Munitions Disposal System (CAMDS) at Tooele was developed to test and evaluate equipment and processes to be used in chemical agent/ munitions destruction plants. Three furnaces were built and tested at CAMDS: a deactivation furnace system, a metal parts furnace, and a liquid incinerator. These furnaces were used to provide the basis for design of the JACADS, which has been used as a testing/demonstration facility for the next generation of chemical agent incinerator systems. Each of the three furnaces underwent a series of tests and evaluations. The last of these tests prior to completing the FPEIS was run in May 1986 to identify products of incomplete combustion of GB agent. "No PICs [particles of incomplete combustion], in terms of RCRA [Resource Conservation and Recovery Act]-specified compounds, were detected in the exhaust gases…" (U.S. Army 1988, p. D-16). Emission standards at that time included the chemical agent, hydrogen chloride, particulates, sulfur dioxide, and opacity. Thus, given the standards at the time and the very high temperatures achieved, little to no attention is visible with respect to the possible production of complex ring structures like TCDD.

The first mention of TCDD and agent incineration identified comes from the report of the first testing of the JACADS. In fulfillment of the operations verification tests requirements, three trial burns were performed in the liquid incinerator on December 5 and 6, 1990, with liquid agent GB as the feed material. These trial burns were conducted to demonstrate compliance with the RCRA during the destruction of GB. In addition to monitoring for RCRA materials, nonregulated materials were also monitored. Dioxins and furans were found in the stack emissions during the trial burns at levels approaching the detection limits, with a range of 0.02 to 0.16 ng/m^3 (SRI 1991). It is also recorded (SRI 1991, p. 12) that "conversations with EPA personnel involved in the assessment of incinerators relative to dioxin/furan emissions suggest that a level of 10 ng/m^3 should not cause concern." [At that time, previous studies of municipal incinerators demonstrated emissions of dioxins in the 50- to 7000-ng/m^3 range.] Additional tests at JACADS have revealed small amounts of dioxins and furans for other agents and incinerators.

E.5.2 Conclusions

Trial burns in the several incineration systems at JACADS with agents containing chlorine resulted in very low levels of dioxins and furans when they were detected. Often, these chemicals were not detected. Trial burns with the non-chlorinated agents sometimes resulted in the detection of low concentrations of PCDDs and PCDFs. The origin of chlorine which must enter into reactions when burning non-chlorinated agents in order to form the dioxins measured was not discussed in any of the literature reviewed except for the possible contamination in fuel oil or process water (SRI 1991). Because JACADS is located on a small island in the Pacific Ocean, there will be significantly more chlorine in the ambient air there than at other stockpile locations. Tests of the deactivation furnace system burning materials containing some PCBs resulted in the finding of small quantities of dioxins. These finding were expected because some of the materials burned contained PCBs, known precursors of dioxins. Overall, the concentrations of PCDDs and PCDFs measured at the JACADS facility are small with respect to regulations for hazardous waste incinerators (see Appendix A, Table A.3), as well as unregulated sources. Dioxin production at hazardous waste incinerators was well known at the time of the preparation of the FPEIS and might have been suspected in trace quantities in agent incineration. However, given the low availability of chlorine atoms in the agents, the general lack of precursor molecules, the high design temperatures and long resident times, and the lack of identification during the CAMDS incineration tests, it is not unreasonable that attention was not given to dioxins in the FPEIS.

E.6 COMPARISON OF JACADS DIOXIN EMISSIONS WITH UNREGULATED AND REGULATED SOURCES

Information about the importance of a new or poorly understood topic can often best be understood when it is presented in the form of relative comparisons and when the standards for comparison are universally recognized. At the time of the development of the FPEIS, there was a general recognition that incinerators could be sources of dioxins. Other, less obvious sources of dioxin are also now recognized within the scientific community. Because of the general familiarity with motor vehicles, cigarettes, wood burning fireplaces and hazardous waste incinerators, their emissions will be compared with those from the JACADS incinerator.

Rogers (1995) analyzed the mass emission rate from the deactivation furnace system at JACADS during the test burns which served the dual purpose of a Toxic Substances Control Act demonstration burn and a RCRA trial burn (AEHA 1992). Emissions from this incinerator are representative of the JACADS incinerators. Rogers (1995) derived a TEQ for average emissions as 22 pg/s. Based on EPAs latest estimates for vehicle emission, a diesel truck traveling at an average speed of 64 km/hr (40 mph) would emit approximately 3 pg/s TEQ. Thus the average emissions from the JACADS incinerator trial burns are about equivalent to 7 trucks.

Data for gasoline powered motor vehicles is only slightly more abundant than for diesel-fueled vehicles. The review presented in EPA (1994) attempted to derive estimates of TEQ for leaded and unleaded fuels. Generally, the leaded fuels had similar or higher TEQs than the diesel, and the unleaded fuels had lower values. However, the gasoline data generally fall within plus or minus an order of magnitude of the diesel figure. From these figures, the JACADS incinerator would be difficult to distinguish from at most a few motor vehicles as a source for TCDD/TCDF.

A second point of reference for human exposure to dioxin is the cigarette. Cigarette smoking is thought to be a secondary source of exposure to dioxins with dietary sources being the predominate pathway (Muto and Takizawa 1992). Total dioxin equivalent TEQ of cigarette smoke has been measured by several researchers; see, for example, the work of Löfroth and Zebühr (1992) and of Muto and Takizawa (1989). One article (Löfroth and Zebühr 1992) found the TEQ of sidestream smoke to be about a factor of two above that of mainstream smoke. While TEQs have considerable variation, Matsueda et al 1994 found the average of seven U.S. brands to be 8.6 pg/pack. A comparison can now be made with the average emission of 22 pg/s for the TEQ of a JACADS incinerator, as estimated by Rogers (1995). An equivalent rate of dioxin release from cigarettes would be the burning of 2.5 packs per second.

Residential wood burning provides another source for comparing dioxin production. Data presented in the EPA study of exposure to dioxin-like compounds (EPA 1998) leads to an average dioxin production rate of 2 ng/kg TEQ. Thus, the burning of an average kilogram of wood in a residential setting produces the equivalent of about 2 ng of dioxin. If the typical wood heating fire consumed about 10 kg (22 lb) of wood per hour, the fireplace (or woodstove) would be emitting about 5.5 pg/s. This is about four times less than the average emission rate of the JACADS incinerator as estimated by Rogers (1995).

The last comparison to be made is for a regulated source, hazardous waste incinerators and the primary source of TEQ data is the EPA's exposure source document (EPA 1998). Again, the emission rate in grams per second released from these sources is highly variable. The average release rate of dioxin equivalent estimated by the EPA is 1.1 ng/s which is roughly 50 times greater than the average emission rate estimated for the JACADS incinerator.

E.7 CONCLUSIONS

- Data published later than the 1988 FPEIS (U.S. Army 1988) suggest that the estimate for a non-cancer NOAEL may need to be lowered, at least by an order of magnitude or more, but to date neither EPA (1994) nor the SAB (SAB 1995) have recommended a new value.
- The EPA draft dioxin reassessment report (EPA 1994) appeared to identify several new effects of dioxin in humans from epidemiological studies including (1) changes in male reproductive hormones, (2) a slightly increased risk of diabetes, and (3) an increased level of the liver enzyme GGT in blood. However, these are not considered to be conclusively established. Furthermore, there is no clear indication that elevated GGT activity by itself without other enzymes normally released in liver disease is an indicator of adverse clinical health effects.
- Immunotoxic effects in humans have not been convincingly documented as a result of TCDD/TEQ exposure.
- The statements in EPA (1994) regarding there being a smaller margin of exposure than previously thought, or the implication that adverse effects on human health are occurring at or near background levels, are judged by the SAB (1995) not to have been convincingly demonstrated in the EPA draft dioxin reassessment report (EPA 1994).
- On-going studies on developmental neurotoxicity (effects on mental function and neuromotor development from *in utero* exposure) in humans (from studies on four groups

of infants with mixed environmental exposures to elevated levels of dioxins and related compounds) may help in determining whether such exposures are likely to have persisting adverse health effects. They may also shed light on what the quantitative relationship between exposure and effects is, if any. However, these studies are subject to confounding factors including exposure to other, potentially neuorotoxic compounds not related to dioxins, which undermine their ability to relate TCDD and the effect(s) being studied.

- The animal evidence and studies of human developmental neurotoxicity together warrant a reexamination by EPA of NOAELs and establishment of benchmark doses and a reassessment of public policy. However, adequate information is not now readily available in the published literature on which to base a revised health assessment of the potential non-cancer health consequences of the anticipated very low emissions of TCDD and other dioxin-like compounds from individual incinerator complexes constructed as part of the CSDP.
- EPA (1994) estimated that if the usual procedures were followed to set a RfD for TCDD, it would be about 10^{-5} µg/d (10 pg/d) or about 10–100 times below the estimated daily intake of dioxin-like compounds. However, both EPA (1994) and SAB (1995) reject the use of an RfD because TCDD/TEQs are not like the substances for which RfDs have been used. Rather, these substances accumulate in the body and it remains to be determined if background levels are high enough that they need to be taken into account in evaluating the impact of incremental exposures associated with a specific source.
- Biochemical and molecular mechanisms of toxicity and carcinogenesis are still insufficiently understood and cannot be used as an index of harm at low-doses.
- As low-dose linearity has been merely assumed, the SAB requested that threshold or benchmark models for cancer be considered; that is, in light of the weight of the evidence, is there a dose level too low to cause cancer?
- Human cancer data are inconclusive and most cancer risk estimates for TCDD are based on the Dow Chemical study of Kociba et al. (1978) with the organ effects data classified independently, and somewhat differently, by three different pathologists; additional imprecision results from choice of the mathematical model used to fit the experimental data as interpreted by the pathologists. A study of U.S. chemical workers found elevated cancer risk only for the most highly exposed workers over long periods of time; even this study was confounded by such alternate causes as smoking and exposure to other potentially carcinogenic chemicals. In reviewing this study the SAB noted, “Given the possible confounding, and the somewhat equivocal links of dioxin to excess cancer in the group as a whole, it is difficult to document a dioxin-cancer relationship.
- Based on animal data TCDD is still considered to be a probable human carcinogen even after exhaustive studies of humans that were highly exposed have failed to provide adequate positive evidence for unambiguous interpretation. While animal data are unambiguous, some human data suggest TCDD is not carcinogenic and even anticarcinogenic at some exposure levels. However, biomarkers of exposure and response seem similar between animals and humans. [A workgroup of the International Agency for Research on Cancer, has concluded that TCDD should be considered a “known human carcinogen,” but this workgroup decision does not provide a regulatory basis (RPR 1997).]
- The unit risk concept of one death in a million persons exposed for a lifetime was associated with a dose of TCDD of 0.006 $pg \cdot kg^{-1} \cdot d^{-1}$ when the FPEIS was prepared and was revised to 0.01 $pg \cdot kg^{-1} \cdot d^{-1}$ in 1994 (no change of significance).

- The human background or body burden dose was not estimated in 1985 but the range of 0.04 to 0.51, published in 1988, is similar to the EPA 1994 range of 0.3 to 0.6 $pg \cdot kg^{-1} \cdot d^{-1}$ for TCDD.
- Consideration of other PCDD and PCDF congeners and dioxin-like PCBs may increase the TEQ (the toxic effect equivalents of TCDD) up to a factor of 10.
- Background exposures to TCDD and the evaluations of cancer risk for TCDD are sensibly unchanged over the past decade. The perceived change is that many other chemicals (comprised of dioxins and furans) are structurally similar to TCDD with respect to the positions of chlorine atoms on the molecule and are summed together using the TEF/TEQ methodology to add to the toxicity of TCDD. Although the molecular and biochemical processes are largely unknown, and are subject to continuing debate, the additive effect model is based on the respective congeners' ability to bind to the Ah receptors of a cell. However, the SAB recommended that the assumption of additivity be more throughly documented by the EPA.
- This arbitrary grouping of a class of compounds, summing their potencies based on affinity for the Ah receptors, and assuming that each of these compounds is always present in a concentration that is at least 50% of the detection limit leads to concerns about risk (if the EPA applied similar models to other chemical classes, it is likely that similar concern would develop for classes of metals, organic solvents, organophosphates, etc.).
- Estimates of exposure are upper-bound in nature, and, in addition, risk coefficients have several factors of upper-bound uncertainty. In conclusion, these compounded and often unrealistic assumptions cause the TEF/TEQ model to indicate concern in situations where risk control practices seemed consistent with EPA intent (51 FR 33992) before the new models and their attendant assumptions were disseminated.
- Large uncertainties exist in estimates of exposure, dose, background, and hazard or risk.
- The general knowledge of hazardous waste incinerators as a source of dioxins has changed little since the early 1980s. However, given the JACADS high temperature design, the low availability or absence of chlorine atoms in most of the warfare agents, and the lack of previous detection of dioxins in the early incinerators at Tooele, dioxin production was not anticipated at JACADS during the design phase. Trial burns at JACADS since 1989 have verified that very small quantities of dioxins are produced.
- Dioxin emissions from JACADS can be compared with a number of familiar combustion sources. The JACADS TEQ emission rate, based on the trial burns conducted to demonstrate compliance with the RCRA for one of the incinerators is estimated to be approximately 22 pg TEQ per second. This average emission rate is roughly equivalent to the operation of seven diesel trucks traveling at approximately 40 mph. A similar comparison can be made of the dioxin content of cigarette smoke. The total smoke from a pack of cigarettes is found to yield about 8.6 pg TEQ. Thus, JACADS may release the equivalent dioxin of about 2.5 packs of cigarettes per second. However, while cigarette smokers are exposed to most of the total amount of TEQ, JACADS emissions or those from other agent destruction incinerators will be greatly diffused before impacting upon receptors. Residential wood burning also provides a basis for comparison. A fireplace burning 10 kg (22 lb) of wood per hour generates about 5.5 pg TEQ per second. Thus average JACADS dioxin emissions are similar to the combined emissions of four fireplaces. Finally, an average hazardous waste incinerator in the United

States may produce 1.1 ng/s or a TEQ emission rate of roughly 50 times greater than that of the average measurement for JACADS.

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ATTACHMENT E-1

EVOLUTION OF EPA PERSPECTIVE ON DIOXIN IMPACTS

1. EPA 1985

   No Observed Adverse Effects Level (NOAEL) for Non-Cancer Effects: A low observed adverse effects level (LOAEL) for non-cancer effects of 0.001 $\mu g \cdot kg^{-1} \cdot d^{-1}$ or 1 $ng \cdot kg^{-1} \cdot d^{-1}$ was identified, based on the three-generation rat reproduction study of Murray et al. (1979) as interpreted by Nisbet and Paxton (1982) (p. 14-11). The effects seen were on offspring survival and possibly on kidney anomalies. However, the Federal Insecticide, Fungicide, and Rodenticide Act Scientific Advisory Panel considered it a NOAEL (EPA 1988 App. C, p. 5).

   Reproductive and Developmental Toxicity: The 1985 EPA *Health Assessment Document for Polychlorinated Dibenzo-p-Dioxins* found that no conclusions could be drawn on dioxin-induced reproductive toxicity in humans (p. 9-36). However, it stated that "animal data clearly indicate teratogenic or fetotoxic effects in all animal species tested (p. 9-36)." Tetrachlorinated dibenzo-*p*-dioxin (TCDD) was characterized as the most potent teratogen known (p. 9-35), with a rat LOAEL greater than or equal to 100 $ng \cdot kg^{-1} \cdot d^{-1}$. Human evidence was insufficient for indicating teratogenic effects.

   Immunotoxicity: No discussion of immunotoxicity was given.

2. EPA 1988

   NOAEL for Non-Cancer Effects: Appendix C gives a fairly detailed analysis of the Murray et al. (1979) rat study that formed the basis for the non-cancer NOAEL. While rejecting the questionable statistical reanalysis of Nisbet and Paxton (1982), it concluded that the 1 $ng \cdot kg^{-1} \cdot d^{-1}$ value had to stand but that it should be considered "highly suspect" (p. 9) and was more likely a LOAEL, especially since data from rhesus monkeys were starting to appear suggesting effects at even lower dose levels (p. 8).

   Reproductive and Developmental Toxicity (Appendices C and D): Appendix C reviews other evidence for reproductive and developmental toxicity in animals. The document concludes that TCDD is a developmental toxicant, based on a large number of studies in a variety of species (p. 1). Long-term, low-dose exposure is a concern and acute and short-term exposures are also effective in causing adverse effects. A series of studies in Rhesus monkeys were highlighted as possibly indicating even greater sensitivity than the rat, as reproductive dysfunction was seen at 2 $ng \cdot kg^{-1} \cdot d^{-1}$ (50 ppt diet) for 7 months (Schantz, Barsotti, and Allen 1979) and preliminary results suggested effects at even lower doses (5 and 25 ppt) (pp. 7,8).

Appendix D contains a review of the epidemiological evidence for developmental and reproductive effects of TCDD exposure. It characterized the evidence from these studies as being open to question from a number of standpoints and inconclusive with respect to human effects (pp. 19, 20).

Immunotoxicity (Appendix E): Evidence for immunotoxicity is reviewed for both animal and human studies in this Appendix. Considerable evidence had accrued by this time for TCDD immunotoxicity in animals. One study in mice gave evidence of immunosuppressive effects at 4 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$ (Clark et al. 1981), but these results were considered very questionable by EPA (p. 19). The document points out that the animal evidence suggested that the developing immune system may be more sensitive than the adult to TCDD-induced effects, thus possibly putting the very young at higher risk (p. 9).

With regard to humans, the reviewers concluded that at that time, the epidemiological literature failed to present “convincing evidence for altered immune function in the exposed populations” (p. 11). Among other criticisms, they noted that “there has been no report of an increase in clinical illness attributable to suppressed immune function” (p. 18).

3. EPA 1994

NOAEL for Non-Cancer Effects: p. 9-45: Current data suggest that the NOAEL in animals should be lower (than the 1 ng $TEQ{\cdot}kg^{-1}{\cdot}d^{-1}$). However, a new NOAEL value was not identified.

Reproductive and Developmental toxicity: p. 5-73: “In adult rats, the most sensitive toxic responses to TCDD have been observed following long-term, low-level exposure.” The document also points out that there is far less interspecies variation for prenatal effects than for postnatal ages (p. 5-59).

p. 7-249 ff: Three epidemiological studies were considered and two were considered to show significant associations as stated on p. 7-250: “Results are limited by the cross-sectional nature of the data and type of clinical assessments conducted. However the available data provide evidence that alterations in human male reproductive hormone levels are associated with serum TCDD.” p. 9-51: “If these data continue to hold up in future observations, their clinical significance will need to be further evaluated.”

Other reproductive effects including spontaneous abortions and congenital malformations in humans are listed as possible effects but not conclusive. Increased neonatal deaths suggested by Ranch Hand study, maternally-mediated effects of dioxin exposure on birth defects indicated by Vietnamese studies, and sperm abnormalities (Vietnam Experience Study) as well as effects on male reproductive hormone levels are said to need more study.

Immunotoxicity: p. 4-32: In animals, the “gold standard” test is for humoral immunity [plaque-forming cell response to sheep red blood cells (SRBCs)]. It is depressed by TCDD in several species, the only endpoint consistently suppressed across species including nonhuman primates. The only exception is an enhancement in rats in 1 study. The toxicity equivalent factors for congeners are based on the dose producing 50% suppression of the anti-sheep red blood cell response in Ah-responsive B6 mice, although responses are not as consistent for other congeners as for TCDD.

New information from animal studies includes insight into mechanism of TCDD and PCB-induced hypersensitivity to endotoxin and also evidence of TCDD-enhanced susceptibility of mice and rats to viral and parasitic diseases (evidence of decreased host resistance to bacterial diseases had been published by 1984). More studies, also in non-human primates, have accrued; a study in marmosets showed that one cannot extrapolate from high to low doses, as directions of effects reversed (Neubert et al. 1990, 1991, 1992) (p. 4-30).

p. 7-261: Too little information to suggest definitively that TCDD, at the levels observed, is an immunotoxin in humans. p. 4-35: Evidence of immunotoxicity in humans is inconsistent, but may be due largely to methodological problems. p. 9-50: "Epidemiological studies provide also conflicting evidence…. Few changes in the immune system in humans associated with dioxin have been detected when exposed humans have been studied."

Other: p. 7-245: Increased gamma glutamyl transferase (GGT) levels; GGT is the only liver enzyme consistently increased in exposed humans; it is not a specific effect, as it is raised in almost all hepatobiliary diseases. The clinical significance here is unclear as long-term pathologic consequences of elevated GGT have not been demonstrated.

p. 247: Concludes that there is a slight but statistically significant or borderline significant risk of developing diabetes or having an elevated fasting serum glucose level associated with dioxin exposure. p. 9-51: Points out that there are no animal data to corroborate such an effect, and while elevated serum glucose might indicate increased risk of developing diabetes, the traditional risk factors appear to be much more important than TCDD exposure.

New Conclusions Regarding Human Health Effects: EPA 1994, Vol. III (Chap. 9), p. 9–81: " … It is not currently possible to state exactly how or at what levels humans in the population will respond, but the margin of exposure between background levels and levels where effects are detectable in humans in terms of toxic equivalents *is considerably smaller than previously estimated*." (Emphasis added)

EPA 1994, Vol. III (Chap. 9), p. 9-87: "Based on all of the data reviewed in this reassessment…a spectrum of effects. Some of these effects may be occurring in humans *at very low levels, and some may be resulting in adverse impacts on human health*." (Emphasis added)

In addition to these, the identification of effects on male reproductive hormones, of a slight risk of diabetes or elevated fasting serum glucose level and of elevated GGT are new findings.

4. EPA SAB 1995.

NOAEL for Non-Cancer Effects: p. 59 “In summary, the current NOAEL of 1 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$ rests on a debatable foundation, and it would be appropriate to reevaluate it.” The Committee listed the evidence of developmental neurotoxicity in Rhesus monkeys at a LOAEL of 0.125 $ng{\cdot}kg^{-1}{\cdot}d^{-1}$, the frank effects level for developmental reproductive effects in male rat offspring at an estimated 34 ng/kg body burden, and several other lines of evidence supporting the need to reevaluate the NOAEL. Among these were studies of developmental neurotoxicity in human infants that had been omitted from consideration in the EPA 1994 document (see below).

Developmental Toxicity Effects: The SAB was critical of the omission of any consideration of the work on developmental neurotoxicity in human infants (e.g., Jacobson, Jacobson, and Humphrey 1990; Rogan et al. 1986; Gladen et al. 1988), particularly because these studies involved exposure at environmental levels, although at higher than general background. They also recommended consideration of a study by Huisman et al. (1995) reporting effects on newborns of intrauterine exposure to TCDDs and tetrachlorodibenzofurans (TCDFs) as well as polychlorinated biphenyls (PCBs). (See SAB 1995, Table 2.2).

Immunotoxicity: p. 60 “Although the immune system is a sensitive target to halogenated aryl hydrocarbons in experimental animal species, as presented, the EPA document does not provide convincing evidence to indicate that background or near background exposure levels to dioxin-like compounds in industrial countries are sufficient to affect the immune system.”

p. 61 “ The ‘gold-standard’ test (i.e., suppression of the primary antibody response following immunization) was not employed in any of the human test panels, although this is a hallmark in experimental animals.” [except for Dewailly’s study on Inuit women (Dewailly 1993)] Thus, the literature on humans isn’t as helpful as would be desirable; lack of data may be due to largely due to methods used and long time gaps between exposure and assessment of immune system function.

Dose Response Issues: p. 65 “This fundamental issue concerns the basis for the selection of the dose-response relationship to be used in assessing the (non-cancer) adverse effects of dioxin…”

p. 66: …The available information on TCDDs suggest that use of the benchmark approach, rather than the reference dose, is probably more appropriate…The Committee recommends that EPA work towards developing and implementing a methodology that would allow the assessment of non-cancer risk resulting from incremental exposures.

Continuum of Response Postulate: p. 66: EPA postulates a continuum of response…. The statement is far too general…could be taken as implying that all (or any) early changes will necessarily lead to ultimate toxicity. The statement is only defensible in reference to a limited number of specific case examples, but cannot be taken as universally proven. Not a postulate but a current hypothesis. That Ah receptor may be a sensing pathway, not a part of toxic response of cell to TCDD was not considered.

Margin of Exposure: p. 77 : The last sentence…[smaller margin of exposure] is (in the opinion of most, but not all of the EPA Science Advisory Board Committee) thought to be speculative and needs to be reexamined.

p. 78: In regard to the EPA 94 conclusion on effects at very low levels and possible adverse impacts: It is difficult to determine what EPA is inferring in that last sentence…("Some of those effects may be occurring in humans at very low levels, and some may be resulting in adverse impacts on human health") "If it is intended to state that adverse effects in humans may be occurring near current exposure levels, it is the Committee's judgement that EPA has not presented findings that support this conclusion adequately."

APPENDIX F

CONSULTATION LETTERS

F.1 CULTURAL RESOURCES

Exhibit F.1

DEPARTMENT OF THE ARMY
BLUE GRASS ARMY DEPOT
2091 KINGSTON HIGHWAY
RICHMOND, KENTUCKY
40475-5060

Reply to
Attention of

May 7, 2001

Environmental Office

Mr. David L. Morgan,
State Historic Preservation Officer
Kentucky Heritage Council
300 Washington Street
Frankfort, KY 40601

RE: Notification of an Environmental Impact Statement at the Blue Grass Army Depot in Madison County, Kentucky

Dear Mr. Morgan:

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of a chemical munitions disposal facility at the Blue Grass Army Depot (BGAD) in Madison County, Kentucky. As part of the decision-making process for this action, two parallel National Environmental Policy Act (NEPA) documents are being prepared by two Department of Defense (DOD) programs to address distinct but related actions.

(1) The DOD Assembled Chemical Weapons Assessment (ACWA) is developing an environmental impact statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapon stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation (SCWO); (2) neutralization followed by biodegradation; (3) neutralization followed by SCWO and gas-phase chemical reduction; and (4) electrochemical oxidation. The ACWA will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (AL), BGAD (KY), Pine Bluff Arsenal (AR), and Pueblo Chemical Depot (CO).

(2) The U.S. Army Program Manager Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating a facility to dispose of the chemical munitions stockpile at BGAD. The PMCD EIS will assess and compare the impacts of incineration technologies as well as the four alternative technologies identified by the ACWA program.

Exhibit F.1 (Continued)

-2-

The enclosed maps show the location of BGAD and the alternative facility footprint locations at BGAD. On April 14, 2000, ACWA issued a Notice of Intent to prepare an EIS for its action (*Federal Register* Vol. 65, No. 73, page 20139). A public scoping meeting for the ACWA EIS was held on May 18, 2000 in Richmond, Kentucky. PMCD issued its Notice of Intent on Dec. 4, 2000 (*Federal Register* Vol. 65, No. 233, page 75677); the public scoping meeting for the PMCD EIS was held in Richmond, Kentucky on January 9, 2001.

Argonne National Laboratory (ANL) is assisting ACWA in preparing the ACWA EIS and will be evaluating potential impacts to cultural resources as part of their analysis. Oak Ridge National Laboratory (ORNL) is assisting with the site-specific EIS for BGAD. For the ACWA EIS, an archaeologist from ANL has researched available survey documents for BGAD. ORNL will use the information compiled by ANL for the site-specific EIS.

This letter initiates consultations with your office regarding the proposed projects. Currently, the proposed areas for the facility have not been completely surveyed for archaeological sites. Surveys would have to be completed and the findings/recommendations reviewed and approved by your office prior to your being able to fully comment on a determination of effect. No sites were recorded during a 1983 survey of the southern part of Area A, but the southern part of Area B has been identified in the BGAD Cultural Resources Management Plan (prepared by Geo-Marine, Inc. in 1996) as an area with a high potential for containing sites. It therefore appears that construction has the potential to affect cultural resources, but whether the effect will be adverse will depend on the project site and results of any required survey.

The Army is also initiating consultations with points of contact (Tribal Historic Preservation Officers or designated representatives) from the following Native American Tribes, Councils, and Nations about the proposed projects:

Absentee-Shawnee Tribe of Oklahoma (Chairperson and NAGPRA Contact)
Eastern Shawnee Tribe of Oklahoma (Chief)
Eastern Band of Cherokee Indians (Principal Chief and NAGPRA Contact)
Cherokee Nation of Oklahoma (Principal Chief and NAGPRA Contact)
United Keetoowah Band of Cherokee (Chief and NAGPRA Contact)
Chickasaw Nation of Oklahoma (Governor and NAGPRA Contact)
Georgia Tribe of Eastern Cherokee (NAGPRA Contact)

We would appreciate receiving information on concerns or issues you may have regarding either proposed project. Please submit comments to Joe Elliott at the return address within 30 days. Your time and consideration are greatly appreciated.

Exhibit F.1 (Continued)

-3-

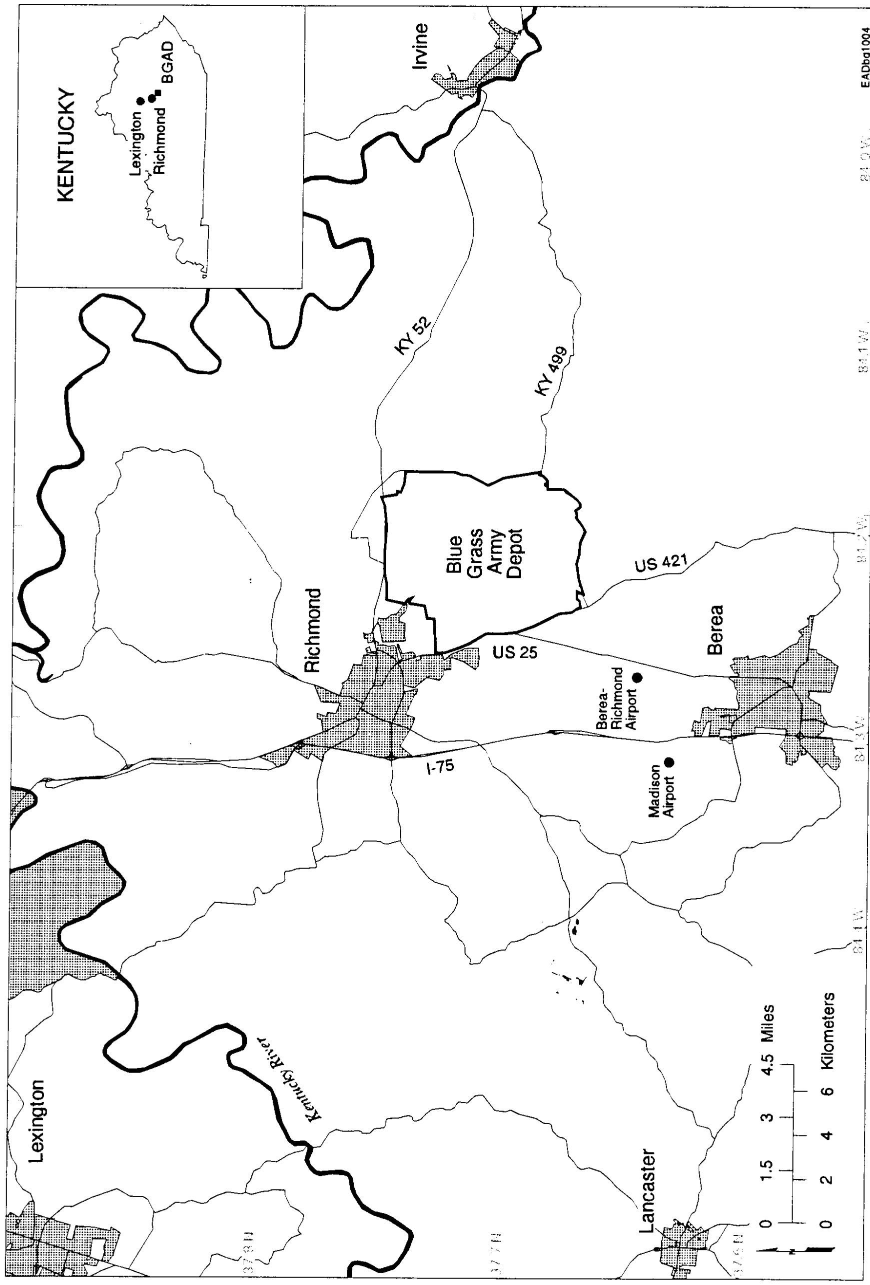
In the meantime, if you have any questions or require further clarification regarding either project please contact Joe Elliott at (859) 625-6021 or elliott.joe@bluegrass.army.mil.

Sincerely,

Jackey L. Edwards
Colonel, U.S. Army
Commanding Officer

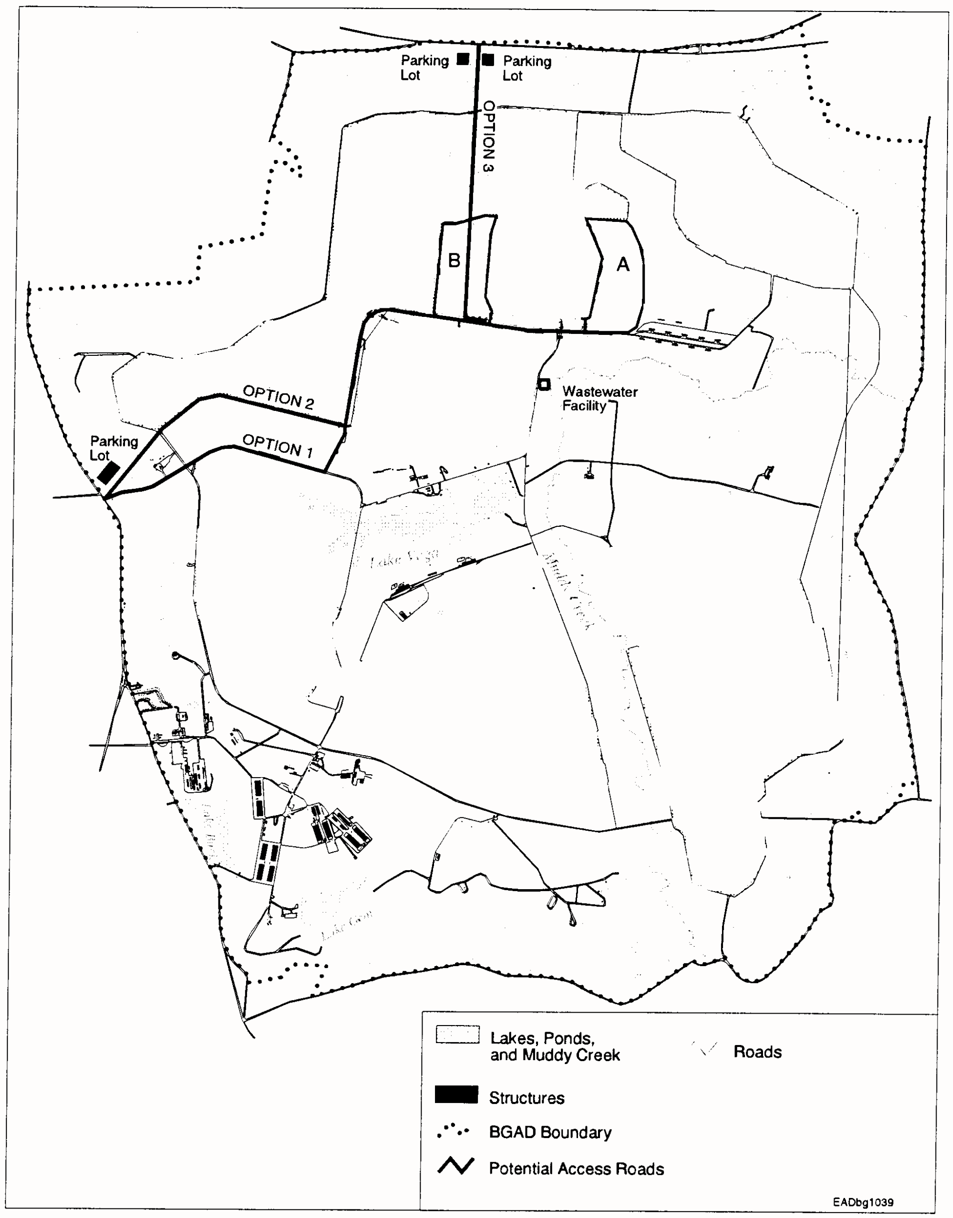
Enclosures

Exhibit F.1 (Continued)



Location of Blue Grass Army Depot

Exhibit F.1 (Continued)



Potential Facility Locations for the ACWA/PMCD Proposed Actions

Exhibit F.2

Education, Arts and Humanities Cabinet

KENTUCKY HERITAGE COUNCIL
The State Historic Preservation Office

Paul E. Patton
Governor
Marlene M. Helm
Cabinet Secretary

David L. Morgan
Executive Director and
SHPO

July 17, 2001

Mr. Joe Elloitt
Department of the Army
Bluegrass Army Depot
2091 Kingston Highway
Madison County, Kentucky 40475-5060

RE: Design, Construction, and Operation of a Chemical Munitions Disposal Facility Environmental Impact Statement, Bluegrass Army Depot, Madison County, Kentucky

Dear Mr. Elloitt:

Thank you for your letter concerning the above referenced project. As noted in your letter the proposed project has the potential to impact archaeological sites eligible for listing in the National Register of Historic Places. Therefore, I recommend that the proposed project area be surveyed by a professional archaeologist. A report documenting the results of this investigation must be submitted for my review, comment, and approval.

Should you have any questions, feel free to contact David Pollack of my staff at (502) 564-7005.

Sincerely,

David L. Morgan

David L. Morgan, Director
Kentucky Heritage Council and
State Historic Preservation Officer

300 Washington Street
Frankfort, Kentucky 40601
An equal opportunity employer M/F/D

EDUCATION PAYS

Telephone (502) 564-7005
FAX (502) 564-5820
Printed on recycled paper

Exhibit F.3

DEPARTMENT OF THE ARMY
BLUE GRASS ARMY DEPOT
2091 KINGSTON HIGHWAY
RICHMOND, KENTUCKY
40475-5060

Reply to
Attention of

May 7, 2001

Environmental Office

Mr. Lee Edwards, Chairperson
Absentee-Shawnee Executive Committee
2025 S. Gordon Cooper Dr.
Shawnee, OK 74801-9381

RE: Notification of an Environmental Impact Statement at the Blue Grass Army Depot in Madison County, Kentucky

Dear Mr. Edwards:

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of a chemical munitions disposal facility at the Blue Grass Army Depot (BGAD) in Madison County, Kentucky. As part of the decision-making process for this action, two parallel National Environmental Policy Act (NEPA) documents are being prepared by two Department of Defense (DOD) programs to address distinct but related actions.

(1) The DOD Assembled Chemical Weapons Assessment (ACWA) is developing an environmental impact statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapon stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation (SCWO); (2) neutralization followed by biodegradation; (3) neutralization followed by SCWO and gas-phase chemical reduction; and (4) electrochemical oxidation. The ACWA will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (AL), BGAD (KY), Pine Bluff Arsenal (AR), and Pueblo Chemical Depot (CO).

(2) The U.S. Army Program Manager Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating a facility to dispose of the chemical munitions stockpile at BGAD. The PMCD EIS will assess and compare the impacts of incineration technologies as well as the four alternative technologies identified by the ACWA program.

Exhibit F.3 (Continued)

-2-

The enclosed maps show the location of BGAD and the alternative facility footprint locations at BGAD. On April 14, 2000, ACWA issued a Notice of Intent to prepare an EIS for its action (*Federal Register* Vol. 65, No. 73, page 20139). A public scoping meeting for the ACWA EIS was held on May 18, 2000 in Richmond, Kentucky. PMCD issued its Notice of Intent on Dec. 4, 2000 (*Federal Register* Vol. 65, No. 233, page 75677); the public scoping meeting for the PMCD EIS was held in Richmond, Kentucky on January 9, 2001.

Argonne National Laboratory (ANL) is assisting ACWA in preparing the ACWA EIS and will be evaluating potential impacts to cultural resources as part of their analysis. Oak Ridge National Laboratory (ORNL) is assisting with the site-specific EIS for BGAD. For the ACWA EIS, an archaeologist from ANL has researched available survey documents for BGAD. ORNL will use the information compiled by ANL for the site-specific EIS.

Currently, the proposed areas for the facility have not been completely surveyed for archaeological sites. No sites were recorded during a 1983 survey of the southern part of Area A, but the southern part of Area B has been identified in the BGAD Cultural Resources Management Plan (prepared by Geo-Marine, Inc. in 1996) as an area with a high potential for containing archaeological sites. It therefore appears that construction has the potential to affect cultural resources, but whether the effect will be adverse will depend on the project site and results of any required survey.

The Army is initiating consultations about the proposed projects with points of contact (Tribal Historic Preservation Officers or designated representatives) from the Native American Tribes, Councils, and Nations listed below, as well as with the Kentucky Heritage Council.

Absentee-Shawnee Tribe of Oklahoma (Chairperson and NAGPRA Contact)
Eastern Shawnee Tribe of Oklahoma (Chief)
Eastern Band of Cherokee Indians (Principal Chief and NAGPRA Contact)
Cherokee Nation of Oklahoma (Principal Chief and NAGPRA Contact)
United Keetoowah Band of Cherokee (Chief and NAGPRA Contact)
Chickasaw Nation of Oklahoma (Governor and NAGPRA Contact)
Georgia Tribe of Eastern Cherokee (NAGPRA Contact)

We would appreciate receiving information on concerns or issues you may have regarding either proposed project. We are especially interested in your assistance in identifying properties of known religious or cultural significance that may be affected by the construction and operation of the proposed facility(ies). Sensitive information will remain confidential as stipulated under 36 CFR Part 800.11. Please submit comments to Joe Elliott at the return address within 30 days. Your time and consideration are greatly appreciated.

Exhibit F.3 (Continued)

-3-

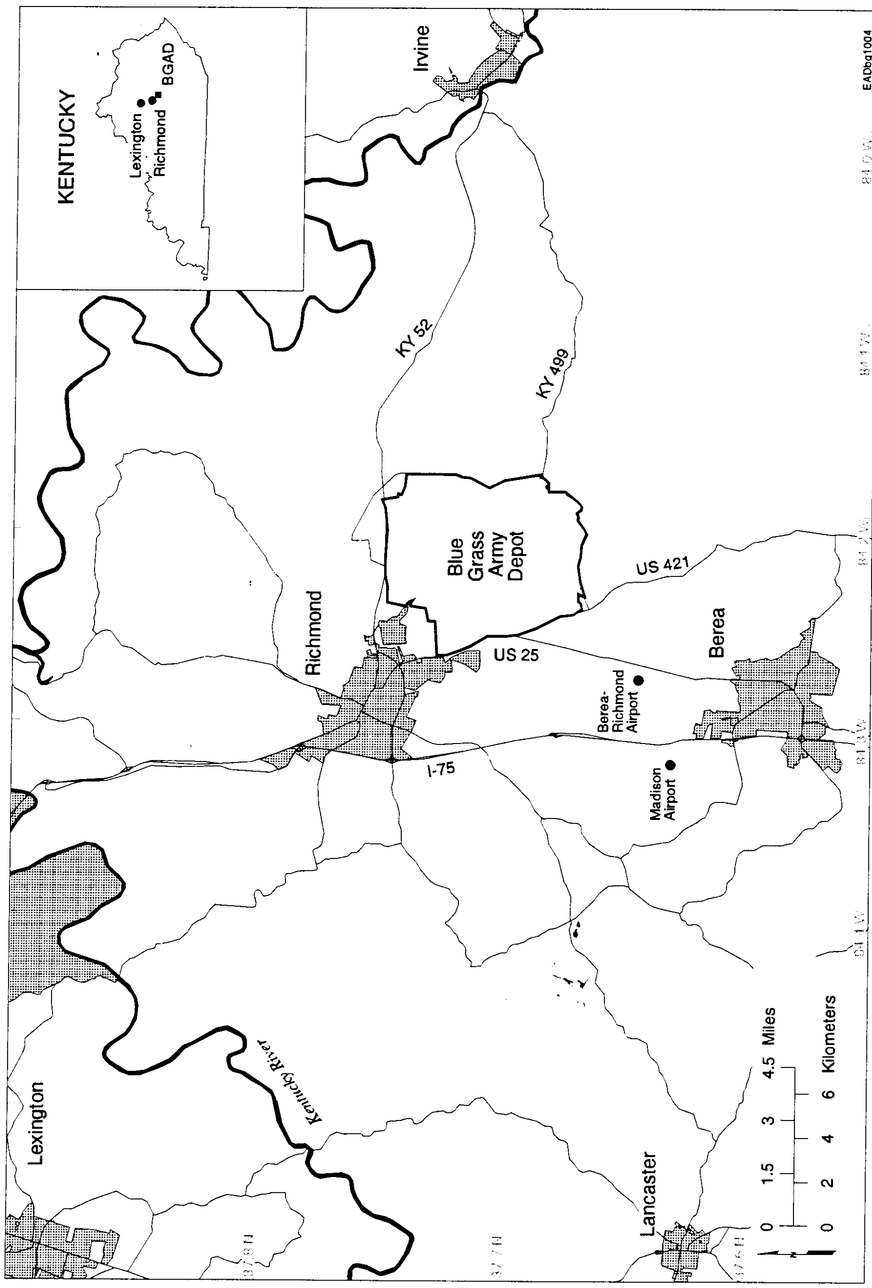
In the meantime, if you have any questions or require further clarification regarding either project please contact Joe Elliott at (859) 625-6021 or elliott.joe@bluegrass.army.mil.

Sincerely,

Jackey L. Edwards
Colonel, U.S. Army
Commanding Officer

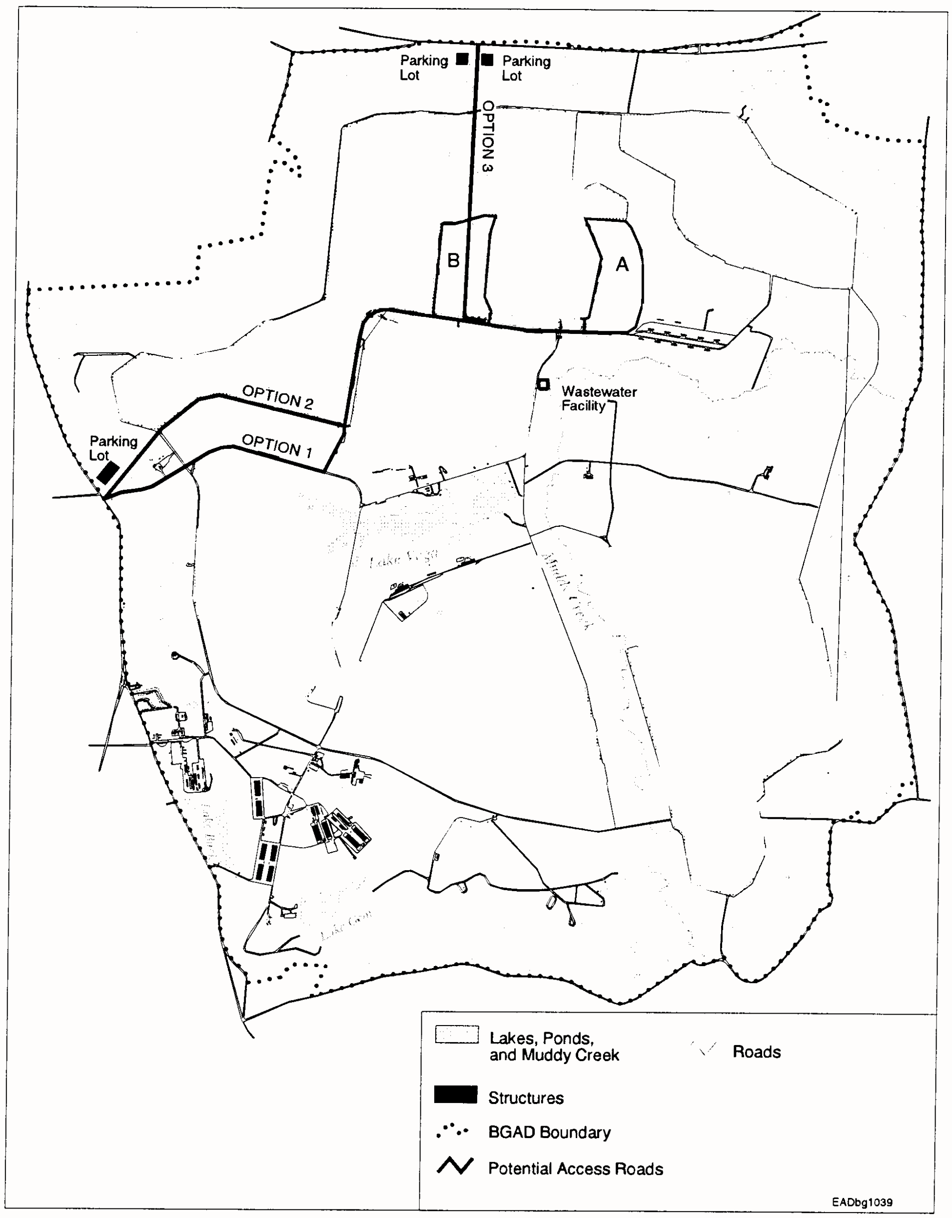
Enclosures

Exhibit F.3 (Continued)



Location of Blue Grass Army Depot

Exhibit F.3 (Continued)



Potential Facility Locations for the ACWA/PMCD Proposed Actions

Exhibit F.4

the Chickasaw Nation HEADQUARTERS
Arlington at Mississippi / Box 1548 / Ada, OK 74821-1548 / (580) 436-2603

Bill Anoatubby
Governor

Jefferson Keel
Lieutenant
Governor

May 25, 2001

Mr. Joe Elliott
Department of the Army
Blue Grass Army Depot
2091 Kingston Highway
Richmond, KY 40475-5060

Dear Mr. Elliott,

Thank you for your letter regarding proposed construction. We are not aware at this time of any culturally sensitive, or sacred sites in or near the project area intended for construction of a chemical munitions disposal facility at the Blue Grass Army Depot in Madison County, Kentucky. However, please understand this construction project could lead to the uncovering of such sites. We would then expect any inadvertent discoveries be brought to our attention immediately and all construction cease according to applicable federal laws. We would also like to be considered a consulting party as this project is developed and look forward to receiving any other information as it becomes available.

Your sensitivity to these issues is appreciated. If you have any questions, please contact Mrs. 'Rena Duncan, director of cultural resources, at (580) 332-8685.

Sincerely,

Jefferson Keel, Lt. Governor
The Chickasaw Nation

Only tribe that responded.

NATIVE VOTE
Putting Our Vote to Work!

Exhibit F.5

Officials Contacted Regarding Potential Cultural Resources Impacts at BGAD

Title	FirstName	LastName	JobTitle	Company	Address1	City	State	Zip
Mr.	Lee	Edwards	Chairperson	Absentee-Shawnee Executive Committee	2025 S. Gordon Cooper Dr.	Shawnee	OK	74801-9381
Mr.	Charles D.	Enyart	Chief	Eastern Shawnee Tribe of Oklahoma	P.O. Box 350	Seneca	MO	64865
Ms.	Jennifer	Makaseah	NAGPRA Contact	Absentee-Shawnee Tribe of Oklahoma	2025 S. Gordon Cooper Dr.	Shawnee	OK	74801-9381
Mr.	Leon	Jones	Principal Chief	Eastern Band of Cherokee Indians	P.O. Box 455	Cherokee	NC	28719
Mr.	Chadwick	Smith	Principal Chief	Cherokee Nation of Oklahoma	P.O. Box 948	Tahlequah	OK	74465
Mr.	Jim	Henson	Chief	United Keetoowah Band of Cherokee	P.O. Box 746	Tahlequah	OK	74465
Ms.	Emma Sue	Holland	NAGPRA Contact	United Keetoowah Band of Cherokee Indian	P.O. Box 746	Tahlequah	OK	74465
Mr.	Bill	Anoatubby	Governor	Chickasaw Nation of Oklahoma	P.O. Box 1548	Ada	OK	74821
Mr.	Gary	White Deer	NAGPRA Contact	Chickasaw Nation of Oklahoma	P.O. Box 1548	Ada	OK	74820
Mr.	Charles	Thurmond	NAGPRA Contact	Georgia Tribe of Eastern Cherokee	Tembrook, Route 2	Clarkesville	GA	30523
Mr.	Richard L.	Allen	NAGPRA Contact	Cherokee Nation of Oklahoma	P.O. Box 948	Tahlequah	OK	74465
Ms.	Kathy	McCoy	NAGPRA Contact	Eastern Band of Cherokee Indians	P.O. Box 455	Cherokee	NC	28719
Mr.	David L.	Morgan	State Historic Preservation Officer	Kentucky Heritage Council	300 Washington Street	Frankfort	KY	40601

F.2 ENDANGERED SPECIES

Exhibit F.6

ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE, BUILDING 900, ARGONNE, ILLINOIS 60439 TELEPHONE: 630/252-8849

June 22, 2000

Mr. Lee Barclay, Field Supervisor
Cookeville Field Office
U. S. Fish and Wildlife Service
446 Neal Street
Cookeville, TN 38501

Dear Mr. Barclay:

The Department of Army, Assembled Chemical Weapons Assessment Program is preparing an environmental impact statement concerning its plans conduct pilot testing for the destruction of chemical agent and munitions stored at the Blue Grass Army Depot, located in Madison County, Kentucky about 3 mi southeast of the city of Richmond. The EIS will evaluate construction and operation of two different disposal technologies for destruction of chemical agent and munitions currently in storage at the depot. I've included a copy of the Federal Register Notice of Intent for the EIS.

We would appreciate receiving information on any federally-protected species that may be present at the Blue Grass site and in the site vicinity (within about a 30 mi radius of the site). Construction of the plant facilities, access rads, and other infrastructure upgrades would likely disturb about 40-50 acres. As part of the analysis of ecological impacts we will assess potential impacts to federally endangered, threatened, and candidate species. A list of these species and their residency status in the Blue Grass vicinity would be useful for the analysis.

Thank you in advance for your assistance.

Sincerely,

Edwin D. Pentecost

Edwin D. Pentecost, PhD
Environmental Assessment Division

Encl.

Exhibit F.7

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

July 25, 2000

Mr. Edwin D. Pentecost, Ph.D.
Argonne National Laboratory
9700 South Cass Avenue, Building 900
Argonne, Illinois 60439

Dear Dr. Pentecost:

Thank you for your letter and enclosure of June 22, 2000, regarding the preparation of an Environmental Impact Statement (EIS) for pilot testing of the destruction of chemical agents and munitions stored at the Blue Grass Army Depot in Madison County, Kentucky. U.S. Fish and Wildlife Service (Service) personnel have reviewed the information submitted and offer the following comments for consideration.

According to our records, the following federally listed endangered species occur on the Blue Grass Army Depot:

Running buffalo clover (*Trifolium stoloniferum*)
Indiana bat (*Myotis sodalis*)

According to our records, the following federally listed endangered species occur within a 30-mile radius of the Blue Grass Army Depot:

Running buffalo clover (*Trifolium stoloniferum*)
Indiana bat (*Myotis sodalis*)
Gray bat (*Myotis grisescens*)
Virginia big-eared bat (*Corynorhinus townsendii virginianus*)
Cumberland bean (*Villosa trabalis*)
Cumberland elktoe (*Alasmidonta atropurpurea*)
Little-wing pearly mussel (*Pegias fabula*)

Qualified biologists should assess potential impacts and determine if the proposed project may affect the species. We recommend that you submit a copy of your assessments and findings to this office for review and concurrence. A finding of "may affect" could require the initiation of formal consultation procedures.

Exhibit F.7 (Continued)

These constitute the comments of the U.S. Department of the Interior in accordance with provisions of the Endangered Species Act (87 Stat. 884, as amended: 16 U.S.C. 1531 et seq.). We appreciate the opportunity to comment. Should you have any questions or need further assistance, please contact Steve Alexander of my staff at 931/528-6481, ext. 210, or via e-mail at *steven_alexander@fws.gov*.

Sincerely,

Lee A. Barclay, Ph.D.
Field Supervisor

Exhibit F.8

DEPARTMENT OF THE ARMY
PROGRAM MANAGER FOR ASSEMBLED CHEMICAL WEAPON ASSESSMENT
ABERDEEN PROVING GROUND, MD 21010-5423

REPLY TO
ATTENTION OF

December 15, 2000

Assembled Chemical Weapons Assessment

Dr. Lee A. Barclay
U.S. Department of Interior
Fish and Wildlife Service
446 Neal Street
Cookeville, TN 38501

Dear Dr. Barclay:

We have completed a Biological Assessment for the proposed Assembled Chemical Weapons pilot test project at Blue Grass Army Depot (BGAD) in Madison County, Kentucky pursuant to the Endangered Species Act requirements. The biological assessment was prepared based on your response to our letter requesting information on federally listed endangered species that occur on BGAD (see your response to Dr. Edwin D. Pentecost, Argonne National Laboratory dated July 25, 2000). Dr. Pentecost contacted Mr. Steven Alexander with questions on endangered species distribution in preparing the assessment. I am enclosing a copy of the biological assessment for your review and concurrence.

If you have questions on the biological assessment, don't hesitate to contact Dr. Pentecost (630) 252-8849 or me at (410) 436-2210.

Sincerely,

Jon Ware

Enclosure

Copies Furnished:
E. Pentecost, ANL
J. Elliott, BGAD

Exhibit F.9

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

January 19, 2001

Mr. Jon Ware
Program Manager for Assembled Chemical
Weapon Assessment
Aberdeen Proving Ground, Maryland 21010-5423

Re: FWS #01-878

Dear Mr. Ware:

Thank you for your letter and enclosure of December 15, 2000, transmitting a biological assessment for the running buffalo clover relative to the proposed Assembled Chemical Weapons Pilot Test Project at the Blue Grass Army Depot in Madison County, Kentucky. Fish and Wildlife personnel have reviewed the document and we offer the following comments.

The biological assessment concludes that the proposed action is likely to adversely affect running buffalo clover. This determination requires initiation of formal consultation. However, the document states that construction impacts to running buffalo clover associated with the proposed action can not be accurately determined until decisions are made regarding facility structure and infrastructure locations. The document also indicates that protective measures would be implemented to avoid adverse effects to the species during construction of the facility, access roads, and utility lines.

If you wish to proceed with the proposed action based on the finding made in the biological assessment, we recommend that you submit a letter to this office requesting initiation of formal consultation. Your request should include the following:

1. A description of the action to be considered.

2. A description of the specific area that may be affected by the action.

3. A description of any listed species or critical habitat that may be affected by the action.

4. A description of the manner in which the action may affect any listed species or critical habitat and an analysis of any cumulative effects.

Exhibit F.9 (Continued)

5. Relevant reports, including any environmental impact statement or environmental assessment prepared.

6. Any other relevant available information on the action, the affected species, or critical habitat.

If you wish to re-evaluate the proposed action and its potential effects to the running buffalo clover pending final decisions on specific locations of the facility and associated roads and utility lines, please submit a supplement to the biological assessment with a determination of effect when those decisions have been made. We will review the supplement and provide a response at that time. This may be done concurrently with development of the environmental impact statement that is being prepared for this action.

Thank you for the opportunity to comment on this action. If you have any questions, please contact Jim Widlak of my staff at 931/528-6481, ext. 202.

Sincerely,

Lee A. Barclay, Ph.D.
Field Supervisor

Exhibit F.9 (Continued)

BIOLOGICAL ASSESSMENT FOR THE ASSEMBLED CHEMICAL WEAPONS ASSESSMENT PROGRAM AT BLUE GRASS ARMY DEPOT, RICHMOND, KENTUCKY

Submitted to

Dr. Lee A. Barclay
U.S. Department of Interior
Fish and Wildlife Service

by

John Ware
PM Assembled Chemical Weapons Assessment
Aberdeen Proving Ground, MD 21010-5424

December 2000

Exhibit F.9 (Continued)

Biological Assessment for the Assembled Chemical Weapons Assessment Program at Blue Grass Army Depot, Richmond, Kentucky

Background

The Department of Defense (DOD) was directed by Congress as part of the Omnibus Consolidated Appropriations Act of 1997 (Public Law 104-208) to "demonstrate not less than two alternatives to the baseline incineration process for demilitarization of assembled chemical munitions". The DOD also was directed by Congress in this legislation to establish an Assembled Chemical Weapons Assessment (ACWA) Program. The Program Manager for ACWA announced the DOD's intent to prepare an Environmental Impact Statement (EIS) on plans to design, construct, and operate one or more pilot test facilities for assembled chemical weapon destruction technologies at one or more storage sites (Fed. Register, Vol. 65, No. 73, pp. 20139-20140, August 14, 2000). Potential locations for pilot testing include Anniston Army Depot in Alabama, Pine Bluff Arsenal in Arkansas, Pueblo Chemical Depot in Colorado and the Blue Grass Army Depot (BGAD) in Kentucky.

In fulfilling its responsibilities under the National Environmental Policy Act of 1969 and the Endangered Species Act of 1974, the DOD has prepared this biological assessment of potential impacts to federally-listed species from constructing and operating ACWA pilot test facilities at the BGAD. The BGAD is an active DOD installation in Madison County, Kentucky occupying 14,596 ac (5909 ha) located about 3.5 miles (5.6 km) south of Richmond. The installation facilities consist of 902 earth-covered igloos, 20 warehouses, 12 above ground magazines, 11 maintenance buildings, and 207 facilities used for administration, operations, medical care, and housing. BGAD allows deer hunting on designated areas of the installation during on specified dates during the deer hunting season. Livestock grazing is also permitted on designated tracts of land at BGAD throughout the year.

Project Description

The ACWA pilot test facilities will occupy an area of about 22 ac (8.9 ha) located adjacent to the Chemical Agent Storage Area in the north-central portion of BGAD (see Figure 1). Two alternative locations for the test facilities are being evaluated in the EIS; one is located along the southeast perimeter of the storage area (Area A) and a second is located along the western perimeter of the storage area (Area B). Each area encompasses about 110 ac (44.5 ha). The ACWA technologies being evaluated are intended to provide DOD with valuable information in deciding on the technology to be selected for disposal of nerve agent and mustard gas currently contained in munitions stored in igloos at the BGAD. The two treatment technologies that would be tested are neutralization followed by super critical water oxidation and neutralization followed by biological treatment. In order to dispose of all nerve and mustard gas at BGAD the ACWA facilities are assumed to operate for about 36 months as a bounding case for the EIS analysis. The following paragraphs provide a brief overview of the treatment technologies.

Exhibit F.9 (Continued)

Neutralization-Super Critical Water Oxidation
After disassembling the munitions to access the agent and energetics (explosives and propellants) this technology would neutralice the chemical agents and energetics with water and caustic chemicals. The products of the neutralization would then be destroyed using the Supercritical Water Oxidation (SCWO) process. SCWO mineralizes the resulting chemicals at temperatures and pressures above the critical point of water (705.2 F. and 3,204.6 psia). Effluents could be held and tested before release through pollution processes. Process water would be reused and solid residues would be disposed of in a hazardous waste landfill.

Neutralization-Biotreatment
After disassembling the munitions to access the agent and energetics this technology would neutralize the chemical agents with water and caustic chemical. The products of neutralization would then be destroyed in a biological treatment process operated at temperature and pressures near ambient conditions. Organic vapors and odors would be passed through an air pollution control process. Recovered metal parts and dunnage would be treated at high temperatures and effluents would be held and tested before release through the pollution control processes. Process water would be reused and solid residues would be disposed on in a landfill.

No liquid wastes produced by the two treatment processes will be released to the environment. Any process-generated liquids will be disposed of properly in containers suitable for disposal in an offsite licensed disposal facility. During pilot testing of the two technologies minor amounts of trace metals (i. e., < 10^{-8} lbs./yr.) and organic compounds will be emitted to the atmosphere. Monitoring of emissions would likely be required under the RCRA permit that would be required for operation of the ACWA facilities. Operation of the facilities will require laundry facilities for workers and construction of a sanitary waste treatment facility.

In addition to land required for the ACWA pilot test facilities about 48 ac (19.4 ha) could be disturbed during construction of the site infrastructure. These areas of disturbance include a new north-south access road connecting the BGAD boundary with the ACWA facilities, road widening, parking lots, vehicle and parts storage buildings, a sedimentation pond to control construction runoff, two electrical substations, rights-of-ways for gas, water, electrical power lines, a sanitary sewer line, and buried communication lines.

Affected Environment

The BGAD is located in the Outer Bluegrass Subsection of the Low Plateaus Province in east central Kentucky. As a result of grazing much of the installation is fescue-dominated grassland with isolated stands of black cherry (*Prunus serotina*), black locust (*Robinia pseudoacacia*) and brambles (*Rubus, spp.*). Other portions of the installation where grazing no longer occurs have been planted in oaks and other hardwood tree species to create larger, contiguous blocks of forest habitat (BGAD 2000a). Forests on well-drained upland areas of BGAD include bluegrass mesophytic cane forest, bluegrass savanna-woodland, calcareous subxeric forest and calcareous mesophytic forest (BGAD 2000a). Canopy dominants vary based on soil moisture, aspect, and past disturbance. Common canopy trees include black walnut (*Juglans nigra*), Ohio buckeye (*Aesculus glabra*), bur oak (*Quercus macrocarpa*), chinkapin oak (*Q. muhlenbergii*), shumard oak (*Q. shumardii*), white oak (*Q. alba*) pignut hickory (*Carya glabra*), shagbark hickory (*C.*

Exhibit F.9 (Continued)

ovata), honey locust (*Gleditsia triacanthos*), sugar maple (*Acer saccharum*), and white ash (*Fraxinus americana*). Understory species have been severely impacted by cattle grazing.

Areas A and B support different plant communities. Area A is an ungrazed grassland plant community with a few scattered American sycamore (*Platanus occidentalis*) trees in the eastern portion. Immediately northeast of Area A is a bluegrass mesophytic cane forest. Area B is comprised of a stand of mixed hardwood trees on a relatively level area immediately west of the Chemical Agent Storage Area. An intermittent stream traverses the western portion of the area. Area B is within a livestock-grazing tract that encompasses most of the western portion of BGAD.

Endangered Species at Blue Grass Army Depot

The only federally-listed endangered species documented from surveys at BGAD is the running buffalo clover (*Trifolium stoloniferum*). Mist net surveys for bats inhabiting or visiting BGAD have failed to detect the endangered Indiana bat (*Myotis sodalis*). Six mist net surveys conducted along Muddy Creek located south and east of the project area during the summer of 1993 recorded four bat species (Bloom, et al., 1995). Although the Indiana bat is thought to occur at BGAD and in the general vicinity (letter dated July 25, 2000 from Lee Barclay, U.S. Fish and Wildlife Service to Edwin Pentecost, Argonne National Laboratory) surveys have yet to document its presence on the installation. Based on discussions with natural resources staff at BGAD during an ACWA site visit in June 2000, there are no documented records of the Indiana bat on the installation. Since 1993 ongoing surveys by the Kentucky Nature Preserves Commission, Kentucky Nature Conservancy, and Eastern Kentucky University researchers have not detected the Indiana bat. Therefore, this biological assessment addresses only running buffalo clover.

The RBC was listed as endangered, effective July 6, 1987 by the U.S. Fish and Wildlife Service (Fed. Register, Vol. 52, No. 108, pg. 21478, June 5, 1987). Historically RBC was documented as occurring in Kansas, Missouri, Arkansas, Illinois, Indiana, Ohio, Kentucky, and West Virginia. At the time of listing the only confirmed populations were from two locations in West Virginia. After field observations at documented locations in these states, Brooks (1983) concluded that *T. stoloniferum* was possibly extinct. Bloom, et al., (1995) reported that the Kentucky Nature Preserves Commission had documentation in 1994 of *T. stoloniferum* occurring in nine Kentucky counties all within the Bluegrass Region. Twenty-five populations were known at Kentucky locations in addition to populations on the BGAD. Bloom, et al., (1995) also reported that experts from Ohio, Indiana and West Virginia confirmed the existence of multiple populations in those states since 1987. The increase in known populations since July 1987 may be a function of more extensive surveys by qualified botanists rather than an increase in the population within the RBC's geographic range. Recent observations at BGAD have also discovered new populations since the surveys in 1993 and 1994 (BGAD 2000b).

Current Status of Running Buffalo Clover at Blue Grass Army Depot

Bloom, et al., (1995) reported that surveys conducted in 1993 and 1994 at BGAD yielded 145 patches of RBC. A patch was defined as "one or more clustered running buffalo clover plants at

Exhibit F.9 (Continued)

least 7.5 m from any other Running Buffalo Clover plants". Patch sizes ranged from one plant in an area of approximately one square foot (0.09 sq m) to hundreds of plants covering over 1200 square feet (>108 sq m). Most patches contained less than 20 plants and covered less than 100 square feet (<9 sq m). The known locations of RBC at BGAD are shown in Figure 1. In May 1999 a collaborative effort by BGAD, Eastern Kentucky University, the Kentucky Office of The Nature Conservancy, and the Kentucky Nature Preserves Commission was made to evaluate a random sample from the 145 patches located in 1994. The study was intended to document site condition and compare data with previously collected information (BGAD 2000b). Study results indicated a decline or loss of 8 of the 30 patches examined that were surveyed and described in 1994, and a change in RBC patch condition based on dense cover from competing vegetation. Healthier populations were found along deer trails and areas of stream scouring. Flowering in some patches, however, was more prolific in 1999 than in 1994. Detailed plans for protection and continued monitoring of RBC on BGAD are described in the Endangered Species Management Plan and Environmental Assessment (BGAD 2000b). Protection measures and planned management goals are discussed later in the biological assessment.

Species Description and Biology

The following description of RBC is taken mostly from Bloom, et al., (1995) and BGAD (2000b): Running buffalo clover (*Trifolium stoloniferum*) is a glabrous, stolon forming perennial species of the Pea family (Fabaceae). It possesses trifoliate leaves that grow from a central rooted crown (referred to as the mother plant) and at nodes along the stolons. The leaves are often typically short making the plant difficult to detect. Plants vary in height from 3-20 inches (7.6 – 50.8 cm) above the soil surface. Some leafy nodes become rooted during the growing season both early in the season and in late summer when the stoloniferous nodes and mother plant senesce. The mother plant typically produces 1-2 flower heads in May and June at BGAD. Fruit forms in July. Flowers are typically white with purple streaking and about 1 inch wide. Each flower stem has a pair of opposite leaves below the flower head. Stipules are green and leafy. RBC differs from white clover (*T. repens*) by having leafier stipules and the pair of leaves on the flower stalk. It also differs from two other clover species, red clover (*T. pratense*) by the flower color and lack of pubescence, and from alsike clover (*T. hybridum*) by its stoloniferous habit.

RBC grows on mesic, well-drained soils with a somewhat open canopy cover having light intensity of about 40-60% full sunlight (Bloom, et al., 1995). It is a perennial species that occurs in savannas, open woodlands, along floodplains, and mesic terraces (BGAD 2000b). Plants seem to thrive in areas where moderate disturbance has reduced competition from other herbaceous and shrub vegetation. Sources of disturbance include livestock grazing, light trampling of floodplain areas, stream scouring, and mowing. Also, the exotic species, scorpion grass (*Microstegium vimineum*) occurs in dense stands in the herbaceous layer of open canopy floodplain areas where many RBC stands have been documented (Bloom, et al., 1995). Scorpion grass was reported at all but 17 of the 145 patches where RBC was found. In many areas where RBC was found during the 1993 and 1994 surveys, scorpion grass represented 75-100% of the herbaceous ground cover. Such dense stands are likely to be unfavorable for the continued survival of RBC, competing for light and nutrients in specific patches. Bloom, et al., (1995) reports that some success has occurred on BGAD where experimental applications of the

Exhibit F.9 (Continued)

monocot-specific herbicide POAST™ was used on dense scorpion grass patches prior to seed production in September. RBC plants survived the application of herbicide while scorpion grass was completely eliminated. Bloom, et al., (1995) suggest that a multi-year application of herbicides may be necessary to eliminate scorpion grass from RBC patches to assure its continued survival at BGAD. Such applications may be required since scorpion grass seeds can remain viable in the soil for several years.

Impacts of ACWA Pilot Test Facilities on Running Buffalo Clover

Construction of the ACWA Pilot Test Facilities will disturb about 22 ac (8.9 ha) at the site selected. Neither Area A nor B is in locations where RBC has been detected during field surveys (see Figure 1). Although surveys have not detected RBC patches at Areas A or B, adjacent areas support open canopy floodplain forest that is considered suitable habitat. Potential RBC habitat along intermittent streams and floodplain forest at BGAD in the vicinity of the candidate ACWA sites is shown in Figure 2. Potential impacts to RBC could occur from construction of a new access road to Area B, a 69 kV electric transmission line, and from new gas, water, and sanitary sewer pipelines needed to support the ACWA site. These rights-of-ways will be subject to surface disturbance during infrastructure construction that may traverse extant patches of RBC along the Muddy Creek and tributaries located south and east of Areas A and B.

Surface disturbance for gas and water lines is expected to occur along previously disturbed road rights-of-ways. Gas and water pipelines are estimated to disturb a right-of-way up to 60 ft (18.3 m) in width. The 69 kV power line will require a 40-foot (12.2 m) wide right-of-way to meet National Electrical Safety Code requirements (Institute of Electrical and Electronics Engineers, Inc., 1987). Approximately 20 and 29 wooden poles with an average 320-ft (97.6 m) spacing would be needed to supply power to Areas A and B respectively. The power line would extend from an existing power line traversing the northern portion the BGAD, south to onsite highway Route 2 and then turn west to the ACWA site. A maximum area of approximately 900 ft^2 (83.6 m^2) would be disturbed at each wooden pole and conductor stringing location during construction. The locations of other areas disturbed during construction cannot be identified at this time. Locations of the following areas will be identified in the final engineering design: the sanitary waste treatment facility, electrical substation, parking lots, a construction sedimentation pond, and routes for buried communication cables. For purposes of this biological assessment however, probable locations were assumed to allow an evaluation of construction activities on known location of RBC populations.

Conservation Measures (Protective Measures to Minimize Effects of ACWA Project)
The BGAD has several goals and plans in place to protect and manage both existing patches of RBC and potential habitat. Potential habitat consists of about 1,000 ac (404.9 ha) along floodplains adjacent to perennial streams. In addition, BGAD intends to follow measures and goals being developed in the Draft Recovery Plan for RBC currently being prepared by the U.S. Fish and Wildlife Service. Specific goals, objectives and actions implemented at BGAD (BGAD 2000b) to protect RBC patches include:

- Develop the BGAD Endangered Species Management Plan (ESMP) with input and interaction from the U.S. Fish and Wildlife Service, Kentucky Nature Preserve Commission, and the Kentucky Office of The Nature Conservancy. Once the ESMP is finalized it will be

Exhibit F.9 (Continued)

incorporated into the BGAD's Integrated Natural Resources Management Plan. A Draft Final ESMP was prepared in June 2000 (BGAD 2000b)

- Conduct an installation-wide survey of RBC beginning in Spring 2000. The objective of the survey is to establish a baseline for evaluating future RBC populations, goals, and management needs for monitoring management success and tracking of future population trends
- Assess the current status of RBC populations on BGAD using the Spring 2000 survey data. New patches will be marked with a sign designating presence of a threatened or endangered species at a specific location
- Develop and initiate intermediate actions to maintain and enhance RBC populations and suitable habitat at BGAD. These actions will be developed with input from the U.S. Fish and Wildlife Service
- Establish study areas encompassing RBC patches. Specific intermediate management actions will be implemented at certain locations. Establishment of the study areas will enable BGAD land management personnel to monitor effectiveness of intermediate management actions
- Conduct annual RBC population counts during the first five years the ESMP is in force using the same data collection and analysis techniques used during the Spring 2000 survey. Results will allow land managers to alter or cancel management activities based on population trends
- In consultation with the U.S. Fish and Wildlife Service, BGAD will develop RBC population goals that are compatible with the military mission. The goals will rely on the Spring 2000 survey results and the Draft RBC Recovery Plan.

If the U.S. Army decides to build an ACWA pilot test facility at BGAD a project specific mitigation plan will be developed for RBC. The following measures will be taken to further protect RBC patches and habitat once draft facility and infrastructure designs are developed and tentative decisions are made on placement of structures and infrastructure requirements.

- Attempt to locate facilities away from existing and potential RBC habitat
- Evaluate how utility corridors and roadways can be moved to avoid or span known RBC patches and potential habitat
- Determine the location and precise locations for fabrication and laydown areas needed for construction of the 22 ac (8.9 ha) ACWA site and support facilities
- Conduct clearance surveys for RBC in areas likely to be impacted by construction
- Instruct construction managers on what types of habitat to avoid and whom to notify if questions arise about possible impact to RBC patches during the construction process
- Have a qualified botanist on site during construction to assure RBC patches are avoided to the extent possible

Conclusions (Effects Determination)

Construction impacts on RBC associated with the ACWA pilot test facility and infrastructure cannot be accurately determined until decisions are made on facility structure and infrastructure locations. Potential habitat and known locations are shown in Figures 1 and 2. The distribution

Exhibit F.9 (Continued)

of RBC on the northern portion of BGAD is also shown on a topographic map of the project area (see Figure 3). Figure 4 shows potential locations for access roads, the 69 kV electrical power line, water lines, gas lines, and fiber optic cable communication lines that would be needed for construction at either Area A or B. By superimposing locations of RBC patches identified in surveys conducted in 1993 - 1994 over the infrastructure and site facility locations, potential areas of impact can be identified. Some flexibility to avoid potential offsite impacts to RBC is possible in locating the ACWA facilities in Areas A and B since about 22 ac (8.9 ha) of the 100 ac (40.5 ha) in each area will be required. A project decision on locations of new access roads or existing BGAG roads (depicted as Option 1 or 2 in Figure 4) could potentially impact previously identified patches of RBC southwest of Area B. Eight separate patches were recorded in close proximity [(i.e., locations less than 100 ft (30.5 m)] to existing roadways within this area. Construction of the communication cable along the road right-of-way under Option 1 could have both negative and positive impacts to existing RBC populations. New habitat could be created by removal of the herbaceous or shrub ground cover along the right-of-way by stringing the fiber optic cable, which could enhance invasion of disturbed areas by RBC following cable installation. To the extent that known populations could not be avoided, direct loss of individual plants or patches would occur. Some loss of RBC plants or potential habitat could result from sediment buildup along rights-of-ways during construction activities, if runoff from disturbed sites occurs.

Construction of the 69 kV power line to Area A would traverse floodplain habitat near known RBC locations along tributaries of the Muddy Creek to the northeast (see Figure 4). Impacts can be minimized or avoided if tower spacing is adjusted to avoid known RBC patches. Clearance surveys prior to decision making on tower and conductor stringing locations would further reduce potential construction impacts.

Construction at the ACWA site would disturb about 22 ac (8.9 ha). A 1.4 ac (0.6 ha) sedimentation pond would be installed to control runoff from construction areas, and avoid sediment buildup in intermittent streams.

Operation of the ACWA facilities is not expected to impact the RBC. Trace elements released to the atmosphere by the destruction methodologies being tested for chemical agent destruction would be $<10^{-8}$ lbs./yr. and be dispersed over a relatively large geographic area. Process water is either recycled or disposed of in a manner to meet existing regulations. No chemical agent (i.e., mustard gas or nerve gas) or degradation products would be released during normal facility operations. Sanitary effluent from the wastewater treatment facility would meet National Pollutant Discharge Elimination System standards set for the facility by the State of Kentucky.

It is concluded that the construction of ACWA facilities and associated infrastructure “may affect and is likely to adversely affect” some individual patches of RBC. This conclusion is based on the proximity of project activities to known patches documented during the 1993 and 1994 surveys. Once BGAD personnel receive the results of spring surveys conducted in 2000, more current information will be available on patch distributions. This new information will be made available to the U.S. Fish and Wildlife Service once reviewed by the BGAD environmental staff.

Exhibit F.9 (Continued)

Literature Cited

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Contacts Made

Lee Barclay	U.S. Fish and Wildlife Service
Steven Carpenter	U.S. Fish and Wildlife Service
Mary Murray	Blue Grass Army Depot
Joseph Elliott	Blue Grass Army Depot

Preparer

Edwin D. Pentecost	Argonne National Laboratory

Exhibit F.9 (Continued)

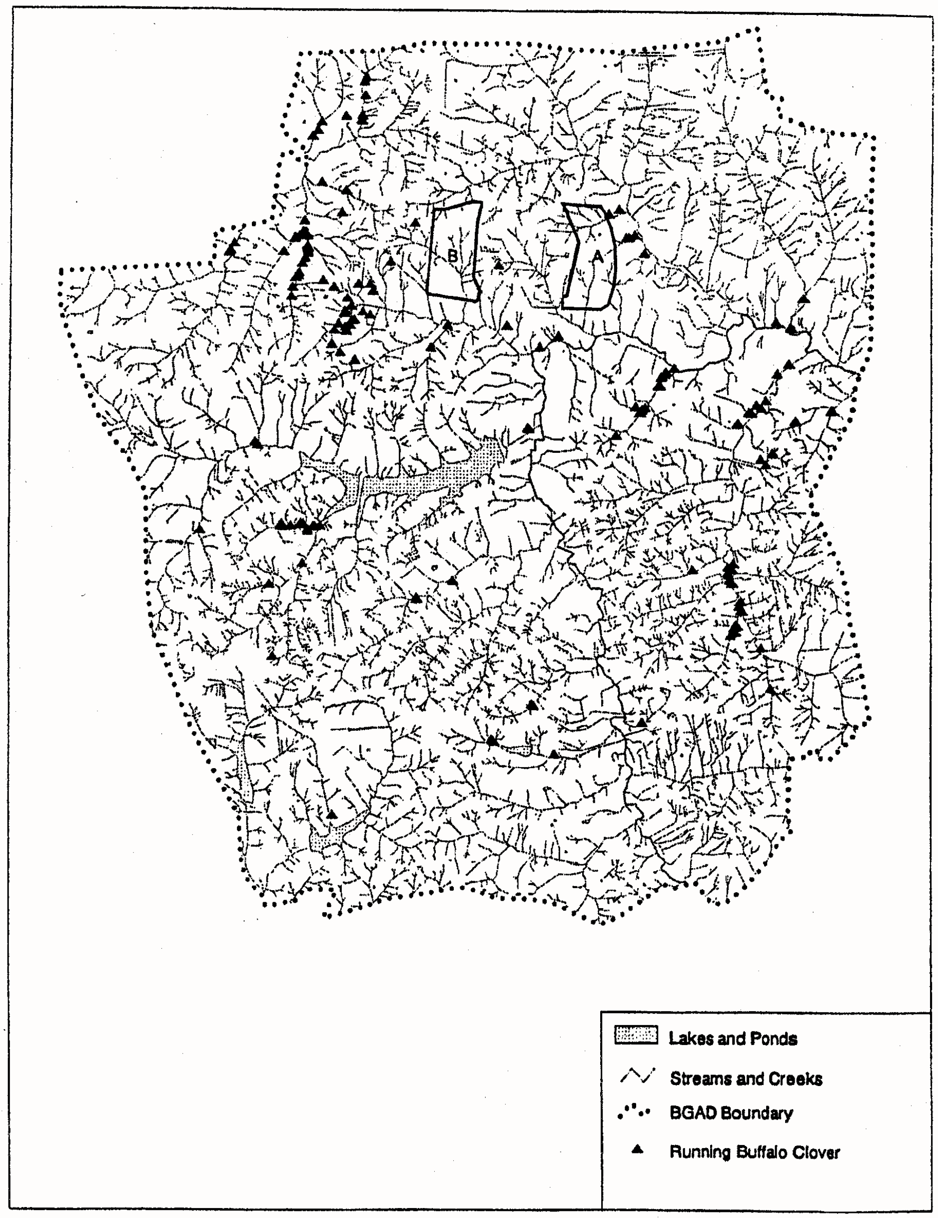

Figure 1. Blue Grass Army Depot showing Possible Locations (A&B) for ACWA Pilot Test Facilities

Exhibit F.9 (Continued)

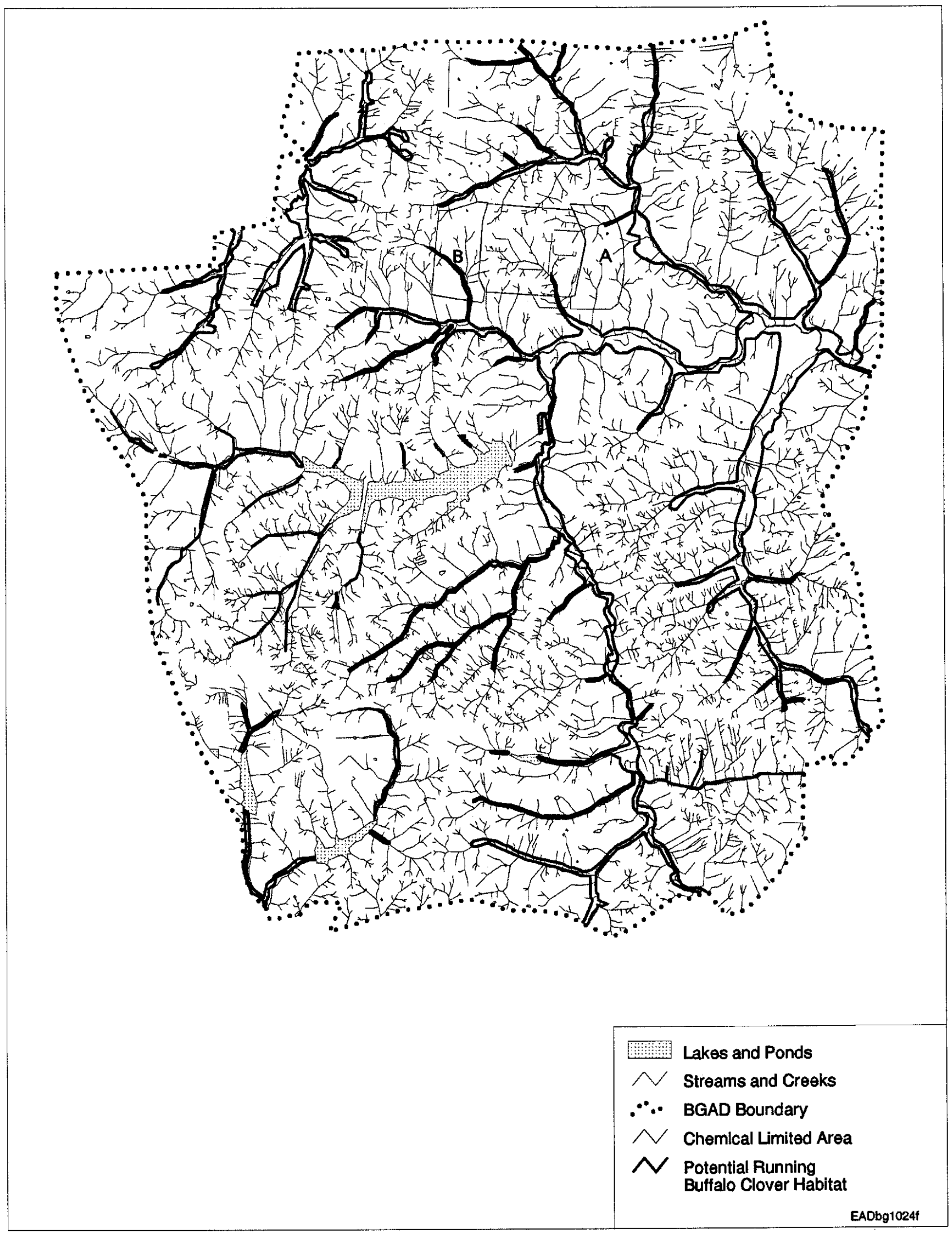

FIGURE 2 Potential Habitat for Running Buffalo Clover (Trifolium Stoloniferum) at Blue Grass Army Depot

Exhibit F.9 (Continued)

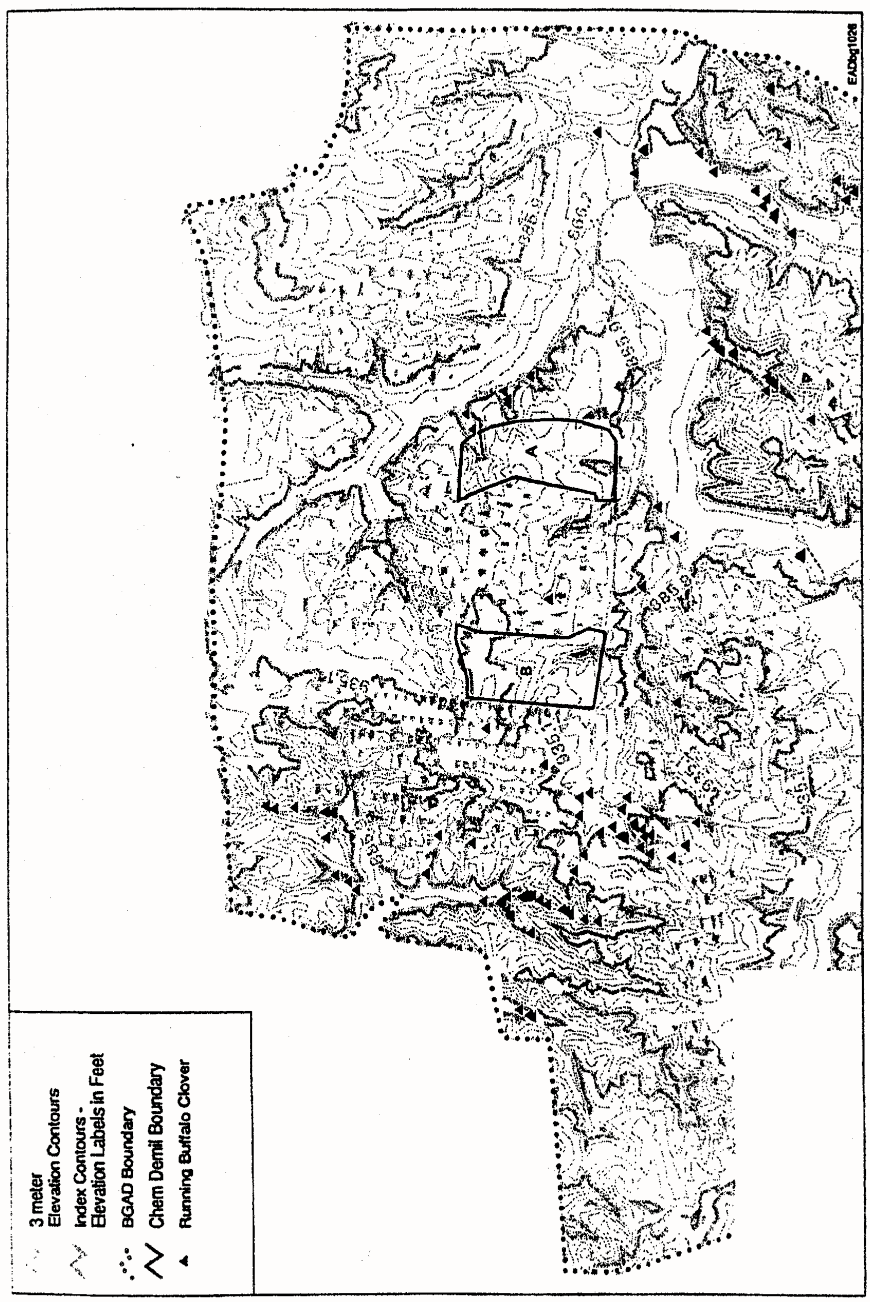

Figure 3. Elevational Contours at Blue Grass Army Depot in the Vicinity of Alternative ACWA Sites (Areas A & B)

Exhibit F.9 (Continued)

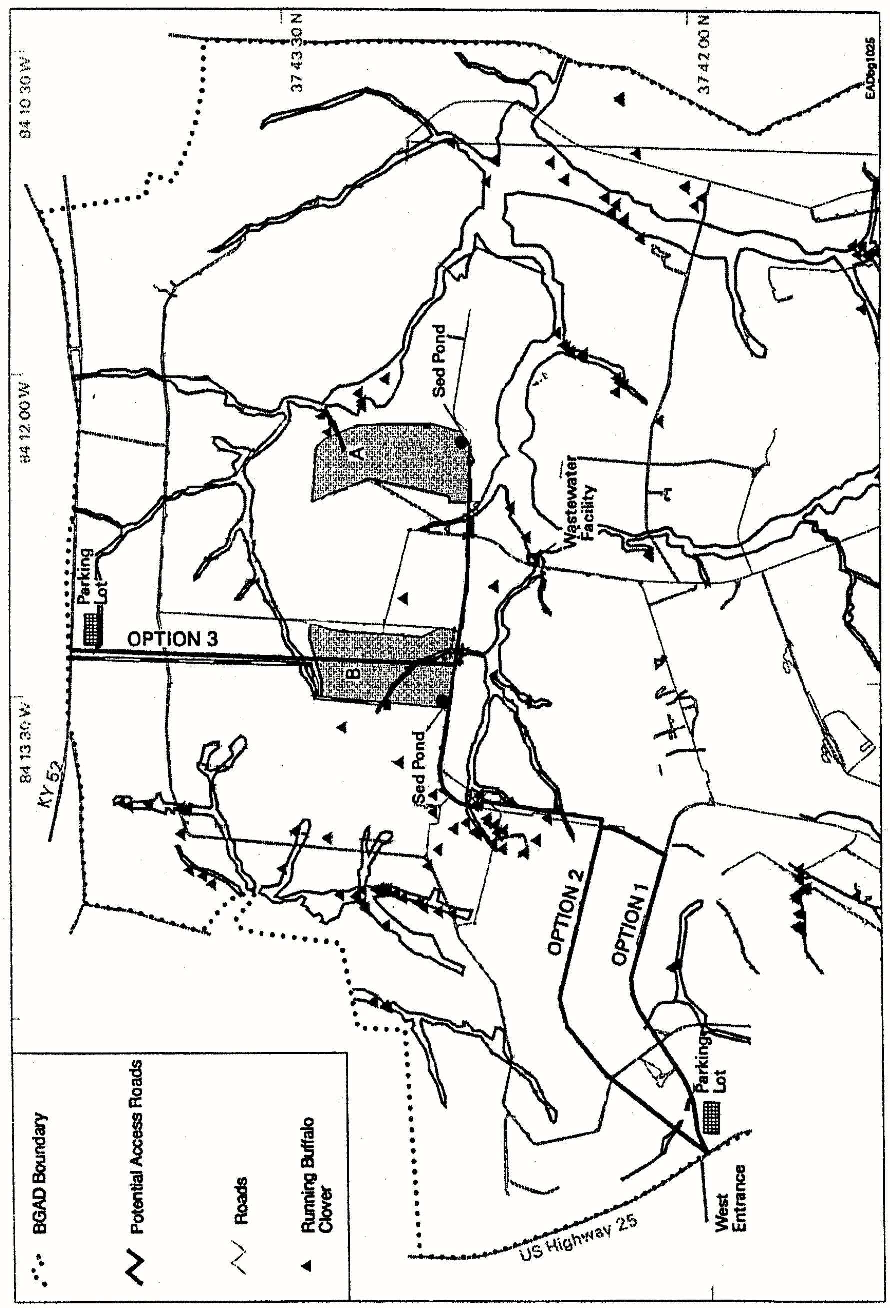

FIGURE 4. Potential Areas of Disturbance for Construction of ACWA Pilot Test Facilities at Blue Grass Army Depot

Exhibit F.10

COMMONWEALTH OF KENTUCKY
DEPARTMENT OF FISH AND WILDLIFE RESOURCES
C. THOMAS BENNETT, COMMISSIONER

November 2, 2001

Mr. Joe Elliott
Environmental Office
Department of the Army
Blue Grass Army Depot
2091 Kingston Highway
Richmond, KY 40475-5060

Re: Preliminary Draft Environmental Impact Statement for Coordinating Agency Review – Destruction of Chemical Munitions at the Blue Grass Army Depot, Kentucky

Dear Mr. Elliott:

The Kentucky Department of Fish and Wildlife Resources (KDFWR) has reviewed the above-referenced document. The document describes the impacts of the construction, operation and closure of a facility designed to destroy the chemical agents and munitions stored at the Blue Grass Army Depot. The proposed facility footprint would require 25 acres with an additional 70 acres potentially being disturbed for construction operations, storm-water management, and upgrade of access roads and utilities.

KDFWR respectfully offers the following comments. Section 4.26.7 states "construction could affect as much as 95 acres of terrestrial, aquatic, and wetland habitat". However, the document does not state exactly how many acres of aquatic and wetland habitat or linear feet of stream are going to be impacted. Furthermore, the mitigation measures for impacts on wetlands as proposed do not mitigate for the loss of wetland acreage or for impacts to intermittent or perennial streams. KDFWR recommends formal consultation with the U.S. Corps of Engineers, Louisville District and the Kentucky Division of Water for guidance on permitting requirements for implementation of the proposed action in jurisdictional wetland areas. KDFWR also recommends at least 2:1 mitigation for any impacts to wetlands or streams that result in a net loss of acreage or function to the resource.

EDUCATION PAYS

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Exhibit F.10 (Continued)

Page 2
Mr. Elliott
November 2, 2001

KDFWR appreciates the opportunity to comment. If you have any questions or comments, please contact Mr. Jim Lane, KDFWR Environmental Section, at 502/564-7109, ext. 366 or via e-mail at jim.lane@mail.state.ky.us.

Sincerely,

C. Tom Bennett
Commissioner

CTB/JSL/jsl

cc: Ted Crowell, Acting Director, Division of Fisheries
Bill Balda, Public Lands Biologist, Bluegrass Region
Environmental Section Files
John Dovak, KY Division of Water, Frankfort, KY
Jim Townsend, Louisville Dist. COE, Regulatory Section

DEPARTMENT OF THE ARMY
PROGRAM MANAGER FOR CHEMICAL DEMILITARIZATION
ABERDEEN PROVING GROUND, MARYLAND 21010-4005

December 10, 2002

Environmental and Monitoring Office

Dr. Lee A. Barclay
Field Supervisor
Cookeville Field Office
US Fish and Wildlife Service
446 Neal Street
Cookeville, Tennessee 38501

Dear Dr. Barclay:

In response to direction from Congress to destroy the US Stockpile of lethal chemical agents and munitions, including those stored at the Blue Grass Army Depot (BGAD) near Richmond, Kentucky, the US Army's Program Manager for Chemical Demilitarization (PMCD) recently prepared a Draft Environmental Impact Statement (EIS), for the Army's proposed Chemical Weapons Destruction Facility (CWDF), at the BGAD. The PMCD has prepared this letter in response to provisions of the Endangered Species Act that require consultation with the US Fish and Wildlife Service (FWS) regarding potential impacts to federally protected species near the proposed BGAD CWDF.

The Army's proposed action includes the construction and operation of an on-site facility for the destruction of stockpiled chemical agent munitions by one of four technologies: (1) The baseline incineration process used previously at Johnston Atoll (JACADS) in the Pacific and currently in use at the Desert Chemical Depot in Utah; (2) Chemical neutralization followed by Supercritical Water Oxidation (SCWO); (3) Chemical neutralization followed by SCWO and Gas Phase Chemical Reduction (GPCR); and (4) Electrochemical Oxidation. Two alternative sites for the proposed CWDF are about 1.4 miles-south of the northern BGAD property line and about 1.8 and 2.7 miles-west of the eastern property line. The environmental effects of the proposed action are discussed in the Draft EIS for the BGAD CWDF.

A Final EIS for constructing and operating a pilot test CWDF at BGAD and other sites using one of several alternative neutralization technologies, including the three non-incineration technologies identified above, has already been issued by the Program Manager for Assembled Chemical Weapons Assessment (ACWA). The BGAD part of this ACWA Final EIS, and its supporting biological assessment (BA), were previously reviewed by your office.

A formal Ecological Risk Assessment (ERA) addressing atmospheric emissions, the principal source of potential operational impacts, if any, has not been performed for the BGAD CWDF options. Therefore, the assessment of possible impacts of emissions of Substances of Potential Concern (SOPCs) on threatened and endangered species on and near the proposed two BGAD sites, including running buffalo clover (RBC), necessarily depends on other lines of evidence: (1) The ACWA Final EIS and its associated BA for neutralization alternatives at BGAD; (2) The completed risk assessments of other Army CWDFs at Anniston, Umatilla, and Tooele Army Depots, and Pine Bluff Arsenal; and (3) The differences in agent inventories between BGAD and the other chemical agent storage sites. Predicted SOPCs emissions from each of these other facilities as well as the BGAD incineration alternative were adapted from actual emissions data from Johnston Atoll Chemical Agent Disposal System (JACADS) and used as surrogate source terms. The potential risks from the SOPCs emitted by the various BGAD alternative technologies would be reasonably expected to be bounded by the ERA predictions for baseline incineration estimated for the Anniston, Pine Bluff, Umatilla, and Tooele CWDFs. The potential effects of emissions from the proposed BGAD incineration alternative, clearly would bound effects from any of the neutralization alternatives, since the latter would emit considerably lower quantities of most contaminants of concern.

The multiple lines of evidence contained in this supplemental BA indicate that neither RBC, although present within the BGAD facility boundaries, nor the other listed species occurring off-site within a 50-kilometer (31-mile) radius, would likely be adversely affected from routine operations from any of the proposed CWDFs. Levels of contaminants likely to be emitted from routine operations would be low and dispersed over a wide area. Deposition of these contaminants directly onto the RBC would be further limited by interception from canopy species present in association with RBC. Finally, although the risk of an accident during the operation of any of the proposed BGAD CWDFs is real, the probability is very low, and must be considered in context with the existing risk of accidents that might occur during the continued, indefinite storage of these aging chemical weapons if they are not destroyed.

The US Army takes pride in responsibly managing the protection of natural resources under its stewardship, especially threatened and endangered species. If at any time, during the on-going implementation of its natural resource management program or any other on-site activities, new information is discovered which reveals that the proposed action may affect a listed species in a manner or to an extent not previously considered, or if any incidental take of a listed species were to occur as the result of the accidental release of chemical warfare agents, the US Army would immediately re-initiate consultation with your office.

This letter transmits information and findings, contained in the enclosed supplemental BA, on the potential impacts from the proposed CWDFs emissions on threatened and endangered species, and it seeks your review of that information, as well as your concurrence with the Army's determination that no significant impacts are likely to occur to any threatened or endangered species during the operation of any of the proposed CWDFs.

Your review of this letter and the enclosed material is appreciated. Because reaching rapid closure on this BGAD action is crucial to our national interests, we request that you please give this matter your immediate attention and provide this office, as soon as practical, with a written response as to whether or not you concur with our findings.

If you need additional information, please contact Mr. Drew Lyle of this office at (410) 436-4199. If you have questions regarding the enclosed BA, please contact Dr. Harry Quarles of the Oak Ridge National Laboratory at (865) 241-2412.

Sincerely,

10 Dec 2002

William J.B. Pringle
Chief, Environmental
and Monitoring Office

Enclosure

Exhibit F.12

SUPPLEMENTAL BIOLOGICAL ASSESSMENT ADDRESSING OPERATIONS IMPACTS FOR THE PROPOSED PMCD AGENT DESTRUCTION FACILITY AT BLUE GRASS ARMY DEPOT, RICHMOND, KENTUCKY

Submitted to

Dr. Lee A. Barclay
U.S. Department of Interior
Fish and Wildlife Service

Prepared for

Program Manager for Chemical Demilitarization
Aberdeen Proving Ground, MD 21010-4005

By

Oak Ridge National Laboratory
Oak Ridge, TN 37831-6200

November, 2002

Exhibit F.12 (Continued)

SUPPLEMENTAL BIOLOGICAL ASSESSMENT ADDRESSING OPERATIONS IMPACTS FOR THE PROPOSED PMCD AGENT DESTRUCTION FACILITY AT BLUE GRASS ARMY DEPOT, RICHMOND, KENTUCKY

Scope

The U. S. Army proposes to build a facility to destroy chemical munitions stored at the Blue Grass Army Depot (BGAD), located in Madison County, Kentucky (see Figure 1). Although various technology alternatives are under consideration, impacts from construction of any facility would be similar. A previous biological assessment (U. S. Army 2000) prepared for the U. S. Fish and Wildlife Service considered potential impacts to threatened and endangered species from construction of an agent destruction facility on the two sites under consideration by the Army. This supplemental biological assessment considers potential impacts to threatened and endangered species from operations of a facility using any of the various technology alternatives.

Background

Under Congressional directive (Public Law 99-145) and an international treaty called the Chemical Weapons Convention (CWC), the U. S. Army is destroying the nation's stockpile of lethal chemical agents and munitions. The U. S. Army's Program Manager for Chemical Demilitarization (PMCD) has prepared an Environmental Impact Statement (EIS) to assess the potential health and environmental impacts of the design, construction, operation, and closure of a facility to destroy the chemical munitions currently being stored at BGAD (U. S. Army 2002b). The BGAD stockpile consists of munitions filled with either mustard agent (type H), nerve agent GB, and nerve agent VX.

BGAD is an active DOD installation in Madison County, Kentucky, occupying 14,596 ac (5909 ha) located about 3.5 miles (5.6 km) south of Richmond. The installation facilities consist of 902 earth-covered igloos, 20 warehouses, 12 above ground magazines, 11 maintenance buildings, and 207 facilities used for administration, operations, medical care, and housing.

Four technology alternatives, in addition to the no action alternative, are addressed in the PMCD's EIS for possible use in destruction of the BGAD stockpile: (1) baseline incineration; (2) chemical neutralization followed by supercritical water oxidation (SCWO); (3) chemical neutralization followed by gas phase chemical reduction and transpiring wall (GPCR/TW) SCWO; and (4) electrochemical oxidation. If any of the latter three developing technology alternatives were selected for implementation at BGAD, full scale pilot testing would be pursued prior to full scale operation and destruction of the BGAD stockpile. Impacts of the latter three alternatives have also been evaluated in a separate EIS prepared by the Army Assembled Chemical Weapons Assessment Program (ACWA) addressing four chemical neutralization technologies being considered for pilot testing at BGAD (U. S. Army 2002a). Whichever type of agent destruction facility (if any) is constructed at BGAD would be located in either of two designated sites in the northern portion of the depot (see Figure 2).

In fulfilling its responsibilities under the National Environmental Policy Act of 1969 and the Endangered Species Act of 1974, the DOD prepared a biological assessment (BA) of potential impacts to federally-listed species from constructing and operating agent destruction facilities

Exhibit F.12 (Continued)

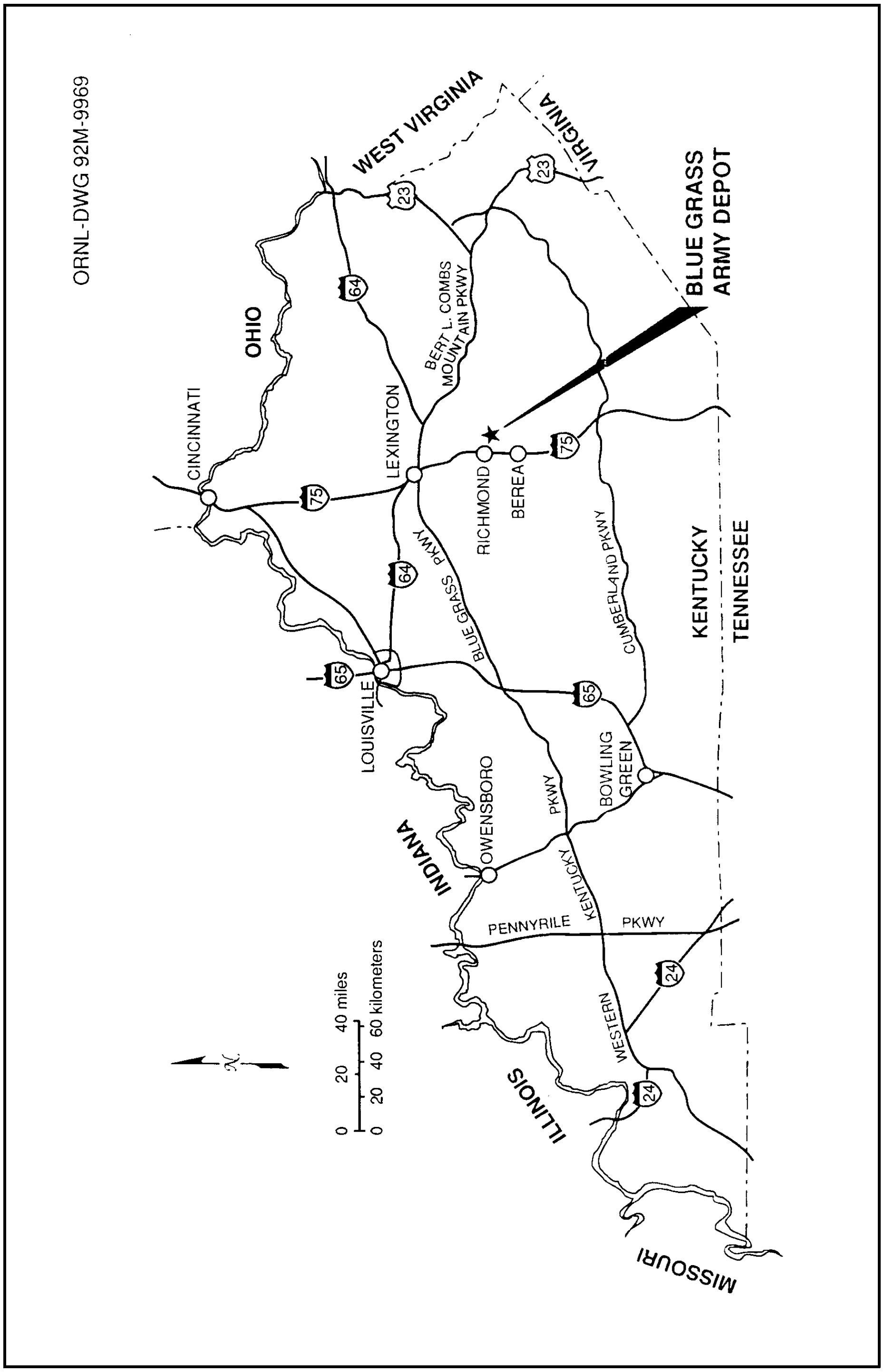

FIG. 1. REGIONAL LOCATION OF THE BLUE GRASS ARMY DEPOT.

Exhibit F.12 (Continued)

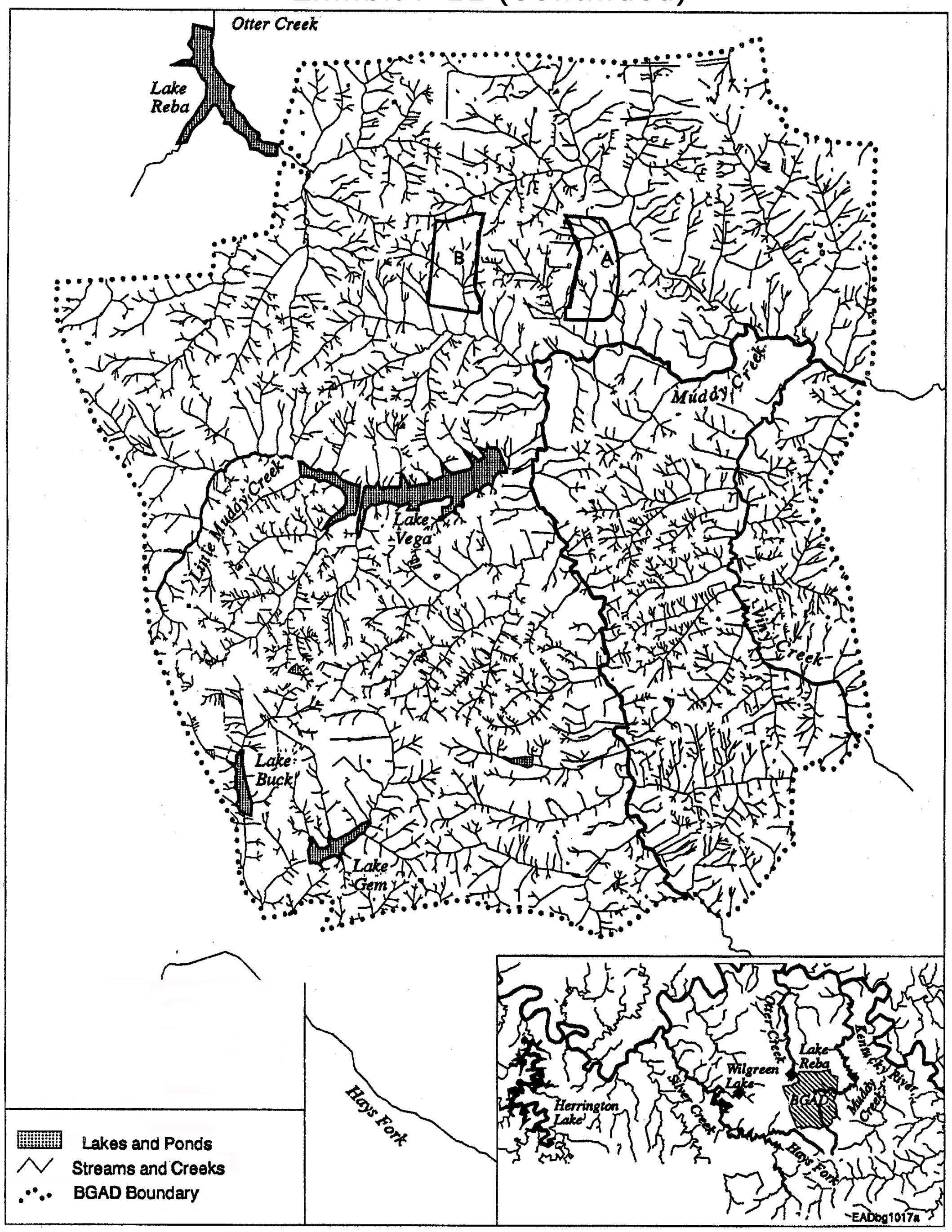

Fig. 2. Proposed site alternatives for the Chemical Agent/Munitions Destruction Facility at Blue Grass Army Depot, Richmond, Kentucky.

Exhibit F.12 (Continued)

(ACWA pilot test facilities) at the BGAD (U. S. Army 2000). Because the impacts of constructing any of the ACWA or PMCD agent destruction facility types would be essentially the same, the PMCD EIS adopted by reference and concurred with the conclusions of the BA prepared by ACWA. The ACWA BA (U. S. Army 2000) and all associated correspondence with the U. S. Fish and Wildlife Service (FWS), was included as Appendix F, in the PMCD EIS (U. S. Army 2002b).

This Supplemental BA is being prepared by PMCD to provide additional consideration of potential impacts of operations of the four agent destruction facility technology alternatives; it incorporates much of the background information from the ACWA BA.

Project Description

Facilities associated with any of the four technologies would occupy an area of about 22 ac (8.9 ha) located adjacent to the Chemical Agent Storage Area in the north-central portion of BGAD (see Fig. 2). Two alternative locations for the facilities are evaluated in the ACWA and PMCD EISs: one is located along the southeast perimeter of the storage area (Area A); the second is located along the western perimeter of the storage area (Area B). Each area encompasses about 110 ac (44.5 ha). The four technology alternatives being evaluated are intended to provide DOD with valuable information in deciding on the technology to be selected for disposal of the nerve agents (VX and GB) and mustard agent (H) currently contained in munitions stored in igloos at the BGAD. In order to dispose of all chemical agents at BGAD the facilities are assumed to operate for about 36 months as a bounding case for the analysis. The following paragraphs provide a brief overview of the treatment technologies.

Baseline Incineration

After disassembly, the metal munition bodies, energetic components (explosives and propellants), and chemical agent would be thermally treated in different types of incinerators. Destruction takes place within a two-story structure designed to contain any leakage of the agent. The nerve and mustard agents and energetics are separated from the metal parts within that structure. The energetics would be disposed of on-site in a rotary kiln deactivation furnace (DFS) that is contained within a reinforced, explosive-containment structure. Liquid agent is transferred to the liquid-injection incinerator for destruction. Metal parts, which may contain residual chemical agent, are treated in a roller hearth metal parts furnace (MPF). In addition to the primary chamber, all of the incinerators have a secondary chamber to destroy any residual agent or other organic compounds not incinerated in the primary chamber.

Scrubbers, high efficiency particulate air (HEPA) filters, and charcoal filters are used to control atmospheric emissions. The primary waste materials from the system consist of scrubber brines, incinerator residue (ash and slag), and charcoal from charcoal filters. After treatment, which may be required to reduce leaching of heavy metals, the brines [after being dried to solids in a brine reduction area brines (BRA)], incinerator ash, and slag would be disposed of in a permitted treatment, storage and disposal facility (TSDF). Ventilation exhaust air from potentially contaminated areas of the MDB and the CHB would be filtered extensively before being discharged. In addition, a PAS filtration system has been developed for the incinerator exhaust gases. The purpose of the PAS Filter System (PFS) is to improve the performance of the pollution control equipment by further reducing low level emissions of products of incomplete combustion (PICs) and metals. The PFS consists of inline gas burners, cooling

Exhibit F.12 (Continued)

systems, and filter units. The gas stream passes through the filter unit to the induced draft fans and finally to the exhaust stack.

Although complete agent destruction will occur during the incineration processes, special activated carbon filter units are being incorporated as an additional safety feature to further preclude the potential for a chemical agent release. The ventilation and incinerator exhaust stacks would be monitored continuously for the presence of agent. The spent carbon from the filter units would be incinerated in the MPF DFS. Current plans are to dispose of the incinerated carbon residue in a permitted hazardous waste landfill.

A baseline incineration system is currently being operated at the Desert Chemical Depot (formerly Tooele Depot, South) near Tooele, Utah. A baseline incineration system on Johnston Island in the Pacific Ocean, the Johnston Atoll Chemical Agent Destruction System (JACADS), completed destruction of the Johnston Island stockpile in November 2000.

Neutralization-Super Critical Water Oxidation (SCWO)

For this technology alternative, the munitions would first be disassembled using a process similar to that used by the baseline incineration system. A modified baseline reverse assembly process would be used to disassemble the chemical munitions stored at BGAD, with some differences for projectiles versus rockets. For projectiles, the energetic materials would be removed, and the agent would be accessed by cryofracturing the munition (the cryofracture process is not part of the baseline system). For rockets, the baseline system would be used.

After disassembling the munitions to access the agent and energetics (explosives and propellants) this technology would neutralize the chemical agents and energetics with water and caustic chemicals. The products of the neutralization would then be destroyed using the Supercritical Water Oxidation (SCWO) process. SCWO mineralizes the resulting chemicals at temperatures and pressures above the critical point of water (705.2 F. and 3,204.6 psia). Effluents could be held and tested before release through secondary waste treatment processes. Process water would be recycled for reuse, and solid residues would be disposed of in a hazardous waste landfill.

Neutralization - Gas Phase Chemical Reduction and Transpiring Wall (GPCR/TW) - SCWO

For this technology alternative, the munitions (projectiles and rockets) would first be disassembled using a process similar to that used by the baseline incineration system. For projectiles, the energetic materials would be removed and the agent would be drained. This would be accomplished using the baseline projectile/mortar disassembly (PMD) and a projectile punch machine (PPM). For rockets, the baseline rocket shear machine (RSM) would be used; however, it has been modified (MRSM) for this application. Agent would be drained from the rockets via a punch and drain process. Then the rocket would be sheared to access the fuze and burster. A tube cutter would be used to section the fiberglass rocket firing tube just forward of the threads of the fin assembly, and the fin assembly would be unscrewed to access the propellant. Propellant would be pulled from of the rocket motor, size-reduced in a grinder, and slurried.

Munitions casings and other hardware would be processed through the Continuously Indexing Neutralization System (COINS ™). This system would be used to place munitions casings and other solids in hanging baskets that are dipped in caustic baths to separate energetics from metal parts, followed by spray washing.

Exhibit F.12 (Continued)

The drained nerve agents (GB and VX) would then be neutralized/hydrolyzed by using a NaOH solution in systems operated at 194ºF and atmospheric pressure. Energetics would be neutralized/hydrolyzed by using a caustic solution in systems also operated at 194ºF and atmospheric pressure. Mustard agent would be hydrolyzed using hot water; however, caustic would be used later in the process. Hydrolysates would be treated in a TW-SCWO unit. TW-SCWO differs from solid-wall SCWO in that a boundary layer of clean water is dispersed from the sides of the SCWO unit as a means of limiting corrosion and solids buildup. TW-SCWO also differs from the solid-wall unit in that the TW-SCWO can treat agent and energetic hydrolysates simultaneously.

Organic vapors and odors would be passed through an air pollution control process. Recovered metal parts and dunnage would be treated at high temperatures and effluents would be held and tested before release through secondary waste treatment processes. Process water would be recycled for reuse, and solid residues would be disposed on in a landfill.

Electrochemical Oxidation

In the electrochemical oxidation process (or Silver II process), the munitions would first be disassembled using a process similar to that used by the baseline incineration system. Following munitions access, treatment of agent and energetics from the various types of chemical weapons is largely independent of munition type and agent fill. Fuzes and supplementary charges from all chemical munitions at BGAD would be sent to a detonation chamber. Slurried explosive material from the chemical munitions (20% by weight) would be sent to a number of holding tanks for feed to the SILVER II reactor. Agent would be pumped to a buffer area similar to the baseline incinerator's holding system. Agents and energetics would be fed into separate SILVER II reactors.

SILVER II is an aqueous electrochemical process that uses AgNO3 in concentrated HNO3. An electrochemical cell is used to generate a reactive material (Ag 2+) that readily oxidizes organic substrates. End products of this oxidation process are primarily carbon dioxide and water. Elements present in the organic substrate, such as nitrogen, sulfur, or phosphorous, are oxidized to nitrate ions, sulfate ions, or phosphate ions. Silver compounds (e.g., chloride) would be recycled or recovered off-site, after which they may be returned to the process. All process off-gases would pass through a catalytic oxidation unit and through carbon filters prior to release to the atmosphere.

Affected Environment

BGAD is located in the Outer Bluegrass Subsection of the Low Plateaus Province in east central Kentucky. As a result of grazing much of the installation is fescue-dominated grassland with isolated stands of black cherry, black locust and brambles. Other portions of the installation where grazing no longer occurs have been planted in oaks and other hardwood tree species to create larger, contiguous blocks of forest habitat (BGAD 2000a). Forests on well-drained upland areas of BGAD include bluegrass mesophytic cane forest, bluegrass savanna-woodland, calcareous subxeric forest and calcareous mesophytic forest (BGAD 2000a). Canopy dominants vary based on soil moisture, aspect, and past disturbance. Common canopy trees include black walnut, Ohio buckeye, bur oak, chinkapin oak, shumard oak, white oak, pignut hickory, shagbark hickory, honey locust, sugar maple, and white ash. Understory species have been severely impacted by cattle grazing.

Exhibit F.12 (Continued)

Areas A and B support different plant communities. Area A is an ungrazed grassland plant community with a few scattered American sycamore trees in the eastern portion. Immediately northeast of Area A is a bluegrass mesophytic cane forest. Area B is comprised of a stand of mixed hardwood trees on a relatively level area immediately west of the Chemical Agent Storage Area. An intermittent stream traverses the western portion of the area. Area B is within a livestock-grazing tract that encompasses most of the western portion of BGAD.

Endangered Species at Blue Grass Army Depot

The U.S. Fish and Wildlife Service (FWS) has identified seven federally-listed endangered species (Barclay 2000) as occurring within 30 mi of BGAD: three mussel species, three bat species, and one plant species. The three endangered mussel species, the Cumberland bean (*Villosa trabalis*), Cumberland elktoe *(Alasmidonta atropurpure*a) and little-wing pearly mussel (*Pegias fabula*), are known to occur within 30 mi of BGAD (Barclay 2000), but all three species are found in the Cumberland River basin to the south of the proposed site, not in the upper Kentucky River basin in which the proposed site lies. Thus, no suitable riverine habitat occurs at BGAD to support any of the endangered mussel species.

Surveys for bats inhabiting or visiting BGAD have failed to detect the endangered Indiana bat *(Myotis sodalis)*, gray bat (*Myotis grisescens*), or Virginia big-eared bat (*Corynorhinus townsendii virginianus*). Six mist net surveys conducted along Muddy Creek located south and east of the project area during the summer of 1993 recorded four other bat species (Bloom et al. 1995). Although the Indiana bat is thought to occur at BGAD and in the general vicinity (Barclay 2000), surveys have yet to document its presence on the installation. Since 1993 ongoing surveys by the Kentucky Nature Preserves Commission, Kentucky Nature Conservancy, and Eastern Kentucky University researchers have not detected the Indiana bat.

Of the listed endangered species, only the plant species running buffalo clover (*Trifolium stoloniferum*) (RBC) is known to occur at BGAD; therefore, detailed information on the biology and distribution of this species at BGAD is presented below. RBC was listed as endangered, effective July 6, 1987, by the U.S. Fish and Wildlife Service (Fed. Register, Vol. 52, No. 108, pg. 21478, June 5, 1987). Historically RBC was documented as occurring in Kansas, Missouri, Arkansas, Illinois, Indiana, Ohio, Kentucky, and West Virginia. At the time of listing the only confirmed populations were from two locations in West Virginia. After field observations at documented locations in these states, Brooks (1983) concluded that *T. stoloniferum* was possibly extinct. Bloom et al. (1995) reported that the Kentucky Nature Preserves Commission had documentation in 1994 of *T. stoloniferum* occurring in nine Kentucky counties all within the Bluegrass Region. Twenty-five populations were known at Kentucky locations in addition to populations on the BGAD. Bloom et al. (1995) also reported that experts from Ohio, Indiana and West Virginia confirmed the existence of multiple populations in those states since 1987. The increase in known populations since July 1987 may be a function of more extensive surveys by qualified botanists rather than an increase in the population within the RBC's geographic range. Recent observations at BGAD have also discovered new populations since the surveys in 1993 and 1994 (BGAD 2000b).

Exhibit F.12 (Continued)

Current Status of Running Buffalo Clover at Blue Grass Army Depot

Bloom et al. (1995) reported that surveys conducted in 1993 and 1994 at BGAD yielded 145 patches of RBC. A patch was defined as "one or more clustered running buffalo clover plants at least 7.5 m from any other Running Buffalo Clover plants." Patch sizes ranged from one plant in an area of approximately one square foot (0.09 sq m) to hundreds of plants covering over 1200 square feet (>108 sq m). Most patches contained less than 20 plants and covered less than 100 square feet (<9 sq m). In May 1999 a collaborative effort by BGAD, Eastern Kentucky University, the Kentucky Office of The Nature Conservancy, and the Kentucky Nature Preserves Commission was made to evaluate a random sample from the 145 patches located in 1994. The study was intended to document site condition and compare data with previously collected information (BGAD 2000b). Study results indicated a decline or loss of 8 of the 30 patches examined that were surveyed and described in 1994, and a change in RBC patch condition based on dense cover from competing vegetation. Healthier populations were found along deer trails and areas of stream scouring. Flowering in some patches, however, was more prolific in 1999 than in 1994. Detailed plans for protection and continued monitoring of RBC on BGAD are described in the Endangered Species Management Plan and Environmental Assessment (BGAD 2000b). Neither Area A nor B is in locations where RBC has been detected during field surveys. RBC patches occur just to the northeast of Area A, and within about 1000 feet to either side of Area B.

Species Description and Biology

The following description of RBC is taken mostly from Bloom et al. (1995) and BGAD (2000b): Running buffalo clover *(Trifolium stoloniferum) is* a glabrous, stolon forming perennial species of the Pea family (Fabaceae). It possesses trifoliate leaves that grow from a central rooted crown (referred to as the mother plant) and at nodes along the stolons. The leaves are often typically short making the plant difficult to detect. Plants vary in height from 3-20 inches (7.6 - 50.8 cm) above the soil surface. Some leafy nodes become rooted during the growing season both early in the season and in late summer when the stoloniferous nodes and mother plant senesce. The mother plant typically produces 1-2 flower heads in May and June at BGAD. Fruit forms in July. Flowers are typically white with purple streaking and about 1 inch wide. Each flower stem has a pair of opposite leaves below the flower head. Stipules are green and leafy. RBC differs from white clover (*T. repens)* by having leafier stipules and the pair of leaves on the flower stalk. It also differs from two other clover species, red clover (*T. pratense)* by the flower color and lack of pubescence, and from alsike clover (*T. hybridum)* by its stoloniferous habit.

RBC grows on mesic, well-drained soils with a somewhat open canopy cover having light intensity of about 40-60% full sunlight (Bloom et al. 1995). It is a perennial species that occurs in savannas, open woodlands, along floodplains, and mesic terraces (BGAD 2000b). Plants seem to thrive in areas where moderate disturbance has reduced competition from other herbaceous and shrub vegetation. Sources of disturbance include livestock grazing, light trampling of floodplain areas, stream scouring, and mowing. Also, the exotic species, scorpion grass *(Microstegium vimineum)* occurs in dense stands in the herbaceous layer of open canopy floodplain areas where many RBC stands have been documented (Bloom et al. 1995). Scorpion grass was reported at all but 17 of the 145 patches where RBC was found. In many areas where RBC was found during the 1993 and 1994 surveys, scorpion grass represented 75-100% of the herbaceous ground cover. Such dense stands are likely to be unfavorable for the continued survival of RBC, competing for light and nutrients in specific patches. Bloom et al. (1995) reports that some success has occurred on BGAD where experimental applications of the monocot-specific herbicide

Exhibit F.12 (Continued)

POAST were used on dense scorpion grass patches prior to seed production in September. RBC plants survived the application of herbicide while scorpion grass was completely eliminated. Bloom et al. (1995) suggest that a multi-year application of herbicides may be necessary to eliminate scorpion grass from RBC patches to assure its continued survival at BGAD. Such applications may be required since scorpion grass seeds can remain viable in the soil for several years.

Impacts of Agent Destruction Facility Operations on Endangered Species

The primary means by which operations of an agent destruction facility using any of the various technology alternatives could potentially affect threatened or endangered species would be (1) through intake and/or deposition of atmospheric contaminants, and (2) through discharges of pollutant-laden effluents directly or indirectly to nearby surface waters. None of the technology alternatives under consideration would release process-related liquid effluents to surface waters on- or off-post. Process water would be either recycled or disposed of in a manner to meet existing regulations. No chemical agent or degradation products would be released during normal facility operations. Sanitary effluent from the wastewater treatment facility would meet National Pollutant Discharge Elimination System standards set for the facility by the Commonwealth of Kentucky. Thus, this supplemental BA concentrates on analysis of potential for impacts due to atmospheric emissions. Although routine atmospheric emissions and deposition potential from baseline incineration is low (U. S. Army 1991, 1997; Raytheon 1996), incinerator emissions are generally greater than, and therefore bound, potential emissions from the other technology alternatives.

A comparison of projected toxic air pollutant emissions from incineration with those from the alternative technologies (as listed by technology alternatives in Appendix I of the PMCD EIS) shows that for nearly all the contaminants, incineration emissions would exceed those from alternative technologies by one, two, or more orders of magnitude. The only substantive exception was the emission rate for the alkane, n-hexane, a member of the aliphatic hydrocarbons noted for their generally low toxicity (Clayton and Clayton 1994). Emission rates of two other contaminants, chromium and PCBs emitted from the Neutralization/GPCR/TW - SCWO Technology, are projected to be comparable to those from the baseline incinerator (i.e., within a factor of about two).

The alternative technologies would each release about two orders of magnitude more n-hexane than the incinerator technology (e.g., 6700 ug/s from Neutralization/GPCR/TW - SCWO, versus 43 ug/s from incineration). Direct proportionality between emission rates for each technology and resulting atmospheric concentrations on site and at the site boundary was assumed in this assessment. N-hexane can reasonably be dismissed from further consideration as an environmental hazard given (1) the resulting extremely low atmospheric concentrations (about 0.000093 ug/m^3 from incineration and about 0.015 ug/m^3 from Neut-SCWO on site), (2) the relatively low toxicity in both water and air [e.g., a 96-h LC0 (concentration at which no deaths are observed) for coho salmon young of 100 mg/L], and (3) the fairly rapid photo- and bio-degradation of n-hexane in water and air (Verschueren, 1996).
A formal ecological risk assessment for atmospheric emissions, the principal source of potential operational impacts, if any, has not been performed for the BGAD facility. Therefore, the assessment of possible impacts of emissions of substances of potential concern (SOPCs) on threatened and endangered species on and near the BGAD site necessarily depends on other lines of evidence. These include the

Exhibit F.12 (Continued)

ACWA FEIS and BA for neutralization technology alternatives at BGAD; the completed risk assessments of other Army chemical agent destruction facilities at Anniston, Pine Bluff, Umatilla, Tooele, and the Johnston Atoll Chemical Agent Disposal System (JACADS), and the differences in agent inventories between BGAD and the other chemical agent depots. Predicted SOPC emissions from each of these other facilities as well as the BGAD incineration alternative were adapted from actual emissions data from JACADS and used as surrogate source terms. The potential risks from the SOPCs emitted by the various BGAD technology alternatives, therefore, would reasonably be expected to be bounded by the ecological risk assessment predictions for baseline incineration estimated for the Anniston, Pine Bluff, Umatilla, and Tooele chemical destruction facilities. Moreover, the potential effects of emissions from the BGAD incineration alternative clearly would bound effects from any of the neutralization alternatives since the latter would emit considerably lower quantities of most contaminants of concern. It should be noted that not all contaminants projected to be released by a given technology would necessarily be emitted by one or more of the other technologies - a source of uncertainty inherent in assessments of this type.

Whereas the Umatilla and Tooele sites lie within the Intermountain Semi-Desert or Desert Provinces, which are quite different ecologically from BGAD's location in the transition zone between oceanic and continental Eastern Broadleaf Forest Provinces, the Anniston and Pine Bluff sites lie within the much more ecologically similar Southeastern Mixed Forest and Lower Mississippi Riverine Forest Provinces. JACADS, on Johnston Atoll, lies in a tropical marine environment nearly 800 mi southwest of Hawaii. While the ecological risk assessments for each of these sites is of some value as an indicator of possible effects of the incineration alternative on some of the ecological resources at BGAD, those performed for the Anniston and Pine Bluff sites are probably most relevant to assessment of potential impacts at BGAD.

The following paragraphs summarize the results of ecological risk assessments previously completed for chemical agent incinerators at the Anniston, Pine Bluff, Umatilla, and Tooele chemical agent destruction facilities**.**

The Anniston, Alabama, Facility

The U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM 2002) conducted a human health risk assessment of predicted emissions from the Anniston Chemical Agent Disposal Facility (ANCDF) located at the Anniston Army Depot (ANAD) in Calhoun County, Alabama. This risk assessment (a re-evaluation replacing an earlier risk assessment; USACHPPM 2001) included a screening-level ecological risk assessment (SLERA). In accordance with EPA guidelines for performing ecological risk assessments (EPA 1997; 1998a; 1998b; 1999), the SLERA was prepared to evaluate the potential for adverse ecological effects of exposure to emissions from the ANCDF, including metals and organic products of incomplete combustion.

Because four federally listed threatened or endangered species occur or have potential habitat within a 10-km (6-mile) radius of the ANCDF (the boundary established for the SLERA study), an important management objective of the SLERA process was to ". . . prevent emission-related health problems in individual organisms of threatened and endangered species" (USACHPPM 2002). These include one fish, one bat, and two plants, one of which is known to reside within ANAD boundaries.

Exhibit F.12 (Continued)

The SLERA endeavored to express as hazard quotients and indices the potential for deposition and (where applicable) inhalation effects of ANCDF emissions on fish, aquatic invertebrates, algae, soil biota (including plants), terrestrial wildlife, aquatic wildlife, and species listed by the FWS as threatened or endangered. These hazard quotients and indices are calculated as ratios of modeled exposure concentrations to published benchmarks or thresholds (including “no-effects and low-effects levels”) for reduced survival, growth, and reproduction of these species.

Hazard ratios for these organisms were less than the numerical target value (i.e., the value above which more in-depth assessment of the potential for adverse impacts is warranted) of 0.25, with the exception of some categories of terrestrial and fish-eating birds. For all categories where hazard ratios exceeded 0.25, with the exception of fish-eating birds, refined toxicity reference values were calculated according to EPA protocols. The revised results indicated that target levels based on these more specific toxicity measures are not exceeded for most SOPC/organism combinations. However, some hazard ratios still slightly exceeded threshold values for terrestrial, invertebrate-eating mammals (1,2,3,7,8-penta CDD; 2,3,4,7,8-penta CDF; silver, mercuric chloride, and methyl mercury). Because the individual hazard ratios for these SOPC/organism combinations only slightly exceeded the 0.25 threshold values, and the model and screening level assessment process are so inherently conservative, the SLERA concluded that these slightly high hazard rations are nevertheless protective of wildlife populations.

For fish-eating birds, the methyl mercury hazard quotient of 0.33 is also greater than the target level of 0.25. Again, due to the magnitude of the uncertainty in the modeling and the tendency to overestimate exposure that are inherent in the model, the maximum calculated hazard quotient was considered by the authors of the SLERA to be indicative of an acceptable hazard. The predicted mercury exposure, moreover, was almost eight times less than the EPA's methyl mercury criterion.

A comparison of modeled versus background concentrations provides another line of evidence. Emission and deposition modeling indicated that the water, sediment, and soil concentrations of naturally occurring inorganic substances for which data were available, with the exception of mercury, would not increase above background levels by more than about 0.3% for water, 0.05% for sediment, and 0.08% for soil. Modeled mercury increases were estimated at about 2.4% and 0.28% above background for soil and sediments respectively. Background mercury concentrations for surface water were not available, but the maximum modeled concentration of 10^{-8} mg/L (0.02 parts per trillion) is diminishingly small. Such small increases in any media would be (1) difficult to distinguish from background, and (2) unlikely to have adverse effects on aquatic and terrestrial life.

Based on these results and the high degree of conservatism in the model and the screening level risk assessment process, the SLERA concluded that emissions from facility operations would be unlikely to adversely affect local and area aquatic and terrestrial ecosystems and their resident species, and especially relevant to this biological assessment, plants. Assuming threatened and endangered species such as RBC respond to modeled contaminants in a similar way, it may be reasonably inferred that they, too, would not be adversely affected.

Exhibit F.12 (Continued)

The Pine Bluff, Arkansas, Facility

An environmental impact risk assessment (EIRA) for the proposed Pine Bluff facility (USACHPPM 1997) evaluated the risks to sensitive ecological resources and ecosystems from routine, daily emissions from the proposed facility. The constituents of potential environmental concern (COPECs) were a subset of those used in the human health portion of the risk analysis. The end point receptors included soil fauna and flora, plant communities, small mammals, and passerine birds. A multi-pathway exposure analysis was conducted, including consideration of bioaccumulation of certain chemicals through the food web. The EIRA concluded that there would be little or no potential for the COPECs to negatively impact the terrestrial resources, and especially relevant to this biological assessment, plant productivity and soil invertebrate function.

In conjunction with the EIRA, three additional studies of ecological risk focusing on species listed as threatened or endangered at that time were conducted (ChemRisk 1996c; Chambers Group, Inc. 1996c; Zimmerman 1997). The effects of daily emissions on three terrestrial species — bald eagle, red-cockaded woodpecker, and interior least tern — were evaluated in some detail because of their potential occurrence near the Pine Bluff facility. The estimates of potential risk to these species associated with the modeled concentrations of mercury, dioxins, and PCBs indicate that no adverse effects from projected daily incinerator emissions would be anticipated (Zimmerman 1997).

The Tooele, Utah, Facility

An ecological risk assessment (A.T. Kearney, Inc. 1996) was completed as part of the human health risk assessment undertaken in the Resource Conservation and Recovery Act (RCRA) permitting process. Emissions data from JACADS were adapted and used as surrogate source terms for the Tooele facility. As with the other ecological risk assessments, multiple chemicals and multiple pathways were considered using an intentionally conservative approach (i.e., overestimating the risks). The ecological assessment compared calculated environmental concentrations in surface waters with water quality criteria designed to be protective of ecological receptors including the endangered fish, the June sucker. None of the predicted surface water concentrations for constituents exceeded federal or state ambient water quality standards. The study concluded that exposure to surface waters impacted by emissions from the Tooele facility would not be expected to pose a significant threat to aquatic species or their predators.

Two additional biological assessments (Chambers Group, Inc. 1996a; ChemRisk 1996a) focused on three chemicals that can have long-term effects through bioaccumulation and biomagnification through the food chain: mercury, dioxins, and polychlorinated biphenyls (PCBs). Receptors considered included two predatory species — peregrine falcon and bald eagle — likely to bioaccumulate these contaminants. Both studies concluded that adverse effects from daily emissions to the two bird species were unlikely. Further, the maximum waterborne concentrations at the location of the endangered fish species, the June sucker, were found to be several orders of magnitude below EPA levels of concern. The Chambers Group study (1996a) also considered the potential for impact on the threatened Ute Ladies-Tresses and the formerly proposed, but never listed, least chub; the modeled concentration of contaminants in water, air, and soil indicate that there should be no adverse effects on these species.

Exhibit F.12 (Continued)

The Umatilla, Oregon, Facility

A pre-trial burn health risk assessment for the proposed chemical demilitarization facility at the Umatilla Chemical Depot (UMCD) was issued in 1997 by the Oregon Department of Environmental Quality (Ecology and Environment 1997). This assessment included a SLERA in conformance with EPA guidance. The receptor locations were generally the same as those for hypothetical human receptors, with one exception — the Conforth Ranch — as described below. The constituents of potential environmental concern (COPECs) were a subset of those used in the human health risk assessment. The SLERA concludes that there is little or no potential for the COPECs to negatively impact terrestrial vegetation or soil invertebrates. The potential effects of mercury on soil macroinvertebrates represented the only HQ (hazard quotient) that exceeded 1.0; however, this was predicted to occur only in the area of highest impact — about 100 m (328 ft) downwind of the facility, well within depot boundaries.

To assess potential impacts to aquatic species and wetlands, the SLERA included the Conforth Ranch as one location of ecological receptors. The Conforth Ranch is 7.1 km (4.4 miles) northeast of the Umatilla depot boundary and adjacent to the south shore of the Columbia River. This area contains appropriate foraging habitats for the peregrine falcon and bald eagle. Because of the wetland characteristics of this area (i.e., low water flow rates and limited dilution potential), the Conforth Ranch area was postulated to accumulate the highest water and sediment concentrations of chemicals of interest to ecological resources within the study area.

No potential adverse effects were predicted in the SLERA for specific COPECs on aquatic or benthic (sediment-dwelling) species in the nearby Umatilla River; however, the total HI (hazard index) indicated a slight potential for effects on aquatic species in nearby wetlands at the Conforth Ranch. The surface water or sediment dioxin concentrations in these same two waterbodies did not exceed levels of concern for mammalian or avian wildlife.

Direct effects of COPECs on endangered, threatened, or sensitive species were not directly assessed as part of the SLERA, but the SLERA concluded that the listed sockeye salmon would not be at risk on the basis of the minimum risks predicted for other fish species, and listed birds of prey would be unlikely to incur high levels of exposure to COPECs. The SLERA concludes overall that adverse ecological effects are unlikely (except for a slight potential for adverse effects on soil invertebrates very near the proposed facility). Particularly relevant to this supplemental BA is the SLERA's conclusion that assessment results indicate that the likelihood of potential ecological effects on plants is low. Because of data gaps and other uncertainties, however, the SLERA recommends that "the potential for ecological effects . . . should be reassessed when the data gaps are filled to the extent possible and realistic . . . trial burn emissions and stack parameters are available."

Two additional studies of ecological risk near the Umatilla facility were conducted (ChemRisk 1996b; Chambers Group, Inc. 1996b). These two studies used the SLERA as a basis but focused on emissions of mercury, 2,3,7,8-dioxin, and PCBs — three chemicals that are known to bioaccumulate in organisms and are transported through the food chain. The receptors included the listed threatened and endangered species near UMDA: bald eagle, peregrine falcon (since delisted), Snake River sockeye salmon, and Snake River Chinook salmon. The receptor locations were taken as the points of maximum concentration as determined in the health risk assessment. A direct and indirect exposure analysis was conducted for the two bird species. The risks from inhalation of routine, daily emissions from the Umatilla facility were found to be negligibly small. A food chain analysis was also conducted using the maximum (i.e., fence-line) concentrations of contaminants in air, soil, and plants to characterize the risks of biomagnification

Exhibit F.12 (Continued)

and bioaccumulation of persistent chemicals to the listed species. The total risk, as measured by the ratio of computed exposures to benchmarked levels of concern, indicate that the risks to the bird species are at least eight times lower than the levels of concern.

For the fish species, the maximum waterbody concentrations in the Umatilla River (i.e., the maximally affected waterbody) were compared with ambient water quality criteria and were found to be several orders of magnitude below levels of concern. As a result of these analyses, it was determined that risks to listed threatened and endangered species from anticipated daily emissions from the Umatilla facility would be negligible.

Potential Ecological Effects of Emissions at JACADS

Studies of bird populations at Johnston Atoll were begun by Schreiber (1996) in 1984, 6 years before the JACADS facility became operational. In other studies, several species of birds like those nesting near JACADS have shown sensitivity to accumulations of biotoxins. The birds near JACADS can therefore be considered indicators of whether impacts are occurring from the emissions of the JACADS facility. The Johnston Atoll studies have been unable to identify any measurable effects on the birds of Johnston Atoll from the JACADS chemical incineration process (Schreiber 1996, 1997).

Other Considerations

An important factor favoring the probability that impacts evaluated in the various SLERAs and other ecological risk assessments do in fact bound the potential impacts of the BGAD baseline incineration and neutralization alternatives is the relatively low total quantity of agents and munitions at BGAD to be destroyed. Table 1 shows, for example, that the agent inventories to be processed at the facilities examined in other risk assessments are 2.2 to 26 times greater than the total inventory at BGAD. Consequently, total lifetime emissions of SOPCs from a BGAD incinerator would be expected to be much lower — only about 4 to 46% of the total emissions at the other facilities, even though emission *rates* would most likely be quite similar for the incineration alternative. The other BGAD neutralization alternatives would be expected to have far lower emission rates for nearly all contaminants produced in common with the other facilities.

Table 1. Initial total agent inventory (tons) at each chemical munitions storage depot

Depot	**GB**	**VX**	**H/HD/HT**	Total
Anniston	437	829	988	2254
JACADS	617	352	165	1134
Pine Bluff	483	147	3219	3849
Tooele	6046	1356	6196	13600
Umatilla	1014	364	2340	3718
Blue Grass	306	127	91	523

Exhibit F.12 (Continued)

Uncertainty is an important element that must be considered in assessments of this type. Because uncertainties are often dealt with through the use of conservative models and assumptions, the direction of effect of most uncertainties tends toward overestimation of risk. Nevertheless, some uncertainties, such as gaps in toxicity, transport, and fate information for some SOPCs, may tend to drive assessment toward underestimation of risk.

Because of uncertainties inherent to the assessment process, the Army has and will continue to conduct health and ecological risk assessments, and, in the event facility operations commence, would monitor exposure of ecological resources to emissions. If at any time during these assessments new information indicates that the proposed action would adversely affect ecological resources including fish, wildlife, and listed species, in a manner or to an extent not previously considered, or if any incidental take of a listed species were to occur as the result of the accidental release of chemical agents, the Army would immediately (1) re-initiate consultation with the U.S. Fish and Wildlife Service, and (2) implement measures for mitigation of adverse effects.

Conclusions (Effects Determination)

In conclusion, the lines of evidence summarized above indicate that neither RBC, although present within the BGAD facility boundaries, nor the other listed species occurring offsite but within a 30-mi radius, would likely be adversely affected due to emissions from operations of any of the proposed alternative facilities. Levels of emission contaminants from operations would be low and dispersed over a wide area. Deposition of these contaminants directly onto the foliage of RBC would be further limited by interception from canopy species present in association with RBC. Thus, it is concluded that operation of an agent destruction facility using any of the various technology alternatives being considered would not affect (“no effect”) federally listed endangered or threatened species.

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Schreiber, E.A., 1996. *Analysis of Expected Effects of Daily Emissions of the Tooele Chemical Agent Disposal Facility on Peregrine Falcons and Bald Eagles,* The Ornithological Council, Washington, D.C.

Schreiber, E.A. 2001. *Breeding Biology and Ecology of the Seabirds of Johnston Atoll, Central Pacific Ocean: Long-term monitoring 1984-2001.* Report prepared Dec. 2001 for Project Manager for Chemical Stockpile Demilitarization, Aberdeen Proving Ground, Maryland.

U.S. Army 1991. *Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Anniston Army Depot, Anniston, Alabama*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., May.

U.S. Army 1997b. *Revised Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Pine Bluff Arsenal, Arkansas,* Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., April.

U. S. Army 2000. *Biological Assessment for the Assembled Chemical Weapons Assessment Program at Blue Grass Army Depot, Richmond, Kentucky,* by John Ware, PM Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Maryland; submitted to Lee A. Barclay, U.S. Department of Interior, Fish and Wildlife Service; December.

U. S. Army 2002a. *ACWA FEIS*

U. S. Army 2002b. *PMCD PFEIS*

USACHPPM (U.S. Army Center for Health Promotion and Preventative Medicine) 1997. *Environmental Impact Risk Assessment in Support of the NEPA Process for the Pine Bluff Chemical Agent Disposal Facility, Pine Bluff Arsenal, Arkansas,* Report No. 39-26-6683-97, prepared for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., April.

USACHPPM (U.S. Army Center for Health Promotion and Preventative Medicine) 2001. *Resource Conservation and Recovery Act Part B Risk Assessment for the Anniston Chemical Agent Disposal Facility, Anniston Army Depot, Anniston, Alabama,* Report No. 39-26-1299-99, prepared for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., January.

USACHPPM (U.S. Army Center for Health Promotion and Preventative Medicine) 2002. *Revised Resource Conservation and Recovery Act Part B Risk Assessment for the Anniston Chemical Agent Disposal Facility, Anniston Army Depot, Anniston, Alabama,* Report No. 39-26-1299-99, prepared for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., August.

Exhibit F.12 (Continued)

Verschueren, K. 1996. *Handbook of Environmental Data on Organic Chemicals.* 3rd Ed. John Wiley and Sons, Inc., New York.

Zimmerman, G.P. 1997. *Review and Evaluation of Updated Numerical Input Values for Determining Risks to Threatened and Endangered Species at the Pine Bluff Arsenal,* Oak Ridge National Laboratory, Oak Ridge, Tenn., March.

APPENDIX G

ASSEMBLED CHEMICAL WEAPONS ASSESSMENT PROGRAM TECHNOLOGY DESCRIPTIONS

The following summary descriptions of the three alternatives being considered for destruction of the chemical weapons stockpile stored at Blue Grass Army Depot are taken directly from:

> Kimmell, T., S. Folga, G. Frey, J. Molberg, P. Kier, B. Templin, and M. Goldberg 2001. *Technology Resource Document for the Assembled Chemical Weapons Assessment Environmental Impact Statement, Volume 5: Assembled Systems for Weapons Destruction at Blue Grass Army Depot,* ANL/EAD/TM-101, Volume 5, Argonne National Laboratory, Argonne, Illinois.

Although the language and figures used in this appendix have been excerpted and copied directly from the ACWA Technology Resource Document, formatting has been altered to facilitate public review of this document (i.e., the PMCD Final EIS). Notes regarding PMCD positions on information in the Technology Resource Document and/or mistakes that have been identified in the Technology Resource Document are noted in brackets [...].

Additional detail regarding these technologies may be found in the ACWA Technology Resource Document as well as in documents referenced therein.

G.1 INTRODUCTION

Four ACWA technology systems are presently under consideration for pilot-scale testing at BGAD.[1] These systems and their corresponding processes are as follows:

- Primary destruction: agent and energetics neutralization; secondary destruction: supercritical water oxidation (SCWO) (demonstrated by General Atomics[2]). This system is referred to herein as neutralization/SCWO.

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[1] The technology system descriptions presented in this TRD were derived from data and information developed by technology providers during the PMACWA demonstration test phase for the ACWA program (PMACWA 1999a; 2001b,c). The use of technology provider names and nomenclature from demonstration documentation (General Atomics 1999, Parsons/Allied Signal 1999, Foster Wheeler/Eco Logic/Kvaerner 2000, AEA/CH2MHILL 2000) does not imply endorsement of a specific technology provider.

[2] General Atomics refers to its ACWA system as the General Atomics Total Solution (GATS).

- Primary destruction: agent and energetics neutralization; secondary destruction: biological treatment (demonstrated by Parsons/Honeywell[3]). This system is referred to herein as neutralization/biotreatment.
- Primary destruction: agent and energetics neutralization, and gas-phase chemical reduction (GPCR); secondary destruction: transpiring-wall supercritical water oxidation (TW-SCWO) (demonstrated by Foster Wheeler/Eco Logic/Kvaerner). This system is referred to as neutralization/GPCR/TW-SCWO.
- Primary destruction: electrochemical oxidation via the SILVER II process (demonstrated by AEA/CH2MHILL). The technology provider indicates that no secondary treatment is needed. This system is referred to as electrochemical oxidation.

The neutralization/SCWO system is a viable technology system for treating ACW containing mustard or nerve agent. The neutralization/biotreatment system is viable only for ACW containing mustard agents [NOTE: Neutralization/Biotreatment is not being considered in the PMCD NEPA process as a fully evaluated alternative due to its inability to destroy chemical munitions containing nerve agent; information from the ACWA Technology Resource Document regarding Neutralization/Biotreatment is therefore not included in this Appendix]. Both of these technology systems were demonstrated during Demonstration I (Demo I) of the ACWA demonstration test program. The latter two technologies, neutralization/ GPCR/TW-SCWO and electrochemical oxidation, were demonstrated during Demonstration II (Demo II) of the ACWA demonstration test program. These technology systems are amenable to treating ACW containing mustard or nerve agent.

Incineration is not a candidate technology in the EIS that this resource document supports (the ACWA EIS). The baseline incineration process is being considered as a potential destruction technology at BGAD under a separate EIS (PMCD 2001). Although incineration is not a candidate ACWA technology, the four ACWA technologies discussed above employ one or more components of the baseline incineration process (e.g., reverse assembly, pollution abatement system). Elements of the baseline incineration process are therefore included in the overview of the baseline and ACWA system technologies.

Table G.1 provides an overview of the baseline incineration process and the ACWA technology systems being considered for BGAD. A more detailed description of each of the ACWA technology systems follows.[4] This document is based on a conceptual “full-scale” facility as defined in the PMACWA Request for Proposal (RFP) for the ACWA program (CBDCOM 1997). Exact specifications of units and processes, including operating temperatures and pressures, may vary.

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[3] Honeywell purchased Allied Signal in early 2000; General Electric purchased Honeywell in 2000. Parsons/Honeywell refers to its ACWA system as the Water Hydrolysis of Explosives and Agent Technology (WHEAT) process.

[4] Monitoring of emissions is part of any environmental waste management scenario. Monitoring of ACW treatment processes will be prescribed in environmental permits issued under the federal Resource Conservation and Recovery Act (RCRA). Monitoring methodologies are not specifically described in this TRD.

Table G.1. Technology overview for baseline incineration and ACWA Technology Systems for BGAD[a]

Technology	Munitions Access	Agent Treatment	Energetics Treatment	Metal Parts Treatment	Dunnage Treatment
Baseline Incineration	Baseline reverse assembly	Liquid incinerator (LIC) (a stationary LIC)	Deactivation furnace system (DFS) (a rotary kiln incinerator), with heated dis-charge conveyor (HDC)	Metal parts furnace (MPF) (a roller hearth incinerator)	Size reduction and stationary bed incinerator
Neutralization/SCWO	Parts of baseline reverse assembly, cryofracture	Hydrolysis[b] followed by SCWO	Caustic hydro- lysis followed by SCWO	Caustic hydrolysis followed by thermal treatment with steam	Size reduction/ pulping followed by SCWO
Neutralization/Biotreatment[c]	Modified base- line reverse assembly (fluid- abrasive cutting and fluid- mining)	Hydrolysis[b] followed by biotreatment	Caustic hydro- lysis followed by biotreatment	Thermal treat- ment with steam	Size reduction/ thermal treatment with steam
Neutralization/ GPCR/TW-SCWO	Modified baseline reverse assembly (uses baseline process with modified equipment)	Hydrolysis[b] followed by TW- SCWO	Caustic hydrolysis followed by TW- SCWO	Caustic hydrolysis and spray washing followed by GPCR using hydrogen and steam	GPCR using hydrogen and steam
Electrochemical oxidation	Modified baseline reverse assembly (fluid- abrasive cutting and fluid- mining)	Electrochemical oxidation using SILVER II process	Electrochemical oxidation using SILVER II process	Detonation chamber and thermal treatment with steam	Size reduction followed by thermal treatment with steam

[a]Combinations of these technologies may also be considered.
[b]Nerve agents are treated using caustic hydrolysis; mustard agents are treated using water hydrolysis followed by a caustic wash.
[c]Biotreatment is viable for mustard agents only.

Source: Adapted from PMACWA (1999a; 2001b,c).

G.2 NEUTRALIZATION/SCWO

The neutralization/SCWO technology system consists of neutralization of agents and energetics and secondary treatment of neutralization residuals using SCWO. This technology system, proposed by General Atomics,[5] is applicable to all ACW stored at BGAD, including ACW containing nerve or mustard agent. It uses a solid-wall SCWO process. Operation of a TW-SCWO unit is discussed in Section G.3. The following subsections provide a more detailed discussion of the technologies and processes involved in this system. The technology provider's technology demonstration report (General Atomics 1999) may be viewed for additional detail.

G.2.1 Process Overview

The neutralization/SCWO process, as applied to projectiles and rockets stored at BGAD, is summarized in Figure G.1. As Figure G.1 illustrates, a modified baseline reverse assembly process would be used to disassemble ACW at BGAD, with some differences for projectiles versus rockets. For projectiles, the energetic materials would be removed, and the agent would be accessed. In the system proposed by General Atomics, this would be accomplished by cryofracturing the munition.[6] The cryofracture process is not part of the baseline system. For rockets, the baseline system would be used. Agent would first be accessed using a punch and drain process. Then the rocket would be sheared to access the fuze, burster, and propellant. The HD and the nerve agents GB and VX would then be neutralized/hydrolyzed with water (for HD) and sodium hydroxide (NaOH) (for GB and VX) in systems operated at 194ºF and atmospheric pressure;[7] energetics would also be neutralized/hydrolyzed with a NaOH solution, in systems also operated at 194ºF (90ºC) and atmospheric pressure. Neutralization of HD and HT using water would be followed by a caustic wash using NaOH. Dunnage would be shredded, micronized, hydropulped, and neutralized/hydrolyzed. Resulting hydrolysates would then be treated in separate SCWO units. Dunnage hydrolysate would be added to energetics hydrolysate and treated in the same SCWO unit. Thermal treatment would be used to treat metal parts to a 5X condition.[8] [NOTE: The ACWA Technology Resource Document implies that agents HD and HT are present at BGAD; agent H is the only mustard agent stored at BGAD]

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[5] Neutralization is a common element of three of the four technology systems discussed in this volume of the TRD.

[6] Cryofracture is a system whereby materials are cooled rapidly, usually by immersion in liquid nitrogen. This embrittles the materials such that they may be easily fractured in a subsequent process.

[7]This unit is not operated under pressure.

[8] The definition of 5X is provided in Volume 1 of this TRD (see Section 1.2.2.4). While materials treated to a 5X condition may be released for unrestricted use (e.g., recycling), materials determined to be 3X must remain under government control. For example, hazardous waste disposal facilities may receive 3X waste.

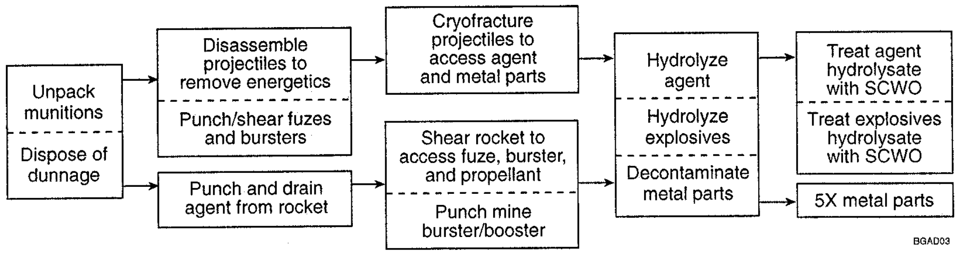

FIGURE G.1. OVERVIEW OF THE NEUTRALIZATION/SCWO PROCESS (GENERAL ATOMICS SYSTEM) **for the Treatment of ACW at BGAD** (Source: Adapted from NRC 1999)

G.2.1.1 Neutralization of Agent and Energetics

Agent neutralization and energetics neutralization by hydrolysis are discussed in detail in a 1999 National Research Council (NRC) report (Appendixes D and E, respectively) (NRC 1999). The literature is extensive on neutralization of HD (NRC 1999). Technically, neutralization is a chemical reaction between an acid and a base to form a salt and water (NRC 1999). In this application, neutralization refers to a hydrolysis reaction in which a target compound is reacted with water, an acid, or a base to break chemical bonds in the target compound (NRC 1999). Chemical demilitarization literature, therefore, often uses neutralization and hydrolysis as interchangeable terms for the same process (NRC 1999).

Neutralization by using hot water (194ºF, 90ºC), followed by the addition of a caustic (NaOH), is the process that will be pilot tested at APG for destruction of the bulk HD stored there (APG 1997). The NRC references work performed at the U.S. Army Edgewood Research, Development, and Engineering Center (ERDEC)[9] and indicates that neutralization has been shown to reduce HD concentrations in hydrolysate to less than 20 ppb (the analytical detection limit); 99% of the HD is converted to thiodiglycol (NRC 1999; ERDEC 1996). Thiodiglycol is a Schedule 2 compound (see Appendix B of Volume 1), and the hydrolysate requires further treatment to meet the requirements of the Chemical Weapons Convention (CWC) (NRC 1999). The neutralization reaction with water requires vigorous stirring because HD is relatively insoluble in water (NRC 1999; see also Appendix C of Volume 1). In addition, a semisolid or gelatinous ieheello of mustard agent can form in stored munitions. The heel, which can amount to up to 10% of the stored agent, can be washed out (NRC 1999). HD hydrolysates contain high levels of thiodiglycol, as explained previously and may also contain a high salt content, various metals, and chlorinated hydrocarbons (NRC 1999).

For energetics, this technology involves caustic neutralization using solutions of NaOH. The NRC reports that there is less experience with base neutralization of energetic materials relative to experience with chemical agents (NRC 1999). However, neutralization of energetics has been substituted for open burning/open detonation, a treatment that has historically been

[9] Now known as the Edgewood Chemical Biological Center (ECBC).

applied to these materials (NRC 1999). The open literature contains many references to caustic hydrolysis of energetics, dating back to the mid-1800s (NRC 1999). The Navy recently published a review of alkaline hydrolysis of energetic materials pertinent to ACW (Newman 1999, as cited in NRC 1999).

Base hydrolysis decomposes energetic materials to organic and inorganic salts, organic degradation products, and various gases (NRC 1999). The base used — typically NaOH, potassium hydroxide (KOH), ammonium hydroxide (NH4OH), or sodium carbonate (Na2CO3) — usually attacks all the functional groups of the energetic material (NRC 1999). While previous work with base hydrolysis involved studying reactions under ambient conditions, recent work has been conducted at elevated temperatures and pressures, which increases the solubility of the energetics in solution, increases the reaction rate, and reduces clogging of the reactor vessel (NRC 1999). The reactions, however, are exothermic and must be carefully controlled and monitored to prevent an explosion (NRC 1999).

The NRC indicates that caustic neutralization of energetics is not a mature technology; nevertheless, it concludes that the current level of understanding is, perhaps, sufficient to indicate that engineering practices can probably restrict the domain of possible reaction products (NRC 1999). Products from the neutralization reaction may include nitrates, nitrites, ammonia, nitrogen, hydrogen, organic acids, and formaldehyde, as well as various salts (NRC 1999).

G.2.1.2 Supercritical Water Oxidation

The NRC reviews the SCWO process in Appendix F of its 1999 report. Much of the material in this appendix is based on a review of the SCWO technology for application to VX hydrolysates that the NRC performed in 1998 (NRC 1998). This work was conducted primarily in response to the proposed use of the SCWO technology for treating the VX hydrolysates resulting from neutralization of the U.S. Army's bulk stockpile of VX at NCD, Newport, Indiana. Hydrolysis followed by application of SCWO is nearing the pilot-scale testing phase at NCD (PMCD 1998b; NRC 1999). The U.S. Army prepared an EIS of the hydrolysis/SCWO process proposed for treatment of bulk VX at NCD (PMCD 1998b) and concluded that the proposed facility would meet stringent permitting requirements of the Clean Water Act (CWA), the Resource Conservation and Recovery Act (RCRA), and the Clean Air Act (CAA). The U.S. Army further concluded that the site and environs of the facility would be affected by construction and pilot testing of the proposed facility, but that appreciable adverse human health and environmental impacts would be unexpected, and those that may occur would be well within regulatory limits (PMCD 1998b).

When using SCWO, the temperature and water pressure are raised to above supercritical conditions (705ºF or 374ºC and 3,204 psia or 22 MPa). Under these conditions, salts precipitate out of solution, and organic compounds are oxidized to carbon dioxide (CO_2) and water (H_2O) (NRC 1999). Figure G.2 is simplified process flow diagram for a typical solid-wall SCWO process.

SCWO is not widely used within the United States. The NRC reports that SCWO has been used on a pilot scale to treat other types of wastes, but that it is used commercially at only one location within the United States (NRC 1998, as cited in NRC 1999). Although SCWO has been under development for over 20 years, both in the United States and overseas, only recently have problems with the reactor vessel been overcome sufficiently to permit consideration of full-scale operations.

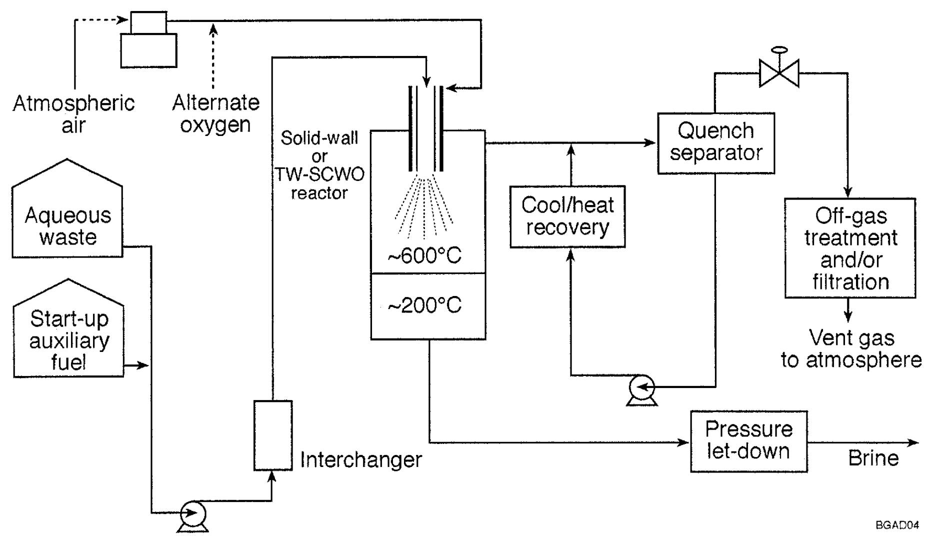

Figure G.2. Typical flow diagram for SCWO. *Source:* Adapted from NRC 1999.)

G.2.2 Summary of Demonstration Testing

Cryofracture and baseline reverse assembly are well-developed technologies and, therefore, were not demonstrated. During demonstration testing, the government validated that caustic hydrolysis is effective for destroying agents and energetics. The agent hydrolysis process produces Schedule 2 compounds; however, the solid-wall SCWO effectively destroyed all Schedule 2 compounds. The SCWO process effectively treats agent hydrolysates (demonstrated for HD and GB only), energetic hydrolysates, and dunnage, thus producing an effluent of low concern and impact to human health and the environment. Three hydrolysis/SCWO critical unit operations were demonstrated. Salt-plugging and corrosion of the SCWO unit are problems that will require further examination. These problems were to be examined during the engineering design studies (see Section 5.2.1.4 of the TRD). The PMACWA reviews the quality of the data generated during demonstration testing in PMACWA (1999c).

On the basis of demonstration testing, a number of process revisions were proposed that are applicable to BGAD and the munitions stored there. Most of these minor revisions relate to the munitions access processes or dunnage treatment. These changes include the following (General Atomics 1999):

- Mortar bursters could not be sheared in the burster size reduction machine (BSRM). However, the tetryl fill in the bursters was found to melt out in the ERH during the demonstration tests. Thus, it appeared that size reduction would not be necessary.

- A live-bottom hopper would be used to collect shredded wood discharged from the low-speed shredder. The hopper would have a screw feeder at the bottom to meter the wood into the hammer mill. This change would prevent overfeeding of the hammer mill and micronizer.
- A separate low-speed shredder and collection hopper would be used to shred and store DPE suits and butyl rubber material before feeding to the cryocooler and granulator. This change would allow wood and plastic/rubber materials to be processed independently.
- DPE metal parts would be manually removed in a glove box before the DPE material would be fed to the DSHS. The metal parts would be treated to a 5X condition in the induction-heated batch MPF.
- A colloid mill would be used to wet-grind spent activated carbon to ensure adequate size reduction. The carbon slurry would then be added to the slurried dunnage and hydrolyzed energetics for processing through the SCWO system.
- Hydrolyzed aluminum, as Al(OH)3, would be filtered from energetics hydrolysate before being fed to the solid-wall SCWO system. This filtering would prevent hard aluminum salt deposits from plugging the SCWO reactor. The filtered Al(OH)3 would be dried and decontaminated to a 5X condition in the MPF.

G.2.3 Detailed Process Description

This section presents a detailed process description for neutralization/SCWO, as applied to BGAD and the ACW stored there, on the basis of demonstration testing results. The equipment used in a pilot-scale facility may vary in nomenclature and design from that described here, depending on the system selected and system requirements.

Munitions access would involve use of a modified baseline reverse assembly and cryofracture for projectiles. For rockets, agent would be accessed first by using a punch and drain process. The rocket would then be sheared to access the fuze, burster, and propellant. Following munitions access, the process for treating specific agents and energetics would be largely independent of munition type and agent fill.

Water hydrolysis followed by a caustic wash would be used for mustard agent, while caustic hydrolysis using NaOH would be used to neutralize nerve agent and energetics. Munition hardware would be treated with caustic in rotary hydrolyzers (rotating vessels with a helical transport flight[10]): the PRH would be used for agent-contaminated, cryofractured projectiles, and the ERH would be used for all other munition components.[11] Drained agents would be neutralized in CSTRs.[12] ERH effluent liquids would be treated in similar CSTRs. Dunnage and other organic solid wastes from projectiles and rockets would be shredded, pulverized, and

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[10] A continuous, flat plate (or ioflightls) attached to the inner wall of the vessel, forming a corkscrew or augerlike apparatus from one end to the other. Material is moved along the bottom of the vessel by the helical transport as the vessel rotates.

[11] The terms PRH and ERH are specific to General Atomics. Conceptually, other processes that use a caustic washout design can be substituted for this process.

[12] CSTRs were developed pursuant to the U.S. Army's ATP.

water/caustic-pulped (with solids removal) into a slurry hydrolysate. Thermal treatment would be used to decontaminate solids not pulped. Solid effluents from the PRH and ERH would pass to modified (inert atmosphere) baseline HDCs for thermal decontamination to a 5X condition. Nonshreddable solid wastes (metals, glass, etc.) would receive thermal decontamination to a 5X condition in an induction-heated, inert atmosphere MPF. Munition bodies (projectiles) decontaminated to a 5X condition can be commercially recycled or disposed of as solid waste. Nonmetal solid waste, if defined as hazardous waste, would be managed as hazardous waste.[13] If defined as nonhazardous wastes, these solid wastes may be disposed of in a nonhazardous waste landfill.

Agent hydrolysate (independent of agent type), energetics hydrolysate from the ERH, and dunnage slurry hydrolysate would undergo secondary treatment in solid-wall SCWO units. The energetics hydrolysate and dunnage hydrolysate would be treated in a separate SCWO processing train. Brine from the SCWO units would be evaporated, the water would be condensed and recycled to the hydrolysis units, and the salts would be sent to a RCRA-permitted hazardous waste landfill.[14] The salts may need to be treated prior to placement in a landfill to meet RCRA land disposal requirements. Off-gases from the HDCs would vent to their respective rotary hydrolyzers. Off-gases from the hydrolyzers and the MPF would pass through condensers, scrubbers, and carbon filters before being released to the atmosphere. Liquid from condensers and scrubbers would return to the rotary hydrolyzers for reuse and eventual treatment by SCWO. SCWO off-gas would pass through carbon filters and be released to the atmosphere.

Short descriptions of each of the unit processes included in the neutralization/SCWO process as applied to projectiles and rockets stored at BGAD are provided below. Because of the differences in the munitions access process for projectiles versus rockets, a separate description of the munitions access process is provided. However, the remaining process descriptions (for agent and energetics treatment, dunnage treatment, metal parts treatment, and effluent management and pollution controls) apply to both projectiles and rockets. General Atomics (1999), which includes detailed process flow diagrams, may be reviewed for additional detail.

G.2.3.1 Munitions Access — Projectiles

The proposed design for munitions access for projectiles incorporates many of the units and processes used in the baseline reverse assembly processes (see Appendix E of Volume 1 for

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[13] Solids treated to remove residual agent may be defined as hazardous waste if they exhibit any of the characteristics of hazardous waste as defined in Title 40, Parts 260.21-260.24 of the Code of Federal Regulations (40 CFR 260.21-260.24).

[14] These salts may be defined as hazardous waste if they exhibit any of the characteristics of hazardous waste as defined in 40 CFR 260.21-260.24. Typically, these salts contain heavy metals and exhibit the RCRA toxicity characteristic (40 CFR 261.24). In Kentucky, the salts may be regulated as listed hazardous wastes because of their association with chemical agent. If the salts are listed as hazardous wastes, a RCRA delisting petition may be pursued to reclassify the waste as nonhazardous.

details). Units and processes include reverse assembly machines, material handling conveyors, robotic loaders and handlers, HDCs, elements of the MPF thermal treatment system, auxiliary systems, and facilities and support systems. Some of these units have been slightly modified from the baseline process, but the basic unit and operations have been retained. The major units are summarized below.

The projectile/mortar disassembly (PMD) machine and supporting equipment have been adopted without modification. The PMD is a custom-designed, automated machine that uses a turntable to position munitions at the various workstations that are arranged around the perimeter of the machine. Munitions would be processed in a horizontal position. Fuzes or lifting plugs, nose closures, supplementary charges, bursters, and other energetics would be removed. Bursters from projectiles would be conveyed to the BSRM. All removed hardware would be discharged through a chute to the floor of the explosion-containment room (ECR).

The BSRM and supporting equipment have been adapted from the baseline process. The BSRM is a modified rocket shear machine used to shear the mortar bursters and includes tooling kits for each burster size.

In the General Atomics system, the projectile/mortar cryofracture process would be used to access agent contained in the body of the projectiles. The process includes LN2 baths and a hydraulic press capable of exerting a pressure of 500 tons (454 t). Two separate cryofracture treatment trains would be used. The press has a relatively small bed area and stroke, thereby reducing its size and weight. It fractures one munition body at a time. All of the tooling used in the baseline process would be adapted to the small press, including the same methods for mounting and fragment discharge. A tilt-table would be used to discharge fragments into a chute, which would deliver the fragments to the PRH. Decontamination/flush solution would also be supplied to the press tooling and discharge chute.

The cryocool bath is modeled after commercial food-freezing tunnels. A belt conveyor configured to handle a wide variety of munition types would transport munitions from the loading station into the bath. The cryobath length would be sized to provide the residence time needed to ensure sufficient cryocooling of the munition and to support the required throughput rate for the production-scale system. The design of the conveyor and support fixtures would minimize ice and frost buildup. The unit would use baseline bridge robots to transport the munitions from the cryobath to the hydraulic press. Ventilation air would be vented through the ducts in the cryocool and press area, where it goes to the PRH.

G.2.3.2 Munitions Access — Rockets

The proposed design for the M55 rockets and the M56 rocket warheads incorporates the units and processes used in the baseline reverse assembly processes (see Appendix E of Volume 1 for details). Units and processes include reverse assembly machines, material handling conveyors, robotic loaders and handlers, elements of the MPF thermal treatment system, auxiliary systems, and facilities and support systems. Some of these units have been slightly modified from the baseline process, but the basic unit and operations have been retained.

The basic unit used for processing the rockets is referred to as the rocket shear machine (RSM). The RSM is a custom-designed, automated machine with both a punch and drain operation and a shear operation. Rockets would be clamped in the punch and drain station where the agent cavity would be punched, and the agent (GB or VX) would be drained. The drained agent would be pumped to a surge tank prior to hydrolysis. The rocket would then be indexed to the shear station where energetics would be accessed and size-reduced. One modification from the baseline process that has been instituted is to increase the size of the hole-punches, as well as the number of punches, to improve agent drainage and increase throughput. Further, a flush system has been added (using hot water) to wash out the agent cavity. Additional shear cuts would also be made to the rocket motor assembly to improve access to propellant.

G.2.3.3 Agent Treatment

Two PRHs would be used to treat agent from the projectiles. These units would be smaller than the ERH described below, but would be similar in design. The PRHs would receive cryofractured projectiles from the two cryofracture systems. The PRHs would operate in parallel; each would process about half of the projectile throughput. The PRHs would consist of large rotary drums with an internal helical flight as well as lifting flights. The helical flight would transport material along the axis of the drum and maintain batch separation. The lifting flights would ensure agitation and mixing of the hydrolyzing solution with the agent and metal parts. The drum would be steam-traced on the outside surface to maintain an internal operating temperature of about 212ºF (100ºC). At this temperature, agents would be readily hydrolyzed. A stationary shell of thermal insulation would enclose the drum and minimize heat loss. The materials would move through the hydrolyzer, where NaOH solution would be continually added at the feed end as agent and metal parts would be discharged by gravity into the drum along with flush solution. The helical flight would move a batch of hydrolyzing solution, agent, and metal parts along the axis of the drum; each batch would contain several feeds of agent and metal parts. The drum would rotate slowly on drive rollers, and the batch would move such that residence time in the drum would be sufficient to ensure complete hydrolysis.

The drum would be supported at the discharge end by a spindle through which the coaxial steam supply and return lines pass. Axial loads would also be taken by the support trunion of the spindle. High-pressure sprays at the feed end of the drum would be used to melt and separate agent and agent heels from the metal parts. Most of the flushed agent and agent heel would flush through a perforated section of the drum at the feed end of the PRH into a tank, where agent hydrolysis would continue. Hydrolyzing solution would be added to the metal parts that travel through the drum beyond the perforated section. This hydrolyzing solution would travel through the drum, thereby decontaminating the metal parts, and would be discharged through a second perforated section at the discharge end of the drum. The hydrolysate would be transferred to a tank, where hydrolysis would be completed and verified.

Air would be pulled through the PRH to remove volatile organic compounds (VOCs) and other vapors. The air would then discharge to an air treatment system consisting of a scrubber, condenser, and carbon filters and would eventually be vented through the plant ventilation system.

The neutralization/SCWO system would incorporate the ATP neutralization system design being used at APG, with minor modifications to interface with other equipment. The neutralization system would be independent of the source of the agent (i.e., would process agent from projectiles and rockets) and would include six CSTRs and associated support systems. The hydrolysis process used for neutralization/SCWO would be chemically identical to that used for neutralization/biotreatment (see Section 5.2.2 of the TRD) and for neutralization/GPCR/TW-SCWO (see Section G.3); however, the physical processes and equipment used would be different. Secondary treatment of the agent hydrolysate to remove Schedule 2 compound would be accomplished using a solid-wall SCWO unit. The SCWO system for BGAD would be sized to process the hydrolyzed agent from the projectiles and rockets. The hydrolysate would first be collected in tanks that are sufficiently large to handle 10 hours of continuous operation. The SCWO system would employ a gas-fired preheater and auxiliary fuel system to heat the reactor to the desired operating temperature (705ºF or 374ºC), and the unit would be maintained at an operating pressure of 3,400 psia (23 MPa). Hydrolysate flow would be initiated, and auxiliary heat would be discontinued. Auxiliary fuel and preheat power would not be required under steady-state conditions.

The SCWO system for BGAD would be similar to that planned for NCD; however, the two SCWO units at BGAD would be slightly larger. The SCWO system would contain components needed to (1) accept and process hydrolysate piped from the hydrolysate holding tanks, (2) release brines to the BRA, and (3) release gaseous effluents to the plant ventilation system.

G.2.3.4 Energetics Treatment

The ERH would be the main element for primary treatment of energetics. This unit would process energetics from projectiles and rockets in an identical manner. The design of the BGAD ERH is slightly larger than the design to be applied at PCD because of the larger throughput rate of energetics that is expected at BGAD (i.e., because of the M28 propellant contained in the M55 rockets).

The ERH would replace the baseline deactivation furnace system (DFS); however, it has been adapted to the same interfaces with other equipment as the DFS. The ERH is similar in design and operation to the PRH and receives energetics and metal parts containing energetics from the ECR. The ERH consists of a large rotary drum with an internal helical flight as well as lifting flights. The helical flight transports material along the axis of the drum and maintains batch separation. The lifting flights ensure agitation and mixing of the hydrolyzing solution with the energetics and metal parts. The drum is steam-traced on the outside surface to maintain an internal operating temperature of 212 to 230ºF. At this temperature, energetics would be melted and the hydrolysis reaction would be enhanced. The materials would move through the hydrolyzer, where NaOH solution would continually be added at the feed end as energetics and metal parts are discharged by gravity into the drum, along with flush solution. The helical flight would move a batch of hydrolyzing solution, energetics, and metal parts along the axis of the drum; each batch would contain several feeds of energetics and metal parts. At the discharge end of the hydrolyzer, a perforated section of the drum would permit the hydrolysate to discharge into a CSTR to complete hydrolysis of any remaining small particles of energetics. The hydrolysate would subsequently be pumped to continuously stirred holding tanks. The hydrolysate would then discharge to the energetics hydrolysate/dunnage hydrolysate SCWO treatment system.

Air would be pulled through the ERH to remove hydrolysis vapors and fumes, including hydrogen produced from the hydrolysis of aluminum burster wells that make up some projectiles. Sufficient air flow would ensure that the hydrogen concentration remains well below the lower explosive limit (LEL) for hydrogen. The air would then discharge to an air treatment system consisting of a scrubber, condenser, and carbon filters and would eventually vent through the plant ventilation and carbon filter system.

Secondary treatment of the energetics hydrolysate and dunnage slurry (see Section G.2.3.6) would be accomplished with a solid-wall SCWO unit identical in design and capacity to the agent hydrolysate SCWO system described above. The SCWO units employed would be similar in design to the SCWO units planned for pilot testing at NCD. The major difference would be in the slurry feed and the high-pressure pump system.

G.2.3.5 Metal Parts Treatment

The munition bodies (projectiles only) would discharge from the PRH to modified baseline HDCs. The metal parts from energetics treatment (including mostly rocket parts, but also metallic parts from energetic portions of projectiles) would continue along the axis of the perforated section of the ERH drum and discharge through a chute to a separate HDC. In both HDCs, metal parts would be heated to a minimum 1,000ºF (538ºC) for a minimum of 15 minutes. The metal parts would be treated to meet a 5X condition, thus destroying residual agent and energetics. Metal from the DSHS would be decontaminated to a 5X condition in the MPF.

G.2.3.6 Dunnage Treatment

Dunnage would be treated during the campaign to the extent possible. Material would be processed by shredding and slurrying. The slurried dunnage would then be treated in the energetics hydrolysate/SCWO system. Although not all dunnage would be agent-contaminated, all dunnage would be treated on-site in this manner.

Nonmetallic dunnage materials — wood, paper, plastic, DPE suits, and spent carbon — would be size-reduced in a series of steps and fed to a commercial hydropulper and grinding pump that would slurry the material to a particle size of less than 0.04 in. (1 mm). Wood dunnage would be size-reduced in a dedicated low-speed shredder, hammer mill, and micronizer to achieve a fine particle size suitable for slurrying. DPE suits and butyl rubber would be shredded in a dedicated low-speed shredder and then cryocooled and granulated to achieve adequate size reduction. Spent activated carbon would be wet-ground in a dedicated colloid mill. A dilute solution of NaOH would be added to decontaminate the size-reduced solids in the slurry. The resulting slurry would be expected to have a particle content of about 10% by weight. This slurry would then be blended with the energetics hydrolysate. At this point, additives would be used to ensure that the solids remain in suspension and that the slurry can be readily pumped and processed in the energetics SCWO system.

G.2.4 Operations Resource Requirements

Annual utility consumption for facility operation at BGAD is presented in Table G.2, including electricity, fuel, and potable water usage. The amount of process water that would be needed for steam generation and other processes has not been calculated, because the technology provider purports that this process is a net producer of water. Chemicals and

Table G.2 Estimated utilities consumed during destruction of ACW at the Neutralization/SCWO Facility at BGAD

Utility	Average Daily Consumption	Peak Consumption	Annual Consumption
Process water [a]	23,000 gal/d	700 gal/min	6,300,000 gal/yr [b]
Potable water [a]	17,500 gal/d	180 gal/min	6,400,000 gal/yr [b]
Fire water [a]	NA [c]	3,000 gal/min	NA
Sanitary sewer [a]	20,650 gal/d	395 gal/min	7,540,000 gal/yr [b]
Natural gas	190,000 scf/d	15,000 scf/h	52,000,000 scf/yr [d]
Fuel oil	962 gal/d	406 gal/h	48,000 gal/yr [e]
Electricity	163 MWh	8.0 MW	59.6 Gwh [b,f]

[a]Assumed to be similar to incineration because the number of operations and maintenance personnel and land area are unchanged from incineration.

[b] Based on 365 days of operation per year.
[c] NA = not applicable.
[d] Based on 276 days of operation per year.
[e] Based on 600 hours of operations per year.
[f] Based on an average power rating of 80%.
Source: PMCD (1998a).

process materials that would be used during the processing of mustard agent and nerve agent include liquid nitrogen (LN_2), liquid oxygen (LOX), water in caustic solution, sodium hydroxide (NaOH), phosphoric acid (H_3PO_4), kerosens (for the SCWO), and air.

G.2.5 Operations Emissions and Waste Estimates

Wastes from the neutralization/SCWO process would include air emissions and solid wastes. The only liquid effluent expected from the destruction facility would be sanitary waste, which would be managed in an on-site treatment unit. All liquids generated by the process and all liquid laboratory wastes would be reused in the process or destroyed internally by neutralization/SCWO. Destruction facility operations, including waste management, would comply with U.S. Army, federal, state, and local requirements. Any wastes that are identified as hazardous would be stored and disposed of in compliance with RCRA requirements. A summary of the types of emissions and solid wastes is provided below.

Atmospheric Emissions. The major process gaseous residuals expected from the neutralization/SCWO operation include the following:

- Nitrogen gas from the cryofracture operation;
- Ventilation gases from the ERHs, PRHs, and MPF;
- Ventilation gases from the agent hydrolysis system; and
- Gases from the agent hydrolysate and energetics/dunnage hydrolysate SCWO systems.

These gases would be vented through scrubbers to the facility ventilation system where they pass through carbon filters prior to release to the atmosphere. Handling and disposal of process residue in accordance with the provisions of RCRA are expected to result in little potential for significant adverse impacts on air quality. Emissions from vehicles and combustion of natural gas and liquefied petroleum gas (LPG) are regulated by the U.S. Environmental Protection Agency (EPA) and the State of Kentucky and are expected to result in little potential for significant adverse impacts on air quality. Dust emissions also would be controlled during operations.

The neutralization/SCWO process would be required to meet RCRA and any other applicable environmental requirements and would operate under permit. The process would be required to destroy agent to a DRE of 99.9999% and to meet agent emission limits as established by the U.S. Army Surgeon General (ASG). Other emissions, including metals and HCl, would be regulated in accordance with the RCRA permit. The operation would also be required to meet air pollution control requirements for conventional pollutants, such as CO, SO2, and opacity. All ventilation air would be processed through carbon filtration units before being released to the atmosphere. Facility effluent release points would include gaseous releases to the environment.

Liquid Wastes. As indicated previously, brine liquids from the SCWO units would be sent to the BRA where they would be dried to form brine salts. Other liquids, such as spent decontamination solutions and laboratory wastes, would be fed to the SCWO units. Domestic sewage is the only major liquid effluent expected to be generated at the destruction facility. Small amounts of hazardous liquids could be generated from chemical makeup and reagents for support activities; the quantities are expected to be minor compared with those for domestic sewage (sanitary waste). Sanitary waste would be managed on-site.

Solid Wastes. The major process solid residuals expected from the neutralization/SCWO operation include the following:

- Brine salts from treatment of the SCWO effluent,
- Decontaminated (5X condition) scrap metal from the HDCs and the inductively heated MPF, and
- Decontaminated (5X condition) salts removed from the energetics hydrolysates and thermally treated in the inductively heated MPF.

The effluent from the SCWO unit would be sent to an evaporator that produces a filter cake with about 70% solids. The water content is bound as water of hydration; free-standing liquid is not expected (NCD 1998b). The filter cake would be transported to an approved off-site hazardous waste treatment, storage, and disposal facility for additional treatment and/or ultimate disposal.

Nonhazardous scrap metal (5X condition) from the munition bodies would be sold to a scrap dealer or smelter for reuse if approved by the regulatory authority. However, if it proves necessary, these metals could be disposed of off-site in a nonhazardous waste landfill or in a RCRA-permitted hazardous waste landfill.

Nonprocess waste streams would include decon solution, DPE suits, spent carbon, waste oils, trash, debris, and spent hydraulic fluid, which are assumed to be potentially agent-contaminated and that would be processed in the dunnage/waste processing system. After this processing, the only streams with a significant solid residue would be the decon solution (containing NaOH and sodium hypochlorite or NaOCl) and miscellaneous metal parts from equipment operation.

G.2.6 Effluent Management and Pollution Controls

The effluent management and pollution control systems used in neutralization/SCWO would be similar to systems used in the baseline incineration plant. These systems would be independent of agent and munition type. Elements of the system are described below. The plant ventilation system is designed with cascading air flow from areas of less contamination potential to areas with more contamination potential. The ventilation system permits room air-change frequencies consistent with area-level designations[15] for normal as well as anticipated maintenance activities. Plant ventilation flow would be collected in the main plenum and directed to a bank of carbon filters. From there, the air would be filtered and monitored, passed through induction draft fans, and exhausted to the stack and the atmosphere. This system would be nearly identical to the baseline system.

The decontamination fluid supply and spent decontamination fluid collection systems would be the same as those in the baseline system. Decontamination fluid would be supplied to most rooms in the main plant area, and spent decontamination fluid would be collected in sumps that would be monitored and controlled. The spent decontamination fluid would then be transferred to the spent decontamination system (SDS) treatment area, where it would be mixed with additional decontamination solution to ensure complete destruction of agent.

The DPE-supplied air and personnel support system would include maintenance air locks, donning/doffing support equipment, and facilities identical to the baseline system.

The BRA would be identical to that used in the baseline system except that it would be modified to handle brine salts from the SCWO process and water recovery by condensation for reuse in the plant. The BRA includes equipment for effluent drying in heated drums. If classified as hazardous waste, dried salts would be disposed of in a hazardous waste landfill.

The plant instrument air supply and steam supply systems would be identical to those employed in the baseline system.

Control rooms would be the same as those used in the baseline system, with changes as needed to accommodate the new systems and equipment.

The process for handling munitions from storage to the unpack area would be similar to that used for the baseline system.

Personnel support, monitoring systems, and analytical laboratories would be similar to those used in the baseline system.

As indicated previously, elements of the baseline incineration process are included in the overview of baseline and ACWA system technologies provided in Volume 1 of this TRD (see

[15] Level A, B, C, D, or E indicates the potential for contamination; Level A is the highest, and E is the lowest.

Section 1.4). In addition, the baseline incineration process is described in Appendix E of Volume 1.

G.2.7 Common Elements — Other Systems

The neutralization/SCWO process has several elements that are identical or nearly identical to other systems. Commonalities with other applicable technology systems include the following:

- The munitions access system used for neutralization/SCWO employs much of the baseline reverse assembly system, as do the other ACWA systems;
- Neutralization/SCWO, neutralization/biotreatment, and neutralization/GPCR/TW-SCWO employ neutralization as a primary treatment for chemical agents and energetics; and
- Neutralization/SCWO and neutralization/GPCR/TW-SCWO each employ SCWO systems. Although the solid wall and transpiring wall SCWO systems differ, they are interchangeable.

Facility structure; ventilation; decontamination fluid supply; personnel support; pollution abatement; water, air, and steam supply systems; control rooms; monitoring systems; and laboratory support would be identical or nearly identical to the baseline system.

G.3 NEUTRALIZATION/GPCR/TW-SCWO

The neutralization/GPCR/TW-SCWO technology system consists of neutralization of agents and energetics, GPCR of solids and gases, and secondary treatment of neutralization residuals using TW-SCWO. This technology is applicable to all ACW stored at BGAD, including ACW containing nerve or mustard agent. This technology was proposed by Foster Wheeler/Eco Logic/Kvaerner.[16] The following subsections provide a more detailed discussion of the technologies and processes involved in this system. The technology provider's technology demonstration report (Foster Wheeler/Eco Logic/Kvaerner 2000) may be viewed for additional detail.

G.3.1 Process Overview

The neutralization/GPCR/TW-SCWO process, as applied to projectiles and rockets stored at BGAD, is summarized in Figure G.3. ACW at BGAD would be disassembled by using a modified baseline reverse assembly process. For projectiles, the energetic materials would be removed and the agent would be drained. This would be accomplished using the baseline PMD and a Projectile Punch Machine (PPM). For rockets, the baseline RSM would be used; however, it has been modified (MRSM) for this application. Agent would be drained from the rockets via a punch and drain process. Then the rocket would be sheared to access the fuze and burster. A tube

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[16] Foster Wheeler, Eco Logic, and Kvaerner were originally part of a larger team under the coordination of Lockheed Martin (PMACWA 1997, 2001a). Lockheed Martin is no longer part of the technology provider team.

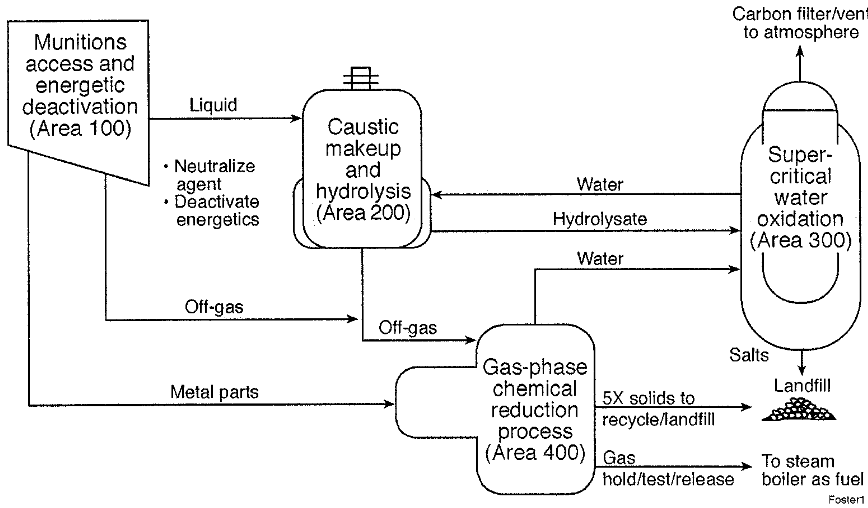

Figure G.3. Overview of Neutralization/GPCR/TW-SCWO process (Foster Wheeler/Eco Logic/Kvaerner System) for the treatment of ACW at BGAD *(Source:* Adapted from NRC 1999).

cutter would be used to section the fiberglass rocket firing tube just forward of the threads of the fin assembly, and the fin assembly would be unscrewed to access the propellant. Propellant would be pulled from of the rocket motor, size-reduced in a grinder, and slurried.

Munitions casings and other hardware would be processed through the Continuously Indexing Neutralization System (COINS™). This system would be used to place munitions casings and other solids in hanging baskets that are dipped in caustic baths to separate energetics from metal parts, followed by spray washing.

The drained nerve agents (GB and VX) would then be neutralized/hydrolyzed by using a NaOH solution in systems operated at 194ºF and atmospheric pressure. Energetics would be neutralized/hydrolyzed by using a caustic solution in systems also operated at 194ºF and atmospheric pressure. Mustard agent would be hydrolyzed using hot water; however, caustic would be used later in the process. Hydrolysates would be treated in a TW-SCWO unit. TW-SCWO differs from solid-wall SCWO (see Section G.2) in that a boundary layer of clean water is dispersed from the sides of the SCWO unit as a means of limiting corrosion and solids buildup (Foster Wheeler/Eco Logic/Kvaerner 2000). TW-SCWO also differs from the solid-wall unit in that the TW-SCWO can treat agent and energetic hydrolysates simultaneously.

Dunnage and metal parts (e.g., from COINS) would be treated using GPCR. GPCR is a thermal system operated at temperatures above 1,560˚F (850˚C) that uses hydrogen in a steam atmosphere to reduce organic compounds to methane (CH4), CO2, CO, and acid gases. The system includes solids treatment in a thermal reduction batch processor (TRBP), which uses a flame-heated batch evaporator to volatilize organic materials to the main GPCR reactor. The TRPB would treat metal parts and dunnage to a 5X condition.[17] A batch or continuous mode TRBP may be employed, depending on the nature of the munitions being treated. The technology provider indicates that recovered gas from the GPCR unit may be able to be used as auxiliary fuel for a steam boiler or industrial furnace (BIF) (NRC 1999). (See Section 5.3.5.3.4 for information on recovered gas content.) Each of these operations is performed in a different area of the destruction facility, as shown in Fig. G.4.

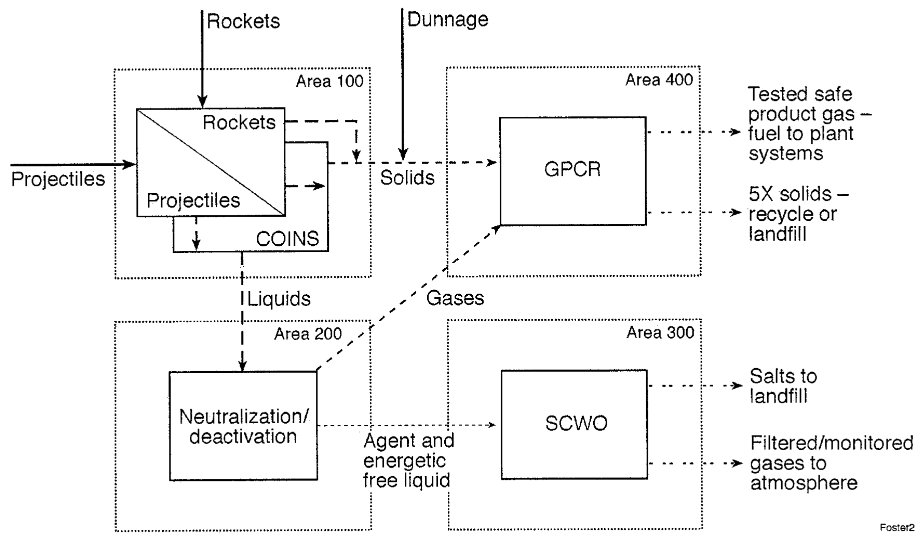

Figure G.4. Neutralization/GPCR/TW-SCWO process overview showing different areas of the destruction facility *Source:* Foster Wheeler/Eco Logic/Kvaener 2000).

G.3.1.1 Neutralization of Agent and Energetics

Agent and energetics neutralization were reviewed in Section G.2.1.1. Because the history of neutralization of agent and energetics for neutralization/GPCR/TW-SCWO does not differ from other technologies, this information is not repeated.

G.3.1.2 Gas-Phase Chemical Reduction

GPCR is used in this technology system as a means of treating solid materials (metal parts and dunnage) and gases from other parts of the facility (from neutralization reactors). The process was developed and patented by Eco Logic (NRC 1999). Figure G.5 is a simplified flow diagram for a typical GPCR process (Foster Wheeler/Eco Logic/Kvaerner 2000).

[17] The definition of 5X is provided in Volume 1 of the TRD (see Section 1.2.2.4).

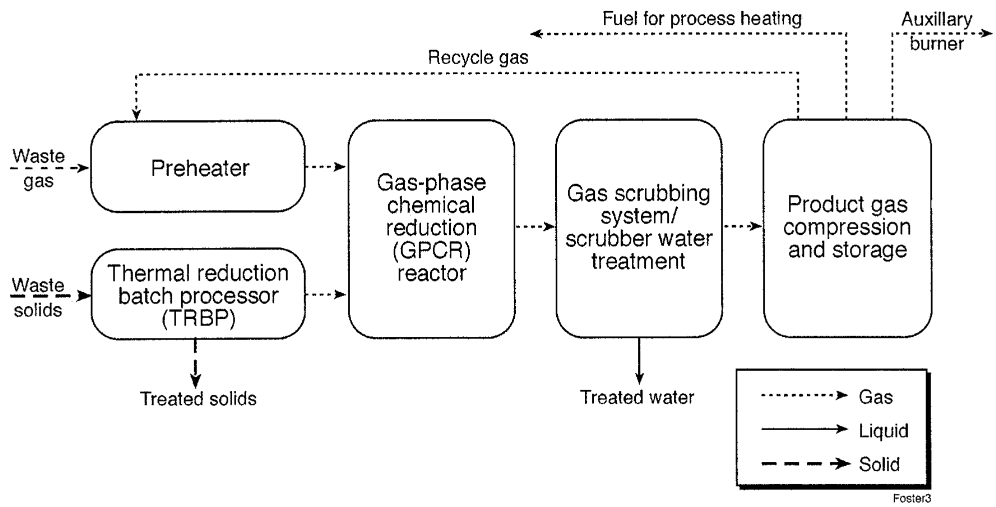

Figure G.5. Flow diagram of gas-phase chemical reduction (GPCR) (Source: Foster Wheeler/Eco Logic/Kvaerner 2000).

GPCR has a history of use in treating waste steams. This technology has been used to treat electrical equipment contaminated with PCBs (NRC 1999). In addition, the process has been used in both Canada and Australia (NRC 1999). The Australian plant currently processes organochlorine pesticide wastes, the major component of which is DDT (Eco Logic 2001).[18] Eco Logic, Inc., indicates that its process was demonstrated at the Middleground Landfill in Bay City, Michigan, under a Toxic Substances Control Act research and development permit during October and November 1992. The test was performed using PCB-contaminated wastewater, waste oil, and soil from the site. Test results yielded a 99.99% DRE for PCBs during all runs; a 99.99% DRE for a tracer compound (e.g., perchloroethylene); and a net destruction of trace feedstock dioxin and furan compounds during all runs (EPA 1994). Eco Logic has also evaluated the ability of this process to treat chemical agents and energetics considered in the ACWA program, including HD and VX (Eco Logic 1995). The PMACWA indicates that GPCR is expected to gain regulator acceptance (PMACWA 2001a).

G.3.1.3 Transpiring-Wall Supercritical Water Oxidation

Supercritical water oxidation was reviewed in Sect. G.2.1.2. The Foster Wheeler/Eco Logic/Kvaerner approach, however, involves a transpiring-wall (TW) SCWO unit. Figure G.6 is a schematic of the TW-SCWP unit. The core technology with respect to organic oxidation for TW-SCWO differs only slightly from that of general SCWO. NRC (1998) and NRC (1999)

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[18] DDT is a banned pesticide, otherwise known as dichlorodiphenyltrichloroethane.

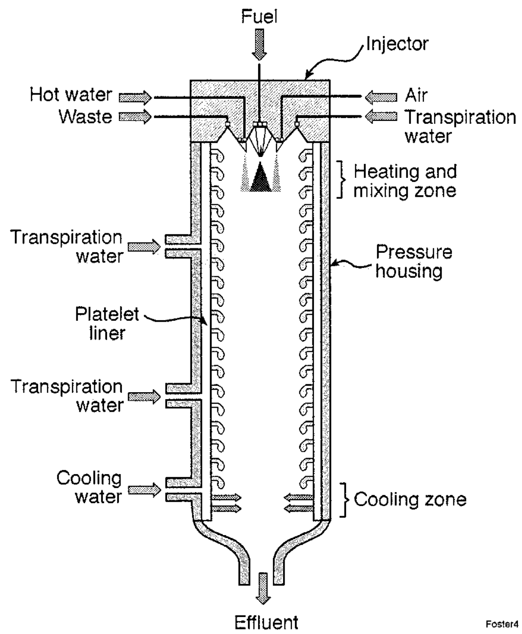

Figure G.6. Transpiring-wall (TW) SCWO reactor. *Source:* Foster Wheeler/Eco Logic/Kvaerner 2000).

provide information on both processes. Thus, the bulk of the information presented in Section G.2.1.2 is not repeated here; only that which is unique to TW-SCWO is discussed.

TW-SCWO is a type of SCWO unit that was developed to overcome plugging and corrosion problems associated with conventional SCWO (NRC 1999). The premise behind the unit is that maintaining a layer of clean water between the unit wall and the primary oxidation reaction limits corrosion and associated plugging. The unit, called a transpiring platelet wall reactor, was developed and patented by GenCorp/Aerojet and Foster Wheeler (NRC 1999). The unit has two walls; an inner TW that is contained within an outer wall. The inner wall consists of a series of platelets that permit continuous transpiration of deionized water into the unit (NRC 1999). Additional details on the device are provided in NRC (1999). NRC (1998) provides an overview of the history of SCWO and TW-SCWO and presents the results of testing using VX and other hydrolysates at PBA. To date, the TW technology has not been commercially used.

G.3.2 Summary of Demonstration Testing

Demonstration testing during Demo II was not as extensive as testing during Demo I because of the similarity of some of the unit processes and technologies. Agent hydrolysis and energetics hydrolysis objectives were met. Much of the testing of the TW-SCWO unit was performed with agent simulant rather than with agent. Operational problems with the TW-SCWO unit included liner integrity, feed flow problems, high effluent temperatures, and slugging of reactor injection ports. Scaling/lining of the equipment downstream of the SCWO reactor was also shown to be problematic during demonstration testing. However, there was no serious corrosion or salt plugging observed within the reactor. The GPCR unit performed with minor problems; however, the product gas and stack gas streams could not be adequately characterized for chemical agents or nonagent-related constituents because of difficulties with on-site analyses. Most of the stack gas analyses and some of the product gas analyses were not conducted for GB and HD validation runs. The PMACWA reviews the quality of the data generated during demonstration testing in PMACWA (2001d,e,f).

On the basis of demonstration testing, the technology provider plans to make the following changes to the neutralization/GPCR/TW-SCWO technology (Foster Wheeler/Eco Logic/Kvaerner 2000):

- Identify and finalize an analytical device and method to evaluate product gas from the GPCR unit for the presence of chemical agent;
- Demonstrate the effectiveness, operability, and cleanout cycles of the new GPCR device; and
- Incorporate equipment downstream of the TW-SCWO unit to remove aluminum and other solids.

G.3.3 Detailed Process Description

This section presents a detailed process description for neutralization/GPCR/TW-SCWO, as applied to BGAD and the ACW stored there, on the basis of demonstration testing results. The equipment used in a pilot-scale facility may vary in nomenclature and design from that described here, depending on the system selected and system requirements.

As indicated previously in Figure G.4, the technology system is segregated into four primary areas.[19] Munitions access and initial treatment of munitions hardware (e.g., empty casings) would be conducted in Area 100. Munitions access would use modified baseline reverse assembly; a different process would be used for projectiles versus rockets. M28 propellant from the M55 rockets would be pulled out of the rocket motor for subsequent neutralization in Area 200. Energetics from projectiles and the rocket burster, as well as other munitions hardware, would be treated with caustic in the COINS to extract and initiate neutralization of energetics and to neutralize agent remaining after the drain process. Following munitions access in Area 100, the process for treating specific agents and energetics would be largely independent of munition type and agent fill.

[19] A fifth process area, Area 500, would be established for infrastructure and support systems.

Drained agents and M28 propellant from the M55 rockets would be neutralized in Area 200. Caustic hydrolysis using NaOH would be used to neutralize nerve agent and energetics. Hot water would be used to neutralize mustard agent; however, a caustic wash would be used later in the hydrolysis process. Neutralization would be performed in a series of closed CSTRs. Gases generated in these closed vessels would be piped to the GPCR unit in Area 400. Hydrolysate produced in Area 200 would be piped to Area 300 where it would be further treated with the TW-SCWO unit to remove Schedule 2 compounds and other organics. The agent and energetics hydrolysates may be treated in the same TW-SCWO processing train. Dunnage and other solids from projectiles and rockets would also be treated using the GPCR unit in Area 400. Solids would first be placed in the TRBP to drive off organic compounds and to complete treatment to a 5X condition. Gases would flow from the TRBP to the GPCR unit where they would be reduced in a hydrogen environment.

Munition bodies (projectiles) decontaminated to a 5X condition can be commercially recycled or disposed of as solid waste. Nonmetal solid waste that is treated to a 5X condition, if defined as hazardous waste, can be placed in a hazardous waste landfill.[20] If defined as nonhazardous wastes, these solid wastes may be disposed of in a nonhazardous waste landfill. Liquid from the SCWO units would be evaporated to drive off water, thereby leaving a crystallized salt. The water would be condensed and recycled to the hydrolysis units, and the salts would be sent to a RCRA hazardous waste landfill.[21] Off-gases from process units (except the TW-SCWO) would vent to the GPCR unit. Off-gases from the GPCR unit would be processed through a series of scrubbers and compressors. The resulting liquefied product gas may be used as a fuel gas in Area 400, assuming it meets regulatory acceptance criteria for BIF. TW-SCWO off-gas would pass through carbon filters and would be released to the atmosphere. Short descriptions of each of the unit processes included in the neutralization/GPCR/TW-SCWO process as applied to projectiles and rockets stored at BGAD are provided below. Because of the differences in the munitions access process for projectiles versus rockets, separate descriptions of the munitions access process are provided. However, the remaining process descriptions (for agent and energetics treatment, dunnage treatment, metal parts treatment, and effluent management and pollution controls) apply to both projectiles and rockets. Foster Wheeler/Eco Logic/Kvaerner (2000) includes detailed process flow diagrams and may be reviewed for additional detail.

G.3.3.1 Munitions Access — Projectiles

The proposed design for munitions access for projectiles incorporates many of the units and processes used in the baseline reverse assembly processes (see Appendix E of Volume 1 for details). Units and processes include reverse assembly machines, material handling conveyors, robotic loaders and handlers, auxiliary systems, and facilities and support systems. Some of these

[20] Solids treated to a 5X condition to remove residual agent may be defined as hazardous waste if they exhibit any of the characteristics of hazardous waste as defined in 40 CFR 260.21-260.24.

[21] While these salts are not known to contain chemical agent, they may be defined as hazardous waste if they exhibit any of the characteristics of hazardous waste as defined in 40 CFR 260.21-260.24. Typically, these salts contain heavy metals and exhibit the RCRA toxicity characteristic (40 CFR 261.24). In Kentucky, the salts may be regulated as listed hazardous wastes because of their association with chemical agent. These salts may be "delisted" and not considered hazardous waste.

units have been slightly modified from the baseline process, but the basic unit and operations have been retained. The major operations are summarized below.

The reverse assembly operation would be segregated into a dry area and a wet area. Projectiles would be reverse assembled in the Area 100 dry area. The COINS would be housed in the Area 100 wet area. Projectiles would be disassembled using the standard baseline projectile loading and PMD machines, where the burster and fuze would be removed first. A burster shearing machine would be used to shear the bursters, which would then be processed in the COINS. The primary difference from the baseline system would be a modified punch and drain system that would use the new PPM to rapidly drain agent from the burster area. Following agent draining, projectile bodies would go directly to the GPCR unit in Area 400 for 5X treatment.

Sheared bursters and other projectile parts would be processed in COINS, which is unique to this technology system. Projectile parts would enter from the dry area through a fill chute with double-explosive doors. The parts would be dropped into baskets that are processed through COINS on a conveyor system. The conveyor would immerse the basket and the parts in caustic baths (dwell stations), followed by a wash station and a dump station. Parts would be held in the dwell stations until energetics have been dissolved and deactivated. Residual solids (including metal parts) that are not dissolved in COINS would be dumped in a TRBP bin, where they would be tested for remaining energetics. If the residual solids met requirements, they would be sent to the GPCR unit in Area 400 for treatment to a 5X condition. Liquid and sludge from the COINS system would be pumped to Area 200, where they would be treated further. Off-gases produced in COINS would be sent to the GPCR unit in Area 400 for further treatment. Additional information on COINS, including several schematics, is provided in Foster Wheeler/Eco Logic/Kvaerner (2000).

G.3.3.2 Munitions Access — Rockets

As with the projectiles, the proposed design for munitions access for rockets incorporates many of the units and processes used in the baseline reverse assembly processes (see Appendix E of Volume 1 for details). Units and processes include reverse assembly machines, material handling conveyors, robotic loaders and handlers, auxiliary systems, and facilities and support systems. Some of these units have been slightly modified from the baseline process, but the basic unit and operations have been retained. The major differences, as compared with the baseline process and the process for projectiles, are summarized below.

Rockets would also be processed through the Area 100 dry and wet areas, as described above. However, a MRSM would be used to shear the rocket. In the modified system, the same procedures as applied in the baseline RSM would be used, except in a different order. The modified RDS punches, drains, and washes out the rockets. One rocket shear station (RSS) shears the fuzes, and another RSS then shears the rocket body into sections. A tube cutter cuts the shipping and firing tube and the fin assembly is unscrewed from the rocket motor to access the propellant grain. The M28 propellant grain is then pulled out of the motor case in its entirety and size-reduced with a grinder into a slurry. Slurried propellant material from the rockets would be transferred to a number of holding tanks for feed to neutralization (Area 200). Agent and spray wash water would be transferred to a buffer area similar to the baseline TOX. The sheared rocket parts (fuze, burster, and igniter) would be treated in the COINS as described above.

G.3.3.3 Agent Treatment

Agent treatment would be conducted in Area 200 in a treatment train separate from treatment of energetics. Nerve agent would be neutralized by reacting with NaOH (20% solution). Mustard agent would be neutralized first with water and then with NaOH solution. This dual treatment process for mustard agent would prevent the formation of undesirable vinyl compounds that could be formed if the mustard agent were treated with just water. Testing would confirm total neutralization. If testing detects residual agent, additional time would be allowed for agent treatment. Once the reaction is completed, treated hydrolysate would be pumped to surge tanks in Area 300, where the hydrolysate would await further treatment by TW-SCWO. Additional NaOH would be added while the hydrolysate is in these surge tanks, to maintain the appropriate pH. This eliminates the potential for agent reformation. All neutralization in the Area 200 reactors would be conducted under a nitrogen blanket. Nitrogen would be vented to Area 400 for treatment using GPCR.

Agent hydrolysate would be further treated by using TW-SCWO to destroy Schedule 2 and other organic compounds. The TW-SCWO system is designed to oxidize remaining organic materials in hydrolysates, including CWC Schedule 2 compounds, to water, CO2, and inorganic salts. The TW-SCWO system is similar to the solid-wall SCWO system discussed in Section G.1.3, except that the unit incorporates a TW design. The TW is designed to place a layer of deionized water on the reactor™s inner wall as a means of limiting corrosion and reducing the generation and buildup of salts and other solids that the technology provider claims can clog conventional systems. TW-SCWO also differs from the solid-wall unit in that the TW-SCWO can treat agent and energetic hydrolysates simultaneously.

After establishing system pressure, the system would initially be heated by startup water passed through a preheater. When the preheater temperature reaches approximately 1,100° F (593° C), startup fuel and oxygen would be pumped to the reactor to initiate the oxidation reaction. With ignition achieved, the startup fuel and startup water would be decreased (but not stopped), while the hydrolysate feed, diluent water, kerosene spike (auxiliary fuel), caustic, and oxygen would be introduced to the reactor. The use of auxiliary fuel would minimize operational fluctuations resulting from incoming hydrolysate variability. The caustic solution would be used to neutralize any acidic species that may form during the oxidation reaction. Two TW-SCWO reactors would be operated in parallel.

Near the exit of the reactor, water at 60° F would be injected to rapidly quench the effluent to 600° F, causing most precipitated salts exiting the reactor to redissolve. After this, the effluent would pass through a back-pressure regulator valve to reduce system pressure before entering a knockout drum. Hot effluent liquid and vapors would be separated in the knockout drum, which includes a scrubber to remove particulate solids from the vapor. The hot vapors would flow to an effluent cooler where they would be cooled to 120°F. The cooled effluent would then flow to a flashed gas separator where the vapor fraction (flue gas) would be separated and filtered through carbon filters and would be vented to the atmosphere. The flue gas would be continually monitored for CO, CO_2, nitrogen oxides (NO_x), N_2O, and O_2. Effluent would be analyzed for the presence of residual organics, and if it meets total organic carbon (TOC) specifications, it would be pumped to an evaporator/crystallizer system where water would be recovered and subsequently reused. If the effluent does not meet TOC requirements, it would be reintroduced into the TW-SCWO unit. Crystallized solids would be sent to a bin. If determined to be hazardous waste, the salts would be treated, as necessary, and disposed of as hazardous waste. As indicated previously, these salts may be delisted from being hazardous waste.

G.3.3.4 Energetics Treatment

Energetics treatment would be conducted in Area 200 in two separate treatment trains. One treatment train would be used for M28 propellant and the other would be used for all other energetics, including energetic material from bursters and fuzes. The M28 propellant would be neutralized after it was size-reduced with a grinder. The other energetic materials would be partially hydrolyzed in the COINS prior to bulk neutralization. As with nerve agent, neutralization would be conducted by reacting with NaOH (20% solution). Energetic material deactivation would be monitored by high-pressure liquid chromatography (HPLC). All other energetic treatment operations in Area 200 would be identical to those used for agent.

Following energetics neutralization, the energetics hydrolysate would be further treated in the TW-SCWO unit. Treatment there would be identical to that for agent hydrolysate.

G.3.3.5 Metal Parts and Dunnage Treatment and Process Off-Gas Treatment

Metal parts from Area 100 (projectile bodies), residual solids from COINS, and all dunnage would be treated in Area 400. Area 400 would also be used to treat process gases from other units that are part of this technology system, except for gases from the TW-SCWO unit. Area 400 would house the GPCR operation. In addition to the GPCR unit, the process would consist of a preheater unit for incoming process gases and a TRBP for 5X treatment of metal parts and dunnage. Gases from the TRBP would flow directly to the GPCR unit. In addition, the process includes a multistage system for gas scrubbing to remove inorganic contaminants and light hydrocarbons. The scrubber system would result in a process stream containing CH_4 and other hydrocarbons; this stream may be able to be used as fuel for a BIF.[22] Area 400 would also contain a product gas compression and storage unit.

Process gases from other units that are part of this technology system (except TW-SCWO), including recycled gases from the GPCR product gas compression and storage unit, would go to the GPCR preheater. There the gases would be preheated prior to processing in the GPCR unit.

The TRBP is a device used to heat metal parts and dunnage, thereby volatilizing organic materials from these solids. The device also vaporizes organic materials such as cellulose and plastics. TRBPs have a capacity of 47 yd^3, and two of these devices are designed to operate in parallel. Each TRBP would operate in batch mode, for dunnage, and have 3 trays capable of holding 15 waste-bearing drums for a maximum weight of 11,023 lb for each batch treated. Air would be purged from the device using nitrogen. Then preheated hydrogen and superheated steam would be injected into each tray of the unit at a temperature of 1,382F, through individual flexible hoses. The TRBPs would operate in a batch cycle from 32 to 48 hours, depending on the agent and campaign. Gases would then be swept from the TRBP and into the GPCR unit by a preheated hydrogen sparging stream. Toward the end of the 32- to 48-hour period, the TRBP

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[22] It is unclear whether the product gas would meet BIF acceptance criteria (40 CFR, Part 266, Subpart H).

would be heated up to a temperature in excess of 1,112°F for 30 minutes or more to help ensure that a 5X condition has been obtained. Finally, the TRBP would be cooled and purged with nitrogen and steam to end the cycle. Remaining 5X solids would be removed and new solids would be loaded; removal and loading would take place through separate doors to prevent cross-contamination.

The GPCR reactor is designed to heat incoming waste streams and chemically reduce organic contaminants. Incoming streams would include preheated hydrogen, superheated steam, Area 100 and 200 off-gases, and volatilized waste from the TRBPs. These streams would be mixed in static mixers and would enter the unit at a temperature of 1,202 to 1,382°F (374 to 750°C). Residence time for incoming streams is between 2.5 and 10 seconds. The hydrogen and steam would react with the organic contaminants to produce HCl, HF, phosphorous oxides, H_2S, and CH_4. A secondary steam reforming reaction would produce CO, CO_2, and H.

The GPCR unit also includes a gas scrubbing, water treatment, and compressing/storage system. The reduced gas from the GPCR unit would be processed through a series of scrubbers where caustic neutralizes acid gases. Inorganic salts would be precipitated from solution and filtered from the effluent. Naphthalene and solid particulates would be removed before the gas, which has now been cooled to near ambient conditions, goes to compressors. The gas compressors consist of a series of coolers for liquid separation. Liquid and gas would be stored in product gas storage tanks where the product would be tested to ensure complete treatment. The product gas is intended for reuse as supplemental fuel in the Area 400 process burners or Area 500 support services (heating) boiler. In the event that any gas fails to meet treatment criteria, it can be reprocessed in the GPCR unit. A final level of emission control redundancy would be provided by use of a catalytic converter. This would ensure that all of the fuel gas and product gas combusted in the process would be fully converted to CO_2 and water.

G.3.4 Operations Resource Requirements

Estimated annual utility consumption for facility operation, including electricity, fuel, and potable water usage, is presented in Table G.3. The estimates in Table G.3 are based on the assumption that the facility would consume potable water and produce sanitary waste 365 days per year. These are conservative assumptions that would identify an upper bound to potable water and sanitary waste treatment requirements. It was also assumed conservatively that fuel oil would be consumed only by an emergency diesel generator that would operate 600 hours per year. This analysis assumed that the amount of natural gas consumed for space heating would be negligible compared with the amount of natural gas consumed during the destruction process.

Destruction processes would consume raw materials. These would include LOX, NaOH, and kerosene that would be consumed during the processing of the three agents.

Table G.3 Estimated Utilities Consumed during Destruction of ACW at the Neutralization/GPCR/TW-SCWO Facility at BGAD

Utility	Average Daily Consumption	Peak Consumption	Annual Consumption
Process water [a]	64,000 gal/d	3,600 gal/h	18,000,000 gal/yr
Potable water [b]	17,500 gal/d	180 gal/min	6,400,000 gal/yr [c]
Fire water [b]	NA [d]	3,000 gal/min	NA
Sanitary sewer [b]	20,650 gal/d	395 gal/min	7,500,000 gal/yr [c]
Natural gas [a]	500,000 scf/d	579,000 scf/d	138,000,000 scf/yr [e]
Fuel oil	962 gal/d	406 gal/h	48,000 gal/yr [f]
Electricity	72 MWh	3.5 MW	26.3 GWh [c,g]

[a] Estimated on the basis of the munitions processing rate and unit utility factors for neutralization/ GPCR/TW-SCWO technology.

[b]Assumed to be similar to incineration because the number of operations and maintenance personnel and land area are unchanged from incineration.

[c]Based on 365 days of operations per year.

[d] NA = not applicable.

[e]Based on 276 days of operations per year.

[f]Based on 600 hours of emergency diesel generator operation per year.

[g]Based on an average power rating of 80%.

G.3.5 Operations Emissions and Waste Estimates

Wastes from the neutralization/GPCR/TW-SCWO process would include air emissions and solid wastes. The only liquid effluent from the facility would be sanitary waste, which would be managed in an on-site treatment unit. All liquids generated by the process and all liquid laboratory wastes would be reused in the process or destroyed internally by the neutralization/GPCR/TW-SCWO process. Destruction facility operations, including waste management, would comply with U.S. Army, federal, state, and local requirements. Any wastes that are identified as hazardous (e.g., SCWO salts and GRCR residues) would be stored and disposed of in compliance with RCRA requirements.

The only solid effluents from the process would include salts from TW-SCWO and solid residues from GPCR. Solid residues from GPCR collected during the PMACWA Demo II Test Program passed the TCLP requirements, with the exception of DPE runs (Foster Wheeler/Eco Logic/Kvaerner 2000).

Gas Effluents. GPCR gas (including COINS and hydrolysate reactors gas streams) containing hydrogen, CH_4, CO_2 and acid gases would be scrubbed with caustic and then held for agent testing. Once cleared, the gas would be passed through a boiler or energy recovery device and then a catalytic converter. The gas product from GPCR would be a RCRA hazardous waste, but may be burned in a BIF if it meets certain requirements. The final technical evaluation for this technology (PMACWA 2001b) states that it appears likely that the GPCR product would exceed the specific heating value threshold (5,000 Btu/h) that is used as a key test to determine the applicability of the BIF exemption.

Product gases would be scrubbed before release to the plant ventilation system. These product gases would be stored and tested prior to release to the atmosphere. Thus, if their concentrations leaving the scrubbers are not acceptable, they would reenter the GPCR process. Consequently, it was assumed that emissions from the product gas burner vent would not be further treated after release from the scrubbers. Facility effluent release points would include gaseous releases to the environment.

Handling and disposal of process residue in accordance with the provisions of RCRA are expected to result in little potential for significant adverse impacts on air quality. Emissions from vehicles and combustion of natural gas and LPG are regulated by the EPA and the State of Kentucky and are expected to result in little potential for significant adverse impacts on air quality. Dust emissions would be controlled during operations as well.

The neutralization/GPCR/TW-SCWO process would be required to meet RCRA and any other applicable environmental requirements, as necessary, and would operate under permit. Permit conditions are expected to require the process to destroy agent and energetics to a DRE of 99.9999% and to meet agent emission limits as established by the ASG. Other emissions, including metals and HCl, would be regulated in accordance with the RCRA permit. The operation would also be required to meet air pollution control requirements for conventional pollutants, such as CO, SO_2, and opacity.

Small amounts of organic and metallic compounds would be emitted from the combustion of natural gas during normal boiler operation and from the combustion of fuel oil during emergency diesel generator operation. Many of these emissions are also HAPs, as defined in Section 112 of the CAA, Title III.

The neutralization/GPCR/TW-SCWO facility at BGAD would be equipped with building ventilation systems that would discharge, to the atmosphere, indoor air from the MDB process area, the Laboratory Building, and the Personnel and Maintenance Building through the filter farm stack. Of the three ventilation systems, only the indoor air from the MDB process area would be potentially exposed to chemical agents during operations.

Liquid Wastes. Through evaporation, crystallization, and filtration, brine salts would be formed from brine liquids from the TW-SCWO units. Remaining liquids would be recycled. Domestic sewage is the only major liquid effluent that is expected to be generated at the destruction facility. Small amounts of hazardous liquids could be generated from chemical makeup and reagents for support activities; the quantities are expected to be minor compared with domestic sewage (sanitary waste). Sanitary waste would be managed on-site. Solid Wastes. The major process solid residuals expected from the neutralization/ GPCR/TW-SCWO operation include the following:

Solid Wastes. The major process solid residuals expected from the neutralization/GPCR/TW-SCWO operation includes the following:

- Scrap metal and other solid residues decontaminated to a 5X condition in the GPCR, a thermal system that uses hydrogen in a steam atmosphere to reduce organics into CH_4 , CO_2 , CO, and acid gases;
- Brine salts from treatment of the SCWO effluent; and
- TRBP residues.

The brine salts (filter cake) would be transported to an approved off-site hazardous waste treatment, storage, and disposal facility for additional treatment and/or ultimate disposal. These waste streams would be shipped from the on-site facility to off-site locations.

G.3.6 Effluent Management and Pollution Controls

The effluent management and pollution control systems used in neutralization/GPCR/ TW-SCWO would be similar to systems used in the baseline incineration plant. These systems would be independent of agent and munition type. Elements of the system are described below.

The plant ventilation system is designed with cascading air flow from areas of less contamination potential to areas with more contamination potential. The ventilation system permits room air-change frequencies consistent with area-level designations[23] for normal as well as anticipated maintenance activities. Plant ventilation flow would be collected in the main plenum and directed to a bank of carbon filters. Two HEPA filters would also be used in series to remove particulates from the air streams. From here, the air would be filtered and monitored, passed through induction draft fans, and exhausted to the stack and the atmosphere. This system would be nearly identical to the baseline system.

The decontamination fluid supply system and spent decontamination fluid collection system would be the same as those used in the baseline system. Decontamination fluid would be supplied to most rooms in the main plant area, and spent decontamination fluid would be collected in sumps that would be monitored and controlled. The spent decontamination fluid would be transferred to the hydrolysis treatment area (Area 200), where it may be mixed with additional decontamination solution to ensure complete destruction of agent.

The DPE-supplied air and personnel support system would include maintenance air locks, donning/doffing support equipment, and facilities identical to baseline.

Rather than the baseline BRA, the evaporator/crystallizer would be used. This system is similar to the BRA unit used in the baseline system except that it would be modified to handle brine salts from the TW-SCWO process and water recovery by condensation for reuse in the plant. The evaporator/crystallizer would include equipment for effluent evaporization. If classified as hazardous waste, dried salts would be treated as necessary and disposed of in a hazardous waste landfill. Dried salts may also be delisted, as indicated previously.

The TRBP portion of the GPCR unit would result in treated metals and solids, which the TRBP is intended to treat to a 5X condition. While metals may be recycled, treated solids would be treated further, if necessary, and disposed of in a solid or hazardous waste landfill in compliance with regulatory requirements.

The plant instrument air and steam supply systems would be similar to those employed in the baseline system.

Control rooms would be the same as those used in the baseline system, with changes as needed to accommodate the new systems and equipment.

The process for handling munitions from storage to the unpack area would be similar to that used in the baseline system.

Personnel support, monitoring systems, and analytical laboratories would be similar to those used in the baseline system.

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[23] Level A, B, C, D, or E indicates the potential for contamination; Level A is the highest, and E is the lowest.

As indicated previously, elements of the baseline incineration process are included in the overview of the baseline and ACWA system technologies provided in Volume 1 of this TRD (see Section 1.4). In addition, the baseline incineration process is described in Appendix E of Volume 1.

G.3.7 Common Elements — Other Systems

The neutralization/GPCR/TW-SCWO process has several elements that are identical or nearly identical to other systems. Commonalities with other applicable technology systems include the following:

- The munitions access system used for neutralization/GPCR/TW-SCWO employs much of the baseline reverse assembly system, as do most of the other ACWA systems,
- Neutralization/GPCR/TW-SCWO employs essentially the same process as neutralization/SCWO and neutralization/biotreatment for neutralization as a primary treatment for chemical agents and energetics, and
- SCWO and TW-SCWO are comparable processes since they both involve oxidation of organics at supercritical conditions. Different ancillary equipment would be required for each type of SCWO unit, however.

Facility structure; ventilation; decontamination fluid supply; personnel support; pollution abatement; water, air, and steam supply systems; control rooms; monitoring systems; and laboratory support would be identical or nearly identical to the baseline system.

G.4 ELECTROCHEMICAL OXIDATION

The electrochemical oxidation technology system uses modified baseline reverse assembly to access agents and energetics. Agents and energetics are then mineralized with an electrochemical oxidation process that uses silver nitrate ($AgNO_3$) in concentrated nitric acid (HNO_3). Hardware and solids are thermally decontaminated.

The technology provider refers to its process as the SILVER II process. This neutralization process takes place in a standard industrial electrochemical cell and relies on the oxidizing capability of Ag 2^+ ions in a solution of HNO_3. The Ag 2^+ ions mineralize organics to CO_2, inorganic salts, water, and acids. Electrochemical oxidation differs from the other three technologies evaluated in this TRD in that no secondary treatment is needed to address Schedule 2 compounds.

This technology is applicable to all ACW stored at BGAD, including ACW containing nerve or mustard agent, and it is reported as also being effective for energetics. The process for munitions access differs slightly for M55 rockets and M56 warheads, versus that for projectiles stored at BGAD. Following munitions access, treatment of agent and energetics from the various types of ACW is largely independent of munition type and agent fill.

SILVER II was proposed by AEA Technology/CH2MHILL. The following subsections provide a more detailed discussion of the technologies and processes involved in this system. The technology provider’s technology demonstration report (AEA/CH2MHILL 2000) may be viewed for additional detail.

G.4.1 Process Overview

Figure G.7 provides an overview of the electrochemical oxidation process using SILVER II. As Figure G.7 illustrates, the U.S. Army's baseline reverse assembly process would be used to disassemble ACW at BGAD. However, fluid-abrasive cutting and fluid-mining that employ water and grit would be used to access the rockets. Spent grit would be filtered from the water and sent to thermal treatment; the water would be reused for fluid-abrasive cutting. A rocket demilitarization machine (RDM) has replaced the baseline RSM. The RDM is a new machine that performs the same function as the existing RSM. The rocket processing begins with the automatic feeding of the rocket, contained in its firing tube, to the punch and drain station. The RDM would punch and drain rockets, and steam would be used to wash the agent reservoir. The agent would be drained and pumped to buffer storage tanks, the same as for projectiles and mortars. The rocket would then be fluid jet cut into three sections. The fuze, warhead, motor, shipping and firing tube, and fin assembly would then be separated. Bursters would be fluid-mined to remove the explosive charges. The M28 propellant grain would be pulled from the motor case in its entirety and size-reduced with a two-stage grinder into a slurry. The rocket parts and fiberglass shipping/firing tube would be transferred to thermal treatment. For projectiles, the baseline PMD process would be used to remove the explosive train. Projectile bursters would be fluid-mined to remove the explosive burster charge. A punch/drain/ washout machine (PDWM) would access the agent cavity in projectiles, and agent would be drained using gravity. Steam would be used to wash the agent reservoir.

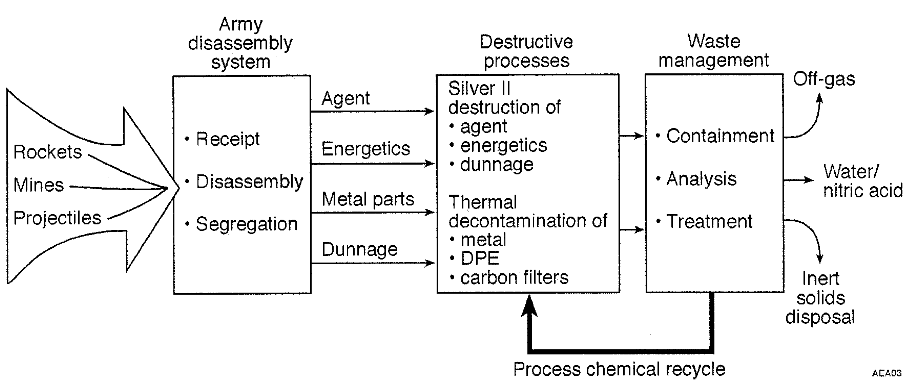

Figure G.7. Overview of the AEA/CH2MHILL SILVER II process for the treatment of ACW at BGAD. (*Source*: Adapted from NRC 1999).

Fuzes and supplementary charges from all ACW at BGAD would be sent to a detonation chamber. The detonation chamber is a thermally initiated, contained detonation device that initiates the energetics by exposing them to heat.

Slurried explosive material from the ACW (20% by weight) would be sent to a number of holding tanks for feed to the SILVER II reactor. Agent would be pumped to a buffer area similar to the baseline TOX holding system. Solid secondary wastes (i.e., dunnage) would be size-reduced using two-stage shredders. Metal components, including projectile bodies, would be thermally treated to a 5X[24] condition in a MPT, and dunnage would be thermally treated in a batch rotary treater (BRT). All process off-gases would pass through a catalytic oxidation unit and through carbon filters prior to release to the atmosphere.

Agents and energetics would be fed into separate SILVER II reactors. A 2-kW unit for agents and a 12-kW unit for energetics were used during demonstration testing. SILVER II is an aqueous electrochemical process that uses $AgNO_3$ in concentrated HNO_3. An electrochemical cell is used to generate a reactive material ($Ag\ 2^+$) that readily oxidizes organic substrates. End products of this oxidation process are primarily CO_2 and water. Elements present in the organic substrate, such as nitrogen, sulfur, or phosphorous, are oxidized to nitrate ions, sulfate ions, or phosphate ions. Silver compounds (e.g., chloride) would be recycled or recovered off-site, after which they may be returned to the process.

G.4.1.1 History of Destructive Processes

The electrochemical oxidation process is a relatively new technology with respect to destruction of agent or energetics in the stockpile of ACW. The SILVER II process has yet to be used commercially for waste treatment, although a number of tests have been conducted on various materials. The type of electrochemical cell used in the SILVER II process is, however, used commercially in the chlor-alkali industry (NRC 1999).

Prior to the PMACWA demonstration, the largest pilot-scale tests for waste treatment have been conducted using a 4-kW cell consisting of a single anode-cathode pair. The most extensive tests have been conducted with spent tributyl phosphate dissolved in kerosene. These tests ran continuously for up to 14 days, and 40 gal (150 L) of feed material was destroyed. The electrochemical oxidation technology also has been successfully tested on 0.35 oz (10-g) batches of agent at a pilot plant in Porton Down, United Kingdom. The Porton Down unit is similar in design to the system being proposed for the ACWA program. It includes anolyte and catholyte feed circuits, an anolyte off-gas condenser, an NOx reformer system,[25] and a modified version of the off-gas treatment circuit, including a NaOH scrubber (NRC 1999).

Additional tests on VX have been conducted at Porton Down. The test involved a continuous run of six and a half days. At the end of the test, no agent residuals could be detected. The VX destruction efficiency was calculated at 99.99998%, in terms of organic carbon. With respect to TOC, the destruction efficiency was calculated at 88.7% (NRC 1999).

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[24] The definition of 5X is provided in Volume 1 of this TRD (see Section 1.2.2.4).

[25] An NO_x reformer is an add-on pollution control device designed to remove NOx after formation. The device uses water to form nitric acid.

The NRC has expressed concerns over the electrochemical oxidation process, particularly in the case of scaling up to meet production schedules for the wide variety of ACW to be destroyed. The NRC expressed concern over the ability to maintain appropriate temperatures in a scaled-up system. The set point of the process is 194°F (90°C); because the process employs large amounts of electricity, there is a potential problem in controlling those temperatures. Another concern comes from the size of particles. In commercial production, particles are expected to be larger than those experienced in tests. According to the NRC (1999), larger particles tend to limit the feed rates. The NRC indicated that these concerns must be addressed in future tests, particularly when approaching commercial scale (NRC 1999). Demonstration testing, described below, was intended, in part, to address these concerns.

G.4.1.2 Demonstration Testing[26]

As discussed for the other technology systems presented in this TRD, baseline reverse assembly, carbon filtration, and the brine reduction operation were not demonstrated as part of the demonstration test program for electrochemical oxidation. Other unit operations proposed for this technology were also not selected for demonstration. The following unit operations proposed for SILVER II were not selected for demonstration by the PMACWA for the reasons given below.

- Shredder (size reduction). This is common commercial equipment used for marginal size reduction of solid secondary wastes for feed to the BRT. Extensive size reduction capabilities were previously validated by the PMACWA as part of Demo I and EDS-I.
- RDM. The RDM is a new addition to the proposed full-scale process and was incorporated after Demo II was conducted (AEA/CH2MHILL 2000). The punch and drain stations are based on the existing baseline RSM.
- Cutting Station. The fluid-abrasive cutting and fluid-mining operations are substantially similar to the rocket-cutting and fluid-mining technology previously validated by the PMACWA as part of the neutralization/ biotreatment technology (PMACWA 1999a,b).
- M28 Propellant Grinding. Several ACWA technologies require size reduction of M28 propellant. Therefore, the PMACWA elected to conduct a single design study (during EDSs) to address this requirement.
- PDWM. The PDWM for projectiles is a new addition to the proposed full-scale process and was incorporated after Demo II was conducted (AEA/CH2MHILL).
- Projectile Burster Washout. This operation is substantially similar to the burster washout technology previously validated by the PMACWA as part of the neutralization/biotreatment technology (PMACWA 1999a,b).
- Steam Spray Wash. Water spray washout of ton container vessels and steam washing of ton container tubing were demonstrated at the ECBC, Aberdeen Proving Ground, Maryland.
- Detonation Chamber. This device is a contained blast chamber and is a commercially available, indirect, electrically heated vessel.

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[26]This material describes the Demo II PMACWA program and was based in part on PMACWA (2001a). Because demonstration testing was intended to apply to a variety of ACW from all storage sites, this section does not discriminate with regard to munition type and storage installation.

- MPT and BRT. The MPT and BRT are similar to the MPT previously validated by the PMACWA as part of the neutralization/biotreatment technology (PMACWA 1999a,b).
- Catalytic Oxidation System. The catalytic oxidation system is commercially available; it is also similar to the CatOx previously validated by the PMACWA as part of the neutralization/biotreatment technology (PMACWA 1999a,b).
- Agent Impurities Removal System (AIRS) and Energetics Impurities Removal System (EIRS). These are new additions to the proposed full-scale process and were incorporated after Demo II was conducted (AEA/CH2MHILL 2000).

The reasons for selecting the electrochemical oxidation demonstration unit operations, testing objectives, and the significant deviations from the planned testing are discussed in the following subsections. Demonstrations with a 2-kW SILVER II unit (for agents) and a 12-kW SILVER II unit (for energetics) are discussed separately.

G.4.1.2.1 2-kW SILVER II Unit (Agent)

A 2-kW SILVER II unit was demonstrated to validate destruction of the agents contained in ACW and to correlate with the 12-kW SILVER II unit through testing with agent simulants. The 2-kW SILVER II unit was demonstrated at Building E3566 at the Edgewood Area of APG, Maryland. The demonstration system was an integrated unit consisting of the following:

- Feed System — The agent for each run is pumped from a steel container into two premix vessels for metering into the anolyte vessel at an appropriate rate, according to the destruction efficiency of the particular organic material.
- Electrochemical Process — The electrochemical cell contains titanium electrodes that are electroplated with platinum. It is designed to operate at a maximum current of 1,000 amps per electrode face; the power supply voltage is automatically varied to maintain the set current. The electrochemical cell consists of two cathodes flanking an anode. The electrodes are separated into anolyte and catholyte compartments by membranes made of a perfluoro ion-exchange polymer. The organic feed is metered into the anolyte vessel that contains 8-M HNO_3 and 10% $AgNO_3$. Fluids from the anolyte circuit flow through the channels and are exposed to the anode in the cell. When the current is turned on, the Ag 2^+ ions generated oxidize the organic feed. Some Ag^+ ions and water (as hydrated protons) pass through the electrochemical cell membrane and flow into the catholyte vessel, which contains 4-M HNO_3. The cathodic reaction reduces the HNO_3 to NO_3 and water in the catholyte vessel.
- Particulate Removal and Treatment — Silver chloride (AgCl) precipitates when chlorinated feeds (i.e., mustard) are exposed to HNO_3 and $AgNO_3$. The particulate removal process is integrated into the electrochemical process unit; a hydrocyclone[27] on the anolyte circuit removes the AgCl before it reaches the electrochemical cell. The AgCl accumulates in a separate evaporator oven for 5X treatment. The vapor from the oven passes to a condenser, and the condensate is returned to the anolyte vessel. The AgCl is then removed as a solid cake for silver reclamation.

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[27] A hydrocyclone, also known as a water cyclone is a device used to separate fluids with different densities.

- NO_x Reformer Circuit — The reactions with Ag 2^+ , which occur in the anolyte circuit, release CO_2, CO, and NO_x. The reactions occurring in the catholyte circuit release NO_x. Off-gas from both circuits passes through a condenser to remove some of the NO_x vapors and then travels to the NO_x reformer. Because of facility size restrictions, the 2-kW plant included an NO_x reformer with a single column for absorption and distillation. As the gas travels up the column, water running down the column reacts with NO_x in the gas to form dilute HNO_3. The dilute HNO_3 is heated to evaporate water and to produce concentrated HNO_3. The evaporated water is condensed and produces very dilute HNO_3, which is recycled to the anolyte vessel or disposed of as waste. The concentrated HNO_3 is recycled to the catholyte vessel or can be used commercially.
- Caustic Scrubber Circuit — Off-gas from the NO_x reformer is sent to the caustic scrubber tower to remove any residual NO_x before release of the gas to the facility ventilation system.

Laboratory-scale testing of a SILVER II unit for agent has previously been performed with GB. Destruction of HT and VX has previously been tested at a scale similar to that of the demonstration unit. Characterization of gaseous, liquid, and solid effluents and verification of operating parameters were required during demonstration testing. The specific test objectives of this demonstration unit included the following:

- Validate the ability of the 2-kW SILVER II unit to achieve a DRE of 99.9999% for mustard, GB, and VX agents.
- Determine the impact of operations on materials of construction to be used in a full-scale system.
- Demonstrate the operation and performance of the following key process components for future scale-up:
  - Instrumentation, valves, pumps, etc.
  - Hydrocyclone (to determine its ability to deal with solids in the anolyte circuit).
  - Electrochemical cell (electrodes and membranes).
- Develop operational data to facilitate comparison of the 2-kW SILVER II unit with the 12-kW SILVER II unit for use in scaling up SILVER II.
- Characterize silver-bearing residuals. Determine potential silver recovery and determine disposal options (via characterization) for residuals from silver recovery operation (mustard only).
- Characterize gas, liquid, and solid process streams from SILVER II for selected chemical constituents and physical parameters, and for the presence or absence of hazardous, toxic, agent, agent simulant, and Schedule 2 compounds.

Significant deviations from the planned demonstration testing included the following:

- Reduction in the VX validation run quantity (from 22 to 9 lb or 10 to 4 kg) and duration because of schedule constraints, and
- Elimination of the chloroethyl ethyl sulfide (CEES) validation run because of difficulty in obtaining CEES in the quantity needed and schedule constraints.

G.4.1.2.2 12-kW SILVER II Unit (Energetics)

A 12-kW SILVER II unit was demonstrated to validate destruction of the energetics contained in ACW and to correlate with the 2-kW SILVER II unit through testing with simulants. The 12-kW SILVER II unit was demonstrated at the Fire Safety Test Enclosure at the Aberdeen Test Center, Aberdeen Area of APG, Maryland. The demonstration system was an integrated unit consisting of the following:

- Feed System — The energetics feed system is designed to maintain the energetics material in a 20% slurry with water by storing it in a continuously mixed feed vessel. Two forms of agitation ensure that the energetics remain in the slurry: an air-driven mixer and a recirculation loop. The energetics slurry is fed to the anolyte vessel by bleeding off a slipstream from the recirculation loop.
- SILVER II System — The SILVER II system of the 12-kW unit is the same as that for the 2-kW SILVER II unit, except that it does not have a particulate removal and treatment system.[28] It does, however, have a complete NO_x reformer circuit that includes separate absorption and distillation columns. As gas travels up the absorption column, water running down the column reacts with the NO_x in the gas to form dilute HNO_3. The dilute HNO_3 leaves the bottom of the absorption column and enters the distillation column where it is heated to evaporate water and produce concentrated HNO_3.

Energetics testing in a laboratory-scale SILVER II unit was previously performed with RDX, TNT, tetryl, and a double-base propellant similar to M28. Characterization of gaseous, liquid, and solid effluents and verification of operating parameters were required. The specific test objectives of this demonstration unit included the following:

- Validate the ability of the 12-kW SILVER II unit to achieve a DRE of 99.999% for Composition B (RDX and TNT), tetrytol (tetryl and TNT), and M28 propellant.
- Validate the ability of the 12-kW SILVER II unit to achieve a DRE of 99.9999% for dimethyl methylphosphonate, a VX/GB simulant.
- Determine the impact of operations on materials of construction to be used in a full-scale system.

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[28] No chlorinated feeds were processed in this unit; thus, the particulate removal and treatment system was removed from the unit.

- Demonstrate the operation and performance of the following key process components for future scale-up:
  - Instrumentation, valves, pumps, etc.
  - Electrochemical cell (electrodes and membranes).
  - Full-height NO_x reformer/silver recovery boiler (ability to maintain H_2O balance).
  - Off-gas scrubber operating in conjunction with the NO_x reformer.
- Develop operational data to facilitate comparison of the SILVER II 2-kW agent system with the 12-kW SILVER II energetics system for use in scaling up the SILVER II agent system.
- Demonstrate the ability or inability to recycle, reuse, or dispose of HNO_3.
- Characterize gas, liquid, and solid process streams of SILVER II for selected chemical constituents and physical parameters and for the presence or absence of hazardous and toxic compounds.

Significant deviations from the planned demonstration testing included the following:

- Elimination of the CEES validation run because of difficulty in obtaining CEES in the quantity required and schedule constraints,
- Reduction of the quantity of M28 propellant (from 440 to 308 lb or 200 to 140 kg) because of schedule constraints, and
- Elimination of planned Composition B testing because of schedule constraints.

G.4.1.2.3 Summary of Demonstration Testing

In summary, demonstration testing during Demo II was not as extensive as testing during Demo I because of the similarity of some of the unit processes and technologies. The 2-kW and 12-kW SILVER II systems were each evaluated during the demonstration. Schedule constraints, however, prevented the PMACWA from completing demonstration testing with VX, some of the energetics, and CEES simulant. Nevertheless, the PMACWA has determined that SILVER II is effective in destroying agents and propellant at the targeted levels. However, the curtailed tetrytol demonstration and lack of any demonstration data for Composition B prohibits the complete validation of the process. The technology includes operations to effectively process metal parts and dunnage. Although Composition B has not been demonstrated, greater than 99.999% destruction of the constituents of Composition B and tetrytol in laboratory experiments indicates the likely effectiveness with these energetic compounds (PMACWA 2001b). The PMACWA reviews the quality of the data generated during demonstration testing in PMACWA (2001f).

On the basis of demonstration testing, the technology provider plans some substantive changes to the electrochemical oxidation SILVER II technology. One concern in regard to process operability is the treatment of burster energetics (tetrytol and Composition B) in the SILVER II system. A limitation of SILVER II was discovered when tetrytol was fed to the 12-kW SILVER II demonstration unit at the originally planned feed rates (AEA/CH2MHILL 2000). Because SILVER II had problems decomposing an intermediate product, material began to precipitate within the anolyte circuit. Consequently, the system had to be shut down to clear the lines. The technology provider's solution to the precipitation problem was to add a hydrocyclone and a high-speed mixer in the anolyte circuit (AEA/CH2MHILL 2000). According to PMACWA (2001b), there was also a buildup of organics in the catholyte. The catholyte circuit was periodically drained, and the drained catholyte solutions were never reintroduced into the anolyte. Thus, it is possible that the intermediate product that was concentrating within the catholyte was only partially treated. A catholyte-to-anolyte recycle stream is proposed to reduce the buildup of organics within the catholyte.

In addition to the above, the technology provider has added a RDM for munitions access of rockets and a PDWM for munitions access for projectiles. An agent impurities removal system (AIRS) and energetics impurities removal system (EIRS) have also been added to the agent and energetic SILVER II units. These are new additions to the proposed full-scale process that were incorporated after Demo II was conducted (AEA/CH2MHILL 2000). Upon incorporation of these changes, the technology provider believes that feed rates can be increased to the originally planned values. While these proposed improvements all have merit, optimization studies may be required (PMACWA 2001b). Additional details of the results of demonstration testing may be obtained from AEA/CH2MHILL (2000) and PMACWA (2001b,c).

G.4.3 Detailed Process Description

This section presents a detailed process description for electrochemical oxidation, as applied to the ACW stored at BGAD, on the basis of demonstration testing results. The equipment used in a pilot-scale facility may vary in nomenclature and design from that described here, depending on the system selected and system requirements.

Munitions access would use modified baseline reverse assembly. Fuzes, boosters, and supplementary charges would be treated in a detonation chamber. Metal parts from the detonation chamber, munitions hardware, dunnage, and other solid wastes would be thermally decontaminated to a 5X condition in either the MPT, an inductively heated vessel with a superheated steam reactive environment, or the BRT, a rotary version of the MPT with a structure similar to that of the baseline DFS. Steam would be condensed from the MPT or BRT and treated in the SILVER II process. Agents would be drained from the ACW, and energetics would be removed and slurried.

Drained agents and slurried energetics would be treated in separate SILVER II processes. These processes mineralize the agent and energetics with electrochemical oxidation facilitated by Ag 2^+ ions. The SILVER II process is supported by an agent impurities removal system (AIRS) and an energetic impurities removal systems (EIRS). These units each generate process solids that would be treated further, as necessary, and that would be disposed of off-site in a RCRA hazardous waste landfill. Silver would be reclaimed off-site, and HNO_3 would be generated for reuse in the process. Dilute acid by-product from SILVER II is intended for treatment in an on-or off-site wastewater treatment plant. All process off-gas would be mixed with air and catalytically converted by the catalytic oxidizer technology, followed by carbon filtration and release to the atmosphere. Treated munition bodies (5X condition) would be commercially recycled.[29] Treated

[29] Solids treated to a 5X condition to remove residual agent may be defined as hazardous waste if they exhibit any of the characteristics of hazardous waste as defined in 40 CFR 260.21- 260.24.

solid wastes (5X condition) would be treated further, as necessary, and placed in a landfill as RCRA hazardous waste or disposed of as nonhazardous waste in accordance with regulatory requirements.[30]

Short descriptions of each of the unit processes included in the electrochemical oxidation technology system are provided below. Following munitions access, the process for treating agents and energetics would be largely independent of munition type and agent fill.

G.4.3.1 Munitions Access — General

The SILVER II process uses modified baseline reverse assembly and fluid accessing (fluid-abrasive cutting and fluid-mining using water) for ACW pretreatment. Spent grit would be filtered from the water and sent to thermal treatment; the water would be reused for fluid-abrasive cutting. Slurried explosive material from the ACW (20% by weight) would be sent to a number of holding tanks for feed to the SILVER II reactor circuit. Agent would be pumped to a buffer area similar to the baseline TOX system. Solid secondary wastes (e.g., dunnage) would be size-reduced using two-stage shredders. Metal parts and dunnage would be treated thermally to a 5X condition in a manner similar to methods used in other technologies. Details for handling of projectiles and rockets are presented in the following subsections.

G.4.3.2 Munitions Access — Projectiles and Mortars

As indicated in Section G.4.3.1, projectiles and mortars would be disassembled in the PMD. They would be received in the unpack area and loaded into the existing feed equipment for transportation into the ECR. Two identical disassembly equipment lines are planned. The PMD would remove the nose closure or fuze, burster, supplemental charge, and miscellaneous parts. Fuzes and supplemental charges would be conveyed to the detonation chamber for deactivation. The detonation chamber is a thermally initiated, contained detonation device that accesses explosive components (i.e., fuzes/boosters, supplementary charges, and igniters) by exposing them to heat. Bursters would be extracted and conveyed to a stand-alone burster washout machine to fluid jet out the burster, with conventional fluid jet technology. This would result in an energetic slurry with a nominal maximum particle size of 0.02 in. (0.5 m) and a slurry concentration not to exceed 20 percent by weight.

The burster slurry would feed directly to SILVER II, though some quantity may also be pumped to the energetics buffer storage tank for subsequent processing in SILVER II. The buffer storage would be designed to allow the SILVER II plant to operate continuously (if needed). The disassembly plant would operate 12 hours per day. The maximum quantity of energetic would depend on the energetic being destroyed.[31]

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[30] While these solid wastes are not known to contain chemical agent, they may be defined as hazardous waste if they exhibit any of the characteristics of hazardous waste as defined in 40 CFR 260.21 — 260.24. These solids may contain heavy metals and exhibit the RCRA toxicity characteristic (40 CFR 261.24). In Kentucky, the solids may be regulated as listed hazardous wastes because of their association with chemical agent. These solids may be delisted and not considered hazardous waste if regulatory delisting criteria are met.

[31] Storage capacity, spread across a number of tanks, will be up to 1,500 pounds of M28 rocket propellant, or significantly lower quantities of high explosive.

A PDWM would access the agent cavity in projectiles and mortars, and drain and wash them. The punch and drain machine would extract the liquid agent. Two 1-in. (2.5-cm) holes, 180° apart at each end, would be punched through the sidewall into the agent reservoir of the projectile. Following draining of the agent, the projectiles would be steamed out to maximize the removal of residual or gelled agent. The agent would be pumped to the agent buffer storage tank and then to SILVER II. The storage tank would be designed to operate continuously (if needed). The storage capacity would be 150 gal (568 L).

Projectile/mortar casings from the punch and drain machine would be placed in a metal carrier tray and conveyed to the MPT for 5X treatment. Burster wells, nose closures, and fragments from the detonation chamber would all be treated in the MPT to achieve 5X decontamination.

G.4.3.3 Munitions Access — M55 Rockets

M55 rockets would be transported to the unpack area and loaded into the rocket loading device in the same manner as the existing baseline system. Two identical parallel rocket disassembly lines, each contained in separate ECRS would be used. The individual rocket would be conveyed through the air lock and into the ECR, which contains the RDM. The RDM is a new machine that performs the same function as the existing RSM. The rocket processing begins with the automatic feeding of the rocket, contained in its firing tube, to the punch and drain station. This is based on the existing punch and drain process, but has the addition of a final steam-out to remove residual agent. The agent would be drained and pumped to buffer storage tanks, the same as for the projectiles. The rocket then would be fluid jet cut into three sections. A fuze cut would be made to separate the fuze and expose the burster section. A tail cut would be made to separate the tail section and expose the bottom end of the propellant grain for subsequent extraction. Disposition of individual rocket components would be as follows:

- The fuze sections would be deposited in mesh containers and conveyed to the detonation chamber for destruction.
- The warhead section would be conveyed to the burster washout station where the burster would be washed out. This would result in an energetic slurry with a nominal maximum particle size of 0.02 in. and a slurry concentration not to exceed 20% by weight. The slurry would feed directly to SILVER II, though some quantity may also be pumped to the energetics storage tank as discussed previously. The warhead section would then be deposited in a container tray and conveyed to the metal parts treatment process. The container tray typically holds 10 to 15 warhead sections.
- The rocket motor and tail section would be conveyed to the propellant removal station, where the M28 propellant grain would be pulled from the motor casing. The motor and tail section would be deposited in a container tray for subsequent metal parts washing. The propellant would be conveyed to the propellant size reduction station.
- Fiberglass firing tube sections would be deposited in a container tray and conveyed to the dunnage treatment process for thermal treatment to a 5X condition.

G.4.3.4 Agent and Energetics Treatment

Agents and energetics would be destroyed using electrochemical oxidation in the SILVER II process. SILVER II is a mediated electrochemical oxidation using Ag 2^+ ions in aqueous HNO_3 (formed by an electrochemical cell) that is circulated through CSTRs (anolyte and catholyte circuits). The electrochemical oxidation process uses essentially the same system for destroying both agent and energetics. During demonstration testing, agent was destroyed in a 2-kW electrochemical cell (Figure G.8), while energetics were destroyed in a 12-kW cell (Figure G.9). Drained agent, along with liquids condensed from the BRT and MPT (see below), would be destroyed in the agent SILVER II unit. Propellant and high explosives (from bursters) would be destroyed in the energetics SILVER II unit. It is probable that the same kW systems for agent and energetics would be used in the pilot-scale design.

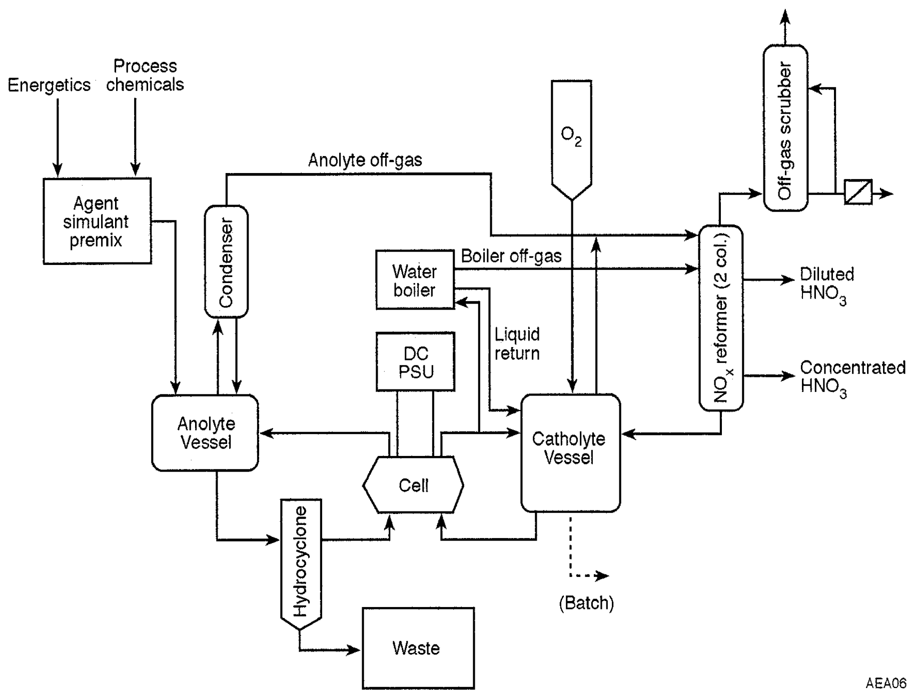

Figure G.8. Process flow diagram for a SILVER II 2-kW agent plant used in demonstration testing. (*Source:* Adapted from AEA/CH2MHILL 2000).

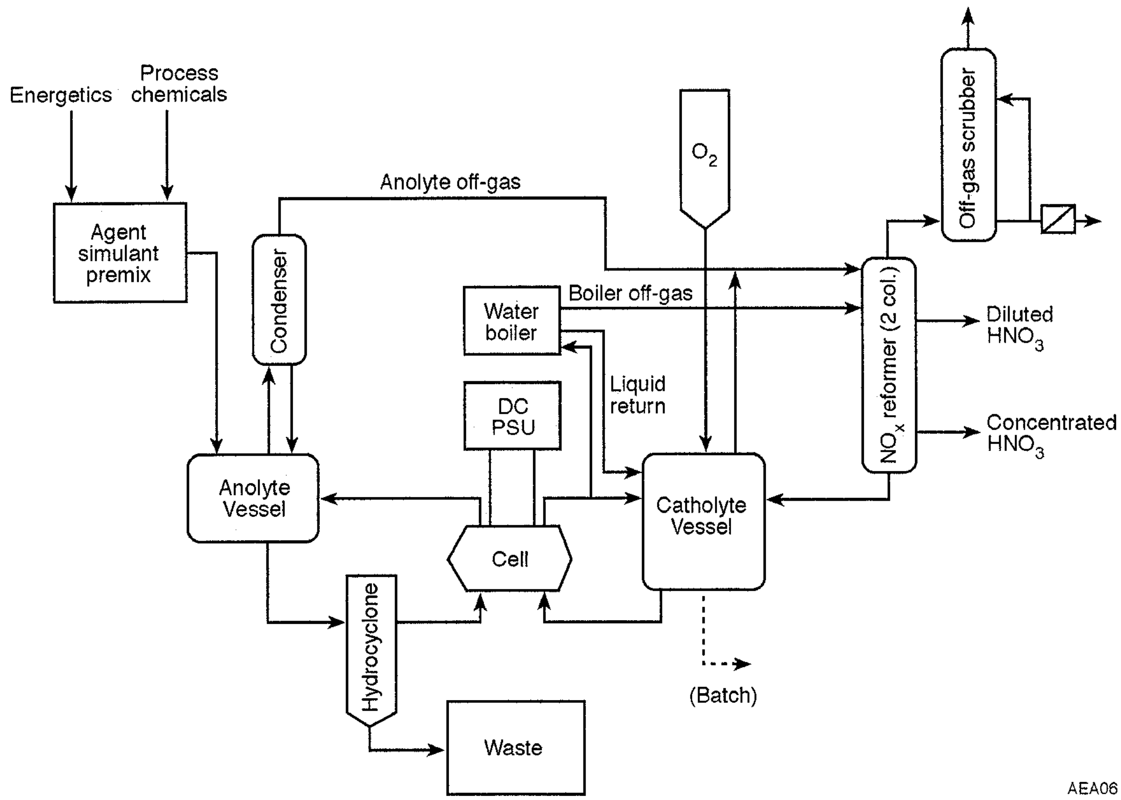

Figure G.9. Process flow diagram for a SILVER II 12-kW energetics plant used in demonstration testing. (*Source:* Adapted from AEA/CH2MHILL 2000).

The SILVER II unit would consist of a feed system, an anolyte circuit, and a catholyte circuit integrated with a NO_x reformer and agent and energetics impurities removal systems (AIRS and EIRS, respectively). It is operated at a temperature of 190°F (90°C) and near atmospheric pressure. SILVER II, originally a semicontinuous batch process, is made a continuous process through a ihbleedlu to impurities removal systems. The AIRS and EIRS are used for removal of impurities.

In these removal systems, a purge system would be withdrawn from the anolyte reservoir. The rate is designed to limit the concentration of impurities in the anolyte to ~ 1M phosphate and sulfate in order to avoid precipitation of their silver salts. Other impurities of lower flux (such as iron, aluminum, etc.) would be maintained at significantly lower concentrations as a result. In order to recover the silver for reuse, hydrochloric acid would be added to precipitate it as the chloride (AgCl). The silver would be recovered by either gravity settling or in a hydrocyclone. As AgCl may contain small traces of agent, AgCl would be treated to a 5X condition prior to being sent for silver recovery. The condensate from this process would be returned to the catholyte of the SILVER II system. The precipitator overflow would then be fractionally distilled to recover water and HNO_3 for recycle to the SILVER II catholyte (to create the AIRS and EIRS purge flow returns). The evaporator bottoms would contain some residual HNO_3 as well as enriched phosphoric and sulfuric acids. These, together with the HF stream, would subsequently be neutralized with lime to precipitate insoluble fluoride, phosphate, and sulfate salts of calcium. This stream could then be treated to a 5X condition. The condensate would be returned to the catholyte of the SILVER II system.

The SILVER II process is based on the highly oxidizing nature of Ag 2^+ ions in a HNO_3 solution. Ag 2^+ ions are among the strongest oxidizing agents known; HNO_3 also makes a significant contribution to the oxidizing process (NRC 1999). The Ag 2^+ ions are produced at the anodes of an electrochemical cell (NRC 1999). The overall chemical reaction can be summarized as follows:

Organic + $AgNO_3$ + HNO_3 + electrical current = CO_2 + mineral acids + water + N_{ox}.

Generation of Ag 2^+ ions depends entirely on the electrical current, and it stops immediately when the power is switched off. This process ensures that the reaction is easily controllable. Electrical power to the cell can be shut off safely at any time (e.g., from safety interlocks at other stages of the overall process). A standard industrial electrochemical cell is at the heart of the SILVER II process.

The anode and cathode compartments of this cell are separated by a permeable membrane that prevents bulk mixing of the anolyte and catholyte solutions. These solutions are circulated around separate closed loops between the cell and its reaction vessels. The organic material for destruction is continuously metered into the anolyte tank to match the rate of destruction. Ag 2^+ ions generated at the anode of the electrochemical cell react with the water and HNO_3 of the anolyte solution to form a range of other oxidizing radicals (-OH, NO_3). In turn, the Ag 2^+ ions and other oxidizing species react with the organic material delivered into the anolyte vessel and are reduced to Ag 1^+ ions, nitrate ions, and water. The organic material is oxidized to CO_2, NO_x (from the direct reaction with the acid), and traces of CO and protons (H^+, not hydrogen gas), and inorganic salts. Off-gas from the reaction passes from the anolyte vessel via a condenser (to return HNO_3 and organic vapors) to an NO_x reformer.

To balance the electrochemical reaction in the anolyte, a supporting cathode reaction occurs that involves reducing HNO_3 to nitrous acid and water, while other reduction reactions generate NO/NO_2. The gases pass from the catholyte tank to the NO_x reformer.

The process is operated at a temperature of approximately 190°F (90°C) and at atmospheric pressure. As a result of the electrochemical reaction, HNO_3 is consumed in the catholyte circuit, which results in the formation of gaseous NO_x. Water is transferred across the membrane in the electrochemical cell from the anolyte to the catholyte. In addition, Ag 1^+ ions are also transferred across the cell membrane, together with a small amount of organic material, depending on the organic feed to SILVER II. To maintain steady-state operating conditions, the operation incorporates internal recycle streams to return the silver and organic material to the anolyte circuit. This ensures that a buildup of organic material or silver in the catholyte does not occur and that steady-state conditions can be maintained.

The off-gas streams from the anolyte and catholyte circuits would be combined and sent to the NO_x reformer system. The reformer would recover the NOx by removing it from the gas stream and would recycle it into concentrated HNO_3 for return to the anolyte and catholyte circuits as required; or alternatively, the excess can be marketed as a product. A dilute stream of HNO_3 less than 1% weight would also be produced. The technology provider plans to send this material to either an on- or off-site wastewater treatment facility. The dilute HNO_3 stream may also be recycled within the plant.

The post-treatment portion of SILVER II also consists of a caustic scrubber and a number of CSTRs for adjusting the pH. NO_x in the off-gas is collected by a NO_x absorber column and reformed to HNO_3 which is concentrated in a packed bed distillation column. The remaining off-gas from the NO_x reformer goes to a caustic scrubber for acid neutralization. HF distilled by the AIRS is neutralized with lime in a CSTR. Similarly, the pH of dilute HNO_3 waste is neutralized with caustic.

After leaving the NO reformer, all off-gas passes through a caustic scrubber to remove very low levels of residual NO_x, thus leaving a stream of CO_2, oxygen, and water vapor. The off-gas is then tested to ensure that no agent is released from SILVER II. This off-gas stream is then processed through the catalytic oxidation process as a polishing step to ensure that trace organics are destroyed. Silver chloride is precipitated when mustard is exposed to the HNO_3 and $AgNO_3$ in the anolyte vessel. In the anolyte circuit, a hydrocyclone is used to continuously remove the AgCl from the recirculating liquid before it reaches the electrochemical cell.

The AgCl is accumulated in a settling vessel and discharged into an oven for 5X treatment on a batch basis. The vapor from the oven is passed to a condenser, and the condensate is returned to the anolyte vessel for destruction of any organic material that may be present. The AgCl is then removed as a solid cake for silver reclamation. Silver reclamation may be conducted on- or off-site.

G.4.3.5 Metals Parts Treatment

Metal parts would be treated to achieve a 5X condition in the MPT, as explained previously. The objective of this unit operation would be to elevate the temperature of the parts to over 1,000°F (538°C) for a period of at least 15 minutes. The PMACWA previously demonstrated this concept at CAMDS and during ACWA Demo I. Metal parts treatment would be accomplished in a chamber designed to receive the various metal parts containers, such as the projectile casing conveyance trays. The metal parts containers would be automatically conveyed into the chamber. The chamber would use electrical heating elements to achieve the design temperature. Steam would be passed through the chamber to enhance the exposure of metal to elevated temperatures and to establish the conditions of 5X treatment. The discharged steam would be condensed and the off-gas would be sent to the catalytic oxidation process for destruction of trace organic compounds, and then to carbon filtration, before discharge to the atmosphere. Two decontamination chambers would be used so that one chamber would be in load and 5X treatment phase, while the second chamber would be in the cool-down and unload phase. Decontaminated metal parts would be transported off-site for either recycling or disposal, in accordance with regulatory requirements.

The specific design of the detonation chamber will be optimized during EDS-II, but the conceptual design indicates that two detonation chambers would be sufficient to provide adequate capacity and to provide redundancy to deactivate fuzes, boosters, and supplemental charges. The chamber would be loaded with a preapproved number of fuzes and detonation charges. The controlled detonation would deactivate the fuzes. The resulting metal fragments would be conveyed to the metal parts treatment process. Off-gas from the chamber would be processed through the catalytic oxidation process, and subsequently through carbon filters prior to discharge.

G.4.3.6 Dunnage Treatment

Dunnage treatment would use the same principle as that for metal parts to achieve 5X decontamination. Contaminated dunnage would be stored in a silo contained within the MDB and would be fed to a two-stage shredder for size reduction to nominal 2 to 3 in. (5 to 8 cm) particle sizes. This would be accomplished with commercially available shredding equipment. The shredded dunnage would be mechanically conveyed to the BRT. As indicated previously, this is essentially the same as the MPT, except that it is a rotary oven that operates as a continuous process. The chamber would be designed to expose the shredded dunnage to the design temperature for a resident time of 30 minutes to provide a reasonable safety factor. Treated dunnage would be discharged into a storage hopper for subsequent placement in a landfill, in accordance with regulatory requirements.

The BRT thermally treats fluid-cutting grit and size-reduced, solid (mostly nonmetallic) secondary wastes (dunnage and rocket shipping and firing containers). The BRT is similar to the MPT; however, it is operated in continuous mode. Off-gas from the MPT and the BRT (mostly steam) would be condensed and sent to SILVER II for treatment. All process off-gas would be mixed with air, treated with a catalytic oxidation system, and passed through carbon filters before release to the atmosphere.

G.4.4 Operations Resource Requirements

Estimated annual utility consumption for facility operation, including electricity, fuel, and potable water usage, is presented in Table G.4. The estimates in Table G.4 are based on the assumption that the facility would consume potable water and produce sanitary waste 365 days per year. These are conservative assumptions that would identify an upper bound to potable water and sanitary waste treatment requirements. It was also assumed conservatively that fuel oil would be consumed only by an emergency diesel generator that would operate 600 hours per year. This analysis assumed that the amount of natural gas consumed for space heating would be negligible compared to the amount of natural gas consumed during the electrochemical oxidation process.

Materials used in this process include $AgNO_3$, HNO_3 (VX process only), calcium nitrate (CaN_2O_6) (mustard and GB processing only), LOX, and NaOH. All materials would be consumed by the destruction processes.

G.4.5 Operations Emissions and Waste Estimates

Wastes from the electrochemical oxidation process would include air emissions, solid wastes, and liquid wastes. The only liquid effluents expected from the facility would be dilute, neutralized HNO3, which would be accepted by a publicly owned treatment works (POTW), and sanitary waste, which would be managed in an on-site treatment unit. All other liquids generated by the process and all liquid laboratory wastes would be reused in the process or destroyed internally by the electrochemical oxidation process. Destruction facility operations, including waste management, would comply with U.S. Army, federal, state, and local requirements. Any wastes that are identified as hazardous (such as possibly evaporator bottoms) would be stored and disposed of in compliance with RCRA requirements. Silver salts would be processed off-site for silver recovery after being treated to a 5X condition.

Table G.4. Estimated utilities consumed during destruction of ACW at the Electrochemical Oxidation Facility at BGAD

Utility	Average Daily Consumption	Peak-Day Consumption	Annual Consumption
Process water [a]	3,700 gal/d	208 gal/h	18,000,000 gal/yr [h]
Potable water [b]	17,500 gal/d	180 gal/min	6,400,000 gal/yr [c]
Fire water [b]	NA [d]	3,000 gal/min	NA
Sanitary sewer [b]	20,650 gal/d	395 gal/min	7,500,000 gal/yr [c]
Natural gas [a]	188,000 scf/d	218,000 scf/d	52,000,000 scf/yr [e]
Fuel oil	962 gal/d	406 gal/h	48,000 gal/yr [f]
Electricity	144 MWh	21.8 MW	122.4 GWh [c,g]

[a] Estimated on the basis of the munitions processing rate and unit utility factors for the electrochemical oxidation technology.

[b] Assumed to be similar to incineration because the number of operations and maintenance personnel and land area are unchanged from incineration.

[c] Based on 365 days of operation per year.
[d] NA = not applicable.
[e] Based on 276 days of operations per year.
[f] Estimated on the basis of 600 hours of emergency diesel generator operation per year.
[g] Based on an average power rating of 80%.
[h] [The ACWA DEIS notes that the amount of process water needed for the electrochemical oxidation technology is 1,000,000 gal/yr. This value seems to be more likely to be correct than the value cited in this table since multiplying the average daily consumption times the number of operating days per year is approximately 1,000,000 gal/yr].

G.4.6 Effluent Management and Pollution Controls

The SILVER II process produces various types of waste. The process off-gases are passed through a catalytic oxidation unit, carbon filtered, and tested (with carbon filter rework as necessary) before exhausting to the atmosphere. Liquids are separated by evaporator and condensers and are reused (on- or off-site) or sent off-site for treatment, as necessary, and disposal. Evaporator bottoms from the impurities removal systems are treated as necessary and disposed of off-site. The pH-adjusted acid streams would undergo wastewater treatment either on- or off-site. Solids from HF neutralization would be de-watered in a filter press, treated as necessary, and placed in a landfill. Metals that had been decontaminated to a 5X condition would be recycled, and 3X/5X solids would be treated as necessary and then placed in a landfill. All waste management would be conducted in compliance with regulatory requirements. As indicated previously, hazardous wastes may be delisted from being hazardous wastes if regulatory delisting criteria are met.

Silver is used to catalyze the oxidation of organics. Normally, this silver remains in solution, except in those instances in which compounds containing chlorine are present (e.g., mustard). Silver combines with chlorine contained in mustard agent to create AgCl, which must be removed from the system. This would be accomplished by using hydrocyclones that separate the precipitated AgCl from the anolyte solution in the plant. The material would then be decontaminated in a 5X oven. The resulting material would be collected and transported off-site. Silver would be reclaimed at a commercial facility. If necessary, this reclamation process can occur on-site.

Concentrated HNO_3 is a product of the SILVER II process when treating energetic materials that contain nitrogen. These materials can be transported off-site for reuse in the manufacture of energetics (assuming a 5X condition is met). Dilute HNO_3 is also produced. This material could be recycled within the system. Any dilute HNO_3 that has not been recycled would be neutralized with scrubber waste and discharged to an on- or off-site wastewater treatment facility. Any materials sent off-site would need to meet U.S. Army safety standards.

G.4.7 Common Elements — Other Systems

The electrochemical oxidation process has several elements that are identical or nearly identical to other systems. This commonality is particularly evident in pretreatment processes. Commonalities with other applicable technology systems include the following:

- The munitions access system used for electrochemical oxidation using SILVER II employs much of the baseline reverse assembly system, as do most of the other ACWA systems.
- Similar to the neutralization/biotreatment process, the munitions access system for the M55 rockets employs fluid jet cutting and fluid-mining to access energetics.
- Process off-gas is passed through catalytic oxidation units prior to carbon filtration and release to the atmosphere. This is also similar to the neutralization/biotreatment process and the neutralization/GPCR/TW-SCWO process.
- Dunnage would be size-reduced and treated in a manner similar to the neutralization/biotreatment technology.
- Decontamination of metal parts would occur thermally to a 5X condition using steam. The process would subject the parts to temperatures in excess of 1,000° F (538°C) for a period of more than 15 minutes. This process is similar to that used in the neutralization/biotreatment technology.

Facility structure; ventilation; decontamination fluid supply; personnel support; pollution abatement; water, air, and steam supply systems; control rooms; monitoring systems; and laboratory support would be identical or nearly identical to the baseline system.

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APPENDIX H

APPROACH TO THE ASSESSMENT OF IMPACTS FROM POTENTIAL ACCIDENTS

This appendix contains information about the consequences of hypothetical accidents that could occur either during the continued storage of chemical munitions at the Blue Grass Army Depot (BGAD) or during the proposed destruction of these munitions. The approach to the assessment of impacts from such accidents is described in this appendix. Information regarding the quantity of released material (i.e., the "source term") is also presented in this appendix and has been incorporated directly into the assessment of impacts in Sect. 4 of this Environmental Impact Statement (EIS).

To assess the environmental impacts of accidents and the accidental release of chemical agent, it is necessary first to identify the hypothetical accident scenarios that could occur. The evaluation of the consequences of such a hypothetical accident then begins with a determination of the quantities of chemical agent that could be potentially released in the associated scenarios. The evaluation also requires an understanding of the method by which the material is released into the environment: it can be spilled, vaporized by an explosion, lofted by a fire, or released by some combination of these modes. Furthermore, the accident analysis requires information on the duration of release. The ways in which the chemical agent is dispersed after a release are called “environmental pathways.” Once the spatial extent of the hypothetical accident and the environmental pathways are defined, the magnitude of potential impacts to humans or to the environment can be identified, quantified, and/or evaluated through dose-response assessments.

This appendix describes hypothetical accident scenarios specific to the BGAD. For the purposes of the environmental review in this EIS, a single, bounding accident is identified and described for further detailed analysis. This appendix closes with an assessment of the potential impacts of the bounding accident upon human health. The assessment of other impacts—particularly to ecological resources—is contained in Sect. 4 of this EIS.

H.1 ACCIDENT SCENARIOS

A hazard is generally defined as a source of danger, injury, or death for humans, animals, or the environment. In the context of the proposed destruction activities and/or continued storage at BGAD, a hazard initiates a sequence of events (also called a "scenario") leading to an accidental release of chemical warfare agent (i.e., either mustard agent or nerve agent GB or VX). The analysis of hazards and accident scenarios in this EIS is solely intended to provide estimates of the extent of the zone of potential impact from hypothetical accidents at BGAD. As such, the accident analysis presented in this appendix should not be considered to be a detailed safety assessment or a substitute for a detailed risk assessment.

A detailed risk analysis (MITRE 1987) was conducted for the Final Programmatic Environmental Impact Statement (FPEIS) for the Chemical Stockpile Disposal Program (CSDP). “Risk” was defined as the mathematical product of the probability of a hypothetical accident and its potential consequences (as measured by impacts, such as potential human fatalities or the size of the area covered by the lethal portion of the plume). “Risk” can thus be used to identify the acceptability of potential impacts to resources, as well as to develop mitigation measures for those impacts.

In 1997, the Army updated the FPEIS's probabilistic risk assessment with a site-specific version of a Quantitative Risk Assessment (QRA) (see SAIC 1997) for a baseline incineration facility at BGAD. The QRA utilized the latest methods and approaches for systematically identifying and assessing potential sources of risk. The QRA utilized site-specific probabilistic weather conditions and detailed seismic assessments of the baseline chemical destruction facility and the storage igloos. The data from the 1997 QRA provide the basis for the assessment of accidents in this appendix.

Although the proposed destruction activities are not without risk to the human and ecological environment (see Sect. 4), the risks of on-site destruction at BGAD are reasonably low and are greatly exceeded by the risks of continued storage (U.S. Army 1988a; SAIC 1997). For example, the QRA found that the risk of public fatalities[1] around BGAD is 1.5 for 20 years of continued storage and is 0.0004 for munition destruction operations (SAIC 1997). The QRA also found that the probability of incurring one or more public fatalities is approximately 1 in 64 for 20 years of continued storage and 1 in 83,000 for stockpile destruction activities.

The accident analysis for the proposed action concentrated on several activities associated with the proposed chemical weapons destruction activities, as well as the continued storage of the inventory at BGAD. Accident initiators included human error and equipment failures, as well as external events (e.g., seismic events, tornadoes and high winds, lightning, and aircraft crashes). The impact analyses are based on the accidents that are specific to the implementation of each alternative under consideration in this EIS. In all cases, the impact analyses are based on "credible accidents." As in previous PMCD EISs, a credible accident is defined in this study as an accident with a probability equal to or greater than 10^{-8} (or 1 in 100 million).

H.1.1 Continued Storage

As part of the assessment of risk in the QRA, an analysis was performed to identify those hypothetical accidents that might occur during the continued storage of chemical munitions at BGAD (SAIC 1997). The greatest concern for impacts following a storage accident would be the airborne hazard created by atmospherically dispersed chemical warfare agent.

The QRA found that potentially serious accidents during continued storage at BGAD are related primarily to externally-initiated events, such as lightning strikes or earthquakes. In the QRA, lightning accounted for about 76% of the acute fatality risk to the public, while earthquakes accounted for the remaining 24%. Aircraft crashes were found to contribute less than 0.5% of the continued storage risk. As described in Sect. H.3.1.1 of this appendix, a lightning strike was identified and selected for further analysis in this EIS.

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[1]"Public fatalities risk" is a numerical representation of the average risk over all accident scenarios and their potential consequences. Mathematically, the risk is a summation of the products of accident sequence probabilities and their associated consequences. The risk of an infrequent accident with large consequences can therefore contribute equally with a more frequent accident having smaller consequences.

Internally-initiated events, such as handling accidents, would include dropping of munitions and forklift collisions resulting in puncture or fire; however, none of these internally-initiated events were found to produce lethal plumes that would propagate as far downwind as the plumes from externally-initiated events (SAIC 1997; CSEPP 1998). In addition, the QRA determined that the contribution to the total storage risk from handling accidents was much less than 1%.

H.1.2 Destruction of Chemical Munitions

Accidents associated with the proposed destruction activities include those that might occur during the handling of munitions, the transport of munitions between the storage igloo and the destruction facility, and inside the proposed destruction facility. Accidents that might occur in the existing storage area during the on-site destruction period would be the same as those that might occur during the continued storage of munitions at BGAD. The analysis of storage accidents has been deliberately separated from the analysis of on-site destruction accidents to facilitate the comparison between the destruction alternatives and the no-action alternative (i.e., continued storage).

H.1.2.1 Non-Incineration Technologies

The ACWA Draft EIS (ACWA DEIS 2001) provides the only information available for the identification or assessment of hypothetical accidents that could occur during the destruction of the BGAD stockpile with non-incineration technologies. No detailed risk assessment has yet been conducted for the ACWA technologies; however, a bounding accident was used in the ACWA Draft EIS to define the magnitude and spatial extent of an accidental release of chemical agent. As described in detail in Sect. H.3.1.2 of this appendix, an aircrash into the Container Handling Building (CHB)—where munitions inside on-site transportation packages would be received at the destruction facility—was identified by the ACWA staff as an appropriate hypothetical event for analysis.

H.1.2.2 Incineration Technologies

The QRA concludes that the public risk at BGDA is dominated by external events, such as earthquakes and air crashes. In particular, earthquake-initiated accidents account for 58% of the disposal risk, and air crashes account for 16%. Handling accidents during disposal of the rockets at BGCA account for 24% of the total risk in the QRA. Other contributors to the risk of chemical weapons destruction at BGAD include tornados (1%) and natural gas explosions (1%).

Because the earthquake-initiated accidents dominate the risks of chemical weapons destruction at BGAD, the largest earthquake-induced accident was identified and selected for further analysis in this EIS. This event is described in detail in Sect. H.3.1.2 of this appendix.

H.2 ENVIRONMENTAL PATHWAYS

Chemical agent can be dispersed after an accidental release through various environmental pathways. The basic pathways include movement of small droplets in the air; movement of vapor in the air; deposition or scavenging of the airborne material onto underlying land, vegetation, or water; movement into bodies of surface water after atmospheric deposition or through runoff of spilled agent; and movement into groundwater (for example, as the result of aquifer recharge from contaminated surface waters). Once chemical agent is released into the environment, it may affect human health, ecological systems, water use, and/or socioeconomic resources. The dispersion processes determine the form and level of the contaminant in the environment and, in turn, the response of various ecological systems to the contaminant.

The greatest immediate concern for impacts following a release of chemical agent would be the airborne hazard. In addition, spilled liquid agent could also impact surface areas and/or surface water and groundwater resources.

H.2.1 Atmospheric Dispersion Analysis

Potential accidental releases were analyzed using an air dispersion model developed by the U.S. Army's Chemical Research Development and Engineering Center. This model, a computer code named D2PC (Whitacre et al. 1986), incorporates detailed information on the type of accident, type of agent, type of release (e.g., explosion, fire, or spill), and duration of release. The latest version (ACS 2000) of this computer code, now called D2PCw, was used for the analyses in this EIS. The D2PCw code incorporates atmospheric assumptions that have been extensively documented and are currently in use in a variety of other atmospheric dispersion models. A vapor depletion technique is also included in D2PCw to estimate the removal of agent vapor from the atmosphere by deposition or scavenging by surfaces.

Atmospheric dispersion, as well as the spatial extent of impacts, could vary considerably according to meteorological conditions during an accidental release. Worst-case (WC) meteorological conditions are credible conditions that result in near-maximum downwind doses. The WC conditions presume a stable atmosphere (stability Class E [Pasquill 1961]) with a wind speed of 1 m/s (2.2 mph). Conservative most-likely (CML) conditions are frequently occurring meteorological conditions that provide greater dispersion (i.e., dilution) of agent but can still result in relatively large downwind lethal hazard distances. CML conditions presume a neutral stability (Class D) with a wind speed of 3 m/s (6.7 mph). A specified quantity of chemical agent accidentally released under WC conditions would result in a greater downwind distance for the no-deaths concentration and a greater number of potential fatalities than the same release under CML conditions.

The D2PCw code predicts the inhalation dose of agent expected at locations downwind from the point of the release. (Dosage is defined as the mathematical product of airborne agent concentration and the duration of exposure.) The D2PCw code was used in this EIS to estimate airborne concentrations of chemical agent that could result in human fatality rates of 0%, 1%, and 50%. The dosage corresponding with the 0% rate—also known as the “no-deaths” dose—is the largest dosage that would be expected to result in no fatalities to exposed healthy adult males.

For this analysis, the dosage levels in Table H.1 were used. With the exception of the dose for 50% lethality, the doses in Table H.1 are the default values used in the D2PCw code. The 50% lethality dose was obtained from previous recommendations by the U.S. Army Chemical and Nuclear Agency (USANCA 1994) and are the same as the values used in the QRA for BGAD.

Table H.1. Toxicity of airborne chemical warfare agents.

	Dose, mg-min/m^3		
Effect	**Mustard Agent (agents H, HD, HT)**	**Agent GB**	**Agent VX**
No effects	2	0.5	0.4
0% lethality (i.e., no-deaths dose)	100	6	2.5
1% lethality	150	10	4.3
50% lethality	600	42	18

Note: A breathing rate of 25 L/min is associated with the doses in this table.
Source: USANCA 1994.

The downwind distances used in this analysis are for locations along the center of the plume or cloud of agent as it travels downwind. Doses of agent are greater along this centerline than to either side and are predicted by the D2PCw code to decrease from the centerline according to a Gaussian distribution. Contours can be drawn graphically to depict a given dosage; these contours form an ellipse (see Fig. H.1). The shape of the ellipse is dependent on the meteorological conditions, as defined above.

The D2PCw model provides conservative estimates of (i.e., it overestimates) the region impacted by atmospheric dispersion of chemical agent because (1) no credit is taken for the potential confinement of the atmospheric plume by terrain effects, and (2) the selected meteorological conditions are assumed to persist invariably over the entire dispersion period [for example, up to 14 hours would be needed for winds blowing at 1 m/s (2.2 mph) to reach 50 km (31 miles)]. The D2PCw modeling results are subject to several qualifications (e.g., estimates of downwind no-death distances are accurate to within ±50%), as documented in Sect. H.3.2.

H.2.2 Deposition Analysis

Surface deposition or scavenging of chemical agent from atmospheric releases is of interest in terms of contamination of ecological resources, surface water, and physical aspects of the socioeconomic environment. To evaluate the effects of deposition or scavenging from an airborne plume of accidentally released chemical warfare agent, the amount of material deposited can be estimated by multiplying the airborne concentration by a deposition velocity. The chemical agent was assumed to be uniformly deposited over the area based on the

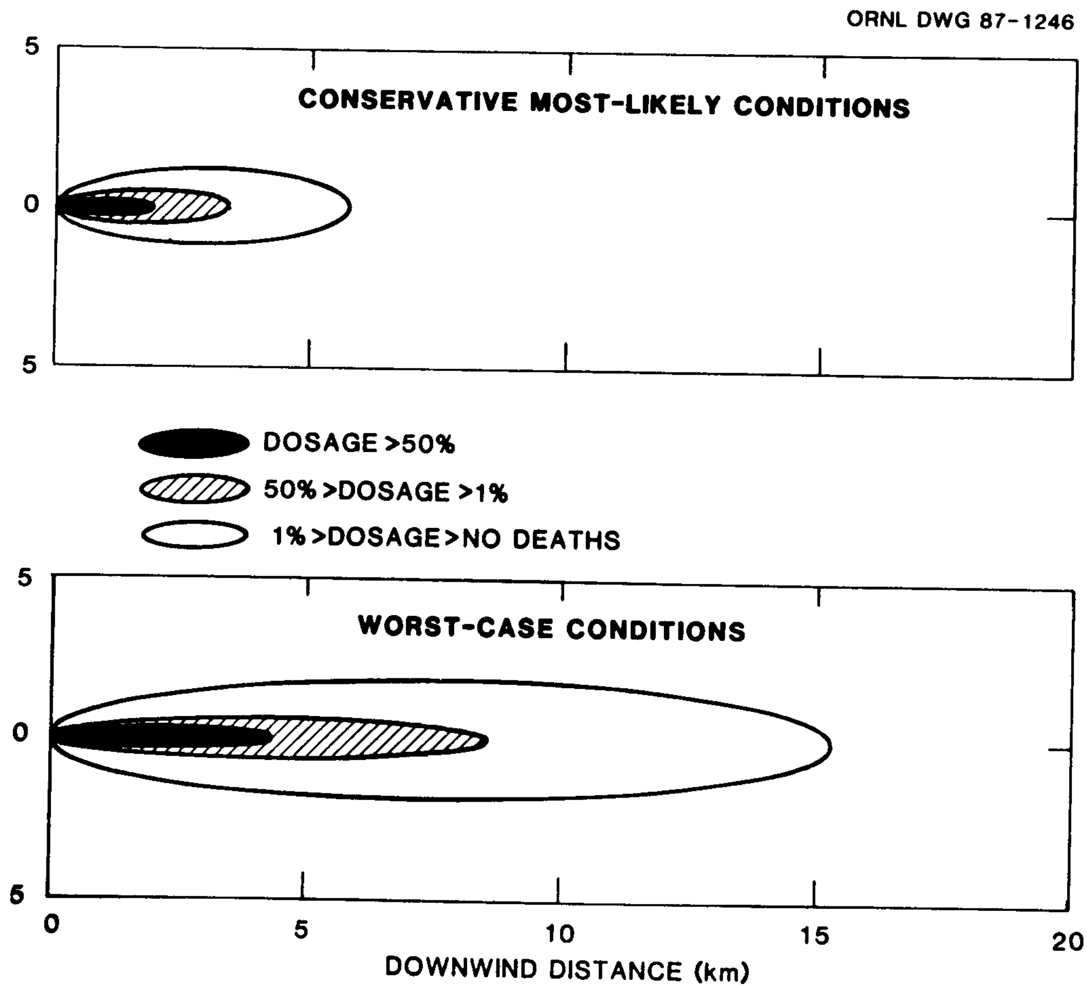

Fig. H.1. A hypothetical scenario illustrating the relationships between plume distances and shapes for accidents releasing the same quantity of chemical agent under different meteorological conditions.

concentration and the time of cloud passage. These resulting deposition rates are used in Sect. 4 of this EIS to assess the impacts to ecological resources. However, because deposition calculations are quite imprecise (see U.S. Army 1988, Vol. 3, Appendix K), the estimated values can only be assumed to be accurate to within about one order of magnitude.

H.2.3 Spills

A spill of chemical agent is the release mode by which the largest impacts might be produced in surface waters or groundwater. Surface waters could be contaminated in four ways: (1) a spill might cause contaminants to directly enter surface water—for example, a spill could migrate into a drainage ditch or small tributary of a waterbody; (2) agent might be deposited from an airborne plume or cloud onto surface water; (3) if a heavy rain or snowmelt occurred shortly after an accident, agent could be washed into surface waters in runoff from land that had been contaminated by the spill or by atmospheric deposition or scavenging; and (4) contaminated groundwater might discharge to surface waters and carry agent back to the surface.

Chemical agent could reach groundwater if agent on contaminated land were carried by water infiltration into the soil and percolated downward. In addition, agent could reach groundwater from contamination of surface water because some groundwater is recharged by surface waters.

H.3 CONSEQUENCES OF ACCIDENTS

The accident database from the QRA (SAIC 1996, 1997) was used by the Chemical Stockpile Emergency Preparedness Program (CSEPP) to assist with planning around BGAD. The CSEPP planning document—i.e., the Emergency Planning Guide (EPG)—contains an appendix identifying and describing each accident scenario from the QRA, its associated source term, and the downwind hazard distances predicted for a variety of meteorological conditions.

An organizing concept for CSEPP planning is a set of emergency response zones. The planners in the Commonwealth of Kentucky have defined the zones shown in Table H.2 for use in planning for potential releases of chemical agent at BGAD. In regard to the relationship between hypothetical accident distances and CSEPP, the boundaries of emergency planning zones under CSEPP are based primarily on the time-distance relationships that would be associated with accidental releases of chemical warfare agent. Other factors considered in the determination of CSEPP planning zones include theoretical plume arrival times, the distribution of people and resources around the depot, and other geopolitical information. The determination of CSEPP planning zone boundaries is ultimately made by local and state authorities. Although the Army does not encourage state and local planners to ignore worst case accidents (i.e., those resulting from catastrophic events, such as lightning strikes, earthquakes or airplane crashes), the Army, the Federal Emergency Management Agency, and other CSEPP participants have elected to use more credible hypothetical accidents (i.e., those having a higher probability of occurrence) for their emergency planning basis. Hence, there may be differences between the accidents used as a basis for CSEPP planning and those used to bound environmental impacts in this EIS.

Table H.2. Accident categories proposed for the Blue Grass Army Depot by the Kentucky Disaster and Emergency Services CSEPP Office

CSEPP Category No.	Description and spatial extent of the airborne chemical agent hazard	Downwind extent of no-effects distance [in km (miles)]
I	Limited Area Emergency; Confined to the Chemical Limited Area at BGAD	less than 0.5 (0.3)
II	Post-only Emergency; Beyond the Chemical Limited Area, but not beyond BGAD boundaries	greater than 0.5 (0.3), but less than 1.7 (1.1)
III	Immediate Response Zone (IRZ) 1; Beyond the BGAD boundaries, but not beyond the Madison County IRZ 1 outer boundary	greater than 1.7 (1.1), but less than 4.0 (2.5)
IV	IRZ 2; Exceeds IRZ 1, but not the Zone 2 boundary (this category does not exceed the outer boundary of the IRZ)	greater than 4.0 (2.5), but less than 6.838 (4.3)
V	Protective Action Zone (PAZ); Exceeds the IRZ boundary, but does not exceed the outer boundary of the PAZ	greater than 6.838 (4.3), but less than 22.5 (14.0)
VI	Protective Zone; Affects areas beyond the outer PAZ boundary	greater than 22.5 (14.0), but less than 100 (62.5)

Source: CSEPP Accident Planning Base Review Group, *Emergency Response Concept Plan for the Chemical Stockpile Emergency Preparedness Program, Rev. 1, Vol. 2: Emergency Planning Guide for the Blue Grass Chemical Activity CSEPP Site*, ANL/DIS/TM-49, Argonne National Laboratory, Argonne, IL, March 1998.

The accidents in the EPG for BGAD that were identified as Category VI events were examined for further analysis in this EIS (see Appendix G in CSEPP 1998). The largest of those hypothetical events are identified and described below.

H.3.1 Identification of Worst-Case Accidents

The impact analyses in this EIS are based on hypothetical accidents that are specific to the implementation of alternatives under consideration in this EIS. The hypothetical accidents associated with continued storage of munitions at BGAD would potentially involve entire igloo quantities of chemical warfare agent. Because the destruction alternatives (i.e., either neutralization or incineration) would involve far less chemical agent than exists in a storage igloo, the largest hypothetical storage accident is used in this EIS to bound the potential environmental impacts of accidents under all alternatives. The largest such hypothetical accidents (also called "worst-case accidents") are identified in Table H.3 and are described below.

To assist the reader in understanding the information contained in the various portions of this appendix, Table H.3 also shows the potential numbers of fatalities that might accompany the hypothetical accidents. The fatality data were obtained from the analysis described in Sect. H.3.2.

Table H.3. Hypothetical accidents involving the largest credible releases of chemical agent at the Blue Grass Army Depot

Accident scenario description	Munition and agent type	Conservative Most-Likely (CML) meteorological conditions[a], km (miles)			Worst-Case (WC) meteorological conditions[b], km (miles)		
		Computed downwind lethal distance[c]	Estimated average number of potential fatalities[d]	Estimated maximum number of potential fatalities[e]	Computed downwind lethal distance[c]	Estimated average number of potential fatalities[d]	Estimated maximum number of potential fatalities[e]
STORAGE ACCIDENTS[f]							
Lightning strikes storage igloo	M55 rockets; VX	15 (9)	220	2,200	50 (31)	730	5,900
Lightning strikes storage igloo	M55 rockets; GB	11 (7)	50	470	33 (21)	270	3,100
ACWA (i.e., NON-INCINERATION) FACILITY ACCIDENT[g]							
Air crash into facility	8-inch projectiles; GB	> 50 (31)[h]	N/A	1,837	> 50 (31)[h]	N/A	41,056
PMCD (i.e., INCINERATION) FACILITY ACCIDENT[f]							
Earthquake at facility	8-inch projectiles; GB	8 (5)	20	180	25 (16)	210	2,300

[a]Conservative Most-Likely meteorological conditions are stability class D with a wind speed of 3 m/s.
[b]Worst-Case meteorological conditions are stability class E with a wind speed of 1 m/s.
[c]The distance to where the airborne concentration is equal to the concentration at which no deaths would be expected to occur (i.e., the 0% lethality dose).
[d]This the average number of potential fatalities as computed from 360 possible plume directions around the location of the accident.
[e]This the largest numerical value of potential fatalities as computed from a set of 360 possible plume directions around the location of the accident.
[f]With the exception of the VX storage igloo accident, the computed distances were obtained from Appendix G in the CSEPP Emergency Planning Guide for BGAD (CSEPP 1998). The downwind distance for the VX storage igloo accident was obtained as described in Section H.3.1.1 of this appendix.
[g]All data were btained from Table 7.21-2 in the ACWA Draft EIS (ACWA DEIS 2001).
[h]Computed distance was truncated to 50 km (31 miles) due to limitations of the D2PCw atmospheric dispersion modeling.

H.3.1.1 Hypothetical Storage Accidents

For the alternative of continuing to store the chemical weapons at BGAD without their destruction, the largest hypothetical accident (as identified in the CSEPP planning document for BGAD [CSEPP 1998]) would involve a lightning strike to a storage igloo filled with VX rockets. This event was postulated to result in a fire involving the entire contents of a single igloo. The amount of agent VX released to the atmosphere during this event was computed in the QRA to be 576 kg (1,270 lb). The release was assumed to occur over a one minute time period. The QRA database (as reported in CSEPP 1998) assigns an annual frequency of 4.73×10^{-4} to this event. This is equivalent to about one chance in 2,000 per year of continued storage.

The CSEPP planning document for BGAD (CSEPP 1998) indicates that the modeled downwind no-deaths distance for this accident would exceed 50 km (31 miles) under WC meteorological conditions. The D2PCw code truncates the computed downwind distances at 50 km (31 miles). This is the value recommended for use with D2PCw code (ACS 2000). This limit is also consistent with the limitations inherent in the straight-line, Gaussian dispersion models used for local-scale impact assessments.

The downwind distance for this accident was re-assessed for this EIS by examining more realistic assumptions for the worst-case meteorological conditions. It would take about 14 hours for the lethal plume to reach 31 miles with a wind speed of 2.2 mph. In order to identify more appropriate conditions at BGAD, and in attempt to obtain a more appropriate plume contour than the one truncated at the 31-mile limit of the D2PCw model, the following conditions were examined, and the results[2] are reported below.

- Stability class E, 1 m/s (2.2 mph) wind speed with an unlimited mixing height. (Note the maximum numerical value available for use in the D2PCw model is 5,000 m [16,400 ft]).
- Stability class D, 1 m/s (2.2 mph) wind speed with the lowest seasonal mixing height at BGAD for class D stability; then switching after one hour to class E stability with a 5,000-m (16,400-ft) mixing height.
- Stability class E, 1 m/s (2.2 mph) wind speed for 12 hours of summer nighttime, then switching to class D stability using the summer mixing height at BGAD for class D stability for the entire duration of the release.
- Stability class E, 1 m/s (2.2 mph) wind speed for 15 hours of autumn nighttime, then switching to class D stability using the autumn mixing height at BGAD for class D stability for the entire duration of the release.
- Stability class E, 1 m/s (2.2 mph) wind speed for 16.5 hours of winter nighttime, then switching to class D stability using the winter mixing height at BGAD for class D stability for the entire duration of the release.
-

[2] The D2PCw code includes a two-minute correction to account for the human body's limited ability to deal with nerve agents GB and VX if the exposure is at a low level over an extended period of time (i.e., greater than two minutes). To be consistent with the numerical data in the CSEPP planning document (CSEPP 1998), all of the D2PCw runs for the analysis in this appendix were made with the "two-minute correction" variable enabled.

- Stability class E, 1 m/s (2.2 mph) wind speed for 13 hours of spring nighttime, then switching to class D stability using the spring mixing height at BGAD for class D stability for the entire duration of the release.

The results of examining the downwind no-deaths distances resulting from the above cases show those distances range from 33.0 km (20.5 miles) to 48.7 km (30.3 miles), with the 12-hr summer nighttime case giving the largest downwind no-deaths distance. Hence, the plume contours matching a 50-km (31-mile) no-deaths distance were used in the impact analyses of storage accidents in this EIS.

H.3.1.2 Hypothetical Accidents during the Destruction of Chemical Munitions

Non-Incineration Technologies. The hypothetical accident identified in the ACWA Draft EIS (ACWA DEIS 2001) for a non-incineration pilot facility assumes that an aircraft crashes into the Container Handling Building (CHB) and a subsequent fire occurs. For this accident scenario, the assumed maximum amount of agent that could be stored in the CHB was used to estimate the maximum release that could result from an aircraft crash accident. The ACWA staff estimated the source term for this accident from documentation for an incineration facility. The CHB was assumed to contain 8-in. GB projectiles at the time of the crash. According to the ACWA Draft EIS, these assumptions result in the largest possible quantity of agent GB present in the CHB among the types of munition to be destroyed at BGAD. An agent GB accident was assessed because its impacts in terms of the estimated number of fatalities was determined by the ACWA staff to be larger than those from a similar release involving agent VX. The facility accident, as identified and modeled by the ACWA staff, has been adopted for use in this appendix without further analysis. This includes both the ACWA estimates of downwind hazard distances and the estimated numbers of potential fatalities.

Incineration Technologies. The largest hypothetical accident identified in the QRA for a BGAD incineration facility assumes that an earthquake with accelerations approaching 1.0 g affects the inventory of 8-inch GB projectiles located in the munitions demilitarization building, the unpack area, and the CHB. The source term for this accident scenario was estimated in the QRA to be 347 kg (766 lb) released over 27 minutes by evaporation, 90 kg (199 lb) released by detonation, and 10.9 kg (24 lb) released over 6 hours through the facility's ventilation and filtration system. The CSEPP planning document for BGAD (CSEPP 1998) gives the downwind no-deaths distance for this accident as 25 km (16 miles) under WC meteorological conditions. The QRA database assigns an annual frequency of 4.69×10^{-6} to this event. This is equivalent to about one chance in 200,000 per year of facility operations.

H.3.2 Estimation of Potential Fatalities from Chemical Agent Releases

The human health impacts of an accidental release of chemical warfare agent stored at BGAD could include fatalities and sublethal effects, such as effects on the skeletal muscles (e.g., uncoordinated motions followed by paralysis), effects on nervous system control of smooth muscles and glandular secretions (e.g., pinpoint pupils, copious nasal and respiratory secretion, bronchoconstriction, vomiting, and diarrhea), and effects on the central nervous system (e.g., thought disturbances and convulsions). Because sublethal effects would vary with the exposure concentrations, the exposure duration, and the health status and number of people exposed, it would be impossible to attempt to definitively quantify such effects. In contrast, the number of potential fatalities would vary directly with the accident size and the population exposed, both of which can be readily quantified.

Estimates of potential fatalities require (1) a description of the population distribution around the accident site, (2) a description of how large an area would be affected by chemical agent if an accident were to occur, and (3) a method of combining these descriptions to produce an estimate. Each of these elements is described in the paragraphs below.

Off-post Populations. For this EIS, the year 2000 census data (U.S. Department of Commerce 2001) were used to develop estimates of the spatial distribution of the residential population around BGAD. The approximate location for the proposed destruction facility was used as the center for the off-site population. The coordinates of this location are 37° 43 minutes 14 seconds north latitude and 84° 12 minutes 53 seconds west longitude.

The year 2000 census information contains population counts by location (i.e., by latitude and longitude) for various hierarchical data levels down to the individual block level (e.g., a neighborhood area bounded by four streets). For this analysis, the block level data were used. Table H.4 shows the distribution of residential population obtained from the block-level census data.

Dose Contours and Fatality Rates. The area affected by a plume from an accident depends upon the meteorological conditions at the time of release, the amount of agent released (also called the "source term"), and the manner in which it is released. This input was obtained from the QRA risk assessment [as reported in the CSEPP planning document for BGAD (CSEPP 1998)] using the D2PCw atmospheric dispersion model described in Sect. H.2.1.

The computational methodology used to estimate fatalities assumed that any person at the point of the release would have a 100% probability of dying. Farther downwind from the point of the release—as the airborne agent disperses—a boundary exists as defined by the 50% lethal dose (see Fig. H.1). That is, people on this boundary would have a 50% chance of dying from exposure to the chemical agent. It was assumed that the entire population within the area between the point of release and the 50% lethal dose boundary would receive a dose midway between the 100% and 50% levels. Therefore, the fatality rate would be 75% for this population.

A similar assumption was made at the lower dose levels. Thus, it was assumed that the fatality rate for persons who would receive exposures between the 50% lethal dose and the 1% lethal dose would average 25%, and that the fatality rate for persons receiving exposures between the 1% lethal dose and no-deaths dose would be 0.5%. These are conservative assumptions that tend to overestimate the number of fatalities, because the time-weighted dose-concentration declines at a greater-than-linear rate as downwind distance increases, and because the dose per unit area also declines at a greater-than-linear rate as downwind distance increases.

Table H.4. Distribution of residential population around the location of the proposed munitions destruction facility at the Blue Grass Army Depot.

	Incremental population between specified distances (km)[a]							
Direction	**0–2**	**2–5**	**5–10**	**10–15**	**15–20**	**20–30**	**30–40**	**40–50**
North	0	525	527	329	278	7,358	19,790	2,181
North-Northeast	0	272	389	268	97	1,418	2,138	12,904
Northeast	0	371	252	591	432	2,989	2,952	6,525
East-Northeast	0	145	964	326	504	3,214	7,162	1,495
East	0	174	264	1,133	2,680	5,073	651	1,440
East-Southeast	0	106	169	522	1,341	1,009	838	5,027
Southeast	0	121	466	112	119	668	1,062	2,418
South-Southeast	0	0	208	555	391	2,237	1,565	3,532
South	0	0	328	1,055	1,169	1,158	621	2,923
South-Southwest	0	0	528	2,395	10,405	3,794	3,217	7,413
Southwest	0	0	1,400	814	918	1,078	2,782	3,605
West-Southwest	0	0	238	485	687	1,223	6,481	7,592
West	0	0	2,461	2,025	717	915	2,927	13,640
West-Northwest	0	5	19,236	4,729	231	1,128	21,836	9,264
Northwest	0	74	2,748	2,688	1,698	1,711	68,783	118,514
North-Northwest	0	335	610	487	1,386	2,176	20,892	51,490
Incremental total	**0**	**2,128**	**30,788**	**18,514**	**23,053**	**37,149**	**163,697**	**249,963**
Cumulative total (through specified distance)	**0**	**2,128**	**32,916**	**51,430**	**74,483**	**111,632**	**275,329**	**525,292**

Note: The location used for the center of the above population lies at 37°, 43 min, 14 sec north latitude and 84°, 12 min, 53 sec west longitude.

[a]Multiply kilometers by 0.6214 to obtain miles.

Source: U.S. Department of Commerce 2001. *2000 Census of Population, SF1 Data Files (on CD-ROM)*, Bureau of the Census, Government Printing Office, Washington, D.C.

Plume Overlays. To estimate the potential maximum fatalities for a specific accident category, the 50%, 1%, and no-deaths dose contours from the D2PCw atmospheric dispersion model were overlain on the census-based population around BGAD; the number of persons within each of the three plume contours was counted; and the number of fatalities was computed using the fatality rates previously described. The downwind plume direction was then rotated in increments of one compass degree around the point of release, and the estimate of fatalities was recomputed at each increment. This process was repeated for the full 360° around the site to identify which wind direction would cause the largest number of potential fatalities. Two numbers were obtained from this calculation: (1) the average number of potential fatalities for all 360 plumes and (2) the maximum number of potential fatalities from the set of all 360 plumes. The resulting fatality estimates for each hypothetical accident are shown in Table H.3.

These estimates of potential fatalities are subject to several qualifications as documented in the FPEIS (U.S. Army 1988, Vol. 1, Sect. 4.2.3.1):

- As noted above, the assumption that 75%, 25%, and 0.5% of the population would die within a dose-exposure contour is conservative (i.e., it over-predicts the actual fatality rates).
- The estimates of fatalities are based on dose data that characterize the expected response of healthy young males. To accommodate the suspected differences in individual sensitivity among the general public, Sect. H.4 presents results of a sensitivity analysis of the fatality estimates over a range of hypothetical sensitivities within the overall population.
- The downwind distance estimates from the D2PCw atmospheric dispersion code are accurate only to within about ±50%. As a result, the fatality estimates (which are affected by area, as well as distance relationships) based upon these distances have corresponding ranges on the order of about -75% to +25%.
- Real variations in wind speed and/or direction during a release would cause the plume from an accident to have a more complex shape over real terrain than the elliptical, straight-downwind shape used here.
- The census data used for determining the population distribution reflect places of residence, and the fatality estimates for a given accident category are thus more representative of nighttime than of daytime accidents.

It was further assumed that no emergency response or protective actions would occur around BGAD in response to an accident. The human health impacts are therefore expressed in numbers of potential fatalities without any credit for possible reductions due to such actions. Hence, the estimated number of potential fatalities in this appendix are likely to exceed those that would actually be experienced in the unlikely event of an accident. The values in Table H.3 can therefore be considered to represent an upper bound on the potential number of fatalities that might result from an accidental release of chemical agent.

H.4 SENSITIVITY OF FATALITY ESTIMATES TO DOSE-RESPONSE VALUES AND DISTRIBUTION OF SENSITIVE POPULATIONS

The toxicological data (see U.S. Army 1988; Vol. 3, Appendix B) used in developing the above estimates of potential fatalities considered only acute lethality for healthy adult males.

Such data are understood to be appropriate for quantitative evaluation of dose response; however, the dose response of a more precise cross section of the population could result in different estimates of potential fatalities. Specifically, infants, children, or the elderly may die from exposure to doses lower than the estimated no-deaths dose for healthy adult males. A sensitivity analysis was performed to address these uncertainties because the potential inclusion of such revised data might result in significant differences in estimated fatalities. The results of this sensitivity analysis are presented in this section.

H.4.1 Approach Taken for the Sensitivity Analysis

In performing such a sensitivity analysis, two approaches can be taken. In the first, the estimates of potential fatalities obtained in the baseline cases described above could be recomputed by using the same plume geometries as for the baseline cases. The potentially affected population would then be subject to increased fatalities in proportion to the assumed increase in sensitivity for infants, children, and the elderly. This approach has the advantage that its results can be directly compared with the estimates of potential fatalities in Table H.3 because the same plumes and populations at risk would be considered. It has the disadvantage that any sensitive populations living outside of the baseline no-deaths plume contour would not be included in the revised estimates of potential fatalities .

In the second approach, the boundary of the lethal plume could be expanded downwind to a new distance to encompass the population that is potentially related to an increased sensitivity. This approach would present problems with predicting plume geometries and boundaries at distances larger than the already sizeable downwind lethal hazard distances for the accident scenarios presented in Table H.3. Furthermore, the D2PC calculations for the plume geometries are only accurate to within ±50% of the downwind distance. This second approach also has the disadvantage that it is not directly comparable to the baseline estimates of potential fatalities, because expanded plume boundaries are required and larger populations at risk would be involved. For these reasons, the first approach was adopted in the sensitivity analysis described in this appendix.

H.4.1.1 Defining the Sensitive Population

Three age classes were included in the sensitivity analysis: infants, children, and the elderly. Infants are defined as those individuals under the age of 5; children are defined as those more than 5 but less than 15 years old; and the elderly are defined as those persons older than 65 years. Members of the total population who were neither infants, children, nor the elderly were assumed to respond to chemical agent exposure as healthy adult males. Table H.5 reports these proportions, as well as those for the counties surrounding Madison County.

In the sensitivity analysis, it has been assumed that the geographical distribution of infants, children, and the elderly is the same in the region around BGAD as in the general population. The statistics for the population of Rockcastle County were taken as representative of the total population because Rockcastle County has the greatest percentage of “sensitive” population among the counties immediately surrounding BGAD and because the percentage of “sensitive” population in Rockcastle County is representative of the numerical data for the state

Table H.5. Sensitive population by age distribution around the Blue Grass Army Depot in Kentucky

County	Sensitive population (%) by age groups: less than 5 years old	5 to 14 years old	more than 65 years old	Total	Remaining population (%)
Clark	6.5	14.0	12.4	32.9	67.1
Estill	6.0	13.7	13.5	33.2	66.8
Fayette	6.2	11.8	10.0	28.0	72.0
Garrard	6.1	14.1	13.1	33.3	66.7
Jackson	6.6	14.8	11.8	33.2	66.8
Jessamine	7.4	14.8	9.5	31.7	68.3
Madison	6.3	12.1	9.8	28.2	71.8
Powell	6.8	14.7	10.6	32.1	67.9
Rockcastle	6.1	14.1	13.2	33.4	66.6
Commonwealth of Kentucky	6.6	13.5	12.5	32.6	67.4
Entire United States	6.8	14.6	12.4	33.8	66.2

Sources: U.S. Bureau of the Census, *2000 Census; Table DP-1, Profiles of General Demographic Characteristics,* Washington, D.C.; on-line data accessed June 12, 2001, at URL http://www.census.gov/prod/cen2000.

of Kentucky and the United States as a whole. Therefore, 33.4% of the total population was assumed to be sensitive to chemical agent exposure, while 66.6% was assumed to respond as healthy adult males.

H.4.1.2 Bounding the Sensitivity to Dose-Response

To calculate the effects of the sensitivity of the population to chemical agent exposure, it was assumed that each of the three sensitive groups would have higher rates of death than the rates for the nonsensitive population. The argument has been made (V. Houk, Center for Environmental Health, Department of Health and Human Services, Atlanta, Ga., letter to D. Nydam, Office of the Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., June 1987) that infants, children, or the elderly might experience fatalities when exposed to chemical agent concentrations almost 80% lower than the no-deaths dose for healthy adult males. It was assumed that those individuals sensitive to a dose equal to 20% of the no-deaths dose for healthy adult males would die at a rate five times greater than the fatality rate for healthy adult males. This assumed fatality rate would be limited only by the size of the sensitive population, such that no more than 100% of that population could be killed.

To bracket the uncertainty in the dose response of the potentially sensitive populations, the sensitivity analysis included three separate downscaled doses: one-half of the no-deaths dose (or ND/2), one-fifth (or ND/5), and one-tenth (or ND/10). These values were used to increase the assumed fatality rate of the affected population by factors of 2, 5, and 10, respectively.

H.4.1.3 Recomputing Estimates of Potential Fatalities

Fatality multipliers for the three zones of each plume are presented in Table H.6. The fatality multipliers for the potentially sensitive population (as shown in Table H.5) were generated as the mathematical product of the increased sensitivity (factors of 2, 5, and 10) and the fatality multiplier for the reference case (i.e., healthy adult males); however, this multiplier could obviously never be larger than 100%.

Table H.6. Fatality multipliers for sensitive populations

Boundary of dose contour within airborne plume[a]	Reference case[b] (ND/1[c])	Scaled no-deaths dose[c]		
		ND/2	ND/5	ND/10
Release point out to 50% lethal dose	0.75	1.00	1.00	1.00
50% lethal dose out to 1% lethal dose	0.25	0.50	1.00	1.00
1% lethal dose out to no-deaths distance	0.005	0.01	0.025	0.05

[a]See Fig.H.1.
[b]See Sect. H.4.
[c]ND = "No-deaths" dose for healthy adult males.

In computing revised estimates of potential fatalities among the sensitive population, the fatality multipliers within each zone of the plume boundary as taken from Table H.6 were applied to the population percentages reported in Table H.5 for Rockcastle County. The number of potential fatalities in the balance of the population (i.e., those who are neither infants, children, nor the elderly) was computed using the fatality multipliers for the reference case.

H.4.2 Discussion of Sensitivity Analysis Results

The sensitivity analysis fatality estimates for BGAD are presented in Table H.7. This table shows that the fatalities for sensitive populations (i.e., those who might be expected to die from one-tenth the healthy adult male dose) would lead to about 1.1 to 1.6 times the reference-case number of potential fatalities for those accidents occurring under “worst case” meteorological conditions (i.e., nighttime conditions, including class E stability) and to about 1.3 to 2.0 times the reference-case number of potential fatalities for those accidents occurring under more likely meteorological conditions associated with daytime hours. The results of a similar sensitivity analysis with similar findings is reported in the ACWA Draft EIS (ACWA DEIS 2001). The ACWA Draft EIS concludes that the estimates of potential fatalities could be 1.2 to 2.0 times higher when the potentially sensitive population is taken into account.

Table H.7. Estimates of potential fatalities, assuming greater sensitivity for infants, children, and the elderly among the residential population surrounding the Blue Grass Army Depot.

Hypothetical Accidents[a]	Potential fatalities among those sensitive to various dose levels[b]			
	Reference case	ND/2	ND/5	ND/10
Conservative most likely meteorological conditions				
VX rocket storage igloo (15 km)	2,200	2,900	4,400	4,400
GB rocket storage igloo (11 km)	470	620	930	940
GB 8-inch projectiles in processing building (8 km)	180	230	350	360
Worst-case meteorological conditions				
VX rocket storage igloo (50 km)	5,900	6,600	6,700	6,700
GB rocket storage igloo (33 km)	3,100	3,700	4,700	4,700
GB 8-inch projectiles in processing building (25 km)	2,300	2,900	3,700	3,700

[a]See Table H.1 for definitions.
[b]Fatality estimates are rounded. ND/2, ND/5, and ND/10 are one-half, one-fifth, and one-tenth, respectively, of the no-deaths dose for healthy adult males (baseline) (see Sect. H.4.1.2).

One result of the sensitivity analysis stands out. The estimated potential maximum fatalities based upon the ND/10 assumptions are essentially the same as those that use the ND/5 assumptions; however, this would be expected from the use of the numerical multipliers in Table H.6. This result indicates that ND/5 dose proposed in Sect. H.4.1.2 represents a reasonable bracketing of differential dose-response sensitivity. However, it should be noted that this result depends in part upon the distribution of the sensitive population around the site, and in part upon the assumed sensitivity (as expressed in fatality rates) of that population to the downscaled dose-response values.

Also, consideration of the potentially sensitive populations could increase the estimates of potential maximum fatalities by as much as 100% above the baseline estimates for the daytime meteorological conditions. However, this increase must be evaluated in light of other uncertainties in the fatality estimation process. For example, the atmospheric dispersion model computes plume geometries that are accurate to within only ±50% of the downwind distance. The resulting plume shapes could therefore cover areas that are approximately 40 to 250% the size of the plume area for the reference case. The potentially affected population in these different areas would also be expected to be proportional to the area. Thus, the uncertainty in the fatality estimates that results from different sensitivities in the population appears to be equal to or less than other sources identified in Sect. H.3.2.

H.6 FINDINGS AND CONCLUSIONS

Hypothetical accidents that could occur to the storage igloos at BGAD include lightning strikes and earthquakes with an extremely low probability of occurrence. Nevertheless, for the purpose of the bounding the extent of potential environmental impacts in this EIS, the worst-case storage accident at BGAD would be a Category VI accident (as defined by CSEPP; see Table H.2). This hypothetical accident would have an associated downwind lethal hazard distance (i.e., a no-deaths distance) of up to 50 km (31 miles) under the type of worst-case meteorological conditions usually associated with nighttime hours. This event would have the potential of creating up to 5,900 fatalities among the residential population around BGAD (see Table H.3). If this event were to occur under the type of meteorological conditions usually associated with daylight hours, the downwind no-deaths distance would be 15 km (9 miles), and the number of potential fatalities could be as high as 2,200.

Potential accidents associated with the destruction of munitions would be significantly smaller than the storage accident described in the preceding paragraph. However, the "worst-case" storage accident is used in this EIS to bound the magnitude and spatial extent of the potential impacts to human health and the environment.

Non-Incineration (i.e., ACWA) Technologies. The accident scenario of an aircraft crash into the CHB while processing 8-inch projectiles filled with agent GB was estimated in the ACWA Draft EIS to result in a downwind no-deaths distance of more than 50 km (31 miles) under worst-case meteorological conditions. The corresponding number of potential fatalities among the general public was estimated by the ACWA staff to be about 41,000. If such an accident were to occur under daytime meteorological conditions, the corresponding estimated number of potential fatalities among the general public would be about 1,500 (see Table H.3).

This number of potential fatalities is large in comparison to the number for the storage accident described above. The reason for the large number estimated by the ACWA staff is related to the size of the chemical weapons inventory assumed to be inside the CHB and to the assumptions used in the atmospheric dispersion modeling of the accident. Nevertheless, the ACWA data are used in this EIS because they represent the best available information.

Incineration (i.e., PMCD) Technologies. The accident scenario of an earthquake affecting the incineration facility while processing 8-inch projectiles filled with agent GB is estimated in this appendix to result in a downwind no-deaths distance of more than 25 km (16 miles) under worst-case meteorological conditions. The corresponding number of potential fatalities among the general public is estimated to be about 2,300. If such an accident were to occur under daytime meteorological conditions, the corresponding estimated number of potential fatalities among the general public would be about 180 (see Table H.3).

H.6 REFERENCES

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APPENDIX I

TOXIC AIR POLLUTANT TABLES

Table I.1. Estimated toxic air pollutant emissions for baseline incineration at BGAD

all values are in micrograms (µg) per second

	LIC	DFS	MPF	All Sources[a]	Fluctuating Conditions[b]	Onsite[c]	Offsite[d]
	µg/second			µg/second	µg/second	µg/m3	µg/m³
Dioxins/Furans							
2,3,7,8 TCDD	5.26E-06	5.54E-05	9.17E-05	2.00E-04	5.59E-04	8.39E-10	1.06E-10
1,2,3,7,8 PeCDD	2.63E-04	2.77E-04	4.58E-04	9.98E-04	2.79E-03	4.19E-09	5.31E-10
1,2,3,4,7,8 HxCDD	2.63E-04	2.77E-04	4.58E-04	9.98E-04	2.79E-03	4.19E-09	5.31E-10
1,2,3,6,7,8 HxCDD	2.63E-04	2.77E-04	4.58E-04	9.98E-04	2.79E-03	4.19E-09	5.31E-10
1,2,3,7,8,9 HxCDD	2.63E-04	2.77E-04	4.58E-04	9.98E-04	2.79E-03	4.19E-09	5.31E-10
1,2,3,4,6,7,8 HpCDD	2.63E-04	5.93E-04	4.58E-04	1.31E-03	3.68E-03	5.52E-09	6.99E-10
1,2,3,4,6,7,8,9 OCDD	5.26E-04	1.20E-03	9.77E-04	2.70E-03	7.57E-03	1.14E-08	1.44E-09
2,3,7,8 TCDF	8.03E-05	5.54E-05	9.17E-05	2.27E-04	6.37E-04	9.55E-10	1.21E-10
1,2,3,7,8 PeCDF	2.63E-04	2.77E-04	4.58E-04	9.98E-04	2.79E-03	4.19E-09	5.31E-10
2,3,4,7,8 PeCDF	2.63E-04	3.15E-04	5.23E-04	1.10E-03	3.08E-03	4.62E-09	5.86E-10
1,2,3,4,7,8 HxCDF	2.63E-04	3.03E-04	4.58E-04	1.02E-03	2.87E-03	4.30E-09	5.45E-10
1.2.3.6.7.8 HxCDF	2.63E-04	2.77E-04	4.58E-04	9.98E-04	2.79E-03	4.19E-09	5.31E-10
2,3,4,6,7,8 HxCDF	2.63E-04	3.53E-04	4.58E-04	1.07E-03	3.01E-03	4.51E-09	5.71E-10
1,2,3,7,8,9 HxCDF	2.63E-04	2.77E-04	4.58E-04	9.98E-04	2.79E-03	4.19E-09	5.31E-10
1,2,3,4,6,7,8 HpCDF	3.44E-04	2.77E-04	1.67E-03	2.29E-03	6.41E-03	9.62E-09	1.22E-09
1,2,3,4,6,7,9 HpCDF	2.85E-04	4.29E-04	6.95E-04	1.41E-03	3.95E-03	5.92E-09	7.50E-10
1,2,3,4,6,7,8,9 OCDF	5.26E-04	5.54E-04	1.36E-03	2.44E-03	6.83E-03	1.02E-08	1.30E-09
Metals							
Aluminum	1.87E+02	3.63E+02	1.62E+02	7.12E+02	1.99E+03	2.99E-03	3.79E-04
Antimony	6.40E+01	1.50E+02	1.19E+02	3.33E+02	9.32E+02	1.40E-03	1.77E-04
Arsenic	9.66E+01	4.33E+01	8.52E+01	2.25E+02	6.30E+02	9.45E-04	1.20E-04
Barium	6.40E+01	1.11E+01	3.16	7.83E+01	2.19E+02	3.29E-04	4.16E-05
Beryllium	1.28E+01	6.39	2.38E+01	4.30E+01	1.20E+02	1.81E-04	2.29E-05
Boron	1.69E+03	1.91E+03	2.29E+03	5.89E+03	1.65E+04	2.47E-02	3.13E-03
Cadmium	1.60E+01	2.69E+01	1.99	4.49E+01	1.26E+02	1.89E-04	2.39E-05
Chromium	7.23	5.82	2.08	1.51E+01	4.24E+01	6.35E-05	8.05E-06
Hexavalent Chromium	1.87E+01	5.01E+01	3.22	7.20E+01	2.02E+02	3.02E-04	3.83E-05
Cobalt	3.20E+01	1.73E+01	5.95E+01	1.09E+02	3.05E+02	4.57E-04	5.79E-05
Copper	3.20E+01	5.54E+01	5.38	9.28E+01	2.60E+02	3.90E-04	4.94E-05

Table I.1 (continued)

	LIC	DFS	MPF	All Sources[a]	Fluctuating Conditions[b]	Onsite[c]	Offsite[d]
	µg/second			µg/second	µg/second	µg/m3	µg/m^3
Metals (continued)							
Manganese	2.45E+03	4.34E+03	1.57E+03	8.36E+03	2.34E+04	3.51E-02	4.45E-03
Mercury	3.06E+01	1.23E+01	4.28E+01	8.57E+01	2.40E+02	3.60E-04	4.56E-05
Mercury Elemental	6.11E-02	2.46E-02	8.57E-02	1.71E-01	4.80E-01	7.20E-07	9.12E-08
Mercury divalent	1.47E+01	5.91	2.06E+01	4.12E+01	1.15E+02	1.73E-04	2.19E-05
Nickel	3.20E+01	3.14E+01	3.04	6.64E+01	1.86E+02	2.79E-04	3.53E-05
Phosphorus	1.11E+03	1.00E+03	1.16E+03	3.27E+03	9.16E+03	1.37E-02	1.74E-03
Selenium	3.28E+01	4.33E+01	7.23E+01	1.48E+02	4.16E+02	6.23E-04	7.89E-05
Silver	6.40E+01	1.73E+01	5.13E-01	8.18E+01	2.29E+02	3.44E-04	4.35E-05
Thallium	6.40	8.67	1.18E+01	2.69E+01	7.52E+01	1.13E-04	1.43E-05
Tin	1.21E+02	1.77E+02	1.02	2.99E+02	8.37E+02	1.26E-03	1.59E-04
Vanadium	3.81E+01	4.33E+01	2.38E+01	1.05E+02	2.95E+02	4.42E-04	5.60E-05
Zinc	9.90E+02	9.29E+02	3.69	1.92E+03	5.38E+03	8.08E-03	1.02E-03
Volatile PICs							
Acetone	1.43E+05	2.92E+05	1.98E+02	4.35E+05	6.31E+05	9.47E-01	1.20E-01
Benzene	1.32E+02	1.21E+02	3.52E+02	6.05E+02	8.77E+02	1.32E-03	1.67E-04
Bromodichloromethane	2.02E+01	2.01E+01	1.85E+01	5.88E+01	8.53E+01	1.28E-04	1.62E-05
Bromoform	4.41E+01	1.49E+02	7.03E+01	2.63E+02	3.82E+02	5.73E-04	7.26E-05
Bromomethane	1.15E+01	2.91E+01	1.85E+01	5.91E+01	8.57E+01	1.29E-04	1.63E-05
2-Butatone	5.21E+02	1.24E+03	2.86E+02	2.05E+03	2.97E+03	4.45E-03	5.64E-04
1,3 Butadiene	3.44E+01	1.82E+02	1.85E+01	2.35E+02	3.41E+02	5.11E-04	6.47E-05
Carbon Disulfide	7.47E+01	4.18E+01	6.63E+01	1.83E+02	2.65E+02	3.98E-04	5.04E-05
Carbon Tetrachloride	1.73E+02	1.33E+01	2.93E+01	2.16E+02	3.13E+02	4.69E-04	5.94E-05
Chlorobenzene	1.64E+01	1.45E+01	1.85E+01	4.94E+01	7.16E+01	1.07E-04	1.36E-05
Chloroform	8.66E+01	3.17E+02	1.98E+01	4.23E+02	6.14E+02	9.21E-04	1.17E-04
Chloromethane	2.44E+02	8.39E+01	4.69E+01	3.75E+02	5.43E+02	8.15E-04	1.03E-04
Dibromochloromethane	2.11E+01	2.27E+01	1.85E+01	6.23E+01	9.03E+01	1.36E-04	1.72E-05
1,2 Dibromomethane	1.11E+01	1.33E+01	1.85E+01	4.29E+01	6.22E+01	9.33E-05	1.18E-05
Dichlorodifluromethane	1.11E+01	1.33E+01	1.85E+01	4.29E+01	6.22E+01	9.33E-05	1.18E-05
1,1 Dichloroethane	1.11E+01	1.33E+01	1.85E+01	4.29E+01	6.22E+01	9.33E-05	1.18E-05

Table I.1 (continued)

	LIC	DFS	MPF	All Sources[a]	Fluctuating Conditions[b]	Onsite[c]	Offsite[d]
		µg/second		µg/second	µg/second	µg/m3	µg/m^3
Volatile PICs (continued)							
1,2 Dichloroethane	1.11E+01	1.33E+01	1.85E+01	4.29E+01	6.22E+01	9.33E-05	1.18E-05
cis 1,3 Dichloropropene	1.12E+01	1.33E+01	1.85E+01	4.30E+01	6.24E+01	9.35E-05	1.18E-05
trans 1,3 Dichloropropene	1.05E+01	1.33E+01	1.85E+01	4.23E+01	6.13E+01	9.20E-05	1.17E-05
Ethylbenzene	1.11E+01	3.15E+01	1.75E+01	6.01E+01	8.71E+01	1.31E-04	1.66E-05
n-Hexane	1.11E+01	1.33E+01	1.85E+01	4.29E+01	6.22E+01	9.33E-05	1.18E-05
2-Hexanone	3.44E+01	1.33E+01	1.85E+01	6.62E+01	9.60E+01	1.44E-04	1.82E-05
Idomethane	1.11E+01	4.59E+02	1.85E+01	4.89E+02	7.08E+02	1.06E-03	1.35E-04
Methylene chloride	1.87E+04	4.89E+04	2.21E+02	6.78E+04	9.83E+04	1.48E-01	1.87E-02
2-Propanol	6.89E+02	1.08E+03	3.45E+02	2.11E+03	3.07E+03	4.60E-03	5.82E-04
Styrene	1.06E+03	1.61E+02	9.11E+01	1.31E+03	1.90E+03	2.85E-03	3.61E-04
1,1,1,2 Tetrachloroethane	1.11E+01	1.33E+01	1.85E+01	4.29E+01	6.22E+01	9.33E-05	1.18E-05
1,1,2,2 Tetrachloroethane	1.11E+01	1.33E+01	1.85E+01	4.29E+01	6.22E+01	9.33E-05	1.18E-05
Tetrachloroethene	1.11E+01	1.33E+01	1.85E+01	4.29E+01	6.22E+01	9.33E-05	1.18E-05
Toluene	9.42E+03	2.52E+04	7.81E+01	3.47E+04	5.03E+04	7.55E-02	9.56E-03
1,1,1 Trichloroethane	6.48E+01	1.35E+02	1.98E+01	2.20E+02	3.18E+02	4.78E-04	6.05E-05
1,1,2 Trichloroethane	1.11E+01	1.33E+01	1.85E+01	4.29E+01	6.22E+01	9.33E-05	1.18E-05
Trichlorofluromethane	1.11E+01	1.33E+01	1.85E+01	4.29E+01	6.22E+01	9.33E-05	1.18E-05
Vinyl Chloride	2.08E+01	1.33E+01	6.19E+01	9.60E+01	1.39E+02	2.09E-04	2.64E-05
m - Xylene	1.11E+01	1.55E+01	1.85E+01	4.51E+01	6.54E+01	9.81E-05	1.24E-05
o - Xylene	1.14E+01	1.54E+01	1.85E+01	4.53E+01	6.57E+01	9.85E-05	1.25E-05
p - Xylene	1.11E+01	1.55E+01	1.85E+01	4.51E+01	6.54E+01	9.81E-05	0
Semi-Volatile PICs							
Acetophenone	4.42E+01	5.23E+01	7.38E+01	1.70E+02	2.47E+02	3.70E-04	4.69E-05
Benzoic Acid	4.42E+02	9.57E+02	4.24E+02	1.82E+03	2.64E+03	3.97E-03	5.02E-04
Benzyl alcohol	2.43E+03	4.43E+03	2.11E+03	8.97E+03	1.30E+04	1.95E-02	2.47E-03
Benzaldehyde	9.24E+01	5.16E+01	7.38E+01	2.18E+02	3.16E+02	4.74E-04	6.00E-05
Di-n-butyl phtalate	4.42E+01	4.93E+01	7.38E+01	1.67E+02	2.43E+02	3.64E-04	4.61E-05
Diethyl phtalate	4.42E+01	4.93E+01	7.38E+01	1.67E+02	2.43E+02	3.64E-04	4.61E-05
Dimethyl phtalate	5.11E+02	5.75E+02	4.64E+02	1.55E+03	2.25E+03	3.37E-03	4.27E-04
bis -(2-Ethlhexyl) phtalate	6.45E+02	1.42E+02	8.00E+02	1.59E+03	2.30E+03	3.45E-03	4.37E-04
Fluroanthene	4.42E+01	4.93E+01	7.38E+01	1.67E+02	2.43E+02	3.64E-04	4.61E-05
2-Methylphenol (o-cresol)	1.14E+02	4.93E+01	7.24E+02	8.87E+02	1.29E+03	1.93E-03	2.44E-04

Table I.1 (continued)

	LIC	DFS	MPF	All Sources[a]	Fluctuating Conditions[b]	Onsite[c]	Offsite[d]
	µg/second			µg/second	µg/second	µg/m3	µg/m^3
3-Methylphenol (m-cresol)	3.60E+02	4.93E+01	6.12E+01	4.71E+02	6.82E+02	1.02E-03	1.30E-04
4-Methylphenol (p-cresol)	8.94E+01	4.93E+01	7.38E+01	2.13E+02	3.08E+02	4.62E-04	5.85E-05
Naphthalene	4.42E+01	4.93E+01	7.38E+01	1.67E+02	2.43E+02	3.64E-04	4.61E-05
Phenathrene	4.42E+01	4.93E+01	7.38E+01	1.67E+02	2.43E+02	3.64E-04	4.61E-05
Phenol	4.42E+01	4.93E+01	7.38E+01	1.67E+02	2.43E+02	3.64E-04	4.61E-05
Pollutant							
Hydrogen Chloride	5.80E+03	8.21E+03	8.05E+03	2.21E+04	6.18E+04	9.27E-02	1.17E-02
Hydrogen Fluoride	1.18E+04	2.64E+03	1.93E+04	3.37E+04	9.45E+04	1.42E-01	1.79E-02
Total PCB	1.02E-02	5.03E-01	0.0173	5.31E-01	1.49	2.23E-06	2.82E-07
Agent[e]							
Mustard	—	—	—	2.40E+03	2.40E+03	2.90E-03	2.40E-04
GB	—	—	—	2.40E+01	2.40E+01	2.90E-05	2.40E-06
VX	—	—	—	2.40E+01	2.40E+01	2.90E-05	2.40E-06

[a]Emissions summed for all three stacks (LIC, DFS, and MPF) to assume all pollutant emissions come from a common stack.

[b]Values increased by a factor of 2.8 for inorganic compounds and 1.45 for organic compounds.

[c]Maximum annual on-post concentration calculated by multiplying fluctuating condition concentration by 1.5 µg/m3 (normalized value provided by ISCST3 model assuming a 1 g/sec release).

[d]Maximum annual off-post concentration calculated by multiplying fluctuating condition concentration by 0.19 µg/m3 (normalized value provided by ISCST3 model assuming 1 g/sec release).

[e]The after-treatment emission rate for chemical agent (GB, VX, mustard) is a worst-case estimate; it assumes emissions at the detection limit, including during fluctuating conditions (Kimmell et al. 2002).

Table I.2. Estimated toxic air pollutant emissions from Neutralization/SCWO Technology at BGAD

	Emissions (µg/s)[b]					
			Mustard agent processing[c]		Nerve agent processing[c]	
Compound[a]	Diesel generator	Boiler	SCWO vent	Filter farm stack	SCWO vent	Filter farm stack
	—	—	—	—	—	—
1,3-Butadiene*	1.1	—	—	—	—	—
2-Methylnaphthalene	—	4.8×10^{-2}	—	—	—	—
3-Methylchloranthrene	—	3.6×10^{-3}	—	—	—	—
Acenaphthene	3.9×10^{-2}	3.6×10^{-3}	—	—	—	—
Acenaphthylene	1.4×10^{-1}	3.6×10^{-3}	—	—	—	—
Acetaldehyde*	2.1×10^{1}	—	2.8×10^{-7}	—	1.0×10^{-6}	—
Acrolein*	2.6	—	—	—	—	—
Aldehydes	1.9×10^{3}	—	—	—	—	—
Anthracene	5.2×10^{-2}	4.8×10^{-3}	—	—	—	—
Antiomony*	—	—	3.7×10^{-7}	—	8.2×10^{-8}	—
Arsenic*	—	4.0×10^{-1}	1.4×10^{-7}	—	2.5×10^{-8}	—
Barium	—	8.8	—	—	—	—
Benz(a)anthracene	2.6×10^{1}	3.6×10^{-3}	—	—	—	—
Benzene*	4.7×10^{-2}	4.2	—	—	—	—
Benzo(a)perylene	5.2×10^{-3}	2.4×10^{-3}	—	—	—	—
Benzo(b)fluoranthene	2.7×10^{-3}	3.6×10^{-3}	—	—	—	—
Benzo(g,h,i)perylene	1.4×10^{-2}	2.4×10^{-3}	—	—	—	—
Benzo(k)fluoranthene	4.3×10^{-3}	3.6×10^{-3}	—	—	—	—
Beryllium*	—	2.4×10^{-2}	2.7×10^{-8}	—	5.0×10^{-9}	—
Butane	—	4.2×10^{3}	—	—	—	—
Cadmium*	—	2.2	2.7×10^{-8}	—	1.3×10^{-7}	—

Table I.2. (continued)

Compound[a]	Emissions (μg/s)[b]					
			Mustard agent processing[c]		Nerve agent processing[c]	
	Diesel generator	Boiler	SCWO vent	Filter farm stack	SCWO vent	Filter farm stack
Chromium*	—	2.8	8.0×10^{-7}	—	1.2×10^{-6}	—
Chrysene	9.8×10^{-3}	3.6×10^{-3}	—	—	—	—
Cobalt*	—	1.7×10^{-1}	1.9×10^{-7}	—	1.5×10^{-7}	—
Copper	—	1.7	—	—	—	—
Dibenzo(a,h)anthracne	1.6×10^{-2}	2.4×10^{-3}	—	—	—	—
Dichlorobenzene*	—	2.4	—	—	—	—
Dimethylbenz(a)anthracene	—	3.2×10^{-2}	—	—	—	—
Ethane	—	6.2×10^{3}	—	—	—	—
Ethyl benzene*	—	—	2.5×10^{-6}	—	—	—
Fluoranthene	2.1×10^{-1}	6.0×10^{-3}	—	—	—	—
Fluorene	8.1×10^{-1}	5.6×10^{-3}	—	—	—	—
Formaldehyde*	3.3×10^{1}	1.5×10^{2}	3.7×10^{-7}	—	1.3×10^{-7}	—
GB[d]	—	—	—	—	—	2.8
H (mustard)[d]	—	—	—	2.8×10^{2}	—	—
Hexane(n)*	—	3.6×10^{3}	—	—	—	—
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	3.6×10^{-3}	—	—	—	—
Lead*	—	1.0	4.4×10^{-7}	—	1.3×10^{-6}	—
m,p-Xylene*	7.9	—	—	—	—	—
Maganese	—	7.6×10^{-1}	6.9×10^{-7}	—	1.2×10^{-6}	—
Mercury*	8.3×10^{-3}	5.2×10^{-1}	—	—	1.0×10^{-7}	—
Methyl ethyl	—	—	9.1×10^{-8}	—	2.6×10^{-8}	—
Molybdenum	—	2.2	—	—	—	—

Table I.2. (continued)

Compound[a]	Emissions (µg/s)[b]					
			Mustard agent processing[c]		Nerve agent processing[c]	
	Diesel generator	Boiler	SCWO vent	Filter farm stack	SCWO vent	Filter farm stack
m-Xylene*	—	—	2.2×10^{-6}	—	—	—
Naphthalene*2.3	—	1.2	—	—	8.5×10^{-10}	—
Nickel*	—	4.2	2.7×10^{-6}	—	5.6×10^{-6}	—
Particulates	—	—	1.5×10^{-4}	—	9.6×10^{-5}	—
p-Cresol (4-methlphenol)*	—	—	1.9×10^{-7}	—	—	—
Pentane(n)	—	5.2×10^{3}	—	—	—	—
Phenanthrene	8.1×10^{-1}	3.4×10^{-2}	—	—	—	—
Phosphorus*	—	—	4.3×10^{-5}	—	3.0×10^{-5}	—
PCBs[e]	—	—	—	—	1.5×10^{-9}	—
PAHs*	4.7	—	—	—	—	—
Propane	—	3.2×10^{-3}	—	—	—	—
Propylene	7.1×10^{1}	—	—	—	—	—
Pyrene	1.3×10^{-1}	1.0×10^{-2}	—	—	—	—
Selenium*	—	4.8×10^{-2}	1.4×10^{-7}	—	—	—
Toluene*	1.1×10^{1}	6.8	—	—	—	—

Table I.2. (continued)

Compound[a]	Emissions (μg/s)[b]					
			Mustard agent processing[c]		Nerve agent processing[c]	
	Diesel generator	Boiler	SCWO vent	Filter farm stack	SCWO vent	Filter farm stack
Total HpCDF	—	—	3.9×10^{-16}	—	—	—
Total TCDD	—	—	2.6×10^{-12}	—	—	—
Vanadium	—	4.6	—	—	—	—
VX[d]	—	—	—	—	—	2.8

[a]Substances designated with an asterisk are listed as HAPs under Title III, Section 112 of the *Clean Air Act*. PAHs = polycyclic aromatic hydrocarbons. PCBs = polychlorinated biphenyls. H-CDF = heptachlorodibenzo-p-furan. TCDD = tetrachlorodibenzo-p-dioxin.

[b]A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c]For SCWO and filter farm stack emissions, organics are assumed to be treated by being passed through six carbon filters in series, each at 95% efficiency. PM is assumed to pass through two HEPA filters in series, each at 99.97% efficiency.

[d]The after-treatment emission rate from the filter farm stack for chemical agent (GB, VX, mustard) is a worst-case estimate; it assumes emissions at the detection limit (Kimmell et al. 2001). It is assumed that no agent would be emitted from the SCWO stack; none would be prestent after neutralization and SCWO treatment.

[e]Although PCB destruction was not included in demonstration testing, for these analyses, it was assumed that SCWO technology would have a destruction efficiency of 99.9999%, and that further treatment as in footnote c would be applied

Source: ACWA DEIS 2001, Table 7.6-2..

Table I.3. Estimated toxic air pollutant emissions from Neutralization/ GPCR/TW-SCWO Technology at BGAD

	Emissions (μg/s)[b]							
			Mustard processing[c]		GB processing[c]		VX processing[c]	
Compound[a]	Diesel generator	Boiler	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack
(R)-(-)-2,2-Dimethyl-a,3-dioxolane-4-methanol	—	—	—	9.0×10^{-8}	—	—	—	—
1,1,1-Trichloroethane	—	—	7.6×10^{-2}	—	8.3×10^{-2}	7.2×10^{-8}	8.5×10^{-2}	—
1,2,3,4,6,7,8-HpCDD	—	—	—	—	—	—	—	—
1,2,3,4,6,7,8-HpCDF	—	—	1.2×10^{-8}	—	1.3×10^{-8}	—	1.3×10^{-8}	—
1,2,3,4,7,8-HxCDF	—	—	9.2×10^{-8}	—	1.0×10^{-7}	—	1.0×10^{-7}	—
1,2,3,6,7,8-HxCDD	—	—	—	—	—	—	—	—
1,2,3,6,7,8-HxCDF	—	—	3.4×10^{-8}	—	3.7×10^{-8}	—	3.8×10^{-8}	—
1,2,3,7,8,9-HxCDD	—	—	—	—	—	—	—	—
1,2,3,7,8-PeCDD	—	—	—	—	—	—	—	—
1,2,4-Trimethylbenzene	—	—	—	—	—	7.9×10^{-9}	—	2.1×10^{-6}
1,3-Butadiene*	1.1	—	—	—	—	—	—	—
1,4-Dichlorobenzene*	—	—	—	—	—	—	—	4.9×10^{-9}
1-Ethyl-2,2,6-trimethylcyclohexane	—	—	—	—	—	—	—	1.6×10^{-6}
1-Hexanol, 2-ethyl-	—	—	2.4×10^{1}	—	2.6×10^{1}	—	2.6×10^{1}	—

Table I.3. (continued)

	Emissions (µg/s)[b]							
			Mustard processing[c]		GB processing[c]		VX processing[c]	
Compound[a]	Diesel generator	Boiler	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack
1H-Idene	—	—	5.8	—	6.4	—	6.5	—
1H-Indene, 2,3-dihydro-	—	—	—	—	—	4.7×10^{-8}	—	—
1-Propene, 3,3,3-trichloro-	—	—	—	1.5×10^{-8}	—	—	—	—
2-(2-Butoxyethoxy) ethanol	—	—	—	—	—	—	—	1.8×10^{-6}
2,3,4,7,8-PeCDF	—	—	—	—	—	—	—	—
2,3,7,8-TCDF	—	—	5.4×10^{-8}	—	5.9×10^{-8}	—	6.0×10^{-8}	—
2,4-Dimethylphenol	—	—	2.3	—	2.5	—	2.6	—
2-Butanone (methyl ethyl ketone)*	—	—	8.1×10^{-1}	—	8.8×10^{-1}	—	9.0×10^{-13}	—
2-Methylnaphthalene	—	8.7×10^{-2}	—	2.5×10^{-7}	—	1.8×10^{-8}	—	7.9×10^{-7}
2-Nitrophenol	—	—	—	—	—	5.2×10^{-9}	—	—
3-Methylchloranthrene	—	6.5×10^{-3}	—	—	—	—	—	—
9H-Fluoren-9-0ne	—	—	—	—	—	2.8×10^{-6}	—	—
Acenaphthene	3.9×10^{-2}	6.5×10^{-3}	—	—	—	9.3×10^{-10}	—	—
Acenaphthylene	1.4×10^{-1}	6.5×10^{-3}	—	—	—	—	—	—

Table I.3. (continued)

	Emissions (μg/s)[b]							
			Mustard processing[c]		GB processing[c]		VX processing[c]	
Compound[a]	Diesel generator	Boiler	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack
Acetaldehyde*	2.1×10^{1}	—	—	2.0×10^{-8}	—	—	—	—
Acetic acid	—	—	—	—	—	—	—	5.9×10^{-7}
Acetone	—	—	2.2×10^{1}	1.3×10^{-6}	2.3×10^{2}	—	2.3×10^{2}	—
Acrolein*	2.6	—	—	—	—	—	—	—
Aldehydes	1.9×10^{3}	—	—	—	—	—	—	—
Aluminum	—	—	7.8	—	8.5	—	8.7	—
Anthracene	5.2×10^{-2}	8.7×10^{-3}	—	—	—	1.0×10^{-8}	—	4.4×10^{-9}
Antimony*	—	—	—	—	2.8×10^{-2}	1.7×10^{-9}	2.9×10^{-2}	1.1×10^{-6}
Arsenic*	—	7.2×10^{-1}	5.8×10^{-2}	6.9×10^{-9}	4.0×10^{-1}	6.9×10^{-9}	4.1×10^{-1}	—
Barium	—	1.6×10^{1}	3.4×10^{-1}	—	3.7×10^{-1}	—	3.8×10^{-1}	—
Benz(a)anthracene	4.7×10^{-2}	6.5×10^{-3}	—	—	6.8×10^{-2}	2.0×10^{-9}	6.9×10^{-2}	—
Benzaldehyde	—	—	—	8.9×10^{-8}	8.9	2.8×10^{-8}	9.1	—
Benzaldehyde, 4-ethyl-	—	—	1.8	—	2.0	—	2.1	—
Benzaldehyde, ethyl-	—	—	1.1	—	1.2	—	1.3	—

Table I.3. (continued)

	Emissions (µg/s)[b]							
			Mustard processing[c]		GB processing[c]		VX processing[c]	
Compound[a]	Diesel generator	Boiler	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack
Benzaldehyde, ethyl-benzenemethanol, 4-(1-methylethyl)-	—	—	1.1	—	1.1	—	1.2	—
Benzene*	2.6×10^{1}	7.6	5.4	3.6×10^{-7}	6.2	1.3×10^{-6}	6.4	1.4×10^{-6}
Benzene, 1,2,3-trimethyl-	—	—	—	—	—	—	—	4.1×10^{-7}
Benzene, 1,2,4,5-tetramethyl-	—	—	—	—	—	—	—	2.0×10^{-6}
Benzene, 1-methyl-2-propyl-	—	—	—	—	—	—	—	1.9×10^{-6}
Benzene, 1-methyl-3-propyl-	—	—	—	—	—	—	—	4.7×10^{-7}
Benzo(a)pyrene	5.2×10^{-3}	4.3×10^{-3}	—	—	—	—	—	—
Benzo(b)fluoranthene	2.7×10^{-3}	6.5×10^{-3}	—	—	—	—	—	—
Benzo(g,h,i)perylene	1.4×10^{-2}	4.3×10^{-3}	—	—	—	—	—	—
Benzo(k)fluoranthene	4.3×10^{-3}	6.5×10^{-3}	—	—	—	—	—	—
Benzyl alcohol	—	—	1.1	4.2×10^{-8}	1.6	—	1.6	1.8×10^{-6}
Beryllium*	—	4.3×10^{-2}	—	—	7.3×10^{-3}	7.4×10^{-10}	7.4×10^{-3}	—
Bis(2-ethylhexyl)phthalate*	—	—	4.3×10^{-1}	1.7×10^{-8}	1.9	6.8×10^{-9}	1.9	6.7×10^{-9}

Table I.3. (continued)

	Emissions (μg/s)[b]							
			Mustard processing[c]		GB processing[c]		VX processing[c]	
Compound[a]	Diesel generator	Boiler	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack
Butanal	—	—	—	1.5×10^{-7}	—	8.1×10^{-9}	—	3.1×10^{-8}
Butane	—	7.6×10^{3}	—	—	—	—	—	—
C3-Alkyl benzenes	—	—	—	7.7×10^{-6}	—	4.9×10^{-7}	—	—
Cadmium*	—	4.0	1.1×10^{-2}	5.4×10^{-9}	1.2×10^{-1}	3.1×10^{-9}	1.2×10^{-1}	3.2×10^{-7}
Calcium	—	—	1.5×10^{1}	1.7×10^{-5}	1.9×10^{1}	8.8×10^{-6}	2.0×10^{1}	7.3×10^{-5}
Carbon disulfide*	—	—	2.2×10^{-1}	—	2.4×10^{-1}	—	2.5×10^{-1}	—
Chloiroform*	—	—	3.4	—	3.7	—	3.8	—
Chromium*	—	5.1	9.5×10^{-1}	1.1×10^{-8}	1.0	—	1.1	—
Chrysene	9.8×10^{-3}	6.5×10^{-3}	—	—	—	4.0×10^{-9}	—	—
Cobalt*	—	3.0×10^{-1}	3.0×10^{-2}	1.0×10^{-7}	3.4×10^{-2}	9.7×10^{-9}	3.5×10^{-2}	1.9×10^{-7}
Copper	—	3.1	6.4×10^{-1}	—	1.9	—	2.0	—
Cyclododecane	—	—	—	—	2.7	—	2.8	—
Cyclohexane, 2-butyl-1,1,3-trimethyl-	—	—	—	—	—	—	—	3.7×10^{-7}
Cyclohexane, butyl-	—	—	—	6.7×10^{-7}	—	5.8×10^{-9}	—	2.9×10^{-6}
Cyclohexane, hxyl-	—	—	—	—	—	—	—	4.2×10^{-7}
Cyclohexane, propyl-	—	—	—	7.7×10^{-7}	—	—	—	—

Table I.3. (continued)

	Emissions (µg/s)[b]							
			Mustard processing[c]		GB processing[c]		VX processing[c]	
Compound[a]	Diesel generator	Boiler	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack
Cyclohexanol	—	—	—	—	—	—	—	9.4×10^{-7}
Cyclohexanone	—	—	—	5.6×10^{-8}	—	3.9×10^{-8}	—	8.1×10^{-9}
Cyslohexasiloxane, dodecamethyl-	—	—	—	3.0×10^{-8}	—	—	—	—
Cycl0tetrasiloxane, octamethyl-	—	—	2.5	—	2.7	—	2.8	—
Decane	—	—	—	3.1×10^{-6}	—	6.4×10^{-8}	—	1.2×10^{-5}
Decane, 2,6,7-trimethyl-	—	—	—	—	—	5.3×10^{-9}	—	—
Decane, 2-methyl-	—	—	—	—	—	—	—	2.7×10^{-6}
Decane, 3-methyl-	—	—	—	7.9×10^{-7}	—	—	—	2.0×10^{-6}
Decane, 4-methyl-	—	—	—	1.1×10^{-8}	—	6.9×10^{-9}	—	1.5×10^{-6}
Decane, 5-methyl-	—	—	—	—	—	2.5×10^{-8}	—	—
Dibenzo(a,h)anthracene	1.6×10^{-2}	4.3×10^{-3}	—	—	—	—	—	—
Dibenzofuran*	—	—	—	—	9.8×10^{-1}	6.1×10^{-8}	1.0	7.3×10^{-8}
Dichlorobenzene*	—	4.3	—	—	—	—	—	—
Diethylene glycol	—	—	—	—	—	—	—	5.5×10^{-6}
Diethylphthalate	—	—	1.5	—	1.7	—	1.7	—

Table I.3. (continued)

	Emissions (μg/s)[b]							
			Mustard processing[c]		GB processing[c]		VX processing[c]	
Compound[a]	Diesel generator	Boiler	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack
Dimethylbenz(a)anthracene	—	5.8×10^{-2}	—	—	—	—	—	—
Di-n-butylphthalate (bis-(2-ethylhexyl)phthalate)*	—	—	3.2	—	3.5	—	3.5	—
Diphenylmethane	—	—	—	—	—	5.1×10^{-9}	—	—
Dodecane	—	—	9.9×10^{-1}	1.2×10^{-6}	1.1	1.2×10^{-7}	1.1	4.6×10^{-6}
Dodecane, 2,6,10-trimethyl-	—	—	—	—	—	7.4×10^{-9}	—	—
Dodecane, 4-methyl-	—	—	—	—	—	2.1×10^{-8}	—	—
Dodecane, 6-methyl-	—	—	—	1.2×10^{-8}	—	1.3×10^{-8}	—	1.4×10^{-6}
Ethane	—	1.1×10^{4}	—	—	—	—	—	—
Ethanol, 2-(2-butoxyethoxy)-, acetate	—	—	—	5.1×10^{-8}	—	2.5×10^{-8}	—	—
Ethanone, 1-(3-methylphenyl)-	—	—	—	—	—	7.8×10^{-9}	—	—
Ethanone, 1-phenyl-	—	—	—	—	—	5.6×10^{-8}	—	—
Ether	—	—	—	—	1.9×10^{2}	—	1.9×10^{2}	—
Ethylbenzene*	—	—	7.6×10^{-2}	—	5.7	—	5.8	—
Ethylene glycol*	—	—	—	4.9×10^{-7}	—	2.2×10^{-7}	—	1.9×10^{-6}

Table I.3. (continued)

Compound[a]	Emissions (μg/s)[b]							
			Mustard processing[c]		GB processing[c]		VX processing[c]	
	Diesel generator	Boiler	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack
Fluoranthene	2.1×10^{-1}	1.1×10^{-2}	—	—	—	1.2×10^{-8}	—	8.8×10^{-9}
Fluorene	8.1×10^{-1}	1.0×10^{-2}	—	—	4.5×10^{-2}	2.2×10^{-8}	4.6×10^{-2}	2.5×10^{-8}
Formaldehyde*	3.3×10^{1}	2.7×10^{2}	—	—	—	—	—	—
H (mustard)[d]	—	—	—	—	—	3.7	—	—
H (mustard)[d]	—	—	—	3.7×10^{2}	—	—	—	—
Heptdecane	—	—	—	—	—	1.7×10^{-8}	—	—
Heptanal	—	—	—	3.6×10^{-7}	—	2.9×10^{-7}	—	—
Heptane, 3-ethyl-2-methyl-	—	—	—	—	—	1.7×10^{-8}	—	9.1×10^{-7}
Hexadecane, 2,6,10,14-tetramethyl-	—	—	—	—	—	3.3×10^{-8}	—	—
Hexanal	—	—	—	9.3×10^{-8}	—	1.0×10^{-7}	—	1.1×10^{-7}
Hexane(n)*	—	6.5×10^{3}	—	—	1.2×10^{2}	—	1.2×10^{2}	—
Hydrochloric acid*	—	—	2.5×10^{1}	1.1×10^{3}	7.3×10^{1}	4.6×10^{-6}	7.4×10^{1}	3.0×10^{1}
Hydrogen fluoride*	—	—	1.2	—	1.3	4.8×10^{1}	1.3	—
Hydrogen cyanide*	—	—	4.6	—	5.1	—	5.2	—
Hydrogen sulfide*	—	—	1.1×10^{1}	—	7.4×10^{3}	—	7.5×10^{3}	—

Table I.3. (continued)

	Emissions (μg/s)[b]							
			Mustard processing[c]		GB processing[c]		VX processing[c]	
Compound[a]	Diesel generator	Boiler	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	6.5×10^{-3}	—	—	—	—	—	—
Iron	—	—	1.2×10^{1}	1.5×10^{-6}	1.3×10^{1}	8.6×10^{-7}	1.3×10^{1}	—
Isobutyl alcohol	—	—	—	—	—	9.1×10^{-8}	—	1.8×10^{-6}
Lead*	—	1.8	6.8×10^{-2}	5.7×10^{-8}	1.5×10^{-1}	3.8×10^{-8}	1.5×10^{-1}	1.2×10^{-6}
m,pl-Xylene*	7.9	—	—	—	—	—	—	—
Magnesium	—	—	2.2	5.0×10^{-6}	2.9	2.7×10^{-6}	3.0	2.0×10^{-5}
Malonic acid	—	—	—	2.3×10^{-5}	—	2.1×10^{-5}	—	—
Manganese*	—	1.4	8.0	6.6×10^{-7}	2.8×10^{1}	1.2×10^{-7}	2.9×10^{1}	6.5×10^{-5}
Mercury*	8.3×10^{-3}	9.4×10^{-1}	—	—	—	1.7×10^{-8}	—	—
Methylene chloride*	—	—	6.2×10^{-1}	9.9×10^{-7}	1.0×10^{1}	1.3×10^{-4}	1.0×10^{1}	7.4×10^{-7}
Molybdenum	—	4.0	5.5×10^{-1}	4.1×10^{-8}	8.2×10^{1}	4.5×10^{-8}	8.4×10^{1}	2.4×10^{-6}
m-Tolualdehyde	—	—	—	—	—	7.2×10^{-8}	—	5.3×10^{-8}
Naphthalene*	2.3	2.2	—	3.3×10^{-7}	1.4×10^{-1}	1.2×10^{-7}	1.5×10^{-1}	6.2×10^{-7}
Naphthalene, 1,2,3,4-tetrahydro-	—	—	—	—	—	—	—	1.0×10^{-6}
Naphthalene, 1,2,3,4-tetrahydro-6-methyl-	—	—	—	—	—	—	—	5.4×10^{-7}

Table I.3. (continued)

	Emissions (μg/s)[b]							
			Mustard processing[c]		GB processing[c]		VX processing[c]	
Compound[a]	Diesel generator	Boiler	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack
Naphthalene, 1,7-dimethyl	—	—	—	—	—	—	—	5.9×10^{-7}
Naphthalene, 1-methyl	—	—	—	—	—	1.9×10^{-8}	—	—
Nickel*	—	7.6	1.1	6.3×10^{-8}	1.2	2.5×10^{-8}	1.2	—
Nitrobenzene*	—	—	—	—	4.3×10^{-1}	6.5×10^{-8}	4.4×10^{-1}	—
Nonane, 2,6-dimethyl-	—	—	—	—	—	2.0×10^{-8}	—	5.0×10^{-6}
Nonane, 3,7-dimethyl-	—	—	—	—	—	—	—	7.4×10^{-7}
Nonane, 3-methyl-	—	—	—	—	—	—	—	3.8×10^{-7}
n-Propylbenzene	—	—	—	—	—	—	—	0.0
Octane, 2,6-dimethyl-	—	—	—	—	—	—	—	0.0
Octane, 3,6-dimethyl-	—	—	—	—	—	—	—	1.8×10^{-6}

Table I.3. (continued)

	Emissions (μg/s)[b]							
			Mustard processing[c]		GB processing[c]		VX processing[c]	
Compound[a]	Diesel generator	Boiler	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack
Octane, 3-methyl-	—	—	—	4.4×10^{-7}	—	—	—	0.0
Pentadecane	—	—	—	1.2×10^{-8}	—	—	—	1.2×10^{-6}
Pentanal	—	—	—	2.9×10^{-7}	—	1.3×10^{-7}	—	—
Pentane(n)	—	9.4×10^{3}	—	—	—	—	—	—
Phenanthrene	8.1×10^{-1}	6.1×10^{-2}	—	2.2×10^{-9}	—	5.4×10^{-8}	—	5.9×10^{-8}
Phenol*	—	—	4.2×10^{-1}	—	3.7	1.5×10^{-8}	3.7	—
Phosphorus*	—	—	4.1	2.2×10^{-6}	5.5	1.3×10^{-5}	5.6	2.1×10^{-4}
PCBs[c]	—	—	—	—	9.6×10^{-2}	—	9.6×10^{-2}	—
PAHs	4.7	—	—	—	—	—	—	—
Potassium	—	—	—	2.2×10^{-6}	—	—	—	9.7×10^{-5}
Propanal (propionaldehyde)*	—	—	—	—	—	9.7×10^{-8}	—	9.8×10^{-8}
Propane	—	5.8×10^{3}	—	—	—	—	—	—
Propylene	7.1×10^{1}	—	—	—	—	—	—	—
Pyrene	1.3×10^{-1}	1.8×10^{-2}	—	—	—	6.7×10^{-9}	—	4.1×10^{-9}
Selenium*	—	8.7×10^{-2}	1.5×10^{-1}	1.4×10^{-8}	1.6×10^{-1}	—	1.6×10^{-1}	—
Silver	—	—	1.3×10^{-2}	1.7×10^{-9}	1.0×10^{-1}	8.8×10^{-9}	1.0×10^{-1}	6.9×10^{-8}

Table I.3. (continued)

	Emissions (µg/s)[b]							
			Mustard processing[c]		GB processing[c]		VX processing[c]	
Compound[a]	Diesel generator	Boiler	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack
Sodium	—	—	2.1×10^{2}	—	2.5×10^{2}	—	2.5×10^{2}	7.1×10^{-5}
Styrene*	—	—	4.8×10^{-1}	—	5.2×10^{-1}	—	5.3×10^{-1}	—
Sulfur, mol. (S8)	—	—	—	3.6×10^{-7}	—	—	—	—
Tetrachloroethene*	—	—	6.9×10^{-2}	—	3.5×10^{-2}	—	7.6×10^{-2}	—
Tetradecane	—	—	—	7.1×10^{-7}	—	7.3×10^{-8}	—	5.7×10^{-6}
Thallium	—	—	—	—	3.7×10^{-2}	—	3.7×10^{-2}	—
Tin	—	—	1.4	—	1.5	—	1.5	—
Toluene*	1.1×10^{1}	1.2×10^{1}	7.6×10^{-1}	—	8.3×10^{-1}	4.1×10^{-7}	8.5×10^{-1}	2.6×10^{-7}
Total H-CDD	—	—	—	1.2×10^{-13}	—	—	—	—
Total H-CDF	—	—	1.3×10^{-6}	—	1.4×10^{-9}	—	1.5×10^{-6}	—
Total HxCDD	—	—	6.8×10^{-7}	5.6×10^{-4}	7.4×10^{-7}	—	7.6×10^{-7}	—
Total HxCDF	—	—	1.4×10^{-6}	—	1.5×10^{-6}	—	1.6×10^{-6}	—
Total PeCDD	—	—	3.9×10^{-7}	1.1×10^{-12}	4.2×10^{-7}	—	4.3×10^{-7}	—
Total PeCDF	—	—	4.8×10^{-7}	7.0×10^{-14}	5.3×10^{-7}	—	5.4×10^{-7}	—
Total TCDD	—	—	3.2×10^{-7}	6.9×10^{-12}	3.5×10^{-7}	—	3.5×10^{-7}	—
Total TCDF	—	—	6.9×10^{-7}	6.5×10^{-13}	7.5×10^{-7}	—	7.7×10^{-7}	—

Table I.3. (continued)

	Emissions (µg/s)[b]							
			Mustard processing[c]		GB processing[c]		VX processing[c]	
Compound[a]	Diesel generator	Boiler	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack
Trichloroethene*	—	—	6.9×10^{-2}	—	7.5×10^{-2}	—	7.6×10^{-2}	—
Tridecane	—	—	—	8.5×10^{-7}	—	1.1×10^{-7}	—	2.6×10^{-6}
Tridecane, 2-methyl-	—	—	—	—	—	—	—	1.6×10^{-6}
Tridecane, 4-methyl-	—	—	—	—	—	—	—	7.3×10^{-7}
Tridecane, 6-propyl-	—	—	—	—	—	—	—	5.6×10^{-7}
Undecane	—	—	—	2.1×10^{-6}	—	1.1×10^{-7}	—	7.6×10^{-6}
Undecane, 2,10-dimethyl-	—	—	—	—	—	3.3×10^{-8}	—	3.3×10^{-7}
Undecane, 2,6-dimethyl-	—	—	—	—	—	4.0×10^{-8}	—	—
Undecane, 2-methyl-	—	—	—	—	—	2.6×10^{-8}	—	—
Undecane, 3,6-dimethyl-	—	—	—	—	—	—	—	1.2×10^{-6}
Undecane, 4-methyl-	—	—	—	—	—	—	—	7.7×10^{-7}
VX[d]	—	—	—	—	—	—	—	3.7
Vanadium	—	8.3	2.6×10^{-2}	1.2×10^{-9}	1.1×10^{-1}	1.6×10^{-9}	1.1×10^{-1}	1.1×10^{-7}
m,p-Xylene*	7.9	—	—	—	—	—	—	—
p-Xylene*	—	—	—	1.1×10^{-6}	—	2.4×10^{-8}	—	—

Table I.3. (continued)

	Emissions (μg/s)[b]							
			Mustard processing[c]		GB processing[c]		VX processing[c]	
Compound[a]	Diesel generator	Boiler	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack	Product gas burner	Filter farm stack
Xylenes*	—	—	3.6×10^{-1}	—	3.9×10^{-1}	—	4.0×10^{-1}	—
Zinc	—	—	1.4	1.4×10^{-7}	1.5	—	1.6	—

[a]Substances designated with an asterisk are listed as HAPs under Title III, Section 112 of the *Clean Air Act*. PAHs = polycyclic aromatic hydrocarbons. PCBs = polychlorinated biphenyls. Polychlorinated dioxins/furans are as follows: HpCDD = heptachlorodibenzo-p-dioxin, HpCDF = heptachlorodibenzo-p-furan, HxCDD = hexachlorodibenzo-p-dioxin' HxCDF = hexachlorodibenzo-p-furan; PeCDD = pentachlorodibenzo-p-dioxin; PeCDF = pentachlorodibenzo-p-furan; TCDD = tetrachlorodibenzo-p-dioxin; TCDF = tetrachlorodibenzo-p-furan.

[b]A hypen indicates that the compound was not detected from this source during demonstration testing.

[c]For the filter farm stack emissions, organics are assumed to be treated by passing through six carbon filters in series, each at 95% efficiency. Particulate matter (metals, dioxins/furans) is assumed to pass through two HEPA filters in series, each at 99.97% efficiency. Product gas burner emissions are assumed not to receive further treatment after release from facility scrubbers.

[d]The after-treatment emission rate from the filter farm stack for chemical agent (GB, VX, mustard) is a worst-case estimate; it assumes emissions at the detection limit (Kimmell et al. 2001). It is assumed that no agent would be emitted from the product gas burner stack; none would be present after neutralization and SCWO treatment.

[e]Although PCB destruction was not included in demonstration testing, for these analyses, it was assumed that Neut/GPCR/TW-SCWO technology would have a destruction efficiency of 99.9999%.

Source: ACWA DEIS 2001, Table 7.6-4.

Table I.4. Estimated toxic air pollutant emissions from Elchem Ox technology at BGAD

	Emissions (µg/s)[b]				
			CatOx/Filter Farm Stack		
Compound[a]	Diesel generator	Boiler	Mustard processing[c]	GB processing[c]	VX processing[c]
1,1-Dichloroethene*	—	—	1.5×10^{-6}	—	—
1,3-Butadiene*	1.1	—	—	—	—
1,5-Pentanediol, dinitrate	—	—	—	5.4×10^{-6}	5.0×10^{-6}
1-Butanol, 3-methyl-, nitrate	—	—	—	2.4×10^{-5}	2.2×10^{-5}
1-Hexanol, 2-ethyl-	—	—	—	3.0×10^{-7}	3.8×10^{-7}
2-Heptanone	—	—	—	5.5×10^{-7}	5.1×10^{-7}
2-Hexanone	—	—	1.4×10^{-7}	5.1×10^{-6}	4.7×10^{-6}
2-Methylnaphthalene	—	4.7×10^{-2}	—	—	—
2-Octanone	—	—	3.2×10^{-8}	9.1×10^{-7}	8.5×10^{-7}
2-Pentanol, nitrate	—	—	—	3.4×10^{-5}	3.1×10^{-5}
3-Methylchloranthrene	—	3.6×10^{-3}	—	—	—
4-Methyl-2-pentanone	—	—	1.0×10^{-7}	2.2×10^{-7}	2.8×10^{-7}
4-Octene, (E)-	—	—	4.6×10^{-8}	9.8×10^{-8}	1.2×10^{-7}
Acenaphthene	3.9×10^{-2}	3.6×10^{-3}	—	—	—
Acenaphthylene	1.4×10^{-1}	3.6×10^{-3}	—	—	—
Acetaldehyde*	2.1×10^{1}	—	—	—	—
Acetamide, N,N-dimethyl-	—	—	—	1.8×10^{-6}	1.7×10^{-6}
Acetic acid	—	—	1.3×10^{-6}	2.8×10^{-6}	3.6×10^{-6}
Acetone	—	—	3.6×10^{-6}	1.7×10^{-8}	2.1×10^{-8}
Acrolein*	2.6	—	—	—	—
Aldehydes	1.9×10^{3}	—	—	—	—
Anthracene	5.2×10^{-2}	4.7×10^{-3}	—	—	—
Arsenic*	—	4.0×10^{-1}	—	—	—
Barium	—	8.7	—	—	—
Benz(a)anthracene	4.7×10^{-2}	3.6×10^{-3}	—	—	—
Benzene*	2.6×10^{1}	4.1	4.1×10^{-8}	1.9×10^{-6}	1.8×10^{-6}
Benzo(a)pyrene	5.2×10^{-3}	2.4×10^{-3}	—	—	—
Benzo(b)fluoranthene	2.7×10^{-3}	3.6×10^{-3}	—	—	—
Benzo(g,h,i)perylene	1.4×10^{-2}	2.4×10^{-3}	—	—	—

Table I.4 (continued)

	Emissions (µg/s)[b]				
			CatOx/Filter Farm Stack		
Compound[a]	Diesel generator	Boiler	Mustard processing[c]	GB processing[c]	VX processing[c]
Benzo(k)fluoranthene	4.3×10^{-3}	3.6×10^{-3}	—	—	—
Beryllium*	—	2.4×10^{-2}	—	—	—
Bis(2-ethylhexyl)phthalate*	—	—	—	8.4×10^{-7}	7.7×10^{-7}
Butane	—	4.1×10^{3}	—	—	—
Cadmium*	—	2.2	—	—	—
Carbon disulfide*	—	—	2.1×10^{-6}	7.1×10^{-5}	6.5×10^{-5}
Chloroethane*	—	—	3.3×10^{-7}	—	—
Chloroform*	—	—	4.2×10^{-7}	—	—
Chloromethane	—	—	1.3×10^{-6}	—	—
Chromium*	—	2.8	—	—	—
Chrysene	9.8×10^{-3}	3.6×10^{-3}	—	—	—
Cobalt*	—	1.7×10^{-1}	—	—	—
Copper	—	1.7	—	—	—
Cyclohexane, 1,2,3-trimethyl-	—	—	1.6×10^{-7}	3.4×10^{-7}	4.3×10^{-7}
Cyclotetrasiloxane, octamethyl-	—	—	—	3.6×10^{-7}	—
Decane	—	—	1.8×10^{-7}	4.9×10^{-6}	4.6×10^{-6}
Decanenitrile	—	—	3.8×10^{-8}	8.3×10^{-7}	7.8×10^{-7}
Dibenzo(a,h)anthracene	1.6×10^{-2}	2.4×10^{3}	—	—	—
Dichlorobenzen*	—	2.4	—	—	—
Dimethylbenz(a)anthracene	—	3.2×10^{-2}	—	—	—
Dodecane	—	—	2.2×10^{-7}	6.7×10^{-6}	6.3×10^{-6}
Ethane	—	6.1×10^{3}	—	—	—
Ethylbenzene*	—	—	—	1.3×10^{-7}	1.2×10^{-7}
Fluoranthene	2.1×10^{-1}	5.9×10^{-3}	—	—	—
Fluorene	8.1×10^{-1}	5.5×10^{-3}	—	—	—
Formaldehyde*	3.3×10^{1}	1.5×10^{2}	—	—	—
GB[d]	—	—	—	3.4	—
H (mustard)[d]	—	—	3.4×10^{2}	—	—
Heptanal	—	—	5.3×10^{-8}	1.2×10^{-6}	1.1×10^{-6}

Table I.4. (continued)

	Emissions (μg/s)[b]				
			CatOx/Filter Farm Stack		
Compound[a]	Diesel generator	Boiler	Mustard processing[c]	GB processing[c]	VX processing[c]
Heptanenitrile	—	—	—	7.2×10^{-7}	6.5×10^{-7}
Hexadecane	—	—	2.6×10^{-8}	1.2×10^{-6}	2.7×10^{-6}
Hexane(n)*	—	3.6×10^{3}	—	—	—
Hexanenitrile	—	—	—	6.4×10^{-7}	5.9×10^{-7}
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	3.6×10^{-3}	—	—	—
Isopropyl nitrate	—	—	7.7×10^{-7}	1.5×10^{-4}	1.4×10^{4}
Lead*	—	9.9×10^{-1}	—	—	—
m,p-Xylene*	7.9	—	—	—	—
Manganese*	—	7.5×10^{-1}	—	—	—
Mercury*	8.3×10^{-3}	5.1×10^{-1}	—	—	—
Methylene chloride*	—	—	1.5×10^{-6}	—	—
Molybdenum	—	2.2	—	—	—
MPA	—	—	—	—	8.4×10^{-12}
Naphthalene*	2.3	1.2	1.6×10^{-5}	3.3×10^{-5}	4.2×10^{-5}
Nickel*	—	4.1	—	—	—
Nitric acid esters	—	—	—	5.8×10^{-6}	5.2×10^{-6}
Nitric acid, butyl ester	—	—	—	2.7×10^{-5}	2.4×10^{-5}
Nitric acid, decyl ester	—	—	5.4×10^{-8}	2.3×10^{-6}	2.1×10^{-6}
Nitric acid, ethyl ester	—	—	—	1.5×10^{-5}	1.4×10^{-5}
Nitric acid, hexyl ester	—	—	—	1.5×10^{-5}	1.4×10^{-5}
Nitric acid, nonyl ester	—	—	1.7×10^{-7}	5.0×10^{-6}	4.7×10^{-6}
Nitric acid, pentyl ester	—	—	—	1.6×10^{-5}	1.4×10^{-5}
Nitric acid, propyl ester	—	—	—	1.6×10^{-5}	1.5×10^{-5}
Nonanal	—	—	4.3×10^{-7}	9.2×10^{-7}	1.2×10^{-6}
Nonanenitrile	—	—	4.8×10^{-8}	1.4×10^{-6}	1.3×10^{-6}
Octanal	—	—	2.9×10^{-7}	1.5×10^{-6}	1.6×10^{-6}
Octanenitrile	—	—	—	1.6×10^{-6}	1.5×10^{-6}
Pentadecane	—	—	4.1×10^{-8}	2.4×10^{-6}	2.2×10^{-6}
Pentane(n)	—	5.1×10^{3}	—	—	—
Phenanthrene	8.1×10^{-1}	3.4×10^{-1}	—	—	—

Table I.4. (continued)

	Emissions (µg/s)[b]				
			CatOx/Filter Farm Stack		
Compound[a]	Diesel generator	Boiler	Mustard processing[c]	GB processing[c]	VX processing[c]
PCBs[e]	—	—	—	1.5×10^{-9}	1.5×10^{-9}
PAHs*	4.7	—	—	—	—
Propane	—	3.2×10^{3}	—	—	—
Propylene	7.1×10^{1}	—	—	—	—
Pyrene	1.3×10^{-1}	9.9×10^{-3}	—	—	—
Selenium*	—	4.7×10^{-2}	—	—	—
Tetradecane	—	—	2.0×10^{-7}	7.8×10^{-6}	7.3×10^{-6}
Toluene*	1.1×10^{1}	6.7	—	5.0×10^{-7}	4.6×10^{-7}
Trichloroethene*	—	—	2.0×10^{-6}	—	—
Tridecane	—	—	1.9×10^{-7}	7.0×10^{-6}	7.5×10^{-6}
Undecane	—	—	2.1×10^{-7}	5.9×10^{-6}	—
VX[d]	—	—	—	—	3.4
Vanadium	—	4.5	—	—	—
Vinyl chloride*	—	—	1.7×10^{-6}	—	—
Xylenes*	—	—	7.8×10^{-8}	—	—

[a]Substances designated with an asterisk are listed as HAPs under Title III, Section 112 of the *Clean Air Act*. PAHs = polycyclic aromatic hydrocarbons. PCBs= polychlorinated biphenyls.

[b]A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c]For the CatOx/filter farm stack emissions, organics are assumed to be treated by being passed through six carbon filters in series, each at 95% efficiency. Particulate matter (metals, dioxins/furans) is assumed to pass through two HEPA filters in series, each at 99.97% efficiency.

[d]The after-treatment emission rate from the filter farm stack for chemical agent (GB, VX, mustard) is a worst-case estimate; it assumes emissions at the detection limit (Kimmell et al. 2001).

[e]Although PCB destruction was not included in demonstration testing, for these analyses it was assumed that Elchem Ox technology would have a destruction efficiency of 99.9999% and the further treatment, as in footnote c, would be applied.

Source: ACWA DEI0 2001S, Table 7.6-5.

APPENDIX J

METHODOLOGY FOR ASSESSING IMPACTS ON AIR QUALITY FROM CONSTRUCTION AND OPERATION OF A FACILITY FOR DISPOSAL OF CHEMICAL AGENTS AND MUNITIONS[1]

Air quality modeling analysis consists of estimating emission rates and calculating concentration levels at receptor locations for a series of varying meteorological conditions. Air emissions from construction and operation of incineration, neutralization/supercritical water oxidation (Neut/SCWO), neutralization/gas-phase chemical reduction/transpiring wall supercritical water oxidation (Neut/GPCR/TW-SCWO), and electrochemical oxidation (Elchem Ox) facilities were estimated on the basis of available standard references and site-specific data. These estimates were used to model air concentrations that might occur at potential off-post (general public) and on-post (worker) receptor locations. Emissions estimates associated with facility construction and operation are discussed in Section J.1, and the air model used, model input data, and assumptions are discussed in Section J.2.

J.1 EMISSION FACTORS AND ASSUMPTIONS USED IN ESTIMATING EMISSIONS

The selection of emission factors and the methodology for estimating emissions associated with construction and operation of a facility for disposal of chemical agents and munitions are briefly presented. Detailed background information is provided in Kimmel et al. (2001).

J.1.1 Construction-Related Emissions

To determine potential impacts on ambient air quality from fugitive dust emissions during earth-moving activities, emissions of PM10 and PM2.5[2] were estimated by using an average fugitive dust emission factor of 1.2 tons/acre/month (Section 13.2.3 of EPA 2000a) and the acreage of land expected to be disturbed during construction.

For each technology, it is estimated that construction of the proposed facility and supporting infrastructure would disturb up to 95 acres of land. Fugitive dust emissions were estimated on the basis of the assumption that a phased approach would be used for construction. Construction of utility lines, which would disturb about 60 acres, would most likely occur during the first phase of construction, but only a small area would be worked on at any particular time. The construction of utility lines would be followed by the construction of the facility, which

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[1]Adapted from Appendix B of the ACWA Draft EIS.

[2] 1 PM = particulate matter. PM 10 = coarse, inhalable PM with a mean aerodynamic diameter of 10 µm or less. PM 2,5 = fine, inhalable PM with a mean aerodynamic diameter of 2.5 µm or less.

would disturb about 25 acres. Fugitive dust emissions during this latter period of construction, when more land surface would be disturbed at one time, were analyzed in the air quality modeling.

It was assumed that 30% of the estimated fugitive dust emissions would be PM10 (EPA 1988) and 15% would be PM2.5 (Kinsey and Cowherd 1992). It was also assumed that conventional dust control measures (e.g., frequent sprinkling of water over disturbed areas) would reduce emissions by about 50% (EPA 2000a).

J.1.2 Operational Emissions

For all technologies, the estimates of process emissions were based on mass and energy balances that were prepared as part of the design packages by the respective design contractors. In turn, the emission rates presented in the mass and energy balances were based on both engineering estimates and test data (e.g., trial burns for the incineration technology and demonstration tests for the other technologies). Theoretical engineering estimates are typically quite conservative in their assumptions, thereby providing higher than expected emission rates, while emissions based on test data are more realistic but are still subject to uncertainty. Regardless of the selected technology, all process vents and stacks would be tested to quantify emissions prior to routine operations.

For the incineration technology, a Pollution Abatement System (PAS) for each furnace would be followed by a Pollution Filtration System (PFS). The PAS consists of a series of pollution abatement devices that are installed primarily to scrub acid gases (e.g., hydrogen chloride) and particulate matter. During the process of removing particulate matter, the PAS removes some metals including lead. The PFS consists of a series of high efficiency particulate air (HEPA) and carbon filters that are used to capture organics and prevent a chemical agent release. Carbon filters would be used on all ventilation gases that potentially would be exposed to agent. The pollution abatement systems for the other technologies would also use a wet scrubber system and carbon filters, as well as a catalytic oxidation unit. For SO_2, NO_x, and CO, controlled emissions would not be much less than uncontrolled emissions because the pollution abatement equipment is not intended for these pollutants.

With regard to control efficiencies, 99.9999% of chemical agent is expected to be controlled. The exact control efficiencies for each pollutant are not known but would be determined as the selected design matures. RCRA permit requirements would necessitate the implementation of procedures to ensure proper operation of all process-related pollution control equipment.

Emissions of criteria pollutants and volatile organic compounds (VOCs) from boilers and emergency generators were also estimated. The estimated emission rates of criteria pollutants and VOCs for the operational period were based on the expected annual consumption rate of fuel. In turn, the annual consumption rate of fuel (assumed to be natural gas) required to operate the various technologies was based on the unit quantity needed to dispose of each munition type and agent, and annual throughput capacity of a facility at each site. The emission rates of criteria pollutants and VOCs for normal boiler operations were estimated with the FIRE 6.22 emission factor program for large wall-fired boilers with greater than 100 million Btu/h of heat input (EPA 2000b).

The emission rates of criteria pollutants and VOCs for emergency generator operations were estimated with the FIRE 6.22 emission factor program for reciprocating diesel engines

(EPA 2000b) and the fuel consumption rate. The annual consumption rate for emergency generators was estimated by assuming (1) 600 hours of generator operations per year and (2) the hourly consumption for actual generator operations at Aberdeen Proving Ground (1997).

J.2 AIR QUALITY MODEL, MODEL INPUT DATA, AND ASSUMPTIONS USED IN AIR QUALITY IMPACT ANALYSIS

J.2.1 Air Quality Model

The Industrial Source Complex Short-Term 3 (ISCST3) model (version 00101; EPA 1995), a steady-state Gaussian plume dispersion model recommended by EPA for use in a wide range of regulatory applications, was used to estimate potential impacts on ambient air quality. All regulatory default options (e.g., stack-tip downwash, buoyancy-induced dispersion, final plume rise) were selected for the analysis. In accordance with EPA's requirements, direction-specific building dimensions were included for all building downwash algorithms using EPA's building profile input program (BPIP) (EPA 1993). Building information for a proposed facility was obtained from the technology provider report (Kimmel et al. 2001).

J.2.2 Meteorological Data

Meteorological data used in air quality modeling included surface data (wind direction and speed, ambient temperature, atmospheric stability) and twice-daily mixing-height data. These meteorological data were preprocessed with the EPA's PCRAMMET program for use in short-term dispersion models (EPA 1999).

On-site surface meteorological data were available for Blue Grass Army Depot (BGAD) from the Demil and Chemical Stockpile Emergency Preparedness Program (CSEPP) towers (Rhodes 2000). The Demil towers meet U.S. Environmental Protection Agency (EPA) siting criteria, and their instrumentation and associated data were checked for quality assurance/ quality control (QA/QC). The QA/QC procedures for data from the CSEPP towers are not as comprehensive as those for data from the Demil towers. Accordingly, Demil tower data collected at a 10-m level were used for the modeling analysis for BGAD. Meteorological data from 1999 were used because this year was the most recent period of readily available, quality-assured data when the air quality analysis began for the EIS.

Section 9.3.3.2(k) of EPA's *Guideline on Air Quality Models* (40 CFR Part 51, Appendix W) recommends the Turner method for determining stability classes. However, the available on-site meteorological data at BGAD do not include cloud cover and ceiling height, which are necessary to use the Turner method. The EPA guidance states that the wind fluctuation statistics ($\sum$) methodology or solar radiation/delta-T (SRDT) methodology may be used in the absence of requisite data to implement the Turner method.Sufficient data are available from the Demil tower to use either the wind fluctuation statistics ($\sum$) methodology or the solar radiation/delta-T (SRDT) methodology. The EPA has not expressed a preference between the two. To be consistent with previous studies, the former was used in the modeling analysis for this assessment.

Twice-daily mixing height data collected at Wilmington, Ohio, the nearest station in a climatological regime similar to BGAD, were also processed for 1999.

J.2.3 Receptor Location Data

Three types of receptors were defined — on-site receptors, site boundary receptors, and off-site receptors. On-site receptors were established to assess air quality impacts for on-site workers resulting from routine emissions of hazardous air pollutants (HAPs). Site boundary and off-site receptors were established to assess air quality impacts to the general public from routine HAPs emissions and construction and operation emissions of criteria pollutants. Irregularly spaced Cartesian receptor grids were developed for on-site and off-site receptors up to 31 mi from the center of the proposed facility. The grid intervals range from 164 ft around the facility to 3.1 mi outside the 6.2-mi radius from the center of the facility (see Figure J.1). This methodology of using nested grids ensures that the receptor grid is relatively dense in locations corresponding to maximum concentrations (maximum concentrations are predicted to occur within 3 mi of the facility). Additional receptors were set at 328 ft apart along the site boundary near the facility (where maximum concentrations from construction-related impacts are predicted to occur) and 984 to 1,640 ft apart along the site boundary far from the facility.

J.2.4 Terrain Data

To reflect the effects of terrain features, the terrain data for the source and receptor locations were input to the model. Elevations for source and receptor locations were read from the electronic data in the U.S. Geological Survey (2001) 1:24,000 scale (7.5-minute series) digital elevation model (DEM).

J.2.5 Other Assumptions

For modeling potential air quality impacts during construction and/or operational periods, the following assumptions were made:

- Construction activities would occur during one daytime 8-hour shift (8 a.m.– noon and 1 p.m.–5 p.m.).
- Rates of dust emissions from the construction site would be constant over the construction area and time.
- Settling of airborne particles due to gravity and removal by dry/wet deposition would be negligible.
- Areas between the pilot test facility site and receptor locations would be in a “rural” setting.

For the operational periods, short-term average (1-hour, 3-hour, 8-hour, and 24-hour) pollutant concentrations were conservatively estimated by assuming that emission sources would operate simultaneously at their peak load. For long-term (annual) average concentrations, annual average emission rates for these emissions sources were used.

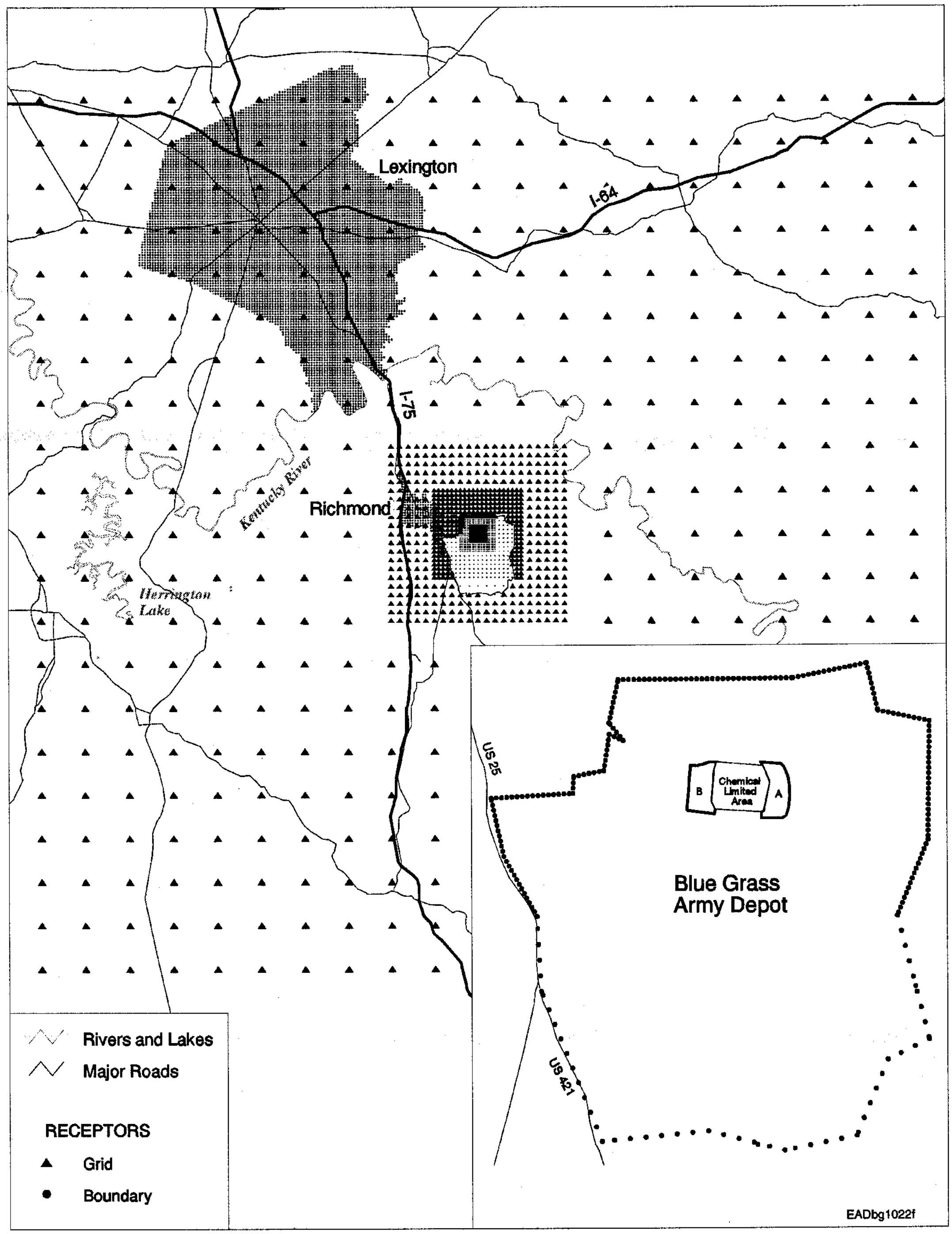

Figure J.1. Locations of receptors used in air quality modeling at BGAD.
Source: ACWA DEIS, Figure B.2.

J.3 REFERENCES

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DESTRUCTION OF CHEMICAL MUNITIONS AT BLUE GRASS ARMY DEPOT, KENTUCKY

FINAL
ENVIRONMENTAL IMPACT STATEMENT
VOLUME II, APPENDIX K

December 2002

PROGRAM MANAGER FOR CHEMICAL DEMILITARIZATION

ABERDEEN PROVING GROUND, MD 21010-4005

LEAD AGENCY: DEPARTMENT OF THE ARMY, PROGRAM MANAGER FOR CHEMICAL DEMILITARIZATION

TITLE OF PROPOSED ACTION: DESTRUCTION OF CHEMICAL MUNITIONS AT BLUE GRASS ARMY DEPOT, RICHMOND, KENTUCKY

AFFECTED JURISDICTION: RICHMOND, KENTUCKY

PREPARER:

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COL CHRISTOPHER F. LESNIAK
Project Manager for Chemical
Stockpile Disposal

PROPONENT:

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DELBERT F. BUNCH
Deputy Program Manager for Chemical
Demilitarization

REVIEWED BY:

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COL MARTIN A. JACOBY
Commander
Blue Grass Army Depot

APPROVED BY:

____

RAYMOND J. FATZ
Deputy Assistant Secretary of the Army
(Environment, Safety and Occupational
Health), OASA (I&E)

DOCUMENT DESIGNATION: FINAL ENVIRONMENTAL IMPACT STATEMENT

ABSTRACT: Public Law 99-145 and subsequent related legislation requires destruction of the U.S. stockpile of lethal unitary chemical agents and munitions. Furthermore, in 1993 an international treaty, the Chemical Weapons Convention (CWC), was signed by 65 nations, including the United States. The CWC, which set the deadline for completing destruction of chemical weapons as 10 years following ratification by the required number of nations, received the necessary ratifications on April 29,1997. Thus, the international deadline for destruction of chemical weapons is April 29, 2007. The Army Chemical Stockpile Disposal Program has prepared this Final Environmental Impact Statement (FEIS) to assess the potential health and environmental impacts of the construction, operation, and closure of a facility to destroy the chemical agent and munitions stored at Blue Grass Army Depot (BGAD), Kentucky.

Four alternatives are addressed in this FEIS for possible use in destruction of the BGAD stockpile: (1) baseline incineration, which is currently in use by the Army at Deseret Chemical Depot (DCD), Utah and was used by the Johnston Atoll Chemical Agent Disposal System (JACADS) to destroy the entire stockpile on Johnston Atoll; (2) chemical neutralization followed by supercritical water oxidation, a developing technology that would be initially operated as a pilot test facility; (3) chemical neutralization followed by supercritical water oxidation and gas phase chemical reduction, a developing technology that would be initially operated as a pilot test facility; and (4) electrochemical oxidation, which is also under development and would be initially operated as a pilot test facility. The latter three alternatives have also been evaluated in a separate EIS prepared by the Army Assembled Chemical Weapons Assessment Program (ACWA) as part of four chemical neutralization technologies being considered for pilot testing at BGAD and three other chemical munitions storage locations. The data and information obtained from testing and full-scale operation of the incineration technology, and available data and information from on-going studies of the technologies provided by ACWA are analyzed and compared to the extent possible in this FEIS.

APPENDIX K

PUBLIC COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT AND U.S. ARMY RESPONSES

K.1 INTRODUCTION

As part of the NEPA scoping and public involvement process (see Sect. 1.4), members of the public and interested organizations and agencies were asked to provide comments on the Draft Environmental Impact Statement (DEIS) that would be used in preparing this Final EIS (FEIS). In addition, the Army solicited comments as part of a public meeting that was held regarding the proposed action; both sessions of the public meeting (morning and evening) were held at Eastern Kentucky University in Richmond, Kentucky. The oral comments offered at those meetings were transcribed by a court reporter. Written comments were accepted during the 45-day comment period (May 31–July 15, 2002) following publication of the DEIS. All oral and written comments were individually identified and reviewed.

This appendix displays the written public comments, summarizes the comments from the public meetings, and provides the Army's responses to the comments.

K.2 LIST OF COMMENTERS

Seventeen letters (including e-mails) containing a total of 212 comments on the DEIS were submitted by the following individuals, organizations, or agencies:

Federal or state agencies and elected officials

- Alex Barber, State Environmental Review Officer, Commonwealth of Kentucky, submitting comments from the Division of Water, Division for Air Quality, and the Transportation Cabinet of the Department of Highways (see letter 17)
- Ann L. Durham, Mayor, Richmond, Kentucky (see letter 8)
- Heinz J. Mueller, Chief, Office of Environmental Assessment, U.S. Environmental Protection Agency, Region 4 (see letter 14)

Organizations, interested groups, and private companies

- Richard Futrell, Eastern Kentucky University, Department of Anthropology (see letter 15)
- Lois Kleffman, submitting for the Kentucky Environmental Foundation (Craig Williams, Executive Director); Chemical Weapons Working Group (John Capillo, Board of Directors); Non-stockpile Chemical Weapons Citizens Coalition (Elizabeth Crowe, Director); Common Ground (Peter Hille, Chair); Concerned Citizens of Madison County (Bracelen and Kathy Flood); Kentucky Resources Council, Inc. (Tom Fitzgerald, Director); and undersigned individuals (Perrin deJong, Richard Futrell, Jeanne Gage, Mike Hannon, Tim Hensley, Connie Hubbard, Edward Hubbard, Robert Menefee, Jan Pearce, Tracy Powell-McCoy,

Winona Ramsey, Charles R. Schindler, Naomi Schulz, Larry Swartz, and Althea Wiggs) (see letter 12)
- Larry D. Shinn, President Berea College (see letter 2)
- Robert C. Tussey, Jr., Kenvirons, Inc. (see letter 11)
- Noel Wheatley, General Atomics (see letter 13)

Individuals

- Jason Fults (see letter 5)
- Evangeline Z. Goss (see letter 3)
- Kathy Hall (see letter 4)
- Douglas Hindman (see letter 9)
- Wendy Satterthwaite (see letter 1)
- Leslie L. Sorrell (see letter 10)
- Carol Stutts (see letter 7)
- J. Walters (see letter 16)
- Stephen L. and Rose M. Wilkins (see letter 6)

K.3 RESPONSES TO WRITTEN COMMENTS

Written comments on the DEIS are reproduced on the pages that follow. The letters, which show the numbered comments, appear on left-hand pages; and the corresponding responses to the comments are displayed on the right-hand pages.

[Intentionally left blank]

From Oberst and Satterthwaite
Sent Monday, June 03, 2002 1139 AM
To gregory.mahall@pmcd.apgea.army.mil
Subject nerve gas

To Gregory Mahall:

I am writing in regard to the stockpile of nerve gas, etc. at the Bluegrass Army Depot in Richmond, KY. I received the draft of the Environmental Impact Statement and want to make sure you know that I am strongly against the option of incineration. I favor the SCWO process over the other alternatives, but either of those over incineration. **1-1**

Thank you for asking for input. Please do not chose incineration!

Wendy Satterthwaite

Comment 1-1

Response: The commenter's preference is noted. All personal preferences for one or more destruction technologies will be considered in making the record of decision but are not part of the scope of the EIS.

BEREA COLLEGE
Berea, Kentucky 40404

Office of the President
Larry Dwight Shinn
(859) 985-3520
FAX: (859) 985-3915

June 3, 2002

Program Manager for Chemical Demilitarization
Public Outreach and Information Office
Mr. Gregory Mahall
Building E-4585
Aberdeen Proving Ground (EA), MD 21010-4005

Dear Mr. Mahall,

I am grateful for the opportunity to offer public comment on the Draft Environmental Impact Statement assessing the impacts of the proposed facilities and technologies that would destroy the chemical munitions stored at the Blue Grass Army Depot in Richmond, Kentucky.

I have read the Executive Summary of the draft EIS, which was mailed to the citizens of Madison County on May 24, 2002. In the tables beginning on page 34, it is striking how similar the three non-incineration alternatives are to incineration across virtually all of the wide variety of categories of "Potentially Affected Resource," with respect to the anticipated small impact upon those resources. Given the information and conclusions in the Executive Summary, I would like to encourage selection of any of the three alternative technologies, and speak out against incineration as a viable option for our area. As you must know, one of the primary criteria of the citizens and neighbors who are concerned about the safety of the disposal technology is that the process be "closed-loop" to minimize the chances of any system failure spreading throughout our communities. As the president of Berea College whose more than 2100 faculty, students and staff are located less than ten miles from the Blue Grass Army Depot (and often "downwind"), the threat of incineration putting minute amounts of toxic chemicals in the air we breathe on a regular basis and a large amount of toxic chemicals in the air in a tragic accident is just too great for us to feel comfortable with incineration. If you had a son or daughter at Berea College would you feel safe if incineration were the chosen method of disposal? Any of the closed-loop solutions are clearly preferable from a safety perspective if we have learned anything from Union Carbide's tragic Bhopal accident that killed thousands of Indians when *three levels* of safety control failed and toxic chemicals were released into the air surrounding their fertilizer/pesticide plant. **2-1**

Another crucial criteria for those of us who live near the depot is that the disposal technology itself should be disassembled upon completion of the mission of destroying the Blue Grass chemical weapons stockpile. The three non-incineration technologies are more likely than an incinerator to be disassembled. There is considerable citizen concern that an incinerator will continue to be used at the depot long after the chemical weapons stockpile has been destroyed. This would be a tragedy for the cities of Richmond and Berea, Berea College, and all of the surrounding communities and countryside. **2-2**

Comment 2-1

Response: The commenter's preference for non-incineration technologies and/or closed loop solutions is noted.

Comment 2-2

Response: As discussed in Section 4.25 of this Final EIS, Congress has mandated, through Public Law 106-79, the dismantlement of any destruction facility unless the administration of a state in which the destruction facility is located determines that future use of the facility is desirable. As also stated in Section 4.25 of the EIS, the Army currently intends to dismantle and close the BGAD facility upon completion of the stockpile destruction activities regardless of the destruction technology selected and implemented.

Mr. Gregory Mahall
June 3, 2002
Page 2

These are two of the main reasons I would like to encourage the selection of one of the neutralization technologies instead of incineration. It is encouraging to me as an educator that the Army has invited the concerned citizens to the table to explore the available range of safe disposal options. As an educator at Berea College, I see a growing and shared view that learning and problem solving is often, at its best, a collaborative process. Mr. Mahall, those of you in the service who are open to collaborative problem solving processes with the stakeholders in your communities are to be congratulated and encouraged. **2-3**

You can be assured that we in Madison County share with you the wish and intention to safely dispose of the chemical weapons stockpile. We are certain this mission can be quickly accomplished if we continue to work together as citizens and servicemen and women. Thank you for your continued good work.

Sincerely,

Larry D. Shinn
President

LDS/jr

Comment 2-3

Response: The Army's commitment to public involvement in the NEPA process for the Chemical Stockpile Disposal Program, as described in Section 1.4 of this Final EIS, is consistent with overall Army requirements and regulations of the President's Council on Environmental Quality. The commenter's remarks are noted.

Evangeline Z. Goss
192 Glades Road, #20
Berea, KY 40403

June 17, 2002

Program Manager for Chemical Demilitarization
Public Outreach and Information Office
Mr. Gregory J. Mahall
Building E-4585
Aberdeen Proving Ground (EA), MD 21010-4005

Dear Mr. Mahall:

Neutralization is the removal of the bonding holding basic chemical elements together to form lethal compounds. The removal of the bonding permits the basic elements to return to their harmless states. **3-1**

I have had the remarkable privilege of participating in a democratic discussion and decision-making experience. I have attended the initial public hearings and most of the Citizens' Advisory Commission hearings. We are all in this together, and most of the participants have well-played their parts. A people without an Army, in our days, lacks strength; and an Army without people lacks much-needed support.

I can imagine that when the men at Blue Grass Army Depot joined as "soldiers", they never dreamed that one of their future assignments would be to "baby-sit" chemical weapons. Given the assignment, they have acted with responsibility and loyalty; and we, the civilians have been and remain deeply grateful.

Many individuals and concerned groups have participated in the serious search for safer methods of destroying chemical weapons. First, there was the Army itself, and next the Chemical Weapons Working Group, the staff and board of Kentucky Environmental Foundation, the local and regional newspapers and other media, and the bipartisan senators from Kentucky, Wendell Ford and Mitch McConnell. Then came the National Academy of Science, the Army Outreach Center and the Governor-appointed Citizen's Advisory Commission with its co-chairmen, Doug Hindman and Worley Johnson and seven additional members. Then, the Army was given a grant to explore alternative methods to incineration, and Assembled Chemical Weapons Assessment came into the massive research programs.

Comment 3-1

Response: The commenter's remarks characterizing the search for appropriate destruction technologies by the Army and many other interested parties are noted.

In the CAC hearings, both those who were knowledgeable about incineration and those exploring alternative methods presented their reports in a non-confrontational way, and the hearings were patient and fair. **3-1 (cont)**

After all the verbal discussions, I saw a video of the neutralization system in Aberdeen, Maryland. I was impressed by the careful and continuous monitoring of the process and that no untreated gas would leave the building. In addition, the cooler temperatures would add to workers' safety. **3-2**

Last week, I received the Environmental Impact Study from the Army, repeating again the better points of incineration. A few days later I received the Environmental Impact Study from Assembled Chemical Weapons Assessment. Because no untreated gas will leave the building, I prefer neutralization more than the emissions from the incinerator smoke stacks. I believe neutralization will leave the health of people and viability of the soil in a less contaminated way.

Therefore, I support neutralization as the win-win choice.

Sincerely,

Evangeline Z. Goss

Evangeline Z. Goss
Citizen

Addendum:

I wish to acknowledge the contribution of a lady who has kept her husband's homefront secure—Teri Williams.

Chad Spring, deceased, retired Unitarian minister would go up to a person and say, "Thank your mother and father for having you."

Those of us, who have worked alongside the firm and quiet leadership of Craig Williams, want to thank his mother and father for having him.

Comment 3-2

Response: See response to Comment 1-1.

From Hall
Sent Thursday, July 11, 2002 833 PM
To gregory.mahall@pmcd.apgea.army.mil
Cc hall@chapel1.com
Subject Comments: Blue Grass Army Depot Chemical Weapons Disposal

Program Manager for Chemical Demilitarization
Public Outreach and Information Office
Mr. Gregory Mayhall
Building E-4585, Aberdeen Proving Ground (EA), MD 21010-4005

July 11, 2002

Dear Mr. Mayhall:

I regret that my husband, Harold, and I were unable to attend the meetings held today (July 11, 2002) for the public hearing on disposal of the Chemical Weapons at the Blue Grass Army Depot. I had attended the Tuesday evening (July 9th, 2002) meeting to review the new technologies available for disposal of the munitions, and would like to share my thoughts with you.

We own a small farm within one mile of the perimeter of the Blue Grass Depot, and raise beef cattle. Madison County is primarily an agricultural community with tobacco and cattle being two of its major products. In addition, many individuals in the area grow gardens. We have expressed continued concern over the possibility of an incinerator being built on sight for the disposal of munitions, which would then become the "Hazardous Waste Incinerator" for the area. **4-1**

Eastern KY University is a major employer in the area, as well as new industry being recruited to provide new jobs. We want assurances that the method of disposal used for the munitions, will NOT become an ongoing "Incinerator" for burning other unknown, dangerous products, spewing fumes into the air and onto vegetation, grazed upon by the cattle, should there be a failure in the filtration system of the smoke stack.

I am very much in favor of ANY of the alternative technologies OVER incineration. I was most impressed with the Silver II Oxidation method for destruction of munitions. It has a 20 year proven tract record in commercial operation. Its safety record is outstanding, and the citizens of Madison County deserve those safety assurances. **4-2**

I have worked in the past as Nurse Epidemiologist at the University of KY for 6 years. I know what is involved in an epidemiological work-up; unfortunately, when one is at that point, there have usually been very serious consequences to require devoting time and resources to finding out "what went wrong". Madison County is a highly populated area. There is zero room for margin of error for whatever the disposal technology chosen, thus the Silver II Oxidation method affords the greatest level of safety. **4-3**

Comment 4-1

Response: As discussed in Section 4.25 of this Final EIS, Congress has mandated, through Public Law 106-79, the dismantlement of any destruction facility unless the administration of a state in which the destruction facility is located determines that future use of the facility is desirable. As also stated in Section 4.25 of this Final EIS, the Army currently intends to dismantle and close the BGAD facility upon completion of the stockpile destruction activities regardless of the destruction technology selected and implemented. In regard to uses for the proposed facility beyond its mission to destroy the chemical weapons at BGAD, see the response to Comment 2-2.

Comment 4-2

Response: See response to Comment 1-1.

Comment 4-3

Response: The results of the analyses presented in the Final Environmental Impact Statement (FEIS) show that any of the four technology alternatives considered could be implemented safely and in an environmentally acceptable manner. The commenter's remarks about safety and the preference for the Silver II Oxidation technology are noted. See response to Comment 1-1.

Letter 4 (cont)
Page 2

Should the 1) Silver II Oxidation method, the 2) Neutralization followed by Supercritical Water Oxidation, or 3)Neutralization followed by Transpiring Wall Supercritical Water Oxidation and Gas Phase Chemical Reduction be chosen, I would fully support the selection. However, I can not now, nor ever, support the incineration method. I feel with incineration we will become the dumping ground for the southeastern half of the United State's Hazardous Waste. Thank you for the opportunity to have input into the process. **4-4**

I also appreciate the efforts of all those serving on the KY Citizen's Advisory Commission who have worked tirelessly to keep the best interest of the local citizens as the primary focus in this very tedious process. We want the munitions disposed of - but safely, for all of us and our children. With the events of September 11, we also know that disposal of these munitions is paramount to assuring the safety of the community as well. **4-5**

Sincerely,
Kathy Hall, RN, MSN

Comment 4-4

Response: The commenter's preference for the non-incineration technologies is noted. See response to Comment 1-1.

Comment 4-5

Response: The commenter's remarks about safety, as well as the efforts of the Kentucky Citizens Advisory Commission, are noted.

From jason fults
Sent Sunday, July 14, 2002 1:30 AM
To gregory.mahall@pmcd.apgea.army.mil
Subject chemical weapons disposal in Madison County, KY

Mr. Mahall,

I received your letter requesting comments on the Army's EIS re: the Blue Grass Army Depot. As a resident of the Madison County area for a few years now, I am deeply concerned about the chemical weapons stored here and appreciate the opportunity to take part in the decision of how to deal with these weapons.

First and foremost, I would like to express my steadfast opposition to incineration as a method of disposal. I think that this process would pose unnecessary risks to the health and safety of folks in our region. I concur with the Citizen Advisory Commission's recent decision that alternative options should be pursued. **5-1**

With incineration taken off the list of possible options, and having reviewed briefly the alternatives that have been put forth thus far, I am confident in the ability of the current leadership within the ACWA program to choose an appropriate disposal technology.

Again, I thank you for reviewing my comments, and I look forward to hearing back from you once the Army has made its decision; a decision I trust will be in the best interests of my community, and one which recognizes the inappropriateness of incineration as a disposal option.

Yours truly,

Jason Fults

Comment 5-1

Response: The minimization of health risk is a substantial part of the overall strategy in the selection of an alternative method for destruction of chemical warfare agents. The commenter's opposition to baseline incineration and preference for non-incineration technologies are noted. See response to Comment 1-1.

From Wilkins, Steve
Sent Sunday, July 14, 2002 350 PM
To gregory.mahall@pmcd.apgea.army.mil
Subject Comments for BGAD DEIS

July 15, 2002

Program Manager for Chemical Demilitarization
Public Outreach and Information Office, Building E-4585
Aberdeen Proving Ground, Maryland 21010-4005

Mr. Gregory Mahall:

This letter is to enter comment into the Draft Environmental Impact Statement (DEIS) for the Disposal of Chemical Munitions at Blue Grass Army Depot (BGAD), Kentucky.

We add our support to that of the entire Congressional Delegation of Kentucky, the Kentucky Citizens' Action Committee, and the Kentucky Environmental Foundation. All of these entities advocate the adoption of one of the "closed-loop" alternatives identified by the Assembled Chemical Weapons Alternatives (ACWA) to destroy BGAD's chemical weapon stockpile. All of these entities oppose the "baseline" technology of incineration; a position we also endorse. **6-1**

More than ten years ago, we moved to this area only to learn of the existence of the chemical weapons stockpile and the, then nascent, citizens' movement to block incineration of the stockpile. As we searched for a home to purchase we purposely sought property only where prevailing winds would place us upwind of the depot and at least ten miles distant. Since we are certain that others behave similarly, there can be no question that the threat of chemical weapons incineration has made downwind properties undesirable and lowered the value of that real estate. Those who are not familiar with the environment surrounding BGAD might think of this as a rural setting not unlike that in Toole, Utah. However, BGAD is located in a relatively suburban area with a middle school and several residential communities located less than two miles downwind. Any weapons destruction technology which vents gasses of any kind to the outside air (open-loop, incineration) poses an unacceptable level of risk to these surrounding communities. As a local chemist pointed out in the DEIS hearing on July 11, 2002, the complexity of the chemistry of stack gases and the inability to fully contain these gases for analysis and management makes incineration a less desirable option than closed loop technologies. **6-2**

Comment 6-1

Response: The commenter's opposition to baseline incineration and preference for non-incineration technologies are noted. See response to Comment 1-1.

Comment 6-2

Response: The downwind risk from accidental exposure to chemical warfare agents is not unique to the proposed destruction activities at BGAD. Such risks are also associated with the continued storage of these munitions.

Any adverse effects on property values that may have occurred to date as a result of the presence of the chemical weapons stockpile or community perceptions of the effects of disposal options represent baseline conditions rather than prospective impacts of the proposed action. To the extent that property values may have been negatively affected by the presence of the BGAD stockpile, it is possible that those values could increase in the future as a result of the stockpile's destruction.

Letter 6 (cont)
Page 2

Since the baseline technology is woefully behind schedule and over budget, any argument that incineration must be adopted at BGAD on the basis of time or cost considerations seems moot. In fact, one can be relatively certain that, if adopted, incineration (and BGAD operations, in general) will experience additional delays as a result of civil disobedience in reaction to the Army's disregard for the wishes of the community. **6-3**

While any of the ACWA options is preferable to incineration, the choice of best option among those three alternative technologies is a difficult call for the layman. Based on our limited knowledge we would give first priority to the "cryofracture followed by neutralization and supercritical water oxidation" option. Thank you for your careful consideration. **6-4**

Respectfully,

Stephen L. Wilkins & Rose M. Wilkins

Comment 6-3

Response: Contrary to what is stated in the comment, there is no text in this EIS using any arguments about schedule to serve as justification for the selection of one technology over any other. See Section 2.3.4 of this Final EIS for a discussion of schedules for the proposed action. See also response to Comment 12-45. As discussed in Section 1.4.6, the decision regarding which technology will be used to destroy the stockpile at BGAD will be made by the Department of Defense Defense Acquisition Executive (DAE).

Comment 6-4

Response: The commenter's preference for the neutralization followed by supercritical water oxidation technology is noted. See response to Comment 1-1.

From Carol Stutts
Sent Monday, July 15, 2002 1250 PM
To gregory.mahall@pmcd.apgea.army.mil
Subject ReDisposal of chemical weapons stored at the Bluegrass Army Depot

To whom it may concern,

I am writing to express my concerns regarding the safe disposal of the chemicals stored at the Bluegrass Army Depot, Richmond, KY. **7-1**

It is my understanding that the issue is to burn, or not to burn. I am against burning. I have learned that other safer alternatives were discussed that may be chosen to destroy the chemicals. I would appreciate if you would select a safer alternative.

I have a personal reason and proof for the seriousness of exposure to chemicals. **7-2** My husband a career military officer is completely disabled after serving in the Gulf War. He also served two tours of duty in Vietnam. He worked very hard all his life and always was rated "promote above his peers" when the OER's were completed. It is documented that the belief for his illness is exposure to Sarin Nerve Agent. While this is difficult to prove, it can not be disproved. The military did blow up a stockpile of weapons containing this agent during the Gulf War. It would have been the effect of this agent in the air the soldiers breathed that caused the health problems thousands are experiencing.

I hope that you don't allow the citizen's of Madison County to risk exposure of even minimal amounts. Because I have attended several funerals of people who were either in the military or served as civilians during the war, one was an intelligence officer, I see no justification for choosing burning.

I hope that you will consider my letter. I would be happy for you to meet my husband and even view before and after photos. One of my friends told me about a year ago that it wasn't until she saw the picture of him taken during the Gulf War and compared it to how he looks now that she was able to really see the impact the illness caused by exposure to chemical weapons has had on him.

I am sorry we were unable to attend the meeting held in Richmond. At that time my husband was having a medical test done.

Sincerely,
Carol Stutts

Comment 7-1

Response: The commenter's opposition to the incineration technology is noted. While no detailed, comparative studies on the safety of the destruction technologies currently exists, the Army believes that any of the alternatives under consideration in this EIS can be operated in a safe and efficient manner. See response to Comment 1-1.

Comment 7-2

Response: Unfortunately the scientific process has yet to uncover the cause of the Gulf War Syndrome, but a combination of multiple factors is suspected. Current exposure guidelines are based on the most sensitive indicator determined within the available data. Recently, the exposure limits for both VX and mustard agents have been lowered on the basis of occular sensitivity and not systemic measures.

The Army shares the commenter's concern about the health and safety of its workers and the public surrounding BGAD. As discussed in Section 4.9 of the EIS, the impacts of exposure to workers and to the general public during routine operations should be within established safety standards. As discussed in Section 4.26 of the EIS, the Army will implement various monitoring and mitigation measures, regardless of the destruction alternative selected, to maintain operations well within established environmental, safety, and health requirements and will respond quickly to any release exceeding those requirements. As discussed in Section 4.27 of the EIS, the Army will also be required to operate within permit requirements established and overseen by federal and Commonwealth regulatory bodies.

Mayor Ann L. Durham
P.O. Box 250
Richmond, Kentucky 40476-0250

July 12, 2002

Program Manager for Chemical Demilitarization
Public Outreach and Information Office
Mr. Gregory Mahall
Building E-4585
Aberdeen Proving Ground (EA), MD 21010-4005

Dear Mr. Mahall:

In response to the Assembled Chemical Weapons Assessment (ACWA) draft Environmental Impact Statement (EIS), I offer the following on behalf of the City of Richmond. Our comments are in response to specific statements listed in the EIS. They should in no way be interpreted to represent all points of concern or be the City's final position in regard to the ACWA Program. **8-1**

The City of Richmond's interest is to assure the safety of our people and to protect the environment while encouraging the expeditious elimination of the chemical weapons at the BGAD. It is our intent to work closely with the Army to effectively support the elimination of chemical weapons at the Bluegrass Army Depot.

If you need additional information, please contact me at (859) 623-1000.

Sincerely,

Ann L. Durham,
Mayor

(859) 623-1000 --- TDD # 1-800-247-2510 --- FAX # 859-623-7618

Comment 8-1

Response: The commenter's reference to the Draft EIS for the Assembled Chemical Weapons Assessment (ACWA) is outside the scope of the Draft EIS from the Program Manager for Chemical Demilitarization (PMCD). Since all comments attached to the letter from the commenter refer to the PMCD Draft EIS, it is assumed that the cover letter simply mistakenly referred to the ACWA Draft EIS and that the commenter intended to reference the PMCD Draft EIS.

BASIS OF RESPONSE

It is proper for this response to be based on hazards that exist with the storage of chemical weapons at the Blue Grass Army Depot in Madison County that will be elevated during chemical demilitarization of whatever technology chosen. Various scenarios in which chemicals can be released into the environment (spill, vaporize by an explosion, lofted by fire or released by some combination of these models, etc.) is justification for this government to expect that every precaution be taken regardless of cost to assure that an accident occurring at the Blue Grass Army Depot during storage or chemical demilitarization eliminate to the extent possible injury or death to humans, animals or the environment. **8-2**

While we must accept the data in the draft EIS that suggests the risk of an accident during demilitarization is low, we cannot assume that our people and our environment are not at great risk during chemical demilitarization. Nor does it negate the Army's responsibility to approach chemical demilitarization openly with a resolve to address our concerns and a commitment to invest in our community. The Army should provide resources to protect our people and our environment regardless of cost and irregardless of schedules for completion of chemical demilitarization. **8-3**

PUBLIC SERVICES

On Page 4-145, Line 133 it is suggested that chemical demilitarization will bring an additional 1,338 people to the Madison County population. It is further stated that if these people all settled in the City of Richmond, three (3) new officers will be required to maintain existing levels of police protection. This statement assumes that the City of Richmond would only be interested in maintaining existing levels of police protection during chemical demilitarization. It is our strong position that there needs to be a higher level of police protection in that the process of chemical demilitarization will in itself provide a greater risk to the community and possibly greater demands on the quality of personnel, the technical expertise they possess, and the demands required of them during chemical demilitarization. It is further the City's position that this determination can best be made once the technology is chosen and the City qualifies the **8-4**

Comment 8-2

Response: The greatest risk to citizens near a stockpile site is the continued storage of chemical weapons. Leaking munitions and the possibility of a release from a cataclysmic event are current threats to the public that only increase with time. The Army is taking every precaution to reduce the likelihood and the potential consequences of an accidental release of chemicals into the environment. These measures include engineering and procedural safeguards, increased security, and enhanced emergency response. These measures are discussed in Section 4.26 of the EIS.

Comment 8-3

Response: Risk assessments indicate that the risk of an accident during demilitarization is low. The Army is working with the Kentucky Department for Environmental Protection, the Kentucky Division of Emergency Management, and the Federal Emergency Management Agency to protect the public and the environment from the risks of storage and disposal operations and to address the concerns of neighboring communities. The Army has provided resources to protect the citizens of Kentucky since 1989 and will continue to do so through the life of the program.

Comment 8-4

Response: CSEPP funding from the Army has provided the appropriate resources since 1989 to enhance the existing capability of the emergency response community, not simply to maintain the existing capability. The appropriate resources were determined through discussions and negotiations between the Federal Emergency Management Agency, the Army, and State and local officials. Future resources will be determined through the same or a similar process.

difference in activities that will be brought about through the process of chemical demilitarization. Generalized statements regarding police protection within the City of Richmond is totally without foundation and premature. **8-4 (cont)**

Similarly it is stated that three (3) new firefighters would be needed to maintain existing levels of fire protection. Again, it is the City's position that these ratios, particularly as it relates to firefighters, do not correspond with the City's perceived involvement with activities at the Blue Grass Army Depot. The City of Richmond already has a mutual aid agreement with Blue Grass Army Depot. Inquiries have been made by Depot personnel to insure the City's intent to honor this mutual aid agreement during chemical demilitarization. It will always be the City' intent to fully cooperate with the Army in its mission. But, the Army must provide training and equipment to help facilitate their obligation to the public for its safety. **8-5**

The City of Richmond has plans for future accommodations for police and fire departments to include the service for areas of the Blue Grass Army Depot. Once a decision is made on technology for chemical demilitarization it is essential that negotiations begin and that staff and equipment needs be identified to assure a continued mutual aid agreement between the Blue Grass Army Depot and the City of Richmond, Kentucky. The City, in December of 1999, hired a Public Safety Director anticipating that ongoing discussions would occur that would address our public safety concerns. To date there have been limited discussions as it relates to the needed expansion of our police and fire departments to be a partner with the Blue Grass Army Depot to assure the safety of our personnel and the citizens of the City of Richmond. **8-6**

The City of Richmond currently maintains its present ISO Fire Classification with the number of fire personnel and equipment it has in the city's Fire Department. But, the Richmond Fire Department has been designated to play a major role in the field decontamination of emergency workers and evacuees. The CSEPP Program has been beneficial in securing warning equipment. However, the emergency personnel and equipment are not in place to handle a major emergency or an evacuation. Funding for these emergency services does not exist in the City of Richmond's Budget.

Comment 8-5

Response: CSEPP funding from the Army has provided the appropriate resources since 1989 to enhance the existing capability of the emergency response community, not simply to maintain the existing capability. The appropriate resources were determined through discussions and negotiations between the Federal Emergency Management Agency, the Army, and State and local officials. Future resources will be determined through the same or a similar process.

Comment 8-6

Response: The Army and the Federal Emergency Management Agency will continue to work with the Kentucky Division of Emergency Management to provide local governments with resources and assistance to respond to emergencies resulting from chemical stockpile storage and disposal operations.

Preliminary estimates by the City of Richmond Emergency Personnel indicates a need for sixteen (16) additional personnel (estimated cost is $476,000 per year), one new pumper (estimated cost is $250,000), one aerial firetruck (estimated cost is $450,000), and one new building to house police and fire administration substation to be located at Blue Grass Army Depot Gate 2 (estimated cost $1,000,000). The existing Madison County Emergency Operations Plan Annex Q, Hazardous Materials Operations, III Direction and Control states "Direction and Control for hazardous material incidents is shared between local and state authority. Locally, efforts will be, coordinated by Fire Services in their respective jurisdictions. This clearly mandates that an emergency within the community created by Chemical Demilitarization Activities at the Depot is the responsibility and jurisdiction of the Richmond Fire Department. To date there has been no investment in training equipping or constructing facilities adequate to respond to a chemical Emergency at BGAD or within the City of Richmond. Thus leaving our Mutual Aid Agreement with little value. (See Attachment #I) **8-6 (cont)**

TRAFFIC

In the event of an accident at the Depot, major routes of evacuation in the center of our county are US 25 with approximately 15,000 cars per day and Highway 52 with 16,000 cars per day that run parallel to the Army Depot. Duncannon Lane which intersects with US 25 will provide immediate access to I-75. It is our position that a dialogue should be immediately initiated between Army personnel, the City of Richmond, the Kentucky and the United States Department of Transportation to assure that all necessary highway up grades immediately be addressed. Highest priority should be given to US 25, Duncannon Lane, and the new exchange off I-75 and should be quickly expedited to assure total completion of these projects before the process of chemical demilitarization begins in this county. The state is already addressing Highway 52 for those who must use that area and US 25 should have been a higher priority to access Interstate 75. That decision in itself is a demonstration of the lack of understanding that exists for our community needs. As of this writing, US 25 is beyond capacity; Duncannon Lane is nothing more than a rural route where it is difficult for two large vehicles to pass. There is no immediate access to I-75 from the Army Depot without the Duncannon – I-75 interchange. We totally **8-7**

Comment 8-7

Response: The Army and the Federal Emergency Management Agency have provided continuing guidance on the need for a balanced strategy of both shelter-in-place and evacuation. This approach balances the risk of sheltering-in-place against the greater risk of exposing evacuating populations to an amount of chemical agent that could affect them while driving. The Army's goal is to avoid exposure of the public through this balanced strategy.

Regarding potential traffic impacts during project construction and normal operations, the EIS states that those impacts would not be significant, provided that certain planned improvements are made to the local system of roads prior to the initiation of disposal facility construction. Those statements are supported by the available data on current road capacity and workforce projections.

reject the statement that for demilitarization no substantial impacts are expected on traffic if the selected access road to Blue Grass Army Depot is off KY 52. 8-7 (cont)

WATER

ES.3.2 Water Supply and Use states due to the amount of process water that would be required, water use at Blue Grass Army Depot would increase during operations of each of the destruction alternatives. It further states that a 500,000 gallon water storage tank would be constructed to provide additional capacity and assure adequate water supply would be available during peak demand period of fires or other emergency service demands. Table D.1. Annual Utility Demands for Destruction Facilities at the Blue Grass Army Depot identifies 18,000,000 gallons annually as the process water demand and 6.4 million gallons annually for potable water. On Page D-8 it states that facility requirements for potable and process water would be withdrawn from an existing main and tie-in at a point thirty (30) feet from the security fence. The source of fresh water at the installation is Lake Vega. It further states that the construction of the 500,000 gallon water storage tank to be constructed would be to supply water for personnel, firefighters, and supply water during peak facility demand thus minimizing peak water withdrawals from the water source. 8-8

This whole premise is inconsistent with conversations that the City has had with Depot personnel concerning the Army's intent to privatize utility services on the Depot prior to chemical demilitarization. It has been represented to us that a request for proposals (RFP) for all utility services, including maintenance, will be issued in mid-September. While the City of Richmond has offered to enter negotiations to provide both water and wastewater services to the entire Depot facility and has submitted sound engineering proposals to suggest that it is the only cost effective alternative to the system that is currently used at the Depot, we have been unable to get the Army involved in meaningful negotiations to provide process and potable water sufficient to meet all facility demands at the Depot. It is inconsistent with common sense and certainly contrary to the concept of regionalization of public service for the Army Depot to maintain and operate a water supply system within sight of a public water supply system that provides water for 75% of Madison County usage. The resources spent on the Depot facility could expand the

Comment 8-8

Response: At this time, no decision has been made regarding the privatization of BGAD water supply, and all options are still being evaluated. A request for proposals (RFP) to privatize BGAD water supply will be released at a later date. The final decision will be based on an economic evaluation of all alternatives while meeting all environmental and legal requirements. Sections 4.3.3.1 and 4.3.3.2 have been amended to address privatization.

City of Richmond water supply to accommodate existing and any new activity associated with the chemical demilitarization project. In the past ten (10) years the City has expanded our water treatment plant to meet the demands of growth. Further we are positioned to enhance our system to address future needs as is indicated in the accompanying documents. (See Attachment II) **8-8 (cont)**

It should be understood by all concerned, particularly those, involved in the process of privatization of the water supply system at the Army Depot that it is the City of Richmond's position that any contractor responding to the Army's request for proposal that would be depending on the City of Richmond to service its water supply needs as a wholesale supplier and private contractor for the Blue Grass Army Depot facility will be denied. The City of Richmond stands ready to negotiate directly with the Army Depot on a system that best serves both of our existing and future needs. A survey of the Depot utility systems is needed to make those determinations.

WASTEWATER

On Page D-10 Appendix D, Lines 15 thru 22 it states a new sewerage treatment plant would be constructed near the facility next to Muddy Creek, near Route 3 on the installation. The wastewater to this plant would consist of effluent from facilities such as bathrooms, showers, and laundries. The effluent from the sewerage treatment plant would be approximately 17,000 gallons per day of liquid effluent. The treatment plant would use approximately 1,140 cubic feet per minute from emergency diesel generators while operating if electric power is lost. No hazardous materials of any type would be discharged into this system, i.e. the destruction process itself would not produce any wastewater. **8-9**

Currently Blue Grass Army Depot operates two (2) wastewater treatment plants. The wastewater plant that discharges into Muddy Creek on the Depot property is logistically capable of accepting the flow from any facility but it does not have the capacity. As stated above, the environmental impact statement proposes to construct a new wastewater treatment plant next to Muddy Creek. This would create three (3) discharge points on the Depot operating under three (3) separate Kentucky pollution discharge eliminations system permits (KPDES). To create another

Comment 8-9

Response: At this time, no decision has been made regarding the privatization of BGAD sewage services, and all options are still being evaluated. As stated in the EIS, sewage could be treated and discharged to Muddy Creek or pumped to the existing infrastructure of Richmond. A request for proposals (RFP) to privatize BGAD sewage services will be released at a later date. The final decision will be based on an economic evaluation of all alternatives while meeting all environmental and legal requirements.

discharge point is counter productive to the concept of regional planning to maximize the use of public funds and is not environmentally the best approach to treating the wastewater at the Blue Grass Army Depot. **8-9 (cont)**

During the planning phase for the development of the City of Richmond's Wastewater Facilities Management Plan, our staff met with representatives of the Blue Grass Army Depot. The result of that meeting was that a major portion of the Depot's wastewater infrastructure lies within the City's planning area boundary. The Kentucky Division of Water mandated the development of a regional wastewater system for the south central portion of Madison County. As a result of the implementation of the Wastewater Facilities Management Plan adopted in 1998, the City of Richmond has invested $9.5 million in wastewater infrastructure to serve the south development area including the Army Depot.

The EIS proposes a new wastewater treatment plant in the Muddy Creek watershed. A more prudent approach is to transport the sanitary wastewater expected during the construction phase from the chemical limited area to existing wastewater collecting system on the Depot.

The installation of the sewerage pumping station and a force-main would be less expensive than construction of a wastewater treatment plant.

The long-term solution to the wastewater treatment situation at the Blue Grass Army Depot would be to invest in the outfall sewer identified in the facilities management plan of the City of Richmond and abandon the existing treatment facilities. (See Attachment II) With this plan both the sanitary wastewater from the construction phase and operation phase of the chemical demilitarization operation could be treated and although the waste from the chemical demilitarization must be treated to eliminate toxic substances, the size of such a process would be considerably reduced if the sanitary wastewater is segregated.
The advantages of this plan are as follows - - - - -

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1. This solution will remove two (2) wastewater discharge points from the Muddy Creek watershed and Hayes Fork water shed. **8-9 (cont)**
2. Eliminate capital expenditures that would otherwise be abandoned in the near future when the chemical demilitarization operation is completed;
3. Allow the Depot to be free of wastewater treatment and operation costs;
4. Reduced cost to the Depot since the wastewater service fees or rates would be cost-based.

The listed benefits of this plan should make it an overwhelming choice for an investment in the long-term wastewater system plans adopted by the City of Richmond and approved by the Kentucky Division of Water.

The statement of intent to construct a new sewerage treatment plant is inconsistent with the Army's request for proposals to privatize the wastewater treatment on the Depot property. It should be clearly understood that a private contractor cannot be considered for servicing the Depot property that is included in the City of Richmond's facilities management plan adopted in 1998. The Plan was adopted from a mandate by the Kentucky Division of Water to develop regional wastewater systems for the south central portion of Madison County. Kentucky law prohibits another utility from providing services within the City of Richmond's wastewater facility area without the consent of the City of Richmond and approval of the Kentucky Division of Water. This response shall serve as notification that consent from the City of Richmond cannot be forthcoming. The City of Richmond offers a sound proposal that is the most cost effective and efficient use of public monies. We are willing to negotiate to expand our system to meet the existing and future needs of both the City of Richmond and the Depot.

WASTE MANAGEMENT

Page 4-17, Lines 33 and 34 states that construction of the chemical munitions destruction facility using any of the four (4) technology alternatives addressed by the draft environmental statement would generate both solid and liquid non-hazardous waste as well as small amounts of solid and **8-10**

Comment 8-10

Response: Section 4.20.4.1 of the EIS notes the small number of daily truck trips that would be required during facility operations for waste product removal and states that this would not add appreciably to road congestion. Current congestion on U.S. 25/421 is noted in Section 4.20.1 of the EIS, as are state plans and construction schedules for constructing a new interchange at I-75 and Duncannon Lane and widening Duncannon Lane from the new interchange to U.S. 25. The EIS also notes that the new interchange and road-widening mentioned above would provide a good alternative route to BGAD (Sections 4.20.3 and 4.20.4).

liquid hazardous waste. It further states that any wastes that are listed as hazardous in the RCRA Regulations would be stored and disposed of as prescribed by EPA and applicable Commonwealth and local regulations. **8-10 (cont)**

Waste from any selected facility may include liquids generated by the agent disposal process which will be dried and the resulting solids should be shipped to a permitted, off-site TSDF. It is further stated that a laboratory hazardous waste management plan will be developed by the systems contractor that will identify the process of handling laboratory waste. The EIS estimates that the total process solid waste expected to be generated during the life of the facility is 4,400 tons or a volume of about 20,000 yards. It is estimated that over a 160 truckloads of metal from the munitions bodies would leave the Blue Grass Army Depot. Page 4-25 of the EIS identifies a quantity of ash residue from the furnace systems as a hazardous solid waste that would be stored and taken to an off-site TSDF. Transportation of the solid hazardous waste would require over 205 truck trips. The City has long recognized that the Kentucky Department of Transportation should address the over crowded US 25, the expedient construction of Duncannon Lane and the Duncannon I-75 interchange! **On Page 4-27 4.6.5 Cumulative Impacts** it states the chemical stockpile destruction program is not long lived because of the relatively small volumes of waste both hazardous and non-hazardous, and the short duration of the program, cumulative impacts from waste are expected to be small. Unless the EIS includes more information here on how waste contaminated with PCB's, etc. could be destroyed the public cannot fully assess the impact of the waste. **8-11**

PCB's are long life components that do not break down, causing adverse health effects. Therefore, they will forever have a long-term effect on ground water, surface water, or any other medium in which they come in contact. We question if there is sufficient data to determine the true impacts of PCB's related to demilitarization. It is the City of Richmond's position that any activity involving chemical warfare agents and acceptable management of the waste cannot be quantified as "expected to be small." Obviously there will be tons of hazardous and non-hazardous waste shipped through the City of Richmond every day to reach a disposal destination. The City of Richmond would expect coordination for shipping with Richmond emergency **8-12**

Comment 8-11

Response: The Army is committed to destroying PCBs and other potentially hazardous or toxic materials at least as efficiently as required by applicable regulations. The destruction of polychlorinated biphenyls (PCBs) is discussed in Sections 4.6 and 4.8.4 of the EIS. During the RCRA permitting process, a site-specific human health risk assessment will be prepared if the incineration technology is selected for implementation at BGAD. The health risk assessment would include consideration of the types of PCB health effects described in the comment. It is not known at this time whether a health risk assessment would be prepared if a non-incineration technology is selected for implementation at BGAD. EPA requires that health risk assessments be prepared only for combustion technologies.

Comment 8-12

Response: Activities with the potential for exposure of the public to hazardous substances would be coordinated with on-post personnel, who would coordinate those activities with the appropriate off-site civilian authorities. Any off-site shipments of hazardous wastes would comply with packaging and transportation requirements established by the U.S. Department of Transportation.

service agencies so we can anticipate any off-site accident. To date there has been no discussion of this subject with the City of Richmond. **8-12 (cont)**

GROUND AND SURFACE WATER

It has long been the position of the City of Richmond that ground water monitoring is an essential component to chemical demilitarization regardless of the technology. It is essential that surface and ground water monitoring begin prior to the disposal process to establish base-line levels to adequately document contamination to any ground water, ground water supply, or aquifer. The City of Richmond has invested millions of dollars in the Lake Reba water shed as a public recreation area. It is our position that ground water monitoring stations around the chemical demilitarization area are essential to assure no contamination of ground or surface water at any point during the chemical demilitarization process. It is further the City's position that the monitoring and the installation of these monitoring stations should be done by a contractor employed by the City of Richmond and that all costs associated with this process should be a reimbursement from the United States Army to the City. **8-13**

OTHER CONCERNS

1. Given the toxicological data (US Army 1988; 16/3, Appendix B) used in developing the estimates of potential fatalities, the greatest risk of death to our population are infants, children or the elderly versus healthy adult males. The atmospheric dispersion models used to estimate potential maximum fatalities clearly indicate a greater risk to this group. **8-14**

2. On Page 1-21 Appendix 1 the accident scenario affecting the facility while processing 8 inch projectiles filled with GB shows potential fatalities among the general public to be estimated at 2,300 under nighttime meteorological condition **8-15**

Comment 8-13

Response: This type of groundwater and surface water monitoring is routinely performed at other PMCD sites and will be performed in Kentucky. Details regarding the identity of the organization that would conduct the monitoring, as well as the contractual costs for such monitoring, will be developed in consultation with appropriate regulatory authorities.

Comment 8-14

Response: In comparison to the susceptibility of healthy adult males to exposure to chemical warfare agents, there may be an increased susceptibility among infants, children, and the elderly because of differences in uptake, metabolism, and immune function. Section H.4 in Appendix H of this Final EIS was prepared to address such differences in susceptibility. The concern expressed in the comment is thus noted.

The accident models run within the EIS are meant to provide relative comparisons between scenarios and not quantitatively certain data. While there are fairly old assumptions of different sensitivities between population groups for exposure to chemical warfare agents, there have been no experiments to test the hypothesis, and none are anticipated. More recent thought suggests a wide spectrum of sensitivities exists among military personnel and this may overlap substantially with the general population. In any case, accident scenarios are meant only to provide qualitative comparisons and not quantitative certainty.

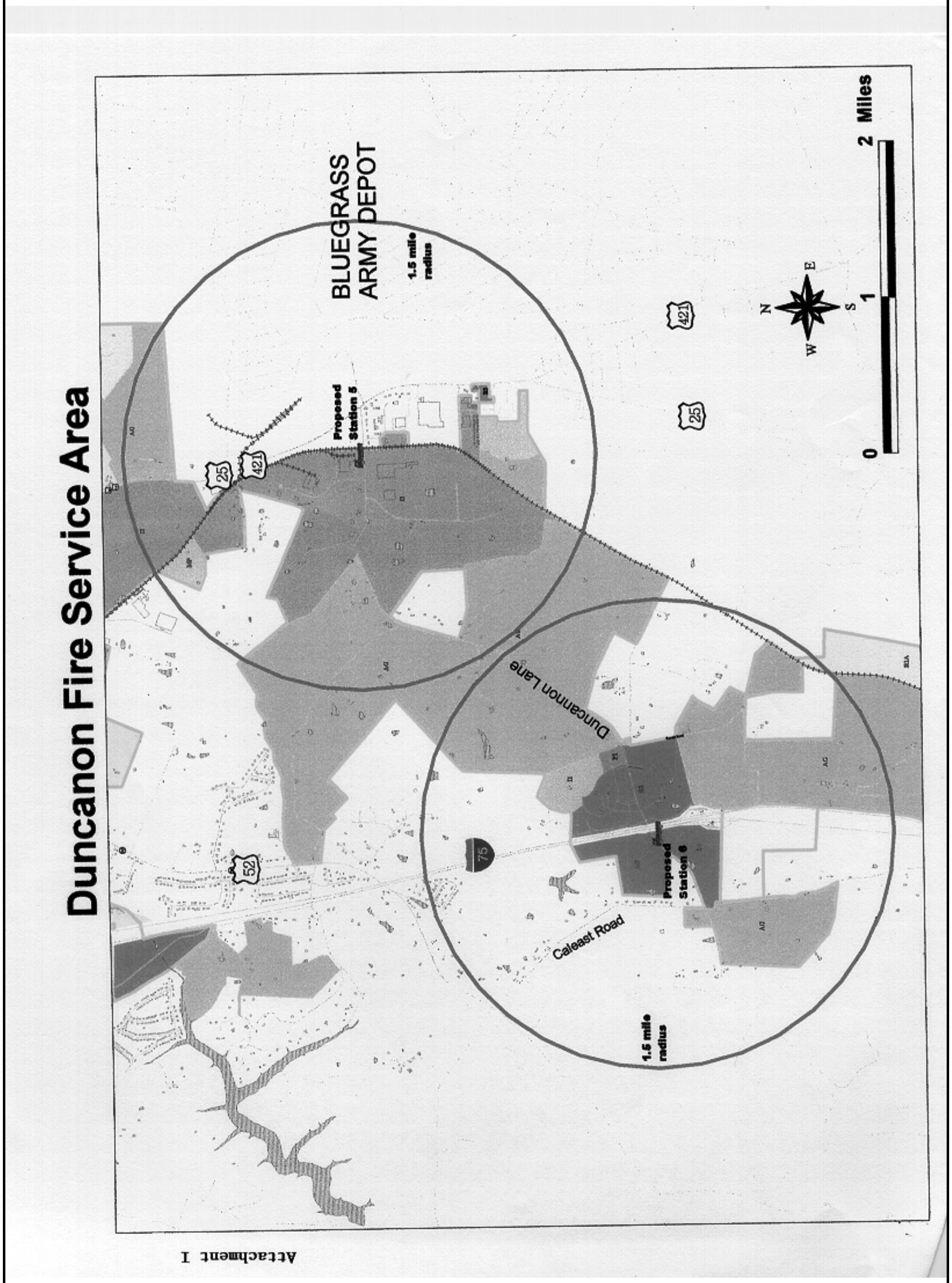
Comment 8-15

Response: The comment accurately summarizes the information presented in Appendix H of this Final EIS. The concern expressed in the comment is noted.

3. Given the demographics of the City of Richmond as they relate to group quarter population i.e. schools, nursing homes, assisted living, daycare centers, etc. there is no doubt that a large group of our population is at risk even at low levels of exposure. Therefore, we believe that a special response and evacuation plan needs to be developed to provide for the safety and welfare of this most vulnerable group. **8-16**

Comment 8-16

Response: The Army concurs in this statement. Special needs populations have been included in the CSEPP planning base since the beginning of the program. Any consideration of the special needs population should be included in the State and local planning and in the request for annual allocation of funds from the Federal Emergency Management Agency and the Department of the Army.


Duncanon Fire Service Area
BLUEGRASS
ARMY DEPOT
1.5 mile radius
Proposed Station 5
Proposed Station 6
Duncannon Lane
Caleast Road
1.5 mile radius
25
421
52
75
N
S
E
W
0
1
2 Miles
Attachment I

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300 Center St.
Berea, KY 40403
859 985-0022
Thu, Jul 4, 2002

Program Manager for Chemical Demilitarization
Mr. Gregory J. Mahall
Building E-4585
Aberdeen Proving Ground, (EA), MD 21010-4005

Mr. Mahall.

I wish to provide input on the Kentucky Draft EIS.

The Draft EIS does an inadequate job of evaluating air pollution issues. It focuses, primarily, on air pollution issues associated with construction and takes little notice of air pollution issues associated with demilitarization. **9-1**

Information provided by PMCD and ACWA is that incineration produces roughly ten times the air emissions of the other alternatives. I request this difference be evaluated with regard to: **9-2**

- local air pollution impacts. Madison County, Kentucky already exceeds EPA air pollution (PM 2.5) standards. Additional air emissions would make an already unhealthy situation even worse.
- impacts of trace toxics. These should be analyzed in terms of total toxics released. While the percentage of these toxics may meet EPA standards, it's also true that higher total air emissions mean higher total trace toxics released into our atmosphere with a wide range of potential health and agricultural impacts. **9-3**
- potential for agent releases to air. While the potential for air releases is limited, incineration plants have had releases historically. The risk, while limited, is greater than zero. In contrast, alternative technologies minimize the possibility and magnitude of accidental agent releases to air. They are "wet chemistry" methods with minimal air emissions and include hold-test-release methods specifically designed to minimize air emissions including the possibility (however remote) of agent releases. **9-4**

In addition, your socioeconomic analysis is inadequate and incomplete. Historically hazardous waste incinerators have been negatively perceived by society. Communities identified as major hazardous waste incinerator sites have experienced negative economic impacts. **9-5**

Madison County is especially sensitive to socioeconomic impacts of negative public perceptions. We are a major agricultural producer of beef and tobacco that are already suspect by some social groups. Our major college attract students across the region. We are becoming a "bedroom community" for surrounding counties resulting in a significant boom in housing construction. We are a significant producer of "alternative" products such as organic produce and Appalachian handicrafts. All of these industries depend on how well the county is perceived by the public. Thus Madison County is especially vulnerable to socioeconomic consequences of negative public perceptions. I request you analyze these socioeconomic impacts.

Thank you for your consideration. I look forward to working with you as we move forward to demilitarize Kentucky's chemical weapons stockpile as rapidly and safely as possible.

Douglas Hindman

Comment 9-1

Response: The EIS provides an extensive evaluation of potential air quality impacts associated with facility operations in Sections 4.7.4, 4.7.5, 4.7.7, 4.8.4, and 4.8.5 of the EIS.

Comment 9-2

Response: The commenter is correct in noting that Madison County exceeds NAAQS for PM2.5. In fact, as noted in Section 4.7 of the EIS, all of the Commonwealth of Kentucky exceeds the standard for PM2.5. Section 4.7.4 of this EIS evaluates the potential air quality impacts of criteria air pollutants (including PM2.5) emitted during facility operations for all technologies. The analysis estimates maximum ground-level concentration increments in the ambient air (at or beyond the installation boundaries), adds these estimates to background concentrations, and compares the results with applicable ambient air quality standards.

Comment 9-3

Response: Section 4.8.4 of this EIS evaluates the potential air quality impacts of hazardous and toxic substances emitted during facility operations for all technologies. Appendix I (Toxic Air Pollutant Tables) contains estimated toxic air pollutant emissions for the technologies. Table I.1 (Estimated toxic air pollutant emissions for baseline incineration at BGAD) in Appendix I has been revised to express emissions for each pollutant in micrograms per second [the unit used in Table I.2 (estimated toxic air pollutant emissions from Neutralization/SCWO Technologies at BGAD), I.3 (Estimated toxic air pollutant emissions from Elchem Ox technology at BGAD)] to facilitate comparisons between baseline incineration and the neutralization and electrochemical oxication alternatives in terms of which technology emits more toxics at the source (i.e., from the stack).

Clearly, an incineration facility would generate larger quantities of atmospheric emissions than any of the non-incineration alternatives. However, if an incineration facility is selected for implementation at BGAD, it would be operated in compliance with applicable air quality standards, regulations, and requirements. As part of the RCRA permitting process for such a facility, the Army would prepare a human health risk assessment of the lifetime (i.e., total) emissions from the facility. This risk assessment would include potentially toxic emissions and would address the potential human health impacts, including human consumption of locally produced agricultural products. The type of "total emission" analysis, as recommended in the comment, is not currently feasible; however, it would be part of the aforementioned Human Health Risk Assessment.

Comment 9-4

Response: Because of the significant differences in the level of detail available for the various technologies under review in this EIS, a direct comparison of the potential risks of accidental agent releases is not possible at this time. For the same reason, the statement in the comment regarding alternate technologies being able to "minimize the possibility and magnitude of accidental releases to the air" cannot be proven or disproven

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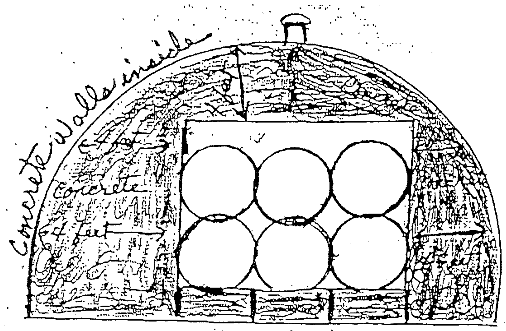
with current risk calculations. The comparative risk of accidental releases of agent is not solely based on the type or quantity of air emissions during operations, as implied by the commenter, but includes, among others, hazardous chemicals used in the neutralization reactions.

Comment 9-5

Response: According to NEPA requirements, an EIS must address potential direct and indirect impacts of the proposed action on the human environment. The public's perceptions or beliefs about other impacts of routine operations that cannot be demonstrated or analyzed by reasonable scientific techniques are outside the scope of EISs.

My proposal is to bury [illegible]
Grave. Build a square metal Container of 1 inch" sheet meta
sybe of stainless steel. Place inside box metal pipes
for each size Rockets or Shells. Remove all fuse's and place
as many of the Rockets or Shells inside pipes, as you con.
At the back side of metal box you could lower
pipe maybe 3 inches in order to place neutralizing
liquid in with Rocket or Shells. Weld in place metal plates
and solid metal on front of box. From the top of igloo
Pour concrete until all the area is filled all the
way up. After everything is filled in no way would anything
interfere like, No Air, No light, no moisture, and
would stay some temp. you would need to weld the big
Metal doors shut and push dirt in front. Fence the area
and place signs for no diging

10-1



submited by: Leslie L. Sorrell
750 Shaker Dr. #301
Lexington, Ky. 40504-3726
Phone (859) 278-1046

Comment 10-1

Response: The storage alternative proposed in the comment is noted. However, the Army has been instructed by Congress to destroy the chemical weapons stockpile (through Public Law 99-145) rather than continue to store the stockpile, and the United States must comply with the Chemical Weapons Convention (CWC), an international treaty to which the United States is a signatory and which requires destruction of the stockpile. The EIS evaluates the continued storage alternative only because the President's Council on Environmental Quality requires consideration of the no-action alternative in all NEPA documents.

From Robert C. Tussey, Jr.
Sent Monday, July 15, 2002 4:52 PM
To GREGORY.mahall@pmcd.apgea.army.mil
Subject Comments-Bluegrass-CWD Draft EIS

Mr Mahall -

Understand that today (7/15/2002) is the deadline to submit comments regarding the Draft EIS for CWD at Bluegrass AD per your newspaper notice and hearing on Thursday July 11 , 2002 . I was unable to attend hearing. Presume that email comments will be accepted.

11-1 I have followed this issue since the first hearing in 1984 and have actively participated in meetings and as a member of an earlier Citizens Advisory Committee . I am pleased with the work and outcome of the alternative technology assessment program . I oppose use of any incineration process for destruction of chemical weapons in a populated area like the Bluegrass Depot . **11-2** I'm sure that one of the three non-incineration processes can be selected that will be safer for this location . Technically any process that can safely puncture and drain agent from the rockets and then flush throughly with a solvent to near 100% removal/seperation followed by neutralization in a closed-loop manner would be safer than the baseline incinerator.

These are my personal comments . I would appreciate receiving a copy of the subject Draft EIS .

Robert C. "Bob" Tussey,Jr.,P.E.
Vice President, Kenvirons,Inc.

Comment 11-1

Response: The commenter's opposition to the incineration technology alternative is noted. See response to Comment 1-1.

Comment 11-2

Response: The commenter's preference for neutralization technologies and the concern for safety are noted. See response to Comment 1-1.

PUBLIC COMMENTS

Destruction of Chemical Munitions at Blue Grass Army Depot, Kentucky

Draft Environmental Impact Statement

Program Manager for Chemical Demilitarization

February 2002

submitted by
Chemical Weapons Working Group
Kentucky Environmental Foundation
Non-Stockpile Chemical Weapons Citizens Coalition
Common Ground
Concerned Citizens of Madison County
Kentucky Resources Council, Inc.

& the undersigned individuals in the area Surrounding Blue Grass Army Depot

July 15, 2002

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PUBLIC COMMENTS

About these Comments

The comments below attempt to chronicle some of the questions inconsistencies, inaccuracies and omissions that we have been able to identify. There are many.

There are many issues that we have not had time to develop into cogent comments and almost certainly many more still that we have not yet identified. Clearly, insufficient time was allowed for public review and comment. We reserve the right to revisit and comment on portions of the DEIS that we did not have sufficient time to address. **12-1**

It is apparent from the substance of the DEIS and the accumulating comments of the public near BGAD, that the people of Kentucky commenting on the DEIS have a much greater understanding of the environmental, health, economic, and agricultural impacts. Therefore, the decision for determining choice of destruction technologies should be referred to the people. **12-2**

Additional Comments

Our comments on the non-incineration technologies were already submitted for comments on the ACWA EIS. They are attached as Appendix C.

COMMENTS ON EXECUTIVE SUMMARY **12-3**

ES.1 PROPOSED ACTION

General Comment. This section should clearly identify the proposed action and perhaps the legal framework for its inception and execution. Finding the statement of the proposed action amidst the language of this section is not easy. Most of the language in this section does not belong here and should be deleted or moved to more appropriate sections of the DEIS.

ES.2 DESTRUCTION ALTERNATIVES **12-4**

General Comment. This section fails to identify for each of the system alternatives the treatment and disposal methods envisioned for all of the weapons components and related materials and for the secondary wastes produced by primary waste treatment. It also fails to identify all of the available alternatives, a deficiency that is carried through the rest of the DEIS. The “no action” alternative is illegal and inappropriate as is another alternative that was considered in the past--transportation. Neither of these illegal and inappropriate options should be considered.

Comment 12-1

Response: As discussed in Section 1.4 of the EIS, the public has been involved in NEPA deliberations for this program since its inception, including the preparation of this EIS. In addition, a 30-day period will be allowed for final review of the Final EIS before publication of a Record of Decision (ROD). As discussed in Section 1.8 of the EIS, opportunities for public involvement have also existed through the Citizens' Advisory Commission for BGAD appointed by the governor of Kentucky.

Comment 12-2

***Response*:** As discussed in Sections 1.4 and 1.8 of the EIS, the people of Kentucky have played and will play an important role in assessing the impacts of the destruction technology alternatives and have substantial opportunity to register their preferences prior to making the Record of Decision (ROD). In any event, the Department of Defense Defense Acquisition Executive will select the destruction technology for BGAD, factoring in the review and input of diverse organizations, as well as the public.

Comment 12-3

***Response*:** The Executive Summary of the EIS is intended to summarize information and analyses in the body of the EIS and, as such, does not attempt to provide the detail found in the body of the EIS. As indicated in the introduction to the Executive Summary, however, and as discussed in greater detail in Section 2 of the EIS, the proposed action is the construction, operation, and closure of a facility to destroy the stockpile of chemical warfare agents and munitions currently stored at BGAD. As further explained there, the legal framework for the proposed action is Public Law 99-145 and the international treaty called the Chemical Weapons Convention.

Comment 12-4

***Response*:** The Executive Summary of the EIS is intended to summarize information and analyses in the body of the EIS and, as such, does not attempt to provide the detail found in the body of the EIS. Section ES.2 of the Executive Summary identifies and briefly describes the four destruction alternatives and the no-action alternative (i.e., continued storage) considered in the EIS. More detailed descriptions of the destruction alternatives considered, including the information requested in the comment, are provided in Section 3 and Appendix D (baseline incineration alternatives) and Appendix G (non-incineration alternatives. Section 4.6 of the EIS discusses waste management for each of the destruction systems.

[Intentionally left blank]

Comment 12-4 (cont)

***Response (cont)*:**

As required by CEQ regulations, the EIS has considered a range of reasonable alternatives for the proposed action. As discussed in Section 1.5 of the EIS, the non-incineration technologies evaluated in the EIS were selected (on the basis of detailed evaluation criteria developed with extensive input from stakeholders) for development by the Program Manager for Assembled Chemical Weapons Assessment. The Army believes that it is reasonable to limit non-incineration alternatives evaluated in this EIS to those that survived the thorough testing and evaluation conducted by the ACWA program (i.e., through Demonstration I and II and Engineering Design Studies).

The 1988 Programmatic EIS conducted an evaluation of the impacts from transporting chemical munitions to regional and national disposal sites. Off-site transportation of munitions and agent was not considered in this EIS.

Although the no-action alternative is not a viable alternative because its implementation is precluded by Public Law 99-145, regulations of the President's Council on Environmental Quality (CEQ) require its evaluation (see Section 3.5 of the EIS).

ES.3 ENVIRONMENTAL IMPACTS

General Comment. This section describes some of the activities that are likely to result in environmental impacts, but generally avoids describing the impacts themselves. Since the Executive Summary is the only section of the EIS that some people will read, it is imperative that impacts be described in this section. Secondary and cumulative impacts are ignored. They, too, must be identified and discussed. **12-5**

ES.3.1 LAND USE

This section fails to recognize the additional on-post and off-post land use impacts that will result from providing housing and other services for construction and operating personnel. Also ignored are the significant and potentially permanent changes in land use that could result from conversion of nearby farm and ranch lands to other uses (or to no use) if the incineration option is chosen and markets for local agricultural products are adversely affected. **12-6**

ES.3.2 WATER SUPPLY AND USE **12-7**

It appears that this section fails to distinguish between process water use and process water consumed. Since the non-incineration options recycle most of the water they use, it seems likely that actual water demand will be less for these systems than for the incineration system.

ES.3.3 ELECTRICAL POWER SUPPLY **12-8**

This section seems to focus on the construction of power lines and related equipment, but ignores the production of the power needed by the facility (e.g., the mining, transport and burning of coal) and the use of power made available as a result of the chem. demil. facility, both during and after the weapons destruction process.

ES.3.4 NATURAL GAS SUPPLY **12-9**

This section seems to focus on the construction of natural gas pipelines and consumption of natural gas, but ignores the production, delivery and combustion of the natural gas needed by the facility.

ES.3.5 HAZARDOUS WASTES **12-10**

This section suggests that important decisions about the processing of secondary wastes have already been made, in violation of the National Environmental Policy Act. Off site shipment of secondary wastes is an option, but in our view an undesirable option. All process wastes, especially hazardous wastes, should be managed fully on site, unless there is some compelling human health or environmental reason why they should not be managed there. It isn't nice to dump your trash in someone else's yard. Shipping chemical weapons-related wastes off site may prove to be politically controversial. More important, however, shifting the burden and the risks associated with waste transport and disposal to other communities would be morally and ethically indefensible.

Comment 12-5

Response: The Executive Summary of the EIS is intended to summarize information and analyses in the body of the EIS and, as such, does not attempt to provide the detail found in the body of the EIS. Section 4 of the EIS provides a detailed discussion of the potential impacts associated with each destruction technology. Tables ES.1 and ES.2 summarize these impacts.

Comment 12-6

Response: Land use impacts resulting from providing housing and other services for workers and their families is not discussed in the Executive Summary because project induced population growth is expected to be relatively small, meaning that any resulting changes in land use would be minimal (Section 4.2.4). The impacts to agriculture are expected to be negligible for all destruction technology alternatives under normal operations (see Section 4.20.4 of the Final EIS).

Comment 12-7

Response: The EIS discusses process water use in common English terminology and not legal terminology, especially legal terminology neither specified in Kentucky Revised Statutes nor in Kentucky Administrative Regulations. None of the process water from any of the alternatives is returned to the local environment. The Army depends upon the ACWA Program for information concerning the ACWA technologies. The water demands for the non-incineration alternatives were taken from Table 7.3-1 of the ACWA Final EIS (*Design, Construction and Operation of One or More Pilot Test Facilities for ACWA Destruction Technologies at One or More Sites,* April 2002). Water use impacts are summarized in Table ES.1 of this Final EIS. In general, water use would be less for the non-incineration technologies (as noted in the comment).

Comment 12-8

Response: The potential impacts of mining, transporting, and burning coal to produce electricity are evaluated in other regulatory documents and permitting processes. The incremental increases in those potential impacts that are attributable to the process of agent and munition destruction would be very small. In terms of electricity use, any of the alternative destruction facilities would be equivalent to a moderately-sized commercial facility. The potential impacts from use of the installed electrical power infrastructure after the completion of munition and agent destruction is beyond the scope of this document.

Comment 12-9

Response: The potential impacts of producing and delivering natural gas are evaluated in other regulatory documents and permitting processes. The incremental increases in those potential impacts that are attributable to the process of agent and munition destruction would be very small. The impacts from on-site combustion of natural gas are evaluated in Section 4.7.2.2 of this EIS.

[Intentionally left blank]

Comment 12-10

***Response*:** Because there is no current or planned capability to dispose of these wastes on site, the decision to remove the final hazardous waste products from BGAD is mandated by the Resource Conservation and Recovery Act. These end point hazardous wastes must be disposed of in an appropriately permitted off-site treatment, storage, and disposal facility since no on-site capability exists. No decisions regarding the fate of wastes have been made. As discussed in Section 1.4.6, the Department of Defense Defense Acquisition Executive (DAE) will make the decision regarding which technology will be implemented at BGAD. Whichever technology alternative is selected by the DAE, the Army intends to proceed with off-site shipment and disposal of secondary hazardous wastes to an off-site permitted treatment, storage, and disposal facility (TSDF) as described in the EIS. Impacts to areas around the permitted TSDF(s) receiving these secondary wastes will be addressed by the permitting and monitoring processes of those specific TSDF(s). The Army will comply with all permit requirements of the receiving TSDF.

The risk to the health of the communities which would receive the hazardous waste needs to be fully considered also. The Army must insure that the off-site hazardous waste disposal vendors will be held to the highest possible standards and that none of the waste will be incinerated. **12-11**

This section appears to assume that a Brine Reduction Area would be used at the Blue Grass Depot for the baseline incineration option since it states that "the quantity of hazardous liquid wastes is expected to be small to non-existent for all alternatives." How can that assumption be made when the BRA has been abandoned in Utah, Alabama and Arkansas? Processing of brine that will not be processed in a BRA must be addressed. **12-12**

Regardless of the methods used, the actual impacts on human health and the environment must be identified and discussed. **12-13**

ES.3.6 AIR QUALITY

This section exemplifies several serious flaws that are repeated many times throughout this document. **12-14**

1) It suggests that the chem. demil. facility would operate throughout its active life with "no exceedances (of environmental standards) expected." That suggestion is absurd. All facilities exceed standards from time to time. The EIS must discuss the possible form of those exceedances and the resultant impacts on human health and the environment.

2) It ignores, indeed dismisses, the impacts on human health and the environment that will result from routine, fully compliant operation of this facility. The National Environmental Policy Act requires identification and discussion of impacts, not compliance status. Many current standards are set at levels where health and environmental impacts Ð including disease and death -- are known to occur, others at levels where such impacts may occur. Those impacts must be discussed and compared. **12-15**

3) It suggests that our knowledge of the releases likely to occur from these facilities is much better than it actually is. As USEPA studies confirm, our knowledge of the combustion products generated in hazardous waste incinerators is far from complete. Our knowledge of the effects of release of most of these combustion products is incomplete to non-existent. Most of them are not regulated. These circumstances and the impacts Ð-known and potential -- that could result from their release must be discussed. **12-16**

In addition, this section makes no mention of the fact that these processes manufacture and release gases that are associated with climate change. The relative contributions to global warming and other climate changes and the health and environmental impacts associated with those changes must be identified and discussed. **12-17**

Comment 12-11

***Response*:** Impacts to areas around the permitted TSDF(s) receiving any secondary wastes will be addressed by the permitting and monitoring processes of the TSDF(s). The Army will comply with all permit requirements of the receiving TSDF.

Comment 12-12

Response: If the baseline incineration technology were selected for implementation at BGAD, the liquid brines at BGAD would be dried to solid wastes in the Brine Reduction Area (BRA). The Army has conducted cost analyses for transporting the liquid brines produced by an incineration system to an appropriately permitted treatment, storage, and disposal facility (TSDF) versus drying the brines in the BRA and shipping the resulting solid wastes to an appropriately permitted TSDF. Although the BRA would have to be permitted, operated, and maintained, drying the brines was determined to be more cost effective than shipping the liquid brines. The opposite results were obtained for brines produced at incineration facilities in Alabama, Arkansas, and Utah.

Comment 12-13

Response: See response to Comment 12-5. The impacts on human health and the environment are summarized in the Executive Summary and discussed in detail in Section 4 of the EIS.

Comment 12-14

Response: With very few exceptions, mostly accidents, adverse health impacts arising from emissions at an industrial facility arise from the slow accumulation of toxic materials in the environment. Most processes do not operate exactly the same from minute to minute because feed rate, fuel rate and even factors such as barometric pressure will affect operational characteristics. Emission standards are set to protect human health. Standards makers understand that emissions cannot be kept exactly the same from minute to minute, but on longer-term averages they can be fairly constant. Each material regulated is regulated on a time-based average that, in some way, represents a safety choice by the regulators. Consequently, materials for which a short exposure could cause an adverse effect, have shorter averaging times, and vice versa. Thus emission standards are based on an understanding of how engineered systems operate (good and bad) as well as how emission rates and averaged emission quantities affect human health. Continuous monitoring will occur for any agent destruction option chosen and alert levels are identified that will allow the operators to modify operation, including shut down before serious health impacts could occur. Continued operation is based on demonstrated safe operation.

Section 4.8.5 of this Final EIS addresses the types of process fluctuations described in the comment.

[Intentionally left blank]

Comment 12-15

Response: The evaluation of health impacts is performed in the human health section (see Section 4.9 of the EIS). Because designs are not complete for any of the options, exact calculations cannot be made for health impacts. Experience with incinerators allows the closest view of potential impacts from any of the options. These are reviewed for similar facilities in Appendix E.1 to provide an idea of what might be anticipated. A site-specific human health risk assessment would be undertaken to evaluate the potential health impacts of the incineration alternative if it is selected for implementation at BGAD. It is not known at this time whether a health risk assessment would be prepared if a non-incineration technology is selected for implementation at BGAD. EPA only requires that health risk assessments be prepared for combustion technologies.

Comment 12-16

Response: It is agreed that scientific knowledge of the combustion products generated in hazardous waste incinerators is incomplete, and scientific knowledge of their effects is also incomplete. Section 4.7.4 of this EIS evaluates the potential air quality impacts of criteria air pollutants emitted during facility operations. Section 4.8.4 of this EIS evaluates the potential air quality impacts of hazardous and toxic substances emitted during facility operations.

Combustion products from hazardous waste and other types of incinerators have been intensively studied during the past decade and this has led to a substantial reduction in the number of seriously polluting sources. On the basis of an effluent survey of a substantial fraction of hazardous waste incinerators, and health impact assessments for their surrounding populations, regulations on emissions from these sources have been developed to provide for the safety of surrounding populations. Regulations do not include all potential effluents, only those deemed by the EPA to be the most important. Effects of both regulated and non-regulated effluents are evaluated in the human health risk assessments that are performed prior to the operation of an incineration system. This will be the case for the Blue Grass Army Depot if incineration is selected for implementation at BGAD. It is not known at this time whether a health risk assessment would be prepared if a non-incineration technology is selected for implementation at BGAD. EPA only requires that health risk assessments be prepared for combustion technologies.

Comment 12-17

Response: Section 4.7.2.2 of this Final EIS has been revised to address the issue of impacts of all alternatives on global climate change. The quantities of carbon dioxide (CO_2) emitted from the baseline incinerator can be derived from the natural gas requirements given in Table 3.1 of this EIS. Approximately 122 pounds of CO_2 are emitted from the combustion of 1000 cubic feet of natural gas. Thus, the annual use of 550 million cubic feet of natural gas in the baseline incineration process would produce about 33,550 tons of CO_2 per year. In comparison to the approximately 5,800 million tons of CO_2 emitted by the United States in the year 2000, the CO_2 emissions from the baseline incinerator would represent only about 0.0006 percent (or about one part in 175,000) of the U.S. total. This incremental amount of CO_2 would not contribute any significant impacts to global warming.

ES.3.7 HUMAN HEALTH

This section, like others, must discuss the impacts of releases and exposures, whether "below standards" or not. Of special concern are the impacts on local vegetable and cattle farmers who consume their own crops and livestock and the implications for those who may consume those products distributed in commerce. **12-18**

When and how will the health risk assessment for incineration be conducted? Will a risk assessment be done for the neutralization technologies also?

ES.3.11 GROUNDWATER

[See comments above on ¤ES.3.2.] This section and/or ¤ES.3.10 should discuss the potential impacts on groundwater beneath the likely site(s) of the facility and potentially affected soils of accidental spills and the presence of an evaporation lagoon. Lagoons leak. **12-19**

ES.3.12 SURFACE WATER **12-20**

It is clearly insufficient to claim that "(t)here would be minimal impact to the surface water regime from destruction plant discharges during incident-free operation." This section must discuss what those impacts will be "during incident-free operation" and when incidents occur.

ES.3.18 SOCIOECONOMICS **12-21**

This part of Kentucky has traditionally been economically dependent on farming. The potential for damage to the rural/agricultural economy, the businesses and employment it supports, and the historic culture it has generated must be discussed.

ES.3.19 ENVIRONMENTAL JUSTICE **12-22**

This section asserts that "under normal operating conditions, the facility would be monitored continuously to ensure that any emissions remain below permitted levels and standards." Baloney! No amount of monitoring can "ensure that any emissions remain below permitted levels and standards." The best monitoring can do is to document the occasions when those levels are exceeded and, depending on how the monitoring is done, it may not even succeed in identifying all of the exceedances.

"Thus, there would be no adverse human health or environmental effects on any of the surrounding communities including those with minority and low income populations." Once again, the assertion that compliance means no impacts is clearly and demonstrably false. If there are releases, there are impacts and those impacts must be discussed.

Comment 12-18

Response: If the incineration technology is selected for implementation at BGAD, the RCRA permitting process requires the preparation of a detailed human health risk assessment. A protocol for the development of this risk assessment would have to be provided to and approved by the Commonwealth of Kentucky (in conjunction with the U.S. EPA) before the actual risk assessment could begin. After a decision is made as to the agent destruction option and before operation is commenced, a site-specific health risk assessment will be carried out. This assessment will evaluate human health impacts using EPA approved methods that incorporate analyses for local crops and livestock, fishing and other food chain pathways and inhalation for pollutants from the chosen technology. In the proposed RCRA human health risk assessment, analyses will be carried out for all identified pollutants that have associated health risk parameters. It is not known at this time whether a health risk assessment would be prepared if a non-incineration technology is selected for implementation at BGAD. EPA only requires that health risk assessments be prepared for combustion technologies.

Section E.1 in Appendix E of this Final EIS provides a summary of previously completed human health risk assessments for chemical weapons destruction facilities at other depots. These previous assessments have included risk calculations for a hypothetical subsistence farmer who consumes his own vegetables and beef (as suggested in the comment). Any human health risk assessment for the proposed BGAD facility would also include a hypothetical subsistence farmer.

Comment 12-19

Response: The comment is made on text that appears in the Executive Summary, which was not intended to fully repeat the detailed analyses contained in the main body of the EIS. The Executive Summary is intended to summarize the findings; hence, it is intentionally brief. The groundwater analyses requested in the comment can be found in Section 4.13 in this Final EIS.

Comment 12-20

Response: The comment is made on text that appears in the Executive Summary, which was not intended to fully repeat the detailed analyses contained in the main body of the EIS. The Executive Summary is intended to summarize the findings; hence, it is intentionally brief. The surface water analyses requested in the comment can be found in Section 4.14 in this Final EIS.

Comment 12-21

Response: The comment is made on text that appears in the Executive Summary, which was not intended to fully repeat the detailed analyses contained in the main body of the EIS. The Executive Summary is intended to summarize the findings; hence, it is intentionally brief. Section 4.22.14 in this Final EIS includes a discussion of the potential impacts to agriculture in the event of an accident. This section also discusses the potential loss of business activity if an accident were to occur.

[Intentionally left blank]

Comment 12-22

Response: It is true that monitoring by itself cannot ensure that emissions remain below permitted levels and standards. However, monitoring can be used to ensure that plant operations are adjusted appropriately if permissible levels and standards are exceeded, and Section ES.3.19 in this Final EIS has been revised accordingly. Because a summary of human health issues is presented in Section ES.3.7, the final sentence of Section ES.3.19, asserting the absence of adverse human health effects, has been deleted as unnecessary. For Environmental Justice purposes, the most relevant information in Section ES.3.19 is that no impacts of any kind are expected to disproportionately affect minority or low-income individuals.

Bringing in an incinerator when far less polluting alternatives are available, is not acceptable. Clearly, incineration poses a much greater risk of air pollution than other methods. There remain too many unanswered questions. The growing migrant and seasonal farmworker community has not been addressed in this section. Data on this population must be uncovered and added to this section. **12-23**

Environmental justice criteria must not only apply to communities that house stockpiles but also communities that would receive any secondary wastes from the destruction facility. The risk to the health of the communities which would receive the hazardous waste needs to be fully considered. The Army must insure that the off-site hazardous waste disposal vendors will be held to the highest possible standards and that none of the waste will be incinerated. People of color communities in California, Texas, Illinois and elsewhere which routinely receive hazardous wastes from TOCDF and JACADS are already heavily contaminated. This needs to be part of the discussion on environmental justice. **12-24**

ES.3.20 ACCIDENTS

This section appears to limit its discussion to "a large uncontrolled accident" and to impacts associated with agent release and exposure. A range of lesser accidents and release of other problematic substances are possible and their impacts must be discussed. This section ignores the potential impacts of accidents on workers. Those impacts must be discussed. **12-25**

The assertion that a "storage accident would provide the worst case scenario" is probably false. It is certainly not the most probable accident scenario. The risk of significant accidents during handling is very real and the risk of significant process accidents will vary considerably based on the technologies used. For example, the risks to workers and the public are likely to be much lower in a low-temperature, low pressure non-incineration systems than in the incineration option. E.g., an incident involving a loss of power (which has occurred in PMCD incinerator facilities) in a facility with a combustion chamber full of largely uncombusted warfare agents could have serious ramifications. **12-26**

ES.3.21 MITIGATION

This section appears to suggest that the only mitigation measures envisioned will be intended to reduce the risk of major accidents. Is that intended? **12-27**

ES.3.22 CLOSURE AND DECOMMISSIONING

This section is nearly devoid of any discussion of impacts. The EIS must discuss the impacts: **12-28**

1) of decommissioning and dismantling the facility with special care to identify any differences that may result from the choice of one system over another;

Comment 12-23

Response: Section ES.3.19 states that any high and adverse impacts that might occur as a result of the proposed project would not disproportionately affect minority or low-income populations. This conclusion is based on an analysis of population data from the 1990 and 2000 decennial censuses. There are no data, either from the U.S. Census Bureau or the Commonwealth of Kentucky, to indicate that migrant farmworkers are present in the area surrounding BGAD in sufficient numbers to alter the above conclusion, even on a seasonal basis.

Comment 12-24

Response: See response to Comments 12-10 and 12-11. An analysis of possible impacts to the health of minority communities in off-site facilities receiving hazardous waste from BGAD is beyond the scope of this document. Any impacts in those areas will be addressed by the permitting and monitoring processes related to waste disposal at those sites.

Comment 12-25

Response: The comment is made on text that appears in the Executive Summary, which was not intended to fully repeat the detailed analyses contained in the main body of the EIS. The Executive Summary is intended to summarize the findings; hence, it is intentionally brief. In regard to a range of lesser accidents, Appendix H of this Final EIS relies upon a 1997 quantitative risk assessment that evaluates a suite of accident scenarios, including accidental releases that are significantly smaller than the "worst case" event selected for evaluation in this EIS.

In regard to the release of other problematic substances, Section 4.22.5 in this Final EIS includes a discussion of non-agent process hazards. Potential impacts to workers during a hypothetical accident would be impossible to assess; however, the workers would be specially trained to identify and respond to an accident situation, and the workers would be provided with special equipment designed to protect them in the event of an accident. Sections 4.9.3.3 and 4.9.3.4 in this Final EIS discuss the potential impacts to workers.

Comment 12-26

Response: The text referenced in the comment about storage accidents being the "worst case" was intended to explain the basis for the "bounding analysis" in this EIS. Because the largest inventories of chemical agent are located inside the storage igloos (as compared to any inventories of agent that would accumulate at other locations during the destruction process), a hypothetical storage accident would justifiably represent a worst-case event. As noted in the comment, a lightning strike to an igloo (i.e., the "worst case" event) is not the most probable storage accident. The probabilities (or frequencies) of the accident scenarios considered for analysis are described in Section H.3.1 in Appendix H of this Final EIS.

Regarding the situation where a complete power loss might occur, the incinerators and furnaces would remain hot for some time after any fuel flow were to cease. This remaining heat has been determined by the Army to be sufficient for the destruction of any residual chemical agent that might still be in the system.

[Intentionally left blank]

Comment 12-27

Response: The mitigation measures identified in Section ES.3.21 and discussed in greater detail in Section 4.26 of the EIS go beyond reducing the risk of major accidents. They, along with monitoring activities, are also intended to reduce the probability and/or consequence of any unintended release or off-normal event and to identify best management practices to protect environmental resources (e.g., ecological mitigation as discussed in Section 4.26.7 of the EIS). In addition, destruction facility permitting (Section 4.27 of the EIS) can be considered part of the mitigation measures in that they require advance consideration of potential health, ecological, and agricultural risks and proof of capability of operate within limits that have been studied and set conservatively by regulatory agencies to provide an adequate margin of safety for the protection of workers, the public, and the environment.

Comment 12-28

Response: The Executive Summary is intended to be brief; additional detail can be found in the main body of this EIS. A discussion on the impacts of closure and decommissioning can be found in Section 4.25 (Closure and Decommissioning). A discussion of future use can be found in Section 2.3.5 (Future Use). The Army cannot speculate on the wishes of a future administration in the Commonwealth of Kentucky regarding dismantling the facility following destruction of the chemical weapons stockpile.

2) of continued use of the facility should the Army and the Governor decide not to dismantle it; and
3) of using the facility to destroy non-stockpile chemical weapons materials from sources both on site and off site. **12-28 (cont)**

"Based on current feasibility studies, the Army will recommend that the BGAD stockpile destruction facility be used to destroy four non-stockpile items stored there. The Army currently intends to close and dismantle the BGAD facility upon completion of the destruction activities." This statement is contradicted somewhat by the statement on p. 4-176: "Nevertheless the Army currently intends to dismantle and close the BGAD facility upon completion of the stockpile destruction activities." Current BGAD reuse plans are not detailed anywhere in the DEIS, nor is there any useful discussion of the potential impacts of the different technologies on progress with the reuse plan, both during and after destruction operations. **12-29**

COMMENTS ON THE BGAD EIS

I PURPOSE OF AND NEED FOR THE PROPOSED ACTION **12-30**

1.1 INTRODUCTION

This section is an inappropriately biased advocacy discussion for incineration. It should be rewritten and limited to essential, balanced introductory information.

"The National Research Council (NRC) has endorsed incineration as the method of choice for destroying the stockpile of chemical agents and munitions (NRC 1994, p.130)." This is imprecise and potentially misleading. In fact, a committee of the National Research Council, one of several empanelled to review and advise chemical weapons programs endorsed incineration in 1994. Other NRC committees have "endorsed" other technologies since then. It is not clear that discussion of NRC activities is necessary here, but if it is included, it should include discussion of the full range of advice the programs have received from NRC committees. **12-31**

1.2 PURPOSE AND NEED **12-32**

"The purpose of the proposed destruction of the BGAD inventory of chemical agents in compliance with U.S. Public Law 99- 145 and the CWC and (2) conduct the destruction activities in a safe and environmentally sound manner. The need for the proposed action is to eliminate the risk to the public and to the 3environment from continued deterioration of the munitions in storage and to destroy obsolete and containerized munitions and agents." The purpose and the need for this project are one and the same -- viz., "compliance with U.S. Public Law 99-145 and the CWC." "(S)afe and environmentally sound destruction" is a matter of methodology, not of purpose or need.

Comment 12-29

Response: Regardless of the technology selected for BGAD (baseline incineration or one of the neutralization technologies or electrochemical oxidation), the Non-Stockpile items (the four items referenced in the comment) would be destroyed by the selected technology. This intent will be included in all permitting discussions with appropriate authorities. This position has been discussed on several occasions with the Safety/Environmental WIPT and provided in the addendum to the 2000 Report to Congress. The language in Sections ES3.22 and 4.25 of this Final EIS has been modified to clarify this intent.

Comment 12-30

Response: The purpose of and need for the proposed action considered in this EIS must be viewed not only in light of the site-specific activities at BGAD but also in the context of the larger programmatic issues and activities associated with chemical weapons destruction. Accordingly, Section 1.1 provides necessary background information regarding (1) the national Chemical Stockpile Disposal Program, (2) U.S. participation in the Chemical Weapons Convention treaty, and (3) the Army's operational experience with munitions destruction activities. To date, the full-scale facilities used by the Army to destroy chemical munitions and agents overwhelmingly employ high-temperature incineration. For that reason, incineration technologies play a larger role in the history of the disposal program and are described at greater length in Sect. 1.1. The non-incineration technologies are also described commensurate with the status of their development. Hence, the longer summary of the Army's experience with incineration results from its greater prominence in the program's history, not from an attempt to present a biased advocacy for its use at BGAD.

Comment 12-31

Response: The text quoted from the introduction (in Section 1.1 of the EIS) and the comment regarding the text being imprecise and misleading are noted. Additional details regarding the evolution of the disposal program, including the development of alternative technologies by the Program Manager for Chemical Demilitarization (PMCD) and the Program Manager for Assembled Chemical Weapons Assessment (ACWA) follow the text quoted in the comment. Additional information regarding the development of alternative technologies and the findings of subsequent National Research Council (NRC) committees related to that development is found in Section 1.5 of the EIS.

Comment 12-32

Response: The comment is noted. Public Law 99-145 does state among other requirements, however, that destruction of the stockpile of lethal unitary chemical agents and munitions so as to provide maximum protection of the environment, the general public, and the personnel involved in the destruction. Moreover, until the stockpile is destroyed, a risk to the public and the environment from the storage of munitions remains.

"(E)limination of the risk...from continued deterioration of the munitions in storage..." is very small. It would not warrant a program of this magnitude and cost to the taxpayer were it not for the legal mandates. These irrelevant references should be removed. The possible 5-year extension to the deadline might be mentioned here. **12-32 (cont)**

1.3 SCOPE

". . . the risks and consequences of possible accidental releases of chemical agent are described and compared among alternatives..." The risks and consequences of releases of substances other than chemical weapons agent must be identified and discussed as well. **12-33**

"Any of these technology alternatives, or combination of alternatives, must be capable of destroying both the chemical agents and the munitions themselves, some of which contain explosive components." The system selected for deployment at the BGAD should be capable of treating all of the components of the weapons and related, potentially contaminated materials on site with minimal release of pollutants to the environment. Final waste products should be managed on site unless they are shipped off site for reuse or recycling. (Metal parts, for example, might fit into this category.) Systems that are unable to meet these criteria are unacceptable. **12-34**

The information contained in this DEIS should be sufficient for a comparative evaluation of the systems under consideration, with full disclosure of both primary and secondary waste management options. Unfortunately, much of the essential information is not contained in this document. **12-35**

"The baseline incineration technology is a demonstrated destruction process." "Baseline incineration" is not a technology. Like all of the alternatives under consideration for disposal of the BGAD chemical weapons stockpile, it is a system of technologies. All of the technologies that make up all of the systems under consideration have been "demonstrated." The Army's experience with "baseline incineration" has been highly problematic. Those problems must be disclosed and discussed candidly in this EIS. **12-36**

"The lessons learned in destruction of chemical munitions at JACADS have resulted in proposed modifications to portions of the baseline process which could be tailored to the BGAD stockpile". These lessons should be described, along with the changes in process design and equipment they generated, the expected differences in process performance they will cause and the resultant health and environmental impacts. **12-37**

Comment 12-33

Response: The quotation from Section 1.3 is incomplete. As noted immediately prior to the partial sentence quoted by the commenter, the EIS states that the potential environmental impacts of constructing, operating, and closing a destruction facility are identified and compared among the four destruction alternatives considered in the EIS. The risks and consequences of possible accidental releases of chemical agent are identified and compared after identifying and comparing the potential impacts of routine construction and operation of the four destruction alternatives. The types of hazards identified in the comment are discussed in Section 4.9.3.2 of the EIS.

Comment 12-34

Response: The commenter's preference that all potentially contaminated materials should be treated on-site is noted. Although none of the four considered alternatives proposes treatment and disposal of all final waste products on-site, the final disposition of all secondary (i.e., final) wastes for all four alternatives would be regulated by the appropriate regulatory authorities of off-site TSDFs or, in the case of munition bodies, decontaminated prior to recycle of metal parts.

Comment 12-35

Response: The comments are noted. The information presented in Section 1.3 is intended to define the scope of the EIS, not provide detailed analyses. The incineration and non-incineration systems are presented in Section 3 in sufficient detail for comparisons. The potential impacts that could arise from implementing each destruction system are analyzed in Section 4. The primary waste management options are the alternatives — baseline incineration, neutralization with supercritical water oxidation, neutralization with gas phase chemical reduction and transpiring wall supercritical water oxidation, and electrochemical oxidation. The Resource Conservation and Recovery Act limits the secondary waste management options. The Army must remove these hazardous wastes (listed in Sections 3.1.1, 3.4.2, and 4.6) from BGAD to an appropriately permitted TSDF where they will be disposed of in accordance with all applicable regulations.

Comment 12-36

Response: Additional information regarding the baseline incineration technology or process is found in Section 3.2.1 and 3.3.3.1 of the EIS. In addition, Appendix C of the EIS provides detailed information on the maturity of the baseline incineration technology or process, including off-normal events recorded at JACADS and at TOCDF. Appendix D of the EIS provides a more detailed description of the baseline incineration technology or process.

[Intentionally left blank]

Comment 12-37

Response: Instituted in 1992, the ongoing Programmatic Lessons Learned program uses a systematic life cycle approach to capturing, evaluating, implementing and assessing operational and managerial lessons learned. Membership in this program includes representatives from all major contractors and government agencies. One of the lessons learned from operational experience at JACADS and TOCDF includes the elimination of the dunnage incinerator (see Section 3.2.1 of the EIS).

By law, the Final EIS for BGAD must discuss in detail **all** of the available options. This superficial discussion of the ACWA-demonstrated systems is woefully inadequate and misrepresents the status of design and development of those systems. It must be substantially improved. **12-38**

12-39

1.4 PUBLIC INVOLVEMENT AND THE NEPA PROCESS

This section discusses only opportunities for public comment, not for public involvement. In fact, there have been very few opportunities for public involvement in decisions affecting the chemical weapons disposal process at the BGAD.

The Environmental WIPT began as a closed process, unavailable to the public. It required a concerted effort by several people to get those meeting opened up. Opportunities for participation in the WIPT discussions are still limited, but valuable.

No mention is made here of the Kentucky Chemical Demilitarization Citizens Advisory Commission. While this commission has not provided local citizens with an opportunity for direct participation in chemical demilitarization decisions, it has proven to be a valuable forum for discussion of some issues and has provided an avenue for indirect input. Although it is discussed in a later section, it should be discussed here. **12-40**

A discussion of the innovative and remarkably successful ACWA public process that led to the demonstration and availability of the neutralization-based systems under consideration for BGAD should be included here, as well. Some of this information appears in Section 1.8. The separation is confusing. We suggest that these two sections be merged, or at least made contiguous with a clear explanation for any separation that remains.

2 THE PROPOSED ACTION

12-41

2.2.1 Chemical Agents

Please list the known or suspected impurities, and their estimated quantities, of the various chemical agents.

“This DEIS focuses on the health effects resulting from inhalation only, since this would be the principal mechanism of exposure during routine handling and destruction activities.” This EIS must discuss all reasonably plausible impacts from chemical weapons destruction activities, not just those associated with “routine handling and destruction activities,” and not just through inhalation and must include a discussion of risks to workers, as well as to the public. Please give rational explanations why inhalation only was the focus. **12-42**

Comment 12-38

Response: The commenter does not refer to a specific law; however, regulations promulgated by the President's Council on Environmental Quality (CEQ) implementing the National Environmental Policy Act stipulate that all reasonable alternatives and the no-action alternative must be fully evaluated (40 CFR Part 1502.14). Section 1.5 of the EIS summarizes the extensive research, development, and demonstration program implemented by the ACWA program and the evaluation criteria it used to identify and pursue a limited number of alternative destruction technologies. The Army believes that it is reasonable to limit non-incineration alternatives evaluated in this EIS to those that survived the thorough testing and evaluation conducted by the ACWA program (i.e., through Demonstration I and II and Engineering Design Studies). The last paragraph of Section 1.3 gives an overview of the status of non-incineration systems. Additional information on the systems selected by ACWA for consideration for use at BGAD is provided in Appendix G of the EIS.

Comment 12-39

Response: The Army has solicited public comment and involvement in its programs to destroy chemical weapons stored at BGAD since the inception of the Chemical Stockpile Disposal Program in 1986. In addition to those activities described in Section 1.4 of the EIS (including the scoping process, commenting on the Draft EIS, and the Environmental Working Integrated Process Team) and in Section 1.8 (the Kentucky Citizens' Advisory Commission), the Army sponsored community-based reviews of the Draft Programmatic Environmental Impact Statement (DPEIS) prior to the release of the Final Programmatic Environmental Impact Statement. Additional opportunities for public involvement in the destruction of the chemical weapons stored at BGAD are available through the permitting process (see Section 4.27 of the EIS).

Comment 12-40

Response: See response to Comment 12-39. The public involvement activities discussed in Section 1.8 of the EIS are not restricted to the NEPA process, whereas those discussed in Section 1.4 of the EIS are generally focused on the NEPA process.

Comment 12-41

Response: Specific data on impurities and amounts in the various chemical agents are not currently available.

Comment 12-42

Response: Inhalation is the most likely route of exposure to workers and, during accidents, to the public. In the work place, other routes of exposure are precluded by engineering controls and operational procedures. Accident analyses are intended to provide a relative comparison between the various scenarios, and, should an accident occur, food- or water borne ingestion would be minimized by evacuation and/or alerting people in the affected zones to avoid eating foods produced within the affected area. As has been the case for all chemical weapons sites where incineration has been selected for implementation and where RCRA permits have been applied for, a human health risk assessment for all pathways will be performed if incineration is selected for implementation at BGAD. These risk assessments utilize site-specific population information and include many scenarios of exposure that contain assumptions to insure that the exposures calculated are at or near the maximum possible exposures.

[Intentionally left blank]

Comment 12-42 (cont)

Response (cont):

It is not known at this time whether a health risk assessment would be prepared if a non-incineration technology is selected for implementation at BGAD. EPA only requires that health risk assessments be prepared for combustion technologies.

Modified explanation of agent exposure limits will be found in revised text of Section 4.9.3.2 in this Final EIS. Very little new information has been accrued since the 1988 FPEIS but some re-analyses have been recently performed.

A detailed explanation of the human health effects of exposure to these agents is given in the FPEIS (see Appendix B in U.S. Army 1988); information on the effects on animals can also be found in the FPEIS (see Appendix O in U.S. Army 1988)." No discussion of the health effects of exposure to toxic chemicals published in 1988 issufficient in 2001. **12-42 (cont)**

2.3.3 Waste Management

12-43

This section is woefully inadequate. It seems to suggest that there is no significant difference between the waste streams produced by the available technologies. Not so. It also seems to suggest that compliance equals "no significant impact." That assumption is clearly and demonstrably false. This section should describe the differences in general terms, should recognize that impacts occur even if facilities operate within regulatory limits all of the time, and should acknowledge that no facility operates within regulatory limits all of the time. Discussion in later chapters should discuss these matters in greater detail.

"Construction and operation of a chemical munitions destruction facility using any of the technologies (incineration or non-incineration) being considered for implementation at BGAD would produce hazardous and non-hazardous solid and liquid wastes." Misleading. Construction and process waste streams should be described and dealt with separately. Process solid waste streams should be described in some detail with emphasis on hazardous constituents and the complexity and risks associated with any further treatment or containment required. **12-44**

2.3.4 Schedules

12-45

This section is largely fiction. There is no excuse for PMCD's continued use of schedule estimates for incineration that are widely recognized as unachievable. It is inexcusable in public discourse and it is illegal in an EIS.

According to presentation #2142-8, Sept. 5, 2001 to DAB OIPT, the operational period for incinration for BGAD shows 36 months. According to CWWG caculations verified by the Congressional Research Service, May 2001, the operational period for baseline incineration at BGAD is 5.8 years. CWWG projection is derived from Army's own document--Operations Schedule Task Force, 2000. Final Report.

2.4 ON-SITE HANDLING AND TRANSPORTATION

12-46

Please detail the "detailed procedures" that would be developed for handling of munitions.

Comment 12-43

Response: Section 2.3.3 of the EIS is intended to provide a summary of waste management for the proposed action (i.e., construction, operation and closure of a facility to destroy the chemical weapons stockpile stored at BGAD), not differentiate the waste streams of the baseline incineration and neutralization and electrochemical oxidation alternatives. Summary information for the different alternatives is found in Section 3.4.2, and detailed information on the waste stream for each alternative (including differences in those waste streams) is found in Section 4.6.3 as well as in Appendix D (the baseline incineration process) and Appendix G (the neutralization and electrochemical oxidation technologies).

EPA and the Commonwealth of Kentucky standards are supported by extensive research into the potential impacts of the regulated substances on human health and the environment, and are set at levels well below those which research indicates would initiate harmful effects. An EIS is not intended to challenge regulatory limits unless there are significant questions. At this time the Army has not identified any of these.

The Army agrees that compliance with regulations is not equivalent to "no significant impact." Prior to being issued a permit for operations, any incineration facility would be required to complete a human health risk assessment, which would evaluate the potential impacts to defined receptors produced by chemicals from the facility, even for chemicals that are substantially within regulatory limits. The protocol for the human health risk assessment would include a study that mimics upset or non-standard operating conditions by increasing the quantities of chemicals released. No such documents currently exist.

It is not known at this time whether a health risk assessment would be prepared if a non-incineration technology is selected for implementation at BGAD. EPA only requires that health risk assessments be prepared for combustion technologies.

Comment 12-44

Response: See response to Comment 12-43.

Comment 12-45

Response: The comment is noted. Schedule projections for all of the alternatives are currently being verified for the Defense Acquisition Executive.

Comment 12-46

Response: Procedures developed would be based on lessons learned from previous chemical munitions destruction operations and on regulatory standards to ensure safety and environmental protection.

3. DESCRIPTIONS OF ALTERNATIVES

This chapter is remarkably superficial and unhelpful in almost every respect. The descriptions of system options are all-but-useless in attempting to understand what actually happens as munitions are processed through them and makes understanding of the differences between the systems nearly impossible. The health and environmental impacts of construction and operation of the various options are not discussed at all. This chapter must be substantially revised and improved before the Final EIS is issued. **12-47**

It is extremely important that one of the three non-incineration systems be chosen for destruction of the chemical weapons at the BGAD. The incineration option is unacceptable. **12-48**
There is significant local and national opposition to the incineration option. The selection of incineration is likely to result in costly conflict, slower permit review, increased operational difficulties, and greater risk to worker and public safety and to human health and the environment.

By comparison, the non-incineration options enjoy widespread public support. Permit reviews should be much easier and faster. Conflict costs and delays will almost certainly be avoided. Compliance problems and costs should be substantially reduced. Health and environmental risks would be substantially lower. The national and international chemical
weapons demilitarization effort will suffer a serious setback if the incineration option is chosen for BGAD.

3.1 INTRODUCTION

3.1.1 Processes Required for Chemical Weapons Destruction **12-49**

Given that the incineration option proposes shipping the liquid brine wastes off-site for treatment , it hardly qualifies as a technology that provides for the "complete approach to weapons destruction" at BGAD. The original plan for the a total incineration system included a Brine Reduction Area. There should be a discussion of why the incineration option in no longer a total solution.

3.1.3 Technology Neutral Infrastructure Projects **12-50**

This section describes the infrastructure projects, but not the impacts. Impacts must be described and discussed.

In obtaining materials for technology-neutral projects the following must be considered: **12-51**

- Use of materials supplied by local businesses and distributors;
- local contractors; and
- consideration of minority-owned businesses.

Comment 12-47

Response: Section 3 of the EIS is intended to provide the detail necessary to inform the reader about the overall similarities and differences among the technologies. Additional detail regarding the alternative destruction technology systems is provided in Appendices D (baseline incineration technology) and G (neutralization and electrochemical oxidation technologies) of this EIS. The health and environmental impacts of construction and operation of the alternative technology systems are not found in Section 3 of this EIS, which is intended to provide merely descriptions of the alternatives considered. The health and environmental impacts of the alternatives considered are found in Section 4 of this EIS.

Comment 12-48

Response: The commenter's opposition to the baseline incineration alternative and preference for one of the three non-incineration alternatives are noted. See response to Comment 1-1. Comments related to the cost of conflict related to the selected technology and the permit review process are not within the scope of the EIS.

Operational difficulties associated with the alternative technology systems cannot be assessed in a comparative manner at this time. Although there is substantial information regarding the operation of baseline incineration facilities, including off-normal operations and delays, there is no comparable information for the neutralization and electrochemical oxidation technologies because of relative immaturity of those systems (i.e., those systems have been developed, operated, and tested only at bench scale rather than at full throughput rates).

The results of the analyses presented in this Final EIS show that any of the four technology alternatives considered could be implemented safely and in an environmentally acceptable manner.

Comment 12-49

Response: As indicated in Section 3.3.4 of the EIS, the Brine Reduction Area (BRA) is still an element of the baseline incineration alternative for BGAD. Language in Section 3.1.1 of this Final EIS has been added to clarify this intent. Although the BRA has been removed from service at the Army's Tooele, Utah, incinerator because of cost constraints, the BRA is expected to be cost-effective at BGAD. Appendix D, which provides additional information regarding use of the BRA, notes that the BRA is used to evaporate liquid effluents from the incinerators' pollution abatement system (PAS) to dryness. Solid (i.e., dried) brine salts, generated by any of the destruction technologies under consideration in this EIS, would be stored and shipped to an off-site permitted treatment, storage, and disposal facility (TSDF).

[Intentionally left blank]

Comment 12-49 (cont)

Response (cont):

If the use of off-site permitted TSDFs for the disposal of some secondary wastes means than an alternative does not meet the requirements of a "total solution" (as referred to in the comment), then none of the considered alternatives could be described in that manner. All of the considered alternatives (incineration and non-incineration) stipulate the use of off-site permitted TSDFs for the disposal of some secondary wastes.

Comment 12-50

Response: As indicated in Section 3.1.3 of this EIS, the health and environmental impacts of the technology neutral infrastructure projects are or will be addressed in separate NEPA documentation. Since these projects are common to all destruction alternatives considered in this EIS, the impacts would be common to all destruction alternatives and would not differentiate among these alternatives.

Comment 12-51

Response: The Corps of Engineers Louisville District administers an Indefinite Delivery/Indefinite Quantity (IDIQ) contract for construction of the Depot support projects. This contract was awarded to a minority contractor who is located locally. Approximately 90% of funds have typically been spent in the local communities for past projects of similar nature. Although this percentage is not guaranteed we expect the percentage to remain very high.

3.2 DESTRUCTION SYSTEMS 12-52

There no discussion of the wash-out option for rockets and projectiles under the non-incineration options. Wash out is a safe and appropriate method to access agent that is known to have gelled in M-55 rockets. This is a highly problematic scenario for the disassembly method used in the incineration method and has led to a dangerous and experimental permit modification at the Alabama incineration facility where they plan to throw 34 fully loaded rockets per hour into the DFS which has never been tried at any other facility. This should be discussed and such a modification should never be considered at BGAD.

3.2.1 Baseline Incineration 12-53

There is no discussion of the proposed modifications of the Anniston, AL. incinerator system to burn much greater amounts of chemical agents in the DFS and the MPF than the furnaces were designed to burn. If there is any inclination to use these modifications at BGAD, they must be throroughly described and rationally explained with scientific justification for what are basically dangerous experiments that have not been attempted at either TOCDF or JACADS. These modifications can certainly not be justified through the Lessons Learned program when they have never been attempted before and should not be proposed for BGAD.

The history of incidents and shutdowns of baseline incineration option in Utah is 12-54
ignored in the DEIS**.** The DEIS has inadequately addressed the "maximum credible event." Identifying an airplane crash into stockpiled weapons avoids the more important disclosure of letting people in the area know what is something that could happen within the process. In particular, and at a minimum, PMCD should consider the event of a complete power loss and systems failure that would result in either a shutdown of the burner with already volatilized hazardous material, noting where that material would go or a release of the material into the atmosphere. This cannot be dismissed as a virtual impossibility since this situation has occurred at other sites. These occurrences as well as near occurrences should be documented and brought into any equations of potential for accidents.

We offer the following list of incidents at the TOCDF and ask that they be 12-55
considered in any determination of effectiveness or reliability of the incineration option and particularly be included in any assessment of Maximum Credible Event:

Tooele Chemical Weapons Incinerator-Shutdowns /Incidents/Key Developments Since Agent Operations Began August 22, 1996

- August 24, 1996-- Shutdown due to agent detection in the heating, ventilation, and air conditioning filter bank vestibules. Possible agent release into the environment.

Comment 12-52

Response: If the baseline incineration alternative is selected for destroying the stockpile stored at BGAD, gelled rockets would be fed into the deactivation furnace system (DFS) in the same manner as non-gelled rockets. The performance of the furnace would be monitored with the use of continuous emission monitoring system (CEMS) and thermocouples. If or when any permit condition is exceeded the feed to the furnace would be stopped.

The baseline incineration facility at Anniston will have destroyed gelled rockets stored there before processing would start at BGAD. The facility at BGAD would follow the lead of Anniston in the incineration of gelled rockets. Any lessons learned from the Anniston facility would be incorporated into the Blue Grass facility.

Comment 12-53

Response: The Army is not proposing to change the feed configuration over what has been demonstrated at the TOCDF or JACADS incinerators. If Anniston or any other sites increase the feed of gelled rockets to the DFS, the BGAD facility would incorporate lessons learned and follow their lead.

Comment 12-54

Response: The possible effects from an operations accident would be potentially smaller than the effects possible from a storage accident. This is because accidents during destruction operations would be smaller events (as measured by their potential downwind lethal distances as well as the size of the potentially affected area) than accidents involving a storage igloo. Therefore the maximum credible event has been appropriately chosen given that the lightning strike to a storage igloo has the potential for greater effects than an operations accident.

In regard to a situation in which a complete power loss were to occur, see the response to Comment 12-26.

Comment 12-55

Response: The list of incidents offered in the comment is appreciated. An additional quantitative risk assessment (QRA) of the facility design and operation would be conducted if an incineration facility were selected at BGAD. The items listed in the comment, as well as the extensive history of successful destruction of large quantities of chemical agent at other sites, would be considered in the preparation of that QRA.

12-55 (cont)

- September 9, 1996-- Shutdown due to complete power failure in the plant. Possible agent release into the environment.
- September 18, 1996-- Shutdown due to potentially agent- contaminated decontamination fluid leaking through cracks in the concrete floor into electrical room below.
- September 19, 1996-- Shutdown due to Liquid Incinerator Slag Removal System malfunction during a shakedown trial burn.
- December 19, 1996-- Shutdown due to M-55 rockets jamming in the feed gates to the Deactivation Furnace.
- January 20, 1997-- Toxic spill in the 90-day storage yard improperly cleaned up. Hazmat team called back to the plant prior to clean-up in "order to continue processing." Toxic material snow- plowed against the boundary fence and left.
- January 26, 1997-- Shutdown due to agent migration inside the observation corridors of the Munitions Disposal Building. Possible agent release to the environment.
- February 6, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- February 14, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- March 13, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- March 20, 1997-- Army Project Manager, Tim Thomas admits in Federal Court to six confirmed nerve agent stack alarms. Nerve agent releases require shutdowns.
- March, 24 1997-- M-55 Rocket campaign halted due to trial burn failure for PCBs under Toxic Substances Control Act Requirements for 99.9999% DRE for PCBs. Public not notified until October 18, 1997.
- April 10, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- April 13-14, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- April 18, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- April 20, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- April 21, 1997-- During routine maintenance alarms sound indicating an unusually high agent reading (> 1200TWA) inside TOCDF.

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12-55 (cont)

- April 22, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- April 23, 1997-- Shutdown due to "Notice of Insufficient Quality." Army Project Manager issues notice to curtail operations due to failure to follow operating procedures. The plant remains shutdown until June 15 for "routine maintenance."
- April, 25 1997-- Over 4,000 pages of official TOCDF documents arrive at CWWG office showing improper analysis, characterization, manifesting, tracking and disposal of Hazardous Waste leaving TOCDF.
- May 3, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- May 6, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- May 7, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date). Second occurrence on same day.
- May 8, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- May 9, 1997-- Army admits to reporters that it "misled" the public about the cause of the six-week shutdown.
- May 13, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- May 14, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- May 15,1997-- Accusations of illegal burning of Lewisite made by CWWG. Army first denies illegal burning then later admits to having burned some containers that previously contained Lewisite. Plaintiffs' evidence indicates Lewisite was burned.
- May 24, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- May 28, 1997-- Citizens from Oregon and Kentucky are escorted through TOCDF into an area with a GB-contaminated bomb casing present. Citizens are not notified until after an anonymous call from TOCDF notifies Utah DEQ and an OR citizen.
- July 6, 1997--Shutdown due to Pollution Abatement System (PAS) blockage. Amount of agent and other toxics emitted unknown.

[Intentionally left blank]

12-55 (cont)

- August 1, 1997-- Former Chief Safety Officer, Steve Jones is ruled for in his Dept. of Labor "Wrongful Termination Action." Judge awards Jones his job back and $500,000 or no rehiring and $1 million. Judge calls EG&G managers "liars."
- August, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- September 8, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- September 9, 1997-- Former Chief of Hazardous Waste Management, Trina Allen wins on her discrimination part of Dept. of Labor claim against EG&G. Allen is awarded $5,000. A Hearing on the merits of the remainder of her claims is scheduled for December,
- September 12, 1997-- Army admits, in documents sent to Utah DEQ, that it has been burning Lewisite (L) contained in Ton Containers of GB previously contaminated with "L," confirming allegations made by citizen activists that TOCDF has illegally operated.
- September 14, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- September 18, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- September 30, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- October 1, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- October 2, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- October 6, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date). Second and third occurrences on the same day.
- October 11, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- October 12, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).

[Intentionally left blank]

- October 16, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date). **12-55 (cont)**
- October 17, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- October/November 1997-- Sources inside TOCDF (who wish to remain anonymous) communicate to CWWG several shutdowns/incidents at TOCDF due to computer malfunctions, slag build-up in the PAS, numerous agent migrations within the facility, and alarm ring-offs in the common stack, MDB and HVAC stack (averaging 2-3 per week).
- November 2, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date). Second occurrence on the same day.
- November 6, 1997-- House Government Reform and Oversight Committee unanimously approves Human Resources Subcommittee Report on Gulf War that concludes exposures to low-level chemical agents (lower than the amount set as "acceptable" at TOCDF) caused or contributed to Gulf War Illness.
- November 18, 1997-- TOCDF is cited for 25 violations by the Utah Department of Environmental Quality. Citations included "numerous instances of noncompliance," but not enough to shut them down, according to a DEQ spokesperson.
- November 26, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- November 27, 1997-- Sources inside TOCDF (who wish to remain anonymous) communicate to CWWG that both Liquid Incinerators (LICs) are "down" due to malfunctions. According to sources, one of the LICs has been down for over a month. Chronic problems with the Brine Reduction Area (BRA) and the Pollution Abatement System (PAS) continue to plague TOCDF.
- November 30, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- December 1, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- December 2, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- December 3, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date). Second and third occurrences on the same day.

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- December 5, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date). **12-55 (cont)**
- December 7, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- December 20, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- December 21, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- December 26, 1997-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- January 1, 1998-- After almost 20 years of denial, a document surfaces showing that the Army had proof as early as 1970 that the 1968 sheep kill in Skull Valley was a direct result of nerve agent exposure by the Army. Recent depositions in CWWG federal lawsuit disclose that Army officials have come to the conclusion that the sheep were killed as a result of the combined effect of the nerve agent sprayed and pesticidesalready present.
- January 28, 1998-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- January 31, 1998-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- January 31, 1998-- Department of Labor Administrative Law Judge, Samuel J. Smith orders EG&G to reinstate whistleblower Trina Allen and to "cease and desist" any retaliation against her and other employees for protected activities in the conduct of performance of their duties.
- February 1, 1998-- Site masking alarm and/or stack alarm. Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).
- February, 1998-- Worker on the hazardous waste crew discloses that vials filled with chemical warfare agent, and having contamination on the outside of the vials, were misplaced for a few days. Later they were found in the toxic maintenance area. Had these vials not been located, they would have been sent off-site as generic waste to be disposed of at a commercial facility.
- February 4, 1998-- Site masking alarm and/or stack alarm Potential case of chemical warfare agent release or release of other related toxic chemicals (unidentified to date).

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- February 12, 1998-- According to the *Deseret News*, TOCDF experienced an "all mask" alarm situation while attempting to go back on line after a 30-day "routine maintenance" period. According to Utah DEQ, "They (TOCDF) did confirm that this was not a false alarm."
- March 11, 1998-- Five TOCDF employees fall ill with symptoms of dizziness, headache and nausea. Army officials say industrial materials are suspected.
- March 16, 1998-- Sources inside TOCDF (who wish to remain anonymous) communicate to CWWG that alarms have been sounding regularly in the Unpack Area during the recently initiated MC-1 bomb campaign. These sources also claim that workers in the area are not wearing "Level B" protective gear as required.
- March 30, 1998-- Shutdown occurrs when the metal parts furnace (MPF) overheats due to feeding an illegal amount of nerve agent GB into the furnace. The ACAMS alarm in the MPF duct rings off at approximately 850 times the allowable stack concentration for agent. The ACAMS alarms in the common stack register a large chemical spike. No DAAMS tubes are located at the duct ACAMS to confirm for agent and no one knows if the DAAMS tubes in the stack at the time of the incident have been analyzed to confirm for agent. Army officials claim that agent did not go out the stack, but can't prove that the large amount of chemical released was not agent. The chemical plume was neither quantified or qualified.
- November 21, 1998 - January 7, 1999-- There are seven instances of Unpack Area ACAMS alarms with individuals wearing inadequate protective clothing.
- November 25, 1998-- Vapor leaks of GB (sarin) are detected from three 105mm projectiles. The agent is detected while one of the projectiles is being processed into an incinerator.
- November 28, 1998-- Another vapor leak of GB is detected from a 105mm projectile which is in an on-site container.
- December 4, 1998-- It is reported that 24 vapor leaks have been detected in the past two months, all involving 105mm projectiles. Each of these 16-inch long bullet-shaped objects contains .17 gallons of GB. 16 of the leaks were detected after the projectiles were transferred from the storage igloos to the incinerator building. Eight of the leaks occurred when crews were removing a heavy bolt screwed into the nose of the projectile.
- December 13, 1998-- Liquid Incinerator is shut down after 140 gallons of GB (sarin) are spilled while being fed into the incinerator, raising serious questions about the engineering and design of the technology.

12-55 (cont)

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12-55 (cont)

- April 13, 1999-- Shutdown occurs when TOCDF back-up power system fails after Depot-wide outage. This failure compromised the negative air flow system, fans leading to the stacks and other critical systems. Possible agent release to the environment and worker exposure.
- April 16, 1999-- There is confirmed agent reading in the DFS Cyclone Enclosure which is adjacent to the outside--possible agent release to environment.
- May 1, 1999-- ACAMS alarms at 508.4 twa in Unpack Area with three workers in inadequate protective clothing. During feed stop on LIC 1, there is ACAMS duct alarm at 1.26 asc and a stack alarm at .34 asc.
- May 5, 1999-- Agent vapor leak forces workers out of certain areas within TOCDF.
- May 21, 1999-- Agent migrates from a Level A to a Level C area where agent is not supposed to be present. The ACAMS reading in the Level C area is 75 times the alarm point of .2twa. After alarm for agent presence, seven workers have to don the masks that are at their hips and evacuate. They are not in adequate protective clothing. Army officials testified in federal court that they don't know if any agent escaped to the outside environment during this incident.
- May 24, 1999-- Workers removing nose closures from 105mm projectiles encounter liquid agent in a burster well where liquid agent isn't anticipated. Workers are not in adequate protective clothing. According to testimony of Project Manager Tim Thomas the ACAMS rang off at approximately 1900twa--50 times the maximum level of agent for the clothing the workers were wearing.
- May 26, 1999-- Workers in the Toxic Maintenance Area are removing plastic bags of waste when the ACAMS alarms at 1985twa causing them to evacuate. One of the bags containing liquid agent is ripped. Again workers are not in adequate protective clothing. Workers still ring off positive for agent after doffing their clothing in the airlock. They then ring off positive after being rinsed with water and still ring off positive after a further rinsing with bleach. They have final positive readings as they depart from the airlock.
- June 4, 1999-- County-wide power outage causes TOCDF negative air flow system (HVAC) to go down. It is 25 minutes before the emergency backup power system comes on. Backup power is supposed to come on automatically. Loss of the HVAC system causes agent to migrate into Level C areas where agent isn't supposed to be. There are 3 site masking alarms during the power outage event. Army officials testified in court that they don't know if agent migrated to the outside environment.

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- June 5-June14, 1999-- TOCDF is in "Stand Down" by order of Chem Demil according to testimony of Col. Joseph Huber in federal court. No munitions are processed during this period while a Review Team from Aberdeen is looking at recent agent events at TOCDF. **12-55 (cont)**
- June 14, 1999-- TOCDF starts up after "Stand Down." Processing of M-55 rockets is resumed. However TOCDF is shut down again because within 6 hours of start-up, allowable feed rate for rocket processing is violated.
- August 1 - September 13, 1999-- There are 19 "potential" worker exposures. 4 are in Level B clothing. 11 are due to rips in protective ensembles or gloves and 4 workers are present in over 500 IDLH atmosphere.
- August 9, 1999-- Tangled air hoses prevent DPE entrants from reaching egress air locks.
- August 9, 1999-- Worker exposed to nerve agent with tear in protective suit not seen at clinic until three and a half hours later.
- August 25, 1999-- ACAMS in Unpack Area alarms at .21 twa. The ACAMS heat trace is discovered to be burning.
- Week of Aug. 31-Sept. 4-- DFS feed chute gets jammed with rocket pieces. Site team shuts down DFS to change out warped section of feed chute. Angle irons used to dislodge previous jam get jammed in chute also.
- Week of Aug. 31-Sept. 4-- Internal report blames cracks in concrete floor of MDB for decon seepage into electrical room and states that new cracks continue to be identified.
- September 9, 1999-- Cleanlines and organization of toxic areas is so bad that processing is shut down for 59 hours to get housekeeping issues straightened out.
- September 20, 1999-- Internal report states that SOPs are happening too quickly for people to keep up and more often than not, new SOPs are not being carried out.
- September 21, 1999-- Internal report reveals that workers are performing unapproved SOP of hitting wooden pallets with a steel mallet to loosen pallet covers which results in projectiles falling from pallets onto to UPA floor.
- September 23, 1999-- Internal report blames poor contamination control and inadequate decontamination attempts for high levels of contamination in airlocks.
- September 27, 1999-- Control room operator discovers that two "pressurized" ton containers have been in the 90-day storage site for greater than the allowed time. Report of incident states that information transmitted to management after discovery of tons is "less than adequate,...training received on environmental inspections is inadequate." Incident results in a Government Nonconformance Report and an EG&G Deficiency Report.

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12-55 (cont)

- November 3, 1999-- Manager orders worker to make DPE entry against advise of monitoring team who informed him of questionable ACAMS reliability in hot area.
- November 3, 1999-- TOCDF system engineer calls LIC slag removal system "fatally flawed"--engineers have to "jumper" the system code to get the system to operate correctly.
- November 3, 1999-- ACAMS alarm of .37 in LIC Secondary room goes unnoticed for 2 hours during which time several workers enter the room.
- November 9, 1999-- ACAMS in EHM alarms at 1.23 twa with unmasked workers present. Personnel are told to exit into airlock but are not told seriousness of situation and are not told to mask.
- December 6, 1999-- The protective suits of two workers are melted during slag removal operation in one of the liquid incinerators.
- December 7, 1999-- In a fire in the upper gate of the deactivation furnace feed chute, three rocket sections burn. Flames are also seen on the floor and at the shear blade. The time of the fire is uncertain "due to unreliability of the fire sensor." Instructions have been given to avoid leaving rocket sections on the upper gate "even if it means burning them in the chute." Three hours earlier, the lower gate malfunctioned and resulted in a stop feed. It takes ten days to prepare report on the incident.
- February 20, 2000-- Two workers exposed to nerve agent GB when it leaks into room where they are working.
- February 23, 2000-- 40 to 45 gallons of molten slag spills from a drum and starts a fire that burns the covering of the concrete floor and electrical equipment in a secondary room of the liquid incinerator.
- April 30, 2000-- A maintenance man just happens to walk past the Cyclone Ash Bin Enclosure of the Deactivation Furnace (DFS) and notices smoke, heat and a bulged out door. There is a fire going on that no one had detected. The fire ignites and decomposes the charcoal in the filter system of the Ash Bin and would have entered the filter banks of the MDB if it hadn't been discovered by a worker out for a walk. The fire was precipitated when the blind flange was installed in preparation for an entry into the DFS to clear a jam in the Heated Discharge Conveyor.
- May 8, 2000-- After workers finish maintenance on deactivation furnace feed chute there is confirmed release of nerve agent GB out of common stack into environment at 11:26 pm. Army reports that afterburner was blown out due to malfunction of air flow meter which was clogged with liquid. Stack alarm rings off for about 20 minutes at somewhere between 3.7 and 8.6 times the allowable stack concentration of GB. Army reports on the alarm reading are inconsistent. Mysteriously, after stack alarm rings off, alarm in

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furnace duct leading to stack rings off for agent presence. Facility managers say they have no clue as to why sequence of alarms was apparently backwards. **12-55 (cont)**

- May 9, 2000-- A confirmed release of GB to the environment takes place at about 1:15 am (less than an hour and a half after the confirmed release May 8) when workers attempt to relight deactivation furnace afterburner. Local emergency officials not notified until four hours after first GB release. Decision made by Army manager not to immediately notify local officials is in violation of Army SOPs, facility's operating permit granted by State of Utah and agreements with local emergency responders. Facility is shut down until investigation team, headed by the Army, makes final report on the incidents. EG&G manager predicts investigation will lead to physical modification, not just new SOPs. Shut down could last several weeks.
- June 6, 2000-- TOCDF is still shut down. It is reported that the facility's shut down is costing about $285,000 per day--totaling almost $8 million to date.
- July 26, 2000-- TOCDF has been shut down for 79 days. At $285,000 per day--the cost so far is more than $22 million.
- July 28, 2000-- The Utah DEQ authorizes the restart of the two liquid incinerators and the metal parts furnace after the entire facility had been shut down for 81 days following the May 8-9 agent releases.
- September 19, 2000-- The Utah DEQ authorizes the restart of the DFS after it had been shut down for 133 days following the May 8-9 agent releases.
- October 19, 2000-- At the Utah CAC meeting, it is stated that there had been 97 agent alarms at TOCDF since May 8. 14 of the alarms were in the common stack.
- November 16, 2000-- At the Utah CAC meeting, it is stated that there had been 41 agent alarms at TOCDF since October 19. Three of the alarms were in the common stack and five were in ducts leading to the common stack.
- November 25, 2000-- The nerve agent GB (sarin) is detected in employees' work clothes. The workers come in from inspecting filters outside in cold weather and apparently the sarin begins vaporizing as their clothing warms up.

12-56

History of mismanagement. What impacts follow from conclusions that can be drawn from recent publications that have documented mismanagement on the part of PMCD, such as the February 2001 Army Audit Agency report where managers who made some 3,000 design changes “didn't assess the full cost, schedule, environmental and operational effects.” In addition there is the testimony before the U.S. Subcommittee on Chemical Demilitarization on April 25, 2001 and the review of that testimony by the Congressional Research Service dated May 14, 2001. How might these indicate impact of schedule, cost, safety, honesty, and accountability?

Comment 12-56

Response: Management arrangements for destruction of the chemical weapons stockpile stored at BGAD are outside the scope of the EIS.

Some of the design changes referenced were based on the change from theoretical operations to actual operational experience and with full attention to worker risk and safety.

The testimony given at the time of the referenced hearings included the costs and schedule figures as approved in the 1998 Acquisition Defense Memorandum (ADM) that was not updated until the Defense Acquisition Board ADM was signed in September 2001. What was given as testimony was true and current at the time of the April 25, 2001 hearing and only changed officially based on the ADM signing in September 2001. In addition, the Congressional Research Service (CRS) report referenced in the comment was prepared on a single document (The Task Force 2000 report) that, while final, was not a stand alone document. That Task Force report did not take into account any mitigation efforts, and the CRS report only confirmed what could be the case if mitigation efforts to address shortcomings in the Task Force 2000 report were not taken.

Additional questions. Why volatilize the hazardous chemical agent before you get rid of it? Volatilization possess greater risk in that a major event or accident could cause much greater damage, threaten workers, and harm the community. Still the question, why? **12-57**

What is the impact on analysis of the use of carbon filters on the final stack? It is our understanding that PMCD decided to try the filters at the Tooele facility in Utah. However, just before they acted, the risk assessment on using the carbon filters as suggested came out, which PMCD had commissioned. What did that assessment really say and what is the impact on plans for BGAD? Is it true that the assessment said that there was zero benefit to putting them on the stack and doing so increased risk to workers-significant risk from a possible "puff" or accident? In addition, workers would apparently have to change them out. This increased work of putting the filters on the stack and taking them off meant increased risk to workers as well. **12-58**

In addition, the carbon micronization system has not been fully approved. Therefore safe disposal of the contaminated carbon filters has not been resolved.

Did the National Research Council warn PMCD in 1994 that there could be potential problems from back pressure that could mean a "puff" or a blow? Could not also any significant change in fluid flow conditions (flow rate, temperature, contaminant mix, etc.) result in "sloughing" or "puff" releases? If these questions are not precisely correct, considering they are offered by lay persons not familiar with these processes, then we request full explanation of these reports or advise and the implications for workers, risk of accident, and potential health and environmental impacts. **12-59**

Is there any plan at BGAD to utilize an isolation valve or "knifegate" on the downstream end of the kiln between the exhaust and the afterburner to isolate the material in the kiln during an upset condition? We understand that it is included in the design at Anniston, Alabama, and is a modification. Are there plans to use it here in Kentucky? Is so, what are the implications of deployment during an incident or upset condition? Is it potentially dangerous and, if so, how? **12-60**

The EIS evaluation of the baseline option as a chemical weapons disposal technology must be based on actual performance data from the Army's Johnston Atoll Chemical Agent Demilitarization System (JACADS) and Tooele Chemical Demilitarization Facility (TOCDF) incineration facilities under all operating conditions including all upset and "shutdown" conditions. **12-61**

Comment 12-57

Response: Under the baseline incineration process, the chemical agents are not volatilized, they are incinerated. Volatilization would result in agent being available for release in a gaseous form, whereas incineration destroys the chemical agent.

Comment 12-58

Response: PMCD would incorporate the PAS Filter System (PFS) into an incineration facility at BGAD. The purpose of the PFS is to provide an additional measure of safety against the release of agent and products of incomplete combustion (PICs). If baseline incineration is selected for implementation at BGAD, the human health risk assessment that would be done in conjunction with RCRA permitting would assume no capture of the compounds on the filters.

The carbon micronization has completed a successful test at JACADS.

Comment 12-59

Response: It is not clear from the comment which NRC findings from 1994 are being referenced. The NRC published two reports in 1994, "Recommendations for the Disposal of Chemical Agents and Munitions" and "Evaluation of the JACADS OVT Part II". In the first report, the NRC committee was comparing the baseline incinerators with the cryofracture concept that involved freezing whole munitions, smashing them and feeding the debris into a larger version of the deactivation furnace system (DFS). Findings/recommendations 7 and 8 of the first report relate to the separation of the munitions into separate waste streams and specifically recommends that "all disposal systems should be designed to separately process agent, energetics, and associated metal parts ..." Recommendation 9 of that report addresses gelled munition processing and recommends researching means to extract, handle and process gelled agents that retain the advantages for handling separate streams. The NRC committee was not predicting back pressure problems with gelled rocket processing. Unfortunately, the NRC committee did not address the issue of gelled agent in rocket processing in the 1999 update report on recommendations after the facility at TOCDF had experience with processing gelled rockets.

Comment 12-60

Response: A knife gate would be employed if baseline incineration were selected as the technology for destruction of chemical agents and munitions at BGAD. The purpose of the knife gate is to isolate the kiln from the afterburner. This allows the afterburner to be started without drawing air from the kiln.

Comment 12-61

Response: The only actual data available for evaluation of any destruction technology under consideration in this EIS are those from baseline incineration. The operational experience at JACADS and TOCDF, including process fluctuations and process upsets, is described in Appendix C of the EIS. Evaluation of the alternative technologies is based on engineering estimates (see Appendix G of the EIS).

3.3 PROCESS OPERATIONS **12-62**

3.3.2 Disassembly Process

In this section why is there no discussion of the wash-out option for rockets under the non-incineration options, only for projectiles? Wash out is a safe and appropriate method to access agent that is known to have gelled in M-55 rockets. This is a highly problematic scenario for the disassembly method used in the incineration method and has led to a dangerous and experimental permit modification at the Alabama incineration facility where they plan to throw 34 fully loaded rockets per hour into the DFS which has never been tried at any other facility. This should be discussed and such a modification should never be considered at BGAD.

3.3.3.1 Baseline incineration process **12-63**

There is no discussion in this section as to why it is appropriate to destroy contaminated dunnage in the DFS or the MPF. There must be an explanation and justification for eliminating the dunnage furnace and using the DFS or the MPF, both of which were not designed for destroying contaminated dunnage. At TOCDF, contaminated dunnage is being stored in igloos. There must be an explanation and justification for this difference in the plan for BGAD.

This whole section is woefully inadequate. There must be a thorough discussion of the problems encountered at the Army's other incinerators.

3.3.4 Pollution Abatement and Waste Handling Processes **12-64**

This section states, "Liquid brines from the baseline incineration alternative would be dried to solids in a brine reduction area (BRA)." This directly contradicts what was stated in 3.2.1 where it is stated the brines "...would be disposed of in a permitted treatement, storage and disposal facility..." The BRA has been abandoned in Utah and in Alabama. Why is it still included in the BGAD DEIS? There must a thorough explanation of its abandonment at other sites while it is still included here and also why the DEIS tries to have liquid brine disposed of both off-site and on-site.

3.4 INPUTS AND OUTPUTS **12-65**

3.4.2 Routine Emissions and Wastes

No matter which destruction system is being considered, the Army and its contractors should seek to prevent as much pollution and waste generation as possible, including the amounts and types of materials used in day-to-day practices.

Comment 12-62

Response: See response to Comment 12-52.

Comment 12-63

Response: As explained in Appendix D of the EIS, the DUN has been removed from service at JACADS and TOCDF because of operating difficulties and is not proposed as part of the baseline incineration technology for destruction of chemical munitions stored at BGAD. Tests at both JACADS and TOCDF have demonstrated that dunnage can be incinerated in the metal parts furnace (MPF). PMCD does not propose to destroy dunnage in the deactivation furnace system (DFS) if baseline incineration is selected to destroy the chemical agents and munitions stored at BGAD.

Comment 12-64

Response: See the responses to Comments 12-12 and 12-49. As indicated in Section 3.3.4 of the EIS, a brine reduction area (BRA) would be used to dry brines at a baseline incineration facility at BGAD. The language has been modified in Section 3.2.1 in this Final EIS to clarify this issue.

In contrast to the situation at TOCDF, where the BRA has been removed from service because of cost constraints, the BRA is expected to be cost-effective for implementation at BGAD.

Comment 12-65

Response: The Army would comply with its pollution prevention program, as developed by the U.S. Army Environmental Center, regardless of which destruction system is selected for implementation. The Army recognizes that pollution prevention is clearly the most cost effective, long-term solution for reducing risks to human health and the environment. By minimizing pollution, the Army reduces potential compliance and restoration violations and expenditures. The Army program is based on the federal pollution prevention hierarchy — eliminate or reduce the pollution sources; recycle or reuse what is not eliminated; treat what is not recyclable or reusable; and properly dispose of remaining waste.

3.4.2.1 Incineration processes

This section is also woefully inadequate. There is no discussion of how the process gases will be monitored or for what chemicals. Also it states that air emissions and solid wastes are the main componenet of waste from the baseline system. However, without a BRA, the brine liquids will also be substantial. There should be a discussion of liquid brine wastes also. **12-66**

3.5 NO ACTION ALTERNATIVE

This section's reliance on a risk analysis published in 1988 is inappropriate. More thorough analyses have been done since then and the results of those efforts should be discussed. **12-67**

4.2 LAND USE

We don't see any difference in land use impacts between any of the non-incineration options. Any of the non-incineration options would be acceptable. **12-68**

4.3 WATER SUPPLY AND USE

4.3.2 Destruction System Requirements

The data in Table 4.2 "Water requirements for proposed action and alternatives" is incorrect. In the narrative it states process water for baseline incineration is about 270,000 gpd. The table's data for incineration is based on 365 d/year operations, which multiplies out to 98,550,000 gals/year. However, the table has process water use for incineration as 18,000,000 gals/year. Quite a glaring error. This table must be corrected. Water use for incineration is much higher than any of the three non-incineration systems. In a drought year, huge water consumption for incineration could be a problem. **12-69**

The DEIS is unclear as to what amount of water is "consumed" and water that is "used." These terms have two very different meanings. Water "consumed" is not returned to the water basin. Water that is "used" is returned to the water basin. The amounts need to be clearly defined. The DEIS is unclear on the amounts of water that is recycled and the amount of the recycled water that is consumed/used. These amounts need to be clearly defined. **12-70**

4.6 WASTE MANAGEMENT AND FACILITIES

It is stated again in this section that liquid brines would be dried on site in the incineration option. A discussion of the BRA abandonment in Utah and Alabama and what that means for a BRA at BGAD must be included in any narrative concerning liquid brines. If there is to be no BRA, then there must **12-71**

Comment 12-66

Response: The Army disagrees with the claim of inadequacy expressed in the comment. Section 3.4.2.1 of the EIS is intended to provide a summary of the routine emissions and wastes of the incineration process. Detailed information regarding the waste streams of the baseline incineration system (and of the neutralization and electrochemical oxidation technologies) is found in Sections 4.6 (for solid and liquid wastes), 4.7 (for atmospheric emissions of criteria pollutants), and 4.8 (for atmospheric emissions of hazardous and toxic substances). Additional information on routine emissions and wastes for the baseline incineration system is found in Appendix D of the EIS, and comparable information for the neutralization and electrochemical oxidation systems is found in Appendix G of the EIS. Appendix I of the EIS provides detailed tabular information on toxic air pollutants expected for all four of the considered alternatives.

Section 4.26.5 of the EIS discusses agent monitoring that would be conducted during destruction operations at BGAD. This discussion addresses standards for agent exposure, instrumentation (including the automatic continuous air monitoring system or ACAMS and the depot area air monitoring system or DAAMS), and monitoring during storage, during handling and on-site transport, destruction plant monitoring, and perimeter monitoring.

During process operations, process gases would pass through a pollution abatement system and be monitored before release to the atmosphere. All stacks would be monitored continuously for agent and periodically for other regulated emissions. Carbon monoxide would be continuously monitored as an indicator of products of incomplete combustion.

As further explained in Appendix D of the EIS, the agent monitoring systems would be employed at various places to detect any chemical agent that may escape into the air in and around the proposed facility. The systems would be located inside the MDB, in the exhaust stacks from the PAS, in the filtered exhaust from the MDB ventilation system, and at appropriate locations outside the MDB. Air monitoring would be provided for worker areas, furnace stack(s), filter vent(s), and process areas. Similar to the monitoring system implemented at other chemical agent destruction facilities, monitoring would provide data to decision makers to ensure operations are being conducted safely and in compliance with all regulatory requirements.

As noted in response to Comments 12-12 and 12-49, a brine reduction area (BRA) would be implemented at BGAD for the baseline incineration system. The liquid brine wastes would be transferred to the BRA for drying to solids for disposal at an off-site permitted TSDF.

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Comment 12-67

Response: Contrary to the claim in the comment, neither Section 3.5 nor the EIS as a whole rely upon the 1988 risk assessment. The citation for the 1988 risk assessment in Section 3.5 of the Draft EIS was merely intended to illustrate the principal hazards of continued storage. It is acknowledged that the 1988 risk assessment is out-dated. New text has been added to Section 3.5 in this Final EIS summarizing the hazards identified in a 1997 quantitative risk assessment. Both the Draft EIS and this Final EIS rely on the 1997 risk assessment as the basis for the assessment of impacts from potential accidents (see Section H.1 in Appendix H of this Final EIS).

Comment 12-68

Response: The comment is noted. Land use impacts for all destruction alternatives are essentially the same. The commenter's preference for any of the non-incineration alternatives is noted. See response to Comment 1-1.

Comment 12-69

Response: The commenter is correct that there is a discrepancy between the process water use given in the text and that given in Table 4.2. The entry in the table is correct. Water use by baseline incineration is essentially equivalent to that of neutralization/GPCR/SCWO, about three times that of neutralization/SCWO, and about 18 times that of electrochemical oxidation. As noted in this EIS and the ACWA FEIS, these water use levels are well within the available capacity of BGAD to provide water from its on-site, man-made lake, Lake Vega. The text in Section 4.3.2 of this Final EIS has been corrected to include the above information.

Comment 12-70

Response: See the response to Comment 12-7. The term "water use" in the DEIS reflects the amounts of water needed for the construction and operation of a facility. Some of this water is used in the technology processes that make up a destruction system; this is "process" water. Other water is used for other purposes such as domestic uses. Water may be recaptured at the end of a process and returned or "recycled" back to the beginning of the process. With the exception of any domestic sewage discharges, all water used for a destruction facility is "consumed" in the legal sense, since it is not returned to the local environment.

Comment 12-71

Response: See the responses to Comments 12-12 and 12-49.

be a discussion of the large amounts of liquid wastes produced. We find the brine solutions resulting from the incineration technologies to be far more problematic than the brine salts of the non-incineration technologies. The volume is higher, and if there is to be no BRA, transporting liquid carries more risk. **12-71 (cont)**

Throughout this section, it is stated that the types and quantities of hazardous and non-hazardous wastes produced during construction and operation of all destruction options would not be expected to produce significant impacts. The basis for this claim is accordance with regulations. NEPA and requirements of the EIS process call for understanding impacts, whether the work comes into compliance or meets regulations or not. The issue is impact, not compliance. It is certain knowledge that one can meet all regulations and still have impact. The DEIS simply does not address itself to impacts in and of themselves. Meeting regulations becomes an excuse for not providing necessary data based upon real experience and knowledge of the site to assess the impact to the community. In addition, it is important for all to understand that to say significant impacts are not expected means nothing without context. By design, one hopes that such is the case. However, catalogued experience of the unexpected should be included so as to discuss impacts for those possible unexpected events. This approach is wholly inadequate for review in the DEIS. It is sloppy and lacks accountability. **12-72**

Regarding PCBs, the goal should be preventing uncontrolled PCBs into the environment. So--incineration has met TSCA standards. Big deal! The goal should be prevention. The US government is committed to ratifying the international Stockholm Convention on POPs which calls for ultimate elimination of PCBs, dioxins, et al. The Convention states, and numerous other governments have realized, that technologies (for example, GPCR) which can destroy PCBs are preferabale to technologies like incineration which simply disperse PCBs back into the environment. **12-73**

Regarding non-hazardous waste, the Army and its contractor is expected to limit, to the greatest extent possible, the amount of wastes generated at the plant, including conventional re-use and recycling practices and choosing the most recyclable materials possible. **12-74**

4.6.1 Current Waste Management and Facilities **12-75**

Off-site incineration of both hazardous and non-hazardous wastes should not be a consideration.

4.6.2 Impacts of Construction **12-76**

The Army and its contractor should use materials with the least toxicity possible. This would include consideration of the least hazardous solvents, paints, construction materials, PVC, et al.

Comment 12-72

Response: In response to the comment, new text addressing the impacts of hazardous wastes has been developed and placed in Section 4.6 in this Final EIS.

Comment 12-73

Response: See the response to Comment 8-9a. The commenter's preferences are noted.

Comment 12-74

Response: See the response to Comment 12-65.

Comment 12-75

Response: Section 4.6.1 of the EIS refers to current (i.e., existing) waste management and facilities at BGAD and does not refer to the incineration of any wastes. The commenter's preference for non-incineration waste solutions is noted.

Comment 12-76

Response: The Army intends to minimize the use of toxic materials during construction. See the response to Comment 12-65.

4.7 AIR QUALITY-CRITERIA POLLUTANTS 12-77

4.7.2 Criteria Pollutant Emissions

Nationally, background levels of air pollutants from power plants and other industrial emission sources, are dangerous enough. Our goal should be to identify disposal options that create the least impact in terms of these pollutants. Tables 4.14 - 4.17, on pages 4-38 - 4-41 respectively, show that the emission rates of criteria pollutants and VOCs are magnitudes higher with incineration than with alternative technologies. Non-incineration technologies will result in far less emissions, and as a result are likely to be less associated with negative health effects.

The sheer volume of air emissions and the number of stacks through which agent contaminated air would pass, as associated with incineration, put this technology at a distinct disadvantage compared to the non-incineration technologies whose "stack" emissions are largely associated with steam boilers and emergency generators. 12-78

4.7.5 Impacts of Process Fluctuations

Correct to assume that process upsets would result in higher levels of emissions. However this section should distinguish between process upsets in an incinerator (high temperature, high pressure, high volume air emissions) compared to a process upset in a non-incineration technology (low temperature, low pressure treatment of agent, low air emissions). Incineration is inherently more prone to process fluctuations, as illustrated by operations at both Utah and the Pacific. Weapon processing modifications, as proposed in Alabama and elsewhere (i.e. processing of fully-loaded rockets, co-processing of agent and weapon parts in the MPF and DFS), are not reflected in this document. However a precautionary approach would be to assume that these changes would result in process fluctuations, or "upset conditions", for which the emission levels are unknown. Incineration is clearly at a disadvantage and entirely unacceptable compared to the non-incineration technologies. 12-79

4.8 AIR QUALITY-RELEASE OF HAZARDOUS AND TOXIC SUBSTANCES 12-80

4.8.2 Hazardous and Toxic Air Pollutant Emissions

The information in this section is so superficial to be useless. The pages of emissions data for incineration in Appendix I is unintelligible and in a completely different format from the other data for the other technologies. In the Appendix, the data for incineration must be translated into a common language with that of the non-incineration technologies before citizens can be expected to properly evaluate the information.

Comment 12-77

Response: It is agreed that non-incineration technologies would result in less air emissions than the baseline incineration technology.

Comment 12-78

Response: It is agreed that non-incineration technologies would result in less air emissions than the baseline incineration technology. The commenter's perceptions of the advantages and disadvantages of alternative systems are noted.

Comment 12-79

Response: The potential for process upsets exists for both incineration and non-incineration technologies (see Section 4.8.5 for a discussion of process fluctuations as described in the comment). While the highest process temperature is associated with incineration, the pressures sustained in the Super Critical Water Oxidation (SCWO) technologies are much higher than those during incineration. Air emissions during upset conditions are not typically considered in annual air emission estimates because of their infrequent occurrence.

In addition, if incineration were selected as the technology for implementation at BGAD, a human health risk assessment would be prepared. This risk assessment would include calculations for process fluctuations and upsets. It is not known at this time whether a health risk assessment would be prepared if a non-incineration technology is selected for implementation at BGAD. EPA only requires that health risk assessments be prepared for combustion technologies.

Comment 12-80

Response: In Appendix I of this Final EIS, the emissions for the baseline incineration technology have been converted from units of grams/second to units of micrograms/second to facilitate comparison with the non-incineration technologies.

4.8.4 Impacts of Operation

The pages of emissions data for incineration in Appendix I is unintelligible and in a completely different format from the other data for the other technologies. In the Appendix, the data for incineration must be translated into a common language with that of the non-incineration technologies before citizens can be expected to properly evaluate the information.

It does not appear that chemical agents are included in the list of incinerator emissions in Appendix I. This is a glaring error, since chemical agents have been released in both normal and upset conditions at JACADS and TOCDF. Actual data from those incidences should be presented in this section. **12-81**

Even in its current format, the data is clear. Incineration has higher total air emissions; and greater level of toxic emissions in the form of dioxins/furans, PCBs, heavy metals, volatile and semi-volatiles, PICS. Incineration is not a "hold-test-release" system, and simply cannot control chemical agents and other toxics from entering the environment. This is unacceptable. Non-incineration technologies are far superior in preventing such emissions, even in upset conditions.

Regarding emissions of PCBs, the trial burn data on PCBs from JACADS and TOCDF is irrelevant if the goal is providing the public maximum protection. Reference comments in section 4.6. Trial burn scenarios reflect the reality of neither routine nor upset plant conditions. Furthermore, destruction removal efficiencies do not accurately represent the effectiveness of the technology in destroying or capturing PCBs; they merely show up elsewhere in the waste stream. **12-82**

Though PCBs were not tested as a part of ACWA demonstrations, at least one ACWA technology, Eco Logic's Gas Phase Chemical Reduction system, is a proven PCB destruction technology. Other non-incineration technologies can at least contain PCB wastes, rather than releasing them into the air to as a new source. Therefore the non-incineration technologies are preferable.

4.8.5 Impacts of Process Fluctuations **12-83**

Shame on PMCD for belittling the impacts of process fluctuations in this section, and for neglecting to point out the consequences of process fluctuations in an incinerator vs. the non-incineration technologies. Chemical agent releases at an incinerator -- under normal operations, upset conditions, or when the facility is shut down altogether -- are not "unlikely" or "hypothetical" They have occurred many times over, out the smokestacks and within the facilities at JACADS and TOCDF. These incidences should be included here.

Comment 12-81

Response: Table I.1 in Appendix I in this Final EIS has been revised to include GB, VX, and mustard for the baseline incineration technology. It is agreed that non-incineration technologies would result in less air emissions than the baseline incineration technology. The preference in the comment for non-incineration technologies is noted.

Comment 12-82

Response: The trial burn data are referenced in this EIS as one measure of the effectiveness of the baseline incineration technology at removing PCBs. While it is true that trial burns may not reflect the full spectrum of possible operating scenarios, they nevertheless provide valuable, real data on actual emissions. Moreover, a trial burn serves several purposes. It is used to determine whether a facility can meet the required performance standards under Subpart O of 40 CFR Part 264 and to determine the operating conditions that should be set in the permit. A permit writer also uses a trial burn to assess whether other limits or requirements are justified under the omnibus authority of RCRA Section 3005(c)(3). Setting permit operating conditions based on the results of trial burns is the best method of assuring compliance with the regulations.

The Eco Logic GPCR system has portable demonstration systems in Japan and Canada. They have operated one commercial full-scale stationary system in Australia, and completed a full-scale demonstration of the system at a GM facility in St. Catharines, Ontario, Canada. In the United States, Eco Logic demonstrated the Eco Logic Process on a pilot-scale at the Bay City, Michigan Municipal Landfill, under the EPA Superfund Innovative Technology Evaluation (SITE) program. PCB wastes were treated at the Australia and Ontario, Canada sites. Evaluation of the process under the ACWA contract encompasses the pilot-scale treatment of neat chemical agent and dunnage.

Contrary to the claim in the comment, baseline incineration would be expected to destroy PCBs and not merely relocate them to other waste streams. Destruction and removal efficiencies are an appropriate measure for the amount of PCB destruction.

Comment 12-83

Response: Section 4.8.5 of the EIS provides an analysis of process fluctuations. As explained there, it was assumed that organics and inorganics exceeded designed values by a factor of 10 (per EPA guidance) and were used to generate ambient air concentrations for exposure estimates shown in Appendix J of the EIS.

Similarly, Section 4.8.5 analyzed upsets resulting in agent releases in the MDB process area. Although the scenario hypothesized to achieve this result is extremely low (requiring all filters within the filter bank to fail and no corrective action to be taken), the results of this analysis show that the maximum hypothetical on-post and off-post agent

[Intentionally left blank]

Comment 12-83 (cont)

Response (cont):

concentrations would be less than 3% of the allowable concentrations for general public exposure established by the Centers for Disease Control.

In addition, Appendix C of the EIS provides a summary discussion of the operating experience at JACADS and TOCDF, including information on emissions and performance and process upsets including incidents and releases of chemical agent.

The statement on p. 4-55, “Therefore, if any agent were detected in the exhaust stream, alarms would sound, the cause would be identified and mitigated, and emissions of agent (if any) would be short-term at low levels,” entirely misrepresents the incineration process. A stack agent alarm means that chemical agent has already been released into the environment. The capability of incineration to detect an agent release is not at all impressive unless it can somehow control the agent and prevent it from going anywhere. It cannot. **12-84**

In contrast, chemical agent treatment with any of the non-incineration options 1) occurs at low temperatures and low pressures, inherently safer for workers; and 2) occurs in facilities designed to contain and control emissions

Furthermore, the Army knows full well that the toxicity of chemical agents is such that even a low-level release -- particularly if there are several low-level releases -- is significant.

As we write these comments, GB agent is alleged to have leaked out from air support hoses in the LIC furnace room, nowhere near the MDB. No matter what the technology, neither the Army nor its contractors should be so arrogant to make the kinds of assumptions in this section.

4.8.7 Cumulative Impacts **12-85**

The DEIS fails to address agricultural impacts. There is no data regarding impacts during the construction or operation of the facility. Regarding agricultural impacts, there is no data regarding cumulative impacts to crops, livestock or grazing land from emissions. It is unclear as to the impacts to surface water or groundwater as it relates to livestock and crops.

4.9 HUMAN HEALTH AND SAFETY ROUTINE OPERATIONS **12-86**

4.9.3 Impacts of Operations

Page 4-63: Safe exposure levels referenced on line 12-13 and in Table 4.28 page 4-65 are obsolete and no longer deemed protective by EPA, CDC or the Army. According to the Federal Register Notice (Vol. 66, No. 85/Wednesday, May 2, 2001) the exposure standards are being revised showing significantly less agent causes impacts than represented in the EIS before us. The Notice states, “It is believed that other Federal and State agencies and private organizations will also adopt AEGL’s for chemical emergency programs in the future”.

Comment 12-84

Response: It is acknowledged that if agent were detected in the stack it would subsequently be released to the atmosphere. The issue here is how the system responds. Specifically, if the monitors detect the presence of agent, the agent feed to the furnace will be shutdown. It is also acknowledged that non-incineration facilities would be designed to contain and control emissions. Actual emissions from full-scale operations of non-incineration facilities are not available at this time. A comparison of actual emissions compared to design specifications will be possible once a full-scale non-incineration facility is built and operated.

Comment 12-85

Response: As indicated in Section 4.8.7, which addresses the cumulative impacts of atmospheric emissions of hazardous and toxic substances, the cumulative impacts of these emissions on human health and biological resources are addressed in Sections 4.9 (human health), 4.15 (terrestrial habitats and wildlife), 4.16 (aquatic habitats and fish), and 4.17 (protected species) of the EIS. Cumulative impacts to surface water and groundwater are addressed in Sections 4.14 and 4.13, respectively, and impacts to agriculture (none are expected) are addressed in Section 4.20. See also the response to Comment 12-18.

Comment 12-86

Response: Revised exposure guidelines developed by the U.S. Army are summarized in a revised Table 4.28 in this Final EIS. The revisions are based on the use of risk assessment procedures developed since the original FPEIS in 1988. Little additional data has been generated since that time. The major reason for the changes to lower concentrations for VX and sulfur mustard has been the decisions to adopt the more sensitive occular effects over systemic effects; miosis (contraction of the pupil) for VX and occular sensitivity for mustard.

The following demonstrates that the Army has indeed adopted the new AEGL's cited in the Notice, "The Army has provisionally accepted the accute Exposure Guidelines [AEGL's] and as a part of that, site evaluations for safety of all the country's chemical demilitarization sites must occur." (East Oregonian: March 22, 2002) Therefore, we disagree with lines 23-25 of this page concerning the latent health effects at "control-limit concentrations as the cited concentrations are no longer applicable. **12-86 (cont)**

Pages 4-65 - 4-66: The EPA Guidelines cited are obsolete and have been superceded by newer. We submit Appendix B as a more indepth analysis of how, using the newer EPA Guidelines and hazard quotient calculations for systemic toxicants, the incineration option contained in the DEIS is woefully unprotective of workers and the general public. **12-87**

Pages 4-66 - 4-67: We disagree strongly with the representation made that there is a "small likelihood" of workers being exposed at baseline facilities. We possess evidence to the contrary. **12-88**

12-89

Page 4-67 -4-68: We reject entirely line 8 (page 4-67) through line 15 (page 4-68) as having any semblance of honest representation of the health risks posed by incineration operations.

Referencing the Anniston HRA is misleading insofar as PMCD knows that a new Screening Health Risk Assessment Protocol has been under review by the Alabama Department of Environmental Management since before the release of tha BGAD DEIS. This Protocal uses the EPA's 1998 guidance, including the 1999 errata which the cited HRA does not include. Citing results of an old HRA from a particular site when a new draft is out at another site indicating significantly different results, and when a new Protocol is under review at the site being used as the example in the DEIS, is fundamentally dishonest. (See Appendix A for more accurate results of a more current HRA).

Lines 20-23 are hypothetical at best. In the Army QRAs for the PAS/CFS, no reduction for mercury emissions is identified. In addition, proposing "modification of operational time" as an alternative to reduce mercury impats on public health is ludicrous. Modification of operationl time has zero impact on the amount of Mercury that will be emitted - only the rate at which it is emitted. This does nothing to reduce the impact on the public, except to perhaps poison them more slowly.

Lines 24-26 are completely misleading, since baseline facilities in Oregon and Alabama are already undergoing numerous MAJOR modifications that would "materially" change the baseline option for BGAD. Examples include: Abandonment of the DUN; abandonment of the BRA; processing completely undrained unassembled M-55's in the DFS; processing fully agent loaded GB/VX/H rounds in the MPF; the addition of isolations valves

Comment 12-87

Response: The comment is noted. The information offered in Appendix B of the comment is appreciated.

Comment 12-88

Response: The comment is noted and minor textual changes have been made in Section 4.9.3.3 in this Final EIS. It is virtually impossible to prevent exposure to a few molecules of any substance. The question is one of relevance. Relevance to occupational health is based on bioassays of workers potentially exposed to agent. Up to this point in the chemical stockpile disposal program, in which approximately 25% of the U.S. inventory has been incinerated, there is only one case of occupational exposure that has been confirmed by bioassays. This case was an exposure to GB (sarin) resulting in a 25% decrease in blood cholinesterase of the affected worker.

Comment 12-89

Response: The quoted January 2001 Anniston Health Risk Assessment makes extensive use of the EPA's 1998 guidance and the 1999 errata to this guidance. To quote the Anniston HRA, "The USEPA HHRAP and its 1999 Errata Sheet were the primary guidance used to complete this HRA."

A variety of methods for reducing mercury emissions are possible. For example, a Department of Energy report ("Controlled Emissions Demonstration Project Final Report Activated Carbon Mercuric-Chloride Removal." PTP-76, September, 2000, prepared by MSE Technology Applications, Inc, 200 Technology Way, P.O. Box 4078, Butte, Montana 59702) details some tests that demonstrate over 99% mercury removal efficiency. However, the Final Standards for Hazardous Air Pollutants for Hazardous Waste Combustors; 40 Code of Federal Regulations, Part 60, September 1999 identify an emission limit of 45 micrograms per dry standard cubic meter. Approaches to achievement of the specified rate are not limited in the regulations; thus modification of feedstock is a legally acceptable method to achieve compliance.

Technological changes to improve the chemical agent destruction are inevitable as experience is gained. This coupled with the increased urgency to complete the inventory destruction in a timely manner leads to the exploration of methods for increasing efficiencies. Even still, there are many similarities of the BGAD facility to operations at sites with more experience or design completion.

and Emergency Safety Vents (more commonly known in the industry as "Dump Stacks"); PFSs (which have never been operational at JACADS or TOCDF); over 4,000 ECPs at UMCDF; off site shipment of brines at ANCDF; and many other changes. With this knowledge, for PMCD to represent the BGAD baseline as being "materially the same" as JACADS and TOCDF is inappropriate and knowingly misrepresents how a baseline facility would operate. In addition, throughout the DEIS, language is used to create the illusion that operational data, operational flow design and other aspects of information gathered from JACADS and TOCDF will be replicated at BGAD. **12-89 (cont)**

Although we are accustomed to this deceptive method of communication from PMCD, we wish to protest in the strongest of terms the continuied practice of representing the baseline as "proven" when indeed what will be erected and operated at BGAD, should incineration be chosen is like saying that a 1968 Plymouth is "materially" the same as a 2002 Lexus - simply because they are both automobiles.

4.9.3.3 Impacts of incineration **12-90**

The statement in this section that there is "small likelihood" of workers experiencing exposure to agent is an outright lie. There have been a parade of whistleblowers at the TOCDF facility who confirm that workers are exposed to agent all the time. The Army's definition of exposure as having to do with depressed cholinesterase levels in workers is a scam. The Army would have us believe that even when workers are stripped naked, washed down with bleach and still ringing off hot for agent, they haven't been exposed because there was no drop in their cholinesterase levels. Please. And what happens to employees whose cholinesterase levels do show a drop. How is that covered up? Worker safety issues, based on actual operations, need complete investigation and discussion in this section.

Following is a series of quotes from a letter by a recent whistleblower who still works at TOCDF and who has documented many of the risks that workers face there.

> I must state that I am concerned that management has placed production over safety which continues to result in workers being exposed to unnecessary dangers. Two recent incidents stand out. First, there has been a recurrence of a worker being tasked to do a hot entry using a supplied air hose that was known to be contaminated with agent GB before the entry took place. Second, workers were sent into the LIC primary room to perform work in a situation where high levels of agent could be expected and in fact did occur (more than 14 IDLH) but the workers were wearing inadequate protective clothing because management chose to not shut down and cool down the LIC, which prevented use of DPE because DPE would have melted due to the high temperatures. In my opinion, in both instances, workers were knowingly placed into a dangerous situation involving exposure to chemical warfare agent and hazardous waste totally unnecessarily.

Comment 12-90

Response: An additional quantitative risk assessment (QRA) of the facility design and operation would be conducted if an incineration facility were selected at BGAD. The information identified in the comment, as well as the extensive history of successful destruction of large quantities of chemical agent at other sites, would be considered in the preparation of that QRA. The comment regarding preference for non-incineration technology is noted.

Regarding "whistleblower" comments, it should be noted that in every case at TOCDF, it was only after punitive or corrective actions were enforced on an employee for cause that he or she "blew the whistle." None of the charges made by whistleblowers has been substantiated.

> I am also concerned about the potential for repeated release of agent and other toxic chemicals to the environment at TOCDF. There have been occasions where agent or other chemicals/interferrants have been detected in areas that are not within engineering controls, i.e. not in areas where the HVAC system controls air flow through carbon filters before exit to the outside environment. I am also concerned that management attitudes and policies are having the effect and apparently the intent of discouraging employees from reporting safety violations and injuries,
>
> There has been several occasions where we have had HVAC upset conditions due to our emergency generators failing to start resulting in agent migration through the plant and into observation corridors requiring the plant to mask.
>
> I have concerns for CHB / Unpack personnel. During leaker munitions operations why aren't these munitions delivered in an Onc? It seems that all other munitions are delivered in an Onc yet, when munitions are hot or leaking we just throw vizqueen over the top of them and deliver them in a truck with no monitoring equipment to detect any off gases that may occur. Why are the leaking munitions just covered with vizqueen draped over the top? Why aren't more precautionary measures taken when we know that munitions are hot? Why isn't there an ACAMS down at CHB unpack where they are unloading these munitions? How long are employees being exposed to agent before the agent migrates across the room to the ACAMS?
>
> When baseline cholinesterase levels drop for personnel, as has occurred at TOCDF, what is the chronic out come for such personnel who have repeated exposures over the long-term? Medical personnel answer - we don't know. Are all cholinesterase medical tests always accurate when determining depreciation of cholinesterase?
>
> I have concerns that our ACAMS are not operating properly. I have seen several incidents where I feel that the ACAMS readings should have came up hot after MDB DPE entries. I am particularly concerned with incidents where one or more workers exited an airlock after the ACAMS indicated below LOQ agent only to have an ACAMS in another location (for example the laundry or clinic) show agent present on the worker(s) or their clothing. In some cases, the worker would have walked in the outside environment to get to the location at which agent was ultimately detected, releasing agent off their person or clothing along the way. I also have concerns that we may be having readings of agent out the stack.

12-90 (cont)

In order to realistically document worker safety issues at the existing incinerator and relate that to the incineration option at BGAD, there needs to be an investigation of worker allegations, including interviews with this worker and others. Incineration, with its inherent technology-specific risks to workers must not be the technology choice for BGAD.

4.20 SOCIOECONOMICS

12-91

There is insufficient data regarding socioeconomic impacts as a result of an accidental spill or release of chemical agent.

Comment 12-91

Response: Section 4.20 of the EIS is intended to discuss the impacts of constructing and operating the proposed facility. The impacts of accidents upon socioeconomic resources is presented in Section 4.22.14 of this Final EIS.

4.21 ENVIRONMENTAL JUSTICE

12-92

Environmental justice seeks to right the wrongs of disproportionate impacts on communities of color and low-income communities. Incineration accomplishes neither of these goals. In fact, contamination from all kinds of incinerators has largely contributed to environmental racism all over the U.S. Non-incineration technologies do far better in bringing about environmental justice in that they control emissions and by-products associated with chemical weapons disposal.

Regardless of central Kentucky's census data, non-incineration technologies simply do better to bring about environmental justice becasue they control emissions and by-products associated with chemical weapons disposal.

12-93

Nowhere in this section is there consideration of the impacts of the various technologies on communities receiving hazardous or non-hazardous wastes from the facility. As noted earlier in these comments, many landfills and incinerators that have already received wastes from JACADS and TOCDF are near predominantly minority and/or low-income communities. The Army is responsible for chemical weapons wastes, cradle-to-grave, therefore the impacts of these communities, along with central Kentucky communities, must be considered.

In assessing those impacts, the technologies should be compared for the amount of hazardous wastes generated; the toxicity of those wastes (it may be less risky for a community to receive more waste if it is relatively benign); the nature of the waste; and whether the waste is slated for a landfill, deep-well injection, incineration, or processing in some other kind of public treatment system. Each has has the potential for further distributing toxics into the environment.

4.25 CLOSURE AND DECOMMISSIONING

12-94

The closure process at the JACADS incinerator -- the only example we have to go on thus far -- seems to have been painful for the Army, environmental regulators and the agency inheriting the site after clean-up. Therefore we sincerely hope that closure of a chemical weapons disposal facility at BGAD will not be similar to the JACADS process! At JACADS, PMCD fought for quite some time to keep the clean-up standards at industrial, rather than the desirable residential levels. It was sent back to the drawing board on its human health and ecological risk assessments. There is not yet agreement as to what buildings will be decontaminated and demolished, and what will be left behind. The schedule for closure is years behind, and costs grow. Kentuckians expect not to be saddled with the same inefficient process.

Comment 12-92

Response: Executive Order 12898 was designed to promote Environmental Justice by preventing the occurrence of disproportionately high and adverse effects to minority and low income populations. None of the disposal options discussed in this document, including incineration, are expected to result in such disproportionate impacts to the relevant populations.

Comment 12-93

Response: An analysis of possible impacts to minority and low-income communities receiving wastes from BGAD is beyond the scope of this document. Any impacts to those communities will be addressed by the permitting and monitoring processes related to waste disposal at those sites.

Comment 12-94

Response: JACADS is successfully progressing through the clean-up or closure phase. After negotiations, the Army and the EPA have agreed on the clean-up standards. JACADS has met or exceeded all the requirements set forth by the EPA. The commenter's observation regarding closure for non-incineration facilities is noted, although it is noted in the ACWA Final EIS (Section 8.1) that closure and decommissioning of an ACWA facility would be likely to be similar to the closure of baseline incineration facilities (such as JACADS and TOCDF) and the closure of destruction facilities that use alternative technologies (located at Aberdeen Proving Ground in Maryland and Newport Chemical Depot in Indiana).

At JACADS, the burning of wastes -- everything from lightbulbs to batteries -- will likely result in highly toxic air emissions Non-incineration technologies, whether then neutralization-based methods or electrochemical oxidation, would not present this hazard. Interestingly, the JACADS closure plan points out that for wastes too hazardous to be burned, the Army would have to use neutralization processes. **12-94 (cont)**

12-95

A comparison of closure processes associated with the various technologies should be discussed. At least one non-incineration technology has the option of processing secondary wastes as they are generated. Non-incineration methods may be less likely to be converted for future use. The technologies may be easier to decontaminate and disassemble. At the very least, the DEIS must mention these kinds of differences.

12-96

4.26 MITIGATION AND MONITORING

4.26.5.6 Destruction plant monitoring

This section is woefully inadequate. It states that for the baseline incinertion alternative, "the incinerator and building ventilation exhaust stacks would be the two main disposal plant sources for agent emission to the atmoshere." This is true if the facility operates as designed and there are no incidents such as power outages, where agent migrates to category C areas which are separated from the outside environment by doors without air tight seals. This section doesn't address the possibility of fugitive emissions, as evidenced at TOCDF, most notably in June 1999 when there was a power outage of more than 25 minutes and because the negative pressure air system failed, agent migrated into C areas and unfortunately there were no agent monitors outside the C area doors to determine whether or not there were fugitive emissions. Incidents like this one must be included as probable scenarios and monitoring plans need to include ACAMS monitors outside category C exit doors.

This section makes no mention of the use of multi-agent monitors in the incinerator systen stacks. Multi-agent monitoring must be sufficient in scope and timing to protect against the contingency that two or more agents may be processed at once unintentionally during a single agent campaign/phase due to waste characterization deficiencies and cross contamination/mixtures that may be present.

This section does not spell out where there are ACAMS and the number of ACAMS in the stacks other than the common stack. It also doesn't state the number of ACAMS in the common stack needed to provide continuous monitoring. The ACAMS are cycled so that there is a gap of a minute or more when they are analyzing and incapable of sampling. Therefore, for continuous monitoring three ACAMS are needed. Since DAAMS tubes are necessary to confirm ACAMS readings, there must be DAAMS in all furnace ducts leading to the common stack (i.e., the DFS, LIC and MPF furnaces). There should also be more than one ACAMS in the furnace ducts to provide continuous monitoring.

Comment 12-95

Response: As discussed in Sections 3.2 and 4.6.3 and Appendices D and G of the EIS, all of the considered alternatives have the capability of processing solid and liquid secondary wastes as they are generated. However, the issue in Section 4.25 of the EIS is closure and decommissioning. Each of the technologies will require decontamination. There is nothing at present to suggest that one technology will be easier to decontaminate than the others.

Future use of a destruction facility, regardless of the alternative selected, is addressed in Section 2.3.5 of the EIS. As noted there, Congress has directed that destruction facilities be dismantled and destroyed upon completion of stockpile destruction activities unless a host state permits future use. There is no evidence to suggest that non-incineration technologies are less likely to be converted to future use.

Comment 12-96

Response: The monitoring plan indicates the monitoring units' location and the areas to be monitored. The monitor in the 'C' area would detect agent if it migrated into that area.

Generally, the facility performs multi-agent monitoring on the common stack for current agent campaign and previous processed agent campaigns. The program developed various inspection procedures to prevent unintentionally processing any another chemical agent.

The monitoring plan would designate monitoring locations and sampling areas. The plan would stipulate the installation of three ACAMS units to monitor the common stack with two monitoring at a staggered configuration and the third as a spare. The second unit would have an offset cycle start time from the first unit.

The program does not have three ACAMS monitoring the MDB ventilation stack. One ACAMS monitors the ventilation stack and a second unit would sequentially sample after the first, second, and third carbon filter elements. If agent is detected after the third element, then that filter unit is taken off-line to prevent potential emission from the ventilation stack. Monitoring for solvents would not be performed; generally, solvents are not used in large enough quantities to affect the filter bank.

There also needs to be three ACAMS in the MDB ventilation stack to provide continuous monitoring. This is important for the potential of a short term break through in a filter bank due to the release in the work place of solvents and possibly moisture. **12-96 (cont)**

This section does not reconcile the fact that ACAMS and DAAMS agent monitors have never been validated for stack monitoring and the statement that the stacks are the main disposal plant sources for agent emissions. There must be an identification, consideration, evaluation, discussion and recommendation of more appropriate monitoring systems for stack monitoring, such as infrared, or other advanced monitoring devices for monitoring within the HVAC system and for the HVAC and common stack. **12-97**

The Army admits that chemicals are emitted from the TOCDF stacks that resemble agent GB to the stack ACAMS nerve agent monitors, causing ACAMS alarms on numerous occasions. Of the three ACAMS in the stack, only one is monitoring for agent at any one time. Also in the stack are two Depot Area Agent Monitoring Systems tubes that collect air samples that can be separately analyzed in a laboratory for agent. If the first DAAMS tube indicates agent when analyzed after an ACAMS alarm, then the second tube is analyzed using a procedure that is considered by the Army to be more precise. The Army procedure is to declare a stack ACAMS alarm and chemical release as not nerve agent unless both of the DAAMS tubes indicate that agent is present. **12-98**

The Army procedure of using ACAMS and DAAMS to measure nerve agent in high temperature high volume high velocity combustion gases in an incinerator stack has never been approved by U.S. EPA. The State of Utah expressed concern that the Army's stack monitoring had never been validated. The State of Utah requested that the Army conduct direct validation tests by placing a known amount of an agent surrogate (or agent) in the stack gases and check to see if the Army instruments registered the correct amount of agent. The Army refused to conduct these tests and the State refused to order that the tests be done. Discussion of monitoring at the incineration option at BGAD should contain an insistance that the Army perform these validation tests . **12-99**

The Army also admits that the ACAMS alarms that the Army declares as "false" or "non-confirmed" for agent are actually caused by chemicals exiting the stack at TOCDF and being detected by both the ACAMS and DAAMS. The Army also admits that is has not identified what these chemicals are nor does the Army know the toxicity level of the chemicals being emitted. Nonetheless, the Army retracts the site masking alarm that sounds when the stack ACAMS alarms after the DAAMS analysis indicates the chemical is not agent, even though the chemical identity and toxicity of the emitted substance is unknown. The Army knows, as do we all, that incineration is capable of creating and emitting substances more toxic than the substance fed into the incinerator, dioxin being a prime example. **12-100**

Comment 12-97

Response: The ACAMS and DAAMS are validated agent monitoring methods that will identify and quantify chemical agents. The implementation of the disposal plant's quality control plan provides the level of confidence to identify chemical agent. Generally, the infrared devices measure higher concentrations or have a higher detection limit for chemical agents than the ACAMS methods. This is not a viable option for the low concentrations of chemical agent that are currently being monitored.

Comment 12-98

Response: The number of ACAMS alarms compared to the sampling interval is a relatively small percentage of occasions. Since the Army uses ACAMS to monitor at low levels (approaching the detection limits of current technology) in order to provide an additional safety factor, it is possible that other chemicals may activate the ACAMS alarms. The method used to analyze the second DAAMS tube has a greater selectivity ability to identify the compound, but it does not have a sensitivity comparable to the method used for the first DAAMS results.

Comment 12-99

Response: The Army has developed monitoring methods for ambient air and incinerator stacks based on its experience in developing chemical agents. The Army's safety requirements do not allow the laboratory to "challenge" any operating stack with neat (i.e., pure) chemical agent. The operating facility laboratory does challenge the stack monitors with dilute chemical agent on a periodic basis.

In this regard, the Army is like industry, which also does not feed hazardous waste directly into the stack for potential emissions to the environment. The Army has conducted validation testing of monitoring equipment at remote sites that are authorized to perform these tests.

Comment 12-100

Response: The Army has completed many trial burn studies that demonstrate the incineration process more than meets compliance with the regulated emissions as compared to other similar incineration operations. The Army has not observed toxic substances such as dioxins exceeding EPA regulations from our trial burn reports.

An incident at TOCDF in 1998 raised the real question as to whether the Army's nerve agent stack monitoring system has any validity at all. The Metal Parts Furnace experienced an unexpected automatic shutdown due to excess temperatures in the furnace. The cause was determined to be 78 pounds of agent GB accidentally fed to the MPF in an MC1 bomb that was not adequately drained prior to being fed to the MPF. During this incident, which clearly and admittedly involved a violation of the Utah DEQ permit limit on agent feed to the MPF, the ACAMS in the MPF duct leading to the common stack registered agent at more than 500 time the Allowable Stack Concentration (ASC). **12-101**

However, the Army maintains that none of the detected chemical was agent and that the ACAMS in the common stack, some 50-100 feet further down the exhaust gas exit route, register nothing that resembled agent and did not alarm at all. The Army admits however, that the stack ACAMS did measure a chemical present that did not resemble agent enough to cause an alarm, as did the DAAMS tubes later analyzed. The Army explanation is 1) that none of the 78 pounds of agent fed mistakenly into the MPF escaped during the shutdown, 2) the chemical present at the duct ACAMS at 500 times the ASC was a non-agent product of combustion that resembled agent to the duct ACAMS which later transformed itself as it traversed the 50-100 feet to the stack ACAAMS at high speed into another product of combustion that did not resemble agent to the stack ACAMS, and 3) the chemical emitted from the stack was harmless even though it has yet to be identified. Discussion of monitoring for the incineration option at the BGAD must include the implications of this event and the necessity of a more appropriate monitoring system that can identify a greater range of toxic chemicals emitted from the incineration process.

This section should contain a review of the 1994 NRC report "Review of Monitoring Activities within the Army Chemical Stockpile Disposal Program" to determine to what extent the monitoring deficiencies identified therein have been resolved. **12-102**

The monitoring system should be designed and implemented so that the total mass of agent reaching the MDB carbon filters over any given period of time can be determined. In addition, the monitoring should be adequate to determine the sources of the agent reaching the MDB filter at any given time. This data should periodically be used to conduct a mass balance analysis by analyzing the carbon in the HVAC filters to determine if the agent load on the carbon accounts for all the agent that reached the filters. Any discrepancies in the amount of agent should be assumed to have exited the stack. **12-103**

Comment 12-101

Response: Confirmation that there was not an agent release in the 1998 incident referred to by the commenter occurred shortly after the incident in in 1998. Review of the strip charts for that ACAMS and the common stack ACAMS revealed an interferant. Analysis of the DAAMS tubes from the common stack confirmed that agent was not present.

Comment 12-102

Response: Section 4.26.5.6 is intended to provide a summary of monitoring systems to be used for destruction plant monitoring and is not intended to provide extensive discussion of the findings and recommendations of independent investigations of those systems. The Committee on Review and Evaluation of the Army Chemical Stockpile Disposal Program (the Stockpile Committee) of the National Research Council (NRC) has investigated and assessed numerous aspects of the chemical demilitarization program since 1989. The review of monitoring activities conducted by the Stockpile Committee in the 1994 report referenced in the comment has been superseded by more recent NRC reviews, including *Tooele Chemical Agent Disposal Facility: Update on National Research Council Recommendations* (1999) and *Occupational Health and Workplace Monitoring at Chemical Agent Disposal Facilities* (2001). These reports assessed the then current monitoring activities and practices and reported findings and recommendations. These findings and recommendations are summarized below.

The 1999 report noted that the Army was "pursuing a wise course" in upgrading ACAMS monitors while simultaneously funding the development of a faster, more reliable ACAMS. The Stockpile Committee also noted that the Army had significantly upgraded laboratory analysis tools for identifying species adsorbed on DAAMS tubes that may trigger false alarms, including the investigation of infrared technology that might provide real-time detection of agent release. The Stockpile Committee recommended that the Army should continue on its course of (1) improving the response times, agent specificity, and overall reliability of the ACAMS alarms, (2) testing and introducing improved laboratory instruments that could identify and quantify interferrants to minimize false positive ACAMS alarms, and (3) sponsoring the development, testing, and potential deployment of new analytical instrumentation capable of providing real-time or near real-time detection of significant levels of agent release and keep abreast of research in the area of rapid-response agent detection.

The most recent Stockpile Committee report that addressed monitoring (2001) noted that the current (as of 2001) airborne agent monitoring program's reliance on single-agent ACAMS monitors (for the agent being processed at the time) meant that an accidental release of a chemical agent not being processed (e.g., from a mislabeled munition or a munition filled with an unexpected or mislabeled agent in nominally agent-free areas) might go undetected. This issue was raised by the Stockpile Committee in its 1994 report, but the Army judged the probability of mislabeling to be low enough that routine deployment of ACAMS monitors for multiagent detection would be restricted to the plant-air

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carbon filtration system. The Army has indicated that multiagent monitoring would be implemented during closure operations when the possibility of multiple agents being accidentally released would be higher.

The 2001 report also repeated the concerns raised in the 1994 report regarding the lack of real-time agent detection and recommended that the Army develop a real-time system that uses a measurement technology independent of the gas chromatography with flame photometric detector methods. As noted in the 1999 report, the Army's attempts to develop and demonstrate such a system have not been successful. The Army continues to monitor technological advances in real-time or near real-time monitoring, particularly in light of expanded government and commercial activities related to antiterrorism activities.

The 2001 report also noted the recurrent problem of false positives — which occur when an ACAMS alarm goes off but the presence of agent cannot be confirmed by later DAAMS tube analysis. Since the ACAMS alarms whenever a preset level of agent (usually 20 percent of the relevant control level for a location) has been exceeded, a number of false positives is inevitable. The Army is committed to prevent the tendency to discount ACAMS alarms and to proceed as if agent were not present, although that commitment results in delays in processing.

The 2001 report also noted its determination that emissions of organic and metallic species (e.g., chlorinated dioxins and furans, heavy metals, and other toxic substances) are "exceptionally low" when the incinerators and their pollution abatement systems are operated as designed. The Stockpile Committee's 1994 report recommended that the Army consider periodically monitor emissions for species other than agent during normal operations as a means or reassuring disposal facility workers and the public that they are not being exposed to unacceptable risk. The Army has agreed to design and assess a plan for periodic monitoring of substances of potential concern (SOPCs) in stack emissions at TOCDF, but this plan has not been finalized or implemented.

Comment 12-103

Response: Providing the carbon loading amounts is a very difficult task. In general, one cannot recover a high percentage of any compound from carbon after its loading onto a filter.

For the incineration option for BGAD there is no indication that the DEIS has insisted on monitoring, sampling, and analysis sufficient to identify the chemicals known to be exiting the common stacks at TOCDF and JACADS which are considered to be non-agent even though the Army has consistently refused to identify these chemicals. Does such a phenomenon of "false" alarms and release of unidentified chemicals exist in regard to the HVAC/MDB and laboratory stacks as well? If so, the monitoring system should be required to identify those chemicals being released whether presumed agent or not. **12-104**

The technology identified by EPA in the last few years--multi-dimensional gas chromatography--should be used in the analysis of DAAMS to identify and separate out overlapping peaks so that agents, agent by-products and other PICs exiting the incinerator's stacks can be specifically and reliably identified. **12-105**

The citizens and agricultural communities around the BGAD and surrounding counties must be assured that all actions necessary to prevent contamination or a perception of contamination of the air, land, water, plants and animals will be taken. Air, land, water, plant and animal samples from the agricultural communities must be tested on a regular and ongoing basis by an independent third party prior to construction of any facility through demolition of the facility. These test results must be available to the public on a timely basis. Real time monitoring by an independent third party of any and all emissions must be in place as evidence of a clean and healthy environment during all chemical destruction at BGAD and the public must be able to access this information on a real time basis. **12-106**

APPENDIX E: INFORMATION SUPPORTING HUMAN HEALTH RISK ASSESSMENTS AT AGENT INCINERATION FACILITIES **12-107**

Does its best to downplay risk from dioxins. Comparisons appear designed to camouflage risk (i.e., equivalent of "2.5 packs per second," instead of saying "approx. 2 billion cigarettes per year," or "79 million packs per year." Instead, a detailed table of the kinds of dioxins to be emitted, the amounts of each kind, along explanation of what kind of filtering system (or other pollution control) will be used to prevent it from entering the air, and how much dioxin would get beyond that system, are needed.

Dioxin is one of the most toxic materials known to man, as well as persistent once it is deposited in the environment. Some dioxins are worse than oher. In the PMCD document, dioxins are lumped together and not treated separately. Guesstimates of dioxin emissions are not acceptable to the public that will be affected by them. All production of dioxins is being phased out internationally. It is already present in the average human body at levels that are too high.

Comment 12-104

Response: Actually, there is a low incidence of 'false' alarms relating to the sample intervals. Trial burn reports indicate successful performance of the incineration process and a minimum amount of other compounds.

Comment 12-105

Response: The Army has developed plans to evaluate new technologies and methods for chemical agent analyses. EPA defines many different methods for analyzing products of incomplete combustion (PICs).

Comment 12-106

Response: This request exceeds any current commercial practices. Generally, the facility will perform these sampling and analytical activities before construction and after demolition of the facility. Agricultural sampling and monitoring plans will be developed after the chemical agent destruction technology is selected for BGAD.

Comment 12-107

Response: With the possible exception of laboratory reagents, dioxins have never been produced intentionally. Inadvertent production has undergone dramatic reductions following the initiation of source reduction a decade ago. Yet, many common sources remain, including internal combustion engines, forest fires etc. The U.S. EPA has developed strict guidelines for dioxin emissions from hazardous waste incinerators (see response to 12-89 for citation). The application for a RCRA permit will require detailed discussion of monitoring methods for all regulated pollutants regardless of which technology is chosen. Until a detailed engineering design is finalized, emission quantities cannot be calculated. Experience at operating facilities provides the best indicator of possible emission quantities and trends in reductions.

There is NO release of dioxin that is inconsequential. Injury to even one person cannot be equated with compliance. No facility operates without violation; the projections made are based on full compliance. However, there is zero probability that they will ever meet those levels. What levels of dioxin might be emitted in case of non-compliance; e.g., from an upset. Where is the protocol to accompany these projections? Are they based on complex, unsupported modeling exercises or taken from the limited experience on Johnson Atoll? If these were discovered by accident and were a surprise by-product of incineration at Johnson Island, how many more could possibly have gone undetected? **12-107 (cont)**

The DEIS leaves it unclear what techniques will be used to monitor dioxin emissions. Admittedly, monitoring for dioxin is very difficult and slow, but it is essential. Incineration is a highly complex process, and the composition of emissions depends on small differences in the waste stream, based on assumptions about what is in the waste, since we can't find out exactly what is true. Conditions in the burn box change constantly. No one knows or can predict what will come out of the top of the box. The Appendix does not reflect the possible scenarios. For example, at existing incinerator(s), how often has the pollution abatement system failed. When it does, what happens? Can there be unplanned releases of toxins? This draft fails to address issues associated with manufacture of greenhouse gases, including but not limited to quantities in all processes and impact **12-108**

Submitted February 15, 2001 by

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Comment 12-108

Response: The Army is working with the U.S. EPA to develop technologies for monitoring dioxins and furans continuously in a stack environment. It is too early in that process to identify what techniques will be identified or used to monitor dioxin emissions.

And on behalf and with the permission of:

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Appendix A -

12-109

Comment: Trial Burns at TOCDF : Army documents show that when PMCD has did trial burns at TOCDF they selectively chose specific munitions out of a particular weapons type (ie: —55 rockets) that they knew would be more likely to pass the trial burn requirements. Yet, they also knew that those selected munitions don't actually represent what will be processed through the system once the trial burns are completed and the operational permit is issued.
Since the trial burns are designed to demonstrate the capability to operate throughout the entire munition campaign for all the munitions of that same type, it is apparent from the documents that the trial burns at TOCDF were manipulated to reflect capabilities that were not actually demonstrated? It appears therefore that the Rocket trial burns at TOCDF were purposefully "rigged", based on the documents cited.
Commentors assert that the same type of approach will be used during the trial burn plan and the modifications to the trial burn plan that is currently under consideration for BGAD should incineration be selected?
Commentors refuse to take PMCD at their word that it won't happen, and demand a specific plan in writing that will prove that any trial burns, surrogate or agent, will be representative of what is planned to be incinerated during the post trial burn and full scale operational period. (Documents cited in this comment: "Issues and Directed Actions with Fact Sheet" from Lessons Learned Meetings at TOCDF dated December 6, 1999 and Issue # 95-104) and Page 8 (Update March 30, 1999)).

Comment: Inadequate Characterization of the Waste Stream: Internal documents show that the Army lacks the capability to identify with certainty what material is contained in various munitions of the same or different types. and that this is reflects their inability to present credible agent analysis information and potential contamination of the waste feed impacting their Waste Analysis Plan submitted to the state. Furthermore, the accuracy of the predicted material in the incinerator feed has also been challenged by the state of Utah in the past.

12-110

Additionally, on page 22 of the “Operations Task Force Report 2000: Section: "Impact of Stockpile Characteristics" it states: " Stockpile chemical weapons disposal operations has identified stockpile deterioration issues with chemical agents, explosives components, and metal parts that have been throughput limiters at both TOCDF and JACADS. Three problems have been discovered with GB : gelled rockets.." is one of these problems.
Also, on page 27 of the “Operations Task Force Report , Section 4 "MACT Rule"; Paragraph 2 it says, "The relative significance of the mercury problem is directly related to the expected mercury content in the feed to the furnaces. ....several data points exist which indicate that higher mercury feeds should be anticipated, at least for some lots or sublots of munitions or containers."
It has also been stated by PMCD that higher levels of arsenic have been found in GB than anticipated during the M-55 Rocket campaign at TOCDF.
It appears from this data, and there are additional documents dealing with the mis-characterization of the feed, that it is actually unknown what is contained in the material slated to be disposed of at BGAD.

Comment 12-109

Response: Trial burn plans will be submitted to state regulators for approval prior to any incineration operations.

Comment 12-110

Response: Waste streams from the baseline incineration and alternative technologies are described in Section 4.6.3 of the EIS. Detailed characterization of waste streams would be done in accordance with Commonwealth RCRA permit requirements.

Therefore Commentors state that it is not possible to make a determination of emissions compliance, destruction efficiency, secondary waste characterization standards, health impacts, etc., through a trial burn when only certain non-representative portions of the overall waste feed will be put into the furnaces during the trial burn will not represent the feed during normal operations. In other words, the trial burn material will not represent what's fed info the furnaces during operations (Documents cited in this comment: "Issues and Directed Actions with Fact Sheet" from Lessons Learned Meetings at TOCDF dated December 6, 1999 and Issue # 95-104 - Update March 30, 1999 and Page 5 (Update from the January 1998 Project Management Workshop: Operations Task Force Report; SFAE-CD-CO-A (50Q)). **12-110 (cont)**

Comment: Gelled Rockets: **12-111**

It is a known fact from operations, prior to the ArmyÕs releasing of the BGAD EIS at JACADS and TOCDF that significant quantities of agent would not drain from the munitions stored at BGAD. These "gelled agents" will therefore **not** be destroyed in the liquid incinerator as presented in the EIS. Therefore the public is being asked to comment on processes that are not correctly represented in the EIS. This false representation of the facility demonstrates that the BGCDF can not, under the baseline option cannot comply with the environmental laws, rules and regulations of the KHWMMA, as amended.

Furthermore, NEPA requires that an EIS provide “an environmental full disclosure” to members of the public. This has not been done and the evidence is clear that information is being withheld intentionally concerning operation of the incineration option under consideration.

Additionally, on page 29 of the 2000 Operations Task Force Report: Section 7 " Operational Issues with Gelled Rockets" it says, "Studies performed to date indicate that the DFS is capable of processing gelled rockets at a rate sufficient to meet projected steady state rates of 9.8 rockets per hour. Trial burn strategies must be developed to ensure this flexibility is obtained. However, TOCDF experience with processing gelled rockets at a rate of one per hour identified a series of operational issues which must also be addressed to achieve higher feed rates. These issues range from obscuring of the camera in the ECR ....to pressure and temperature fluctuations which occur as the gelled rockets begin to combust."

Commentors note that the EIS under consideration ignores non-gelled rocket processing as cited in the 2000 Operations Task Force Report.

Based on this information Commentors position is that ignoring gelled munitions undermines the PEPA mandate of providing “an environmental full disclosure” to members of the public .

(Documents cited in this comment: "Issues and Directed Actions with Fact Sheet" from Lessons Learned Meetings at TOCDF dated December 6, 1999 and Issue # 95-104 - Update March 30, 1999 PAGE 3 and 4 Operations Task Force Report; SAFE-CD-CO-A (50Q)).)

Comment: The proposed incineration option will violate RCRA 42 USC ¤ 6973 **12-112**

Commentors assert that processing gelled rocket munitions would create an Imminent Hazard under RCRA ¤ 42 UCS ¤ 6973 Commentors allege this would be is in violation of federal law and poses an imminent hazard to public health and the environment.

Comment 12-111

Response: The Anniston Chemical Disposal Facility (ANCDF) has submitted for approval a trial burn plan for the DFS of processing only gelled rockets. The lessons learned at the ANCDF with gelled rockets will be applied at the Blue Grass facility, if incineration is chosen as the destruction technology. The TOCDF experience with processing gelled rockets, referred to by the commentor, was one gelled rocket per hour along with 88 bursters from 105-mm projectiles.

Comment 12-112

Response: The comment is noted. The comment offers no proof or evidence to support the claim of imminent hazard. Experience to be gained upon implementing the plan for processing gelled rockets at the Anniston Chemical Disposal Facility (ANCDF) will provide lessons learned for an incineration facility at BGAD, if incineration is selected as the destruction technology for BGAD.

Comment: DFS Feed Chute: **12-113**

Commentors point to chronic and ongoing problems with the DFS Feed Chute at the TOCDF, Utah facility and also recognize the part this system plays in the proposed incineration option at BGAD and Recognize that these problems have not been rectified, that they played a substantive role in the release of agent GB out the stack of the TOCDF on May 8, 2000, and that there have been continuing problems with this system. Based on this information Commentors position is that ignoring gelled munitions undermines the PEPA mandate of providing “an environmental full disclosure” to members of the public

Commentors also allege this situation would also add to the an Imminent Hazard under RCRA cited above.

Comment: Ignoring of Options to Mitigate M-55 Rocket Storage Risk: **12-114**

Commentors point to PMCD’s ignoring of options for elimination of the risk from continued risk of storage of M-55 Rockets (gelled or non-gelled).
As early as November 1985, the Army knew of options to remove the chemical agent and transferring it to standard chemical agent storage containers. (A.D. Little Report P21-0008.1; 1985).
In addition, the Army has ignored the 1993 National Research Council Finding that states, “Initial weapons disassembly and agent detoxification and partial oxidation could meet international treaty requirements and eliminate the risk of catastrophic agent releases during continued storage.” (Alternative Technologies for the Destruction of Chemical Agents and Munitions ; NRC 1993)
In addition, the Army has ignored the 1994 National Research Council Recommendation to “...consider reconfiguring each high-risk stockpile to a safe condition prior to disposal if this will significantly decrease cumulative total risk.” (Recommendations for the Disposal of Chemical Agents and Munitions; NRC, 1994).
By ignoring all of the above and more the Army reflects its disregard for the principles of protecting public health and the environment contained in Kentucky and Federal environmental laws along with the Congressional directive of offering “maximum protection” to the public during disposal of these munitions.

Comment: Baseline Incineration Design Misrepresented: **12-115**

The Baseline Incineration at BDAG is represented as processing three differing waste streams in three dedicated furnaces - one for each stream.
Under the proposed modifications currently under review at AANCDF and UMCDF, three waste streams would be processed in a common furnace which undermines the basic concept of the baseline design and conflicts with the safety and performance standards represented to Commenters since the disposal program was brought forward.
This approach creates significantly greater agent quantities within the DFS system than contemplated within the "baseline" design, leading to the potential for higher amounts of agent releases during upset conditions and/or operational malfunctions, and raises serious questions surrounding steady state operational capabilities given the delicate air flow balance required between the HVAC and combustion systems.
Additionally, these factors have not been addressed in the Safety and Hazard Analysis or the Health Risk Assessments for BGAD.

Comment 12-113

Response: The main corrective action taken at TOCDF was an isolation valve installed on the DFS at TOCDF. That valve is now included in the incinerator facilities at all other CONUS sites.

Comment 12-114

Response: Issues related to the risks associated with the storage of M-55 rockets are outside the scope of this EIS. Nonetheless, the recommendations the commenter refers to have not been ignored. The Army has examined the fairly general recommendations presented in the NRC documents and has selected a number of methods to reduce the risks associated with the storage of M-55 rockets. These methods include the installation of improved lightning protection and the closure of igloo vents to prevent the downwind hazard in the event of a leaker. The Commonwealth of Kentucky prohibits moving and/or reconfiguring or changing the munitions without a permit.

Comment 12-115

Response: Incinerator design at BGAD would have three waste streams leading to three dedicated furnaces as described in the EIS. The Anniston Chemical Disposal Facility (ANCDF) and Umatilla Chemical Disposal Facility (UMCDF) also have this design. Perhaps the commenter is referring to the dunnage incinerator (DUN). This involves the handling of secondary waste. The DUN incinerator would not be part of the BGAD design. The DUN is not being used at UMCDF nor is it planned on being used at ANCDF.

The health risk assessment to which the commenter refers will be prepared as a part of the RCRA permitting process and is not a part of this EIS.

(1)

Comment: The modified baseline approach would require "Certification" under PL 105-261: The Certification requirement contained in PL 105-261 (¤ 142 (d) cites that the Under Secretary of Defense (A&T) certify that any alternative to incineration be found to be (A) "as safe and cost effective for disposing of assembled chemical munitions as is incineration of such munitions; and is capable of completing the destruction of such munitions on or before the later of the date by which the destruction of the munitions would be completed if incineration were used or the deadline for completing the destruction of the munitions under the Chemical Weapons Convention" (emphasis added). **12-116**

Commenters assert that the intent of Congress in 105-261 by referencing "incineration" referred to "baseline incineration" as that was the only "incineration" design available at the time the law was enacted (ie: separation of agent, explosives/propellant, metal parts and dunnage into separate streams to be fed into furnaces each dedicated to treating that individual stream).

The major changes to "incineration" as defined in 105-261 that are being proposed within the MOD under consideration in ANCDF and UMCDF were not contemplated as "incineration" and are indeed an alternative to "incineration" as defined in 105-261.

Commenters therefore contend that the intent of 105-261 requires that such modifications to the baseline facility at BGAD would be required to be "Certified" by the Secretary of Defense or his designee as compared to baseline "incineration" in regards to safety, cost and schedule

This would appear to be appropriate, particularly in light of the NRC's pointed findings on the concept of processing such mixed waste streams within the same furnace.

Commenters contend that if the baseline is deployed at BGAD, it would not be the same technology as the "incineration" process referred to in 105-261 at the time of its passage and would indeed be an alternative to "incineration" as defined within the law and therefore require "Certification" prior to deployment at BGAD.

Comment 12-116

Response: The technology base evaluated in this EIS is still incineration which is not a new technology requiring certification. Contrary to the claims in the comment, Public Law 105 261 does not apply.

Appendix B -

12-117 (cont)

Referencing ¤ 4.9.3 "Impacts of Operations" Pages 4-62 thru 4-68

This below is submitted as refuting the claims made in the above referenced section of the Bluegrass Draft EIS *regarding the protectiveness of the baseline incineration option contained in the EIS. Although developed in response to the Utah DRAFT HRA commentors* feel the *information contained herein is or will be relevant to the BGAD HRA* particularly since this is the first HRA done for CW incineration under the new EPA Guidance (1998) including the 1999 errata *Since there is no Kentucky DRAFT HRA available, and the most recent HRA for any baseline facility is Utah's. commentors wish to incorporate the following as part of the*ir *Kentucky EIS comments.*

I. THE UTAH STATE DEQ DSHW'S HANDLING OF THE HRA SHOWS A BIAS, A PREDISPOSITION TO PERMIT TOCDF AND FIND THE TOCDF RISKS ACCEPTABLE DESPITE CONTRARY EVIDENCE, WHICH BIAS IS EXEMPLIFIED IN THE STATE'S DECISION TO ABANDON ITS HRA PROTOCOL IN SELECTED AREAS AND TO LATER ABANDON ITS CHOSEN RISK ASSESSMENT METHODOLOGY AFTER SEEING THE RISK CALCULATION RESULTS, AS WELL AS IN THE STATE'S DECISION TO DECLARE THE CLEARLY UNACCEPTABLE RISK ESTIMATES IN THE HRA ACCEPTABLE BASED ON A POLITICAL DECISION TO USE BEST CASE RATHER THAN REASONABLE WORST CASE ASSUMPTIONS

The State proposed a HRA protocol and then took public comment on the protocol (ignoring most of commentors' recommendations) and finalized the protocol. The State then proceeded to calculate the TOCDF and CAMDS risk using this protocol, with some departures which are also of concern and noted elsewhere, and using data selected by the State. The State also selected the risk standards it would rely on. Risks for several chemicals, including mercury, 2 PAHs, DNOP and EMS were found to exceed the State adopted EPA risk standards. Then, after calculating the risks with its own procedures, data and standards, the State promptly abandoned the HRA methodology and declared its own risk results for numerous chemicals of potential concern (COPCs), those that exceeded the risk standards, to be meaningless and unreliable. The fact that the State abandoned its own approach only after seeing the risk results shows a bias and a predisposition to find in favor of the TOCDF operators, the Army and EG&G. The State could just as easily have discounted its finding that the risks were acceptable for those chemicals having risks calculated as within the risk

Comment 12-117

Response: The information offered in the comment is appreciated. Health Risk Assessments (HRA) follow federal and state guidance in evaluating potential human and environmental health effects from the chemical agent disposal facilities. The regulating agencies have the authority to approve a health risk assessment, including the protocol under which it will be prepared. All the HRA conducted for the chemical agent disposal facilities so far have been approved by the regulating agencies.

Appendix E of this EIS provides a summary discussion of HRAs for proposed agent incinerators. The HRA discussed in this comment (i.e., for the TOCDF) was not available at the time the Draft EIS was prepared. Because the Draft TOCDF HRA has now been published, Appendix E in this Final EIS has been revised to include a summary of the HRA with some commentary related to selected concern areas in this comment.

standards based on the omissions and flaws in the HRA methods noted herein. However, the State only discounted the results for those chemicals found to exceed the standard. **12-117 (cont)**

Mercury risk is a prime example of this State bias. The State argues in the HRA that it can explain away the unacceptable hazard quotient calculated in the HRA for mercury based on the fact that the BRA is not currently in operation and is not yet approved for operation. But this is a fact that was known before the risk calculations were performed and if the State really believed that the BRA would never operate the BRA should have been omitted from the HRA at the protocol stage before the State saw the risk calculations results. The State has not permanently prohibited the BRA from ever operating based on mercury risk or for any reason and thus the risk is still real. Further, the mercury in the stack gases remains 9 times greater than that in the brine and BRA emissions regardless of whether the BRA operates or not, as explained below, because the scrubber brine can only remove 10% or less of the mercury from the combustion gases, so the BRA operation is a red herring. The State bias on mercury risk is also shown by the fact that the State did not require the mercury mass balance data from the TOCDF GB campaign to be submitted before the mercury emissions rate was determined to be the detection limit in the HRA. Based on the high levels of mercury found in GB ton containers, the fact that mercury as an element cannot be destroyed by incineration, and no TOCDF pollution control device currently installed or required by the State effectively removes mercury from the combustion gases, the State had every reason to believe that the mercury emissions rates would not be at the detection limit. At a minimum, TOCDF operators should have been required to confirm the ultimate fate of all the mercury found in the ton containers before selecting a mercury emissions rate for the HRA. Ms. Brenda Mugleston and her attorney, the undersigned, have reported to the State that much of the mercury ostensibly cleaned from the GB tons at TOCDF before incineration has not been accounted for in TOCDF's effort to do a mass balance, indicating substantially higher fugitive and/or stack emissions of mercury have occurred at TOCDF that reflected in the HRA. The TOCDF mercury risk is unacceptable and this fact does not change even if the BRA is never operated. The State has embraced information that purportedly supports discounting the mercury risk while ignoring the substantial information that shows that the mercury risk is real. This clearly shows the State's bias.

The Utah DEQ and DSHW knows, among other reasons because they have been told by the Sierra Club, the Chemical Weapons Working Group, the Vietnam Veterans of America Foundation, FAIR and their attorneys, that TOCDF continues to experience repeated stack ACAMS alarms which have been acknowledged by the Army and EG&G to involve the actual release to the environment of some chemical that resembles chemical warfare agent to the ACAMS agent air monitor. The Army and EG&G have steadfastly refused to

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identify what those chemicals are that are admittedly released to the environment on an on-going basis at TOCDF. The Utah DEQ and DSHW have taken the three monkeys' approach to this problem. Considering the current HRA approach (apparently mandated by U.S. EPA, and properly so) adopted by UDEQ of analyzing a number of chemicals in the HRA expected to be emitted but which have not been actually detected in the limited testing done to date at the detection limits for those tests, and estimating the emissions of these chemicals at the detection limits, with resulting calculation of some extraordinary high and unacceptable risks, it is clearly unconscionable, not to mention arbitrary, capricious and contrary to law, for the UDEQ to close their eyes, ears and mouths regarding the risks posed by the admitted repeated TOCDF stack releases of yet to be identified chemicals, which are with virtual certainty in whole or part either actual chemical warfare agents or toxic byproducts thereof. Under the States' RCRA obligations, these emissions must be assumed to be agent until proven otherwise and must be identified and quantified as soon as possible and included in the HRA. No further TOCDF operation should be included until this task is completed. For the State to do otherwise is to recklessly disregard real dangers to workers, the public and environment, which shows a clear bias.

12-117 (cont)

The State departed from EPA guidance and its own protocol on a number of factors that resulted in a lower risk estimate. An example is the omission in the HRA of any cancer risk from ingesting chromium, a known carcinogen. The State decided to ignore EPA guidance which dictates that ingested chromium be assumed as carcinogenic as inhaled chromium given current data gaps. The State decided, contrary to this EPA guidance, to treat ingested chromium as having zero cancer risk. Departing from EPA guidance to lower the risk estimate shows a bias.

The State arbitrarily ignores important evidence of unacceptable risk from dioxin presented in the EPA Dioxin Health Assessment on the excuse that it is a draft and then relies heavily on other EPA draft documents for the HRA. This double standard shows a bias.

The State's bias was clearly demonstrated during the preparation of the 1996 predecessor HRA for TOCDF during which preparation the infant was calculated to receive a dioxin dose from TOCDF alone of 50 pg/kg/day (50 times greater than the EPA RfD and the ATSDR MRL) upon which calculation the State promptly ordered the infant deleted from the HRA before that result ever became public. That risk to the infant would never have been made public had it been left to the State and its prior contractors. Only the diligent inquiry of concerned citizens resulted in that risk to the infant being made known to the public. The current HRA carries on in that not so venerable tradition.

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II. THE HRA EVIDENCES, NOTWITHSTANDING ITS SHORTCOMINGS NOTED HEREIN, THAT OPERATION OF TOCDF POSES AN UNACCEPTABLE RISK BY EPA STANDARDS, BUT THE STATE IMPROPERLY STATES IN THE HRA THAT THESE RISKS WILL BE DEEMED ACCEPTABLE **12-117 (cont)**

The HRA does calculate a dose of dioxin for the breast fed infant of greater than 1.7 pg/kg/day which exceeds the ATSDR MRL and EPA Office of Water (which are identical) of 1 pg/kg/day and exceeds more so any RfD which EPA might set today based on the currently available scientific information on dioxin toxicity. The State has not been honest with the public regarding the fact that the EPA Office of Water does have and uses an RfD for dioxin non-cancer effects of 1 pg/kg/day TEQ as does the ATSDR (via their MRL), and the new literature on dioxin and the new EPA Dioxin Health Assessment, draft or not, provide no basis for making this number less protective (larger), but do provide a basis for making the number considerably smaller. There is no scientific or public health rationale that justifies continued exposure of human infants, children and adults to levels of hazardous waste and contaminants known to cause harm or to be virtually certain to cause harm, as is the case here with dioxin. Using the 1 pg/kg/day RfD for total dose for the infant is much more defensible than what the State has done, which is to adopt an arbitrary 10% more exposure is ok standard when the existing infant dioxin exposure is horrendous. Using a smaller RfD value based on the recent studies, the greater sensitivity of the infant and additional unknowns regarding dioxin impacts on developing organisms is more defensible yet. The State ignores the recent Arkansas (Cramner) studies and Dutch studies of infants, children and adults which show neurological and diabetes like adverse effects at levels of dioxin exposure already exceeded by most infants and children and many adults. The State is allowing the infant, already more than 60 times overexposed via the average infant 60 pg/kg/day current dioxin exposure, to have an additional dioxin exposure of 6 pg/kg/day from TOCDF and CMDS alone. Under this strange logic, the public health protection standards adopted by the State is essentially the more you have already been exposed from existing sources, the more the State will allow you to be exposed from new sources. This is a recipe for disaster by allowing an ever increasing dioxin exposure that would never be declared to be too high even if the entire population was receiving a lethal dose. This approach has nothing to do with science, public health, logic or ethics. This approach is simply playing politics with public health, victimizing further an already victimized infant population, a population that cannot speak for or defend itself, for the benefit of corporate profit and agency convenience. This is, in a word, unconscionable.

The HRA does calculate a mercury non-cancer risk that exceeds the EPA standard of a hazard quotient of 0.25 based primarily on emissions of mercury from the Brine Reduction Area (BRA). The BRA was estimated as accounting for 93% of the TOCDF mercury risk calculated in the HRA. However, the BRA mercury emissions rate was calculated based on the detection limit (DL). The DL was used

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apparently because, notwithstanding that mercury was detected via sampling and analysis in the actual brine, mercury was not detected in the BRA emissions during the limited sampling performed. But the mercury emissions from the stack would be expected to be considerably greater than from the BRA (the reverse of what the HRA calculated) because mercury is not efficiently removed from the stack gases and the scrubber brine would not be expected to remove more than 10% of the mercury at best. Thus the stack gases would have 9 times or more the mercury contained in (removed from) the brine and the stack mercury emissions and risk should be correspondingly greater than the mercury emissions from the BRA. Thus, the HRA calculation of an unacceptable mercury risk is actually an understatement of the risk. The mercury risk is greater than the HRA calculates because 1) mercury emissions will be greater than the detection limit rate relied on in the HRA due to high mercury levels found in some ton containers and agent and omission in the HRA of any data from the MPF burning these high mercury tons and omission in the HRA of the TOCDF mercury mass balance data which apparently indicates substantial releases of mercury to the environment; 2) the portion of mercury emitted as fugitive emissions rather than stack emissions still contributes to the risk but was excluded from the HRA; 3) the stack gas will contain 9 times or more the mercury that the brine contains and this fact was ignored in the HRA; 4) existing mercury levels in water, fish, soil and food in Utah were ignored or assumed to be zero. The State argument offered in the HRA to explain away the unacceptable hazard quotient calculated in the HRA for mercury B that the BRA is not currently in operation and is not yet approved for operation B is unpersuasive because this is a fact that was known before the risk calculations were performed and if the State really believed that the BRA would never operate the BRA should have been omitted from the HRA at the protocol stage before the State saw the risk calculations results. The State has not permanently prohibited the BRA from ever operating based on mercury risk or for any reason and thus the risk is still real. Further, the mercury in the stack gases remains 9 times greater than that in the brine and BRA emissions regardless of whether the BRA operates or not so the BRA operation is a red herring. The TOCDF mercury risk is unacceptable and this fact does not change even if the BRA is never operated. **12-117 (cont)**

The HRA also calculates an unacceptable risk from 2 polycyclic aromatic hydrocarbons (PAHs), whose emissions rates were assumed to be the detection limit because the State has found no data detecting these compounds in TOCDF, JACADS or CAMDS emissions. After calculating this unacceptable risk the State promptly discounted the unacceptable hazard quotients because the State believes the PAHs will not actually be present in emissions and the PAHs will be substantially metabolized. But the members of the family of PAHs are commonly found in incinerator emissions and it is not unrealistic to expect the 2 PAHs in question to be present at a significant fraction of the detection limit. If there was

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legitimate scientific reason to rule out the presence of these PAHs in TOCDF emissions, that fact should have been raised prior to the State seeing the results of the risk calculations. If the State was sincerely concerned with risk from chemicals actually known to be present in TOCDF emissions it would have required the Army to determine the identity and toxicity of the chemicals known to be repeatedly emitted from the TOCDF common stack that set off the stack ACAMS alarms (the chemical agent air monitors), so that the risk from these emissions could be calculated in the HRA. The State has knowingly ignored these emissions for years. **12-117 (cont)**

The HRA calculates a number of cancer risk standard exceedances in addition to the non-cancer risk exceedances. Considering all of the factors excluded from the HRA that would have increased cancer risk, there is no reason to assume that these cancer risk exceedances can be discounted based on uncertainties or conservative assumptions used in the HRA for what was addressed.

The risks calculated in the HRA for EMS, DNOP, PAHs and mercury are clearly unacceptable and were calculated based on the procedures and assumptions selected by the State and should not be discounted based on after the fact (after the results are known) self-serving criticism by the State of the States' own methods. If the emission of these chemicals, or any one of them, at the dangerous levels calculated in the HRA cannot be scientifically ruled out, as appears to clearly be the case from the analysis in the HRA itself, then, based on the State's obligation under RCRA to ensure protection of public health and the environment and to ensure trial burn and long term operations do not pose an imminent hazard to the public (which includes workers) or the environment, consistent with the precautionary principle, the permit must be denied based on these unacceptable risks.

III. THE HRA OMITS EMISSIONS SOURCES, EXPOSURE ROUTES, TOXICITY DATA, AND RISK STANDARDS THAT IF INCLUDED WOULD, WITH VIRTUAL CERTAINTY, RESULT IN RISKS ESTIMATES THAT WOULD EXCEED EPA TARGET LEVELS AND WOULD REPRESENT UNACCEPTABLE RISKS BY ANY REASONABLE STANDARD

The HRA completely omits risk from fugitive emissions, which is a major source of both chemical warfare agent emissions and toxic metals emissions at TOCDF.

The HRA completely omits risk to workers from exposure to chemical warfare agents, metals and other contaminants during the course of their job performance, including but not limited to exposures that have been documented from the DFS waste and the MPF waste, hot cut outs, stack plume exposures, agent migration, and incidents involving leaking munitions. It is a fallacy to assume that worker protection is not part of RCRA requirements and the administrative rules for the Division, as implied by Division of Solid and Hazardous Waste representative on

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June 25, 2002, at the public information meeting. In a letter received from the Division of Solid and Hazardous, June 25, 2002, it states: “The DSHW agrees that worker safety is an important consideration.” (Source: Letter from: Dennis R. Downs, Executive Secretary Utah Solid and Hazardous Waste Control Board; dated: June 24,2002; To Cindy King, Utah Chapter of Sierra Club). **12-117 (cont)**

The HRA completely omits dioxin emissions from burning dunnage (e.g., chemical agent contaminated wood, plastic and charcoal) although burning dunnage in the metal parts furnace and deactivation furnace has been considered and has not been ruled out.

The HRA omits emissions data from burning agent ton containers that were found to contain high levels of mercury, and omits TOCDF mercury mass balance data for those high mercury tons, resulting in use of detection limits for mercury emissions rates which substantially underestimates mercury emissions which have occurred from the stack and via fugitive emissions.

The HRA omits risk estimates from stack emissions known to occur at TOCDF which cause ACAMS (agent air monitor) alarms and which are thought by the Army to be non-agent. These emissions have yet to have their chemical identities or toxicity determined.

Risk from acute (short term) exposures to chemical warfare agent are completely omitted from the HRA. Thus risk to workers and the public from agent release during accidents or incidents, of which there have been numerous examples to date at TOCDF, is omitted, as is risk to workers and the public from non-stack (fugitive) releases of agent which has been reported by workers to have occurred on an on-going basis at TOCDF (e.g., releases from the DFS HDC bin enclosure).

The HRA omits any risk standard or toxicity estimate for dioxin non-cancer effects such as a reference dose (RfD) or minimal risk level (MRL) despite the fact that such an RfD is available from the U.S. EPA Office of Water and such an MRL is available from the federal Agency for Toxic Substances and Disease Registry (ATSDR). The State, ignoring the EPA OW and ATSDR 1 pg/kg/day virtually safe dose for dioxin for adults, has taken the position that it has not determined what would be a virtually safe dose of dioxin for an infant or adult but has nonetheless represented in the risk assessment that it is safe for the infant to be exposed to an additional 6 pg/kg/day dioxin toxic equivalents (TEQs) from TOCDF on top of the average infant dioxin exposure of 60 pg/kg/day TEQs from other existing dioxin sources. The State’s omission of a dioxin virtually safe dose is a knowing and intentional political decision to avoid admitting to the public that the population is already overexposed to the ultra toxic chemical dioxin and consequently the TOCDF risk is unacceptable and the TOCDF permit should be

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denied because TOCDF emissions add additional dioxin exposure to an already unacceptable total dioxin exposure. **12-117 (cont)**

The HRA omits the developing fetus as a sensitive population.

The HRA should but does not address the risks from sensitization effects for organophosphates (nerve agents and pesticides) and potentiation/synergistic effects for same and other TOCDF emissions including dioxin.

The emissions estimates for TOCDF should be based on and include, but are not based on nor do they include, a measurement of the total dioxin-like emissions and total dioxin-like toxicity of a representative sample of stack gas (for example, using a bioassay approach).

The emissions estimates for TOCDF do not but should include inter alia a measurement of the total toxicity of a representative sample of stack gas from each waste stream (for example, using a bioassay approach).

The emissions estimates for TOCDF should but do not include an identification and measurement of each of the PICs in a representative sample of stack gas (for example, using the multi-dimensional gas chromatography approach described by the 1998 EPA report on identifying a target analyte list for hazardous waste incinerators).

The HRA does not provide for emissions characterization by measurement rather than estimate in some cases where technology allows measurement.

The HRA should but does not consider the accident risks at TOCDF using an analysis based on the approach of Professor Charles Perrow based on his studies of complex systems and in light of the new agent toxicity and accident analysis regarding the Umatilla, Oregon sister CDF by Dr. Black.

The HRA should but does not include an analysis of EPA and industry data on organophosphate pesticides showing surprising toxicity at lower doses, e.g. U shaped dose response curves.

The HRA should but does not consider combined and cumulative exposures to pesticides together with nerve agent emissions from TOCDF.

The HRA/PP should but does not include a careful analysis of chemical warfare agent toxicity including consideration of the recent GAO study, the Congressional reports on Gulf War illness, the Army and NRC studies on upgrading agent toxicity estimates, the Dugway sheep kill data available from the Army on CD-ROM, and the new CDC and EPA agent toxicity and exposure estimates and standards.

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The HRA should but does not include emissions estimates based on trial burns of longer duration than standard trial burns based on recent studies showing short term trial burns give biased low emission measurement. **12-117 (cont)**

The HRA is not based on valid data showing emissions when burning undrained and gelled agent munitions, but incidents at TOCDF indicate such emissions can be dramatically higher than when burning drained munitions.

The HRA should but does not consider risk to workers based on the recent worker exposure and injury incidents at the Umatilla CD facility, the Pine Bluff CD facility, and the Anniston CD facility.

The HRA should but does not base agent emissions on actual measurements using a method validated by EPA for stack gas measurement of agent emissions, including a careful analysis of the emissions during repeated stack alarms at TOCDF.

The TOCDF HRA should but does not consider the cumulative and combined impacts of open burning/open detonation (OB/OD) past, present and future with the TOCDF and other area emissions because both TOCDF and OB/OD and other area pollution sources emit persistent toxic compounds that will not quickly degrade in the environment and will ultimately pose a combined threat via this persistence (for decades) and simultaneous presence in the food chain notwithstanding that UDEQ may not allow OB/OD simultaneous with TOCDF operation.

The HRA should but does not include an assessment of the total local impact of TOCDF emissions together with existing levels and continuing emissions of air pollutants from all other area sources, particularly in light of recent findings in a study by the Physicians for Social Responsibility, the National Environmental Trust, and the Learning Disabilities Association of America that concluded that air in Tooele County to be the most toxic in the nation, and polluted enough that local children could be seriously harmed by inhalation of the contaminants.

The HRA should but does not include an assessment of the total non-local impact of TOCDF emissions together with existing levels and continuing emissions of air pollutants from all other national air pollution sources, particularly in light of recent findings in a study by Dr. Barry Commoner that concluded that long range atmospheric transport of persistent organic pollutants from air pollution sources in the United States was causing contamination of native lands, ecosystems and the foodweb in northern Canada, and similar studies showing that colder climate areas are the ultimate environmental sinks for persistent organic pollutants and are consequently developing dangerous levels of contamination.

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The HRA should but does not include an assessment of the total non-local impact of TOCDF emissions of dioxin-like compounds together with existing levels and continuing emissions of such air pollutants from all regional air pollution sources, particularly in light of recent findings in a report by the National Research Council (NRC) that concluded that regional atmospheric transport of persistent organic pollutants from air pollution sources is causing contamination at levels of concern. **12-117 (cont)**

The TOCDF HRA should but does not provide a mass balance analysis, accounting for all of the toxic emissions from TOCDF in terms of their ultimate long term fate and public health and environmental consequences, including a mass balance for agent purportedly captured on charcoal/carbon HVAC filters but some of which may have been released from the filter material into the environment, and including a mass balance for mercury and dioxin-like compounds.

The HRA inadequately considers the impacts of TOCDF lead emissions in combination with other lead emissions sources on children.

The HRA inadequately considers endocrine disruption effects of TOCDF emissions alone and in combination with other pollution sources.

The criticisms posed by the recent testimony and disclosures of former TOCDF permit coordinator Gary Harris need to be addressed in the HRA including adequate provision for local consumption of locally produced beef, dairy products and vegetables.

The existence of a commercial goat milk/cheese enterprise in the Tooele area was not considered in the HRA but should have been, and could result in a total risk estimate being unacceptable for residents who consume some of the locally commercially available goat cheese.

The criticisms posed by the recent testimony and disclosures of former TOCDF permit coordinator Gary Harris need to be addressed in the HRA including assessment of impacts on employees who spend 60 hours or more a week on site at the Depot.

The risk characterization and uncertainties sections of the HRA need to be centered around and focused on the precautionary principle, rather than blatantly ignoring this principle as is the case with the current HRA. If the evidence indicates a reasonable possibility that harm to human health or the environment may occur from TOCDF emissions, either based on calculations based on known factors or truly conservative assessment of unknown factors, then the burden of proof must be placed on the owner and operator of the pollution source and the facility should fail the HRA. As an example, if there is a scientific basis for believing that certain types of potentially toxic chemicals may be emitted in the

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TOCDF stack gas as products of incomplete combustion and those chemicals have not been identified or the toxicity of the chemicals have not been identified, then the UDEQ must prohibit operation of TOCDF until all such emissions have been identified and until the toxicity data has been obtained. Unknowns cannot be assumed to be harmless. If a facility operator does not know the chemicals being fed into an incinerator and/or does not know the chemicals coming out, the facility should fail the HRA and be denied a permit to operate. The potential for unacceptably high health risks to result from emissions of chemicals even at the detection limit was effectively demonstrated in the HRA in its calculation of high risks from DNOP, EMA and 2 PAHs assumed to be emitted at the detection limit. The stack emissions known to occur at TOCDF but yet to be identified clearly cannot be assumed to be harmless. **12-117 (cont)**

The HRA in the uncertainty section or perhaps more appropriately in the main body of the HRA needs to quantitatively as well as qualitatively address unknown or uncertain factors by use of mathematical uncertainty factors of sufficient size and in a manner that allows a mathematical bounding of the risk estimate on the bottom and top. This was not adequately done in the HRA. If this cannot be done, or if the range of potential risks thus bounded exceeds an acceptable risk standard, then the facility should fail the HRA and be denied a permit to operate.

The HRA improperly disregards the potential for workers to be directly engulfed in the TOCDF stack plume.

The HRA improperly disregards the potential for workers to bring TOCDF contaminants home with them where a child, infant, or developing fetus may be exposed.

The TOCDF human health risk assessment does not use of the new increased toxicity estimates and exposure standards for VX announced by CDC and EPA. The Army has "provisionally accepted" the new acute exposure guidelines for VX. The TOCDF human health risk assessment must address this increased toxicity for VX.

IV. NEITHER THE HRA ITSELF NOR THE STATE'S HANDLING OF IT ADEQUATELY PROMOTE, PROVIDE FOR, ENCOURAGE, FACILITATE OR ASSIST THE PUBLIC IN UNDERSTANDING THE RISKS POSED BY THE TOCDF RCRA FACILITY OR IN PARTICIPATING IN THE STATE TOCDF RCRA PERMIT DECISIONS IN LIGHT OF THOSE RISKS

Chris Bittner of DSHW in the June 25, 2002 public information meeting asserted that the risk assessment itself need not be written so that lay persons could

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12-117 (cont)

understand it because “simplicity loses accuracy.” But documents that are too technical do not promote legitimacy and accountability in governmental decision-making processes. Public participation documents which are written at too technical a level like this HRA disenfranchise the public and de facto restrict who can participate in the RCRA process, and therefore limiting who can influence that decision-making process. This “draft Human Health Risk Assessment” can be, and should be, more user friendly. If DSHW cannot write the HRA in a manner that preserves technical accuracy and at the same time is understandable by the public, then the Division should pay for an independent technical consultant chosen by the public and concerned environmental and citizen groups to assist the public in understanding this very important RCRA document.

The slides given at Division of Solid and Hazardous Waste Control Board meeting and both public information meetings stated that there are “no regulatory requirements” for doing a HRA and then stated that the HRA is a “DSHW tool for evaluating the protectiveness of the operating permit.” The Commentors here take issue with these statements because RCRA and its implementing regulations do require a HRA or its equivalent in some legitimate form to support the required determination that TOCDF does not pose an unacceptable risk to public health and the environment or pose an imminent and substantial endangerment, either during trial burns or operations. RCRA requires long-term operations to be protective of human health and the environment. Trial burns themselves must not present an imminent hazard to human health and the environment. The Utah Court of Appeals has ruled that the State should update its HRA with new information as it is required including the development of or discovery of a dioxin RfD. The “draft human health risk assessment” states: “The objectives of the risk assessment (2) cumulatively to provide a basis for evaluating the protectiveness of the operation conditions in the Resource Conservation and Recovery Act (RCRA) hazardous waste permit.” See, e.g., Utah Administrative Code R315-3-23; Title 40, Code of Federal Regulations 270.32 (b)(2)); In re Ecolotec (Decision of EPA Administrator).

The use by DSHW of certain “draft” reports, documents, etc. and then not using other “draft” reports, documents, etc., such as the EPA Dioxin Health Assessment is arbitrary and capricious. The State’s policy on use of drafts has not been disclosed to the public and should be established with public comment pursuant to law.

The DSHW acts as if draft human health risk assessment is correct as it stands and that public comment is an after the fact formality which is not really wanted but a technical requirement the DSHW must endure. It appears the DSHW has already made its decision re the HRA. There is a difference between “public outreach,” which implies a decision has been made and the governmental agency is informing the public of the decision versus “Public participation,” which allows

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for two-way dialogue, consulting, and includes all entities in the decision-making process prior to a decision. **12-117 (cont)**

V. ADDITIONAL SPECIFIC COMMENTS

It is a fallacy to assume that all JACADS, TOCDF and CAMDS trial burn data is equal and has the some kinds of quality control and quality assurance. For example: CAMDS has never completed trial burns under the part B RCRA permit requirements.

There a is general assumption that all of the various waste streams for CAMDS and TOCDF have been analyzed for waste characteristics for determining feed rates and emissions for the purpose of this "draft human health risk assessment." This is a fallacy. The Division of Solid and Hazardous Waste staff, during the June 25, 2002, meeting, stated that less than 10% of the VX tons have been analyzed and apparently none of the other VX munitions have been tested to characterize the waste they contain.

It is a fallacy to claim all applicable permit modifications of CAMDS and TOCDF have been reviewed (to date) to assure compliance with this "draft human health risk assessment."

The "draft human health risk assessment" has no safety margins, error margins and/or default factors for increased feed rates and/or operation production rates. For example: CAMDS is currently in a Class III permit modification process to increase feed rates from 200 pounds to 1500 pound per charge. One cannot assume that a given increase in feed rate will result in linear increase of products of incomplete combustion, and therefore cannot assume a linear change in the risk assessment. It is similar to the analogy of a car going from 20 mile per hour to 80 mile per hour, an increase of four times the original velocity. One might think it takes four times as much energy when, in fact, it takes about 16 times as much energy, since the air resistance of the car increases as the square of its velocity.
What is meant by "warranted mitigation"?

What will be the effects of upset conditions?

What is meant by "defaults"?

An explanation must be given for why in each instance the protocol or EPA guidance was not used.

There is no explanation of EPA's default values that are used sometimes and other times not; nor is there explanation of what the EPA default values are, and how protectiveness levels change in using or not using certain defaults.

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There is assumption that the "reporting levels" are more protective than the "target levels," and that the range between the two is to prevent exceedance of the "draft human health risk assessment" accepted levels. Yet it appears from what the HRA does and does not state that "warranted mitigation" would not occur until after exceedance of the "target levels." In some cases the "draft human health risk assessment" establishes exceedances that are already occurring or have occurred. **12-117 (cont)**

"Cancer effects" should be clarified in terms of what it includes or excludes (e.g. Soft tissue cancer effects are different that hard tissue cancer effects in regard to short term versus long term).

If TOCDF will be allowed to process multi-agent and/or multi-agent contaminated waste, how does the HRA address this risk when it looks at each agent campaign separately.

The HRA references reporting levels and target levels but does not ever really say what the DSHW would consider an unacceptable risk warranting permit denial and at what stage this determination would be made. This should be made explicit.

SPECIFIC COMMENTS: *(pg. 2 section 2.1; par. 3): "Leaking munitions are not handled in the CHB. Therefore, fugitive emissions (to the atmosphere) from the systems are unlikely. Therefore, potential fugitive emissions were not evaluated separately from the TOCDF HVAC system."* This statement is factually incorrect. It also makes the assumption that there is no migration of agent into other areas of the facility and/or fugitive emissions into the ambient environment.

(pg. 3 section 2.2; par. 1): "The MPF may also be used to treat debris from the Assembled Chemical Weapons Assessment (ACWA) support work and debris from ACWA research and development that is generated at CAMDS." This makes the assumption that the MPF will be used as a dunnage incinerator. The MPF was not originally for dunnage. It also makes the assumption that all of ACWA waste has been characterized.

(pg. 5; table 2-1 first agent for DFS and last detected compounds for unit HVAC): "VS" This is typo; it should be "VX," This is misleading, since there have been problems in the HVAC of TOCDF where compounds have been found. This needs to be corrected.

(pg. 6; continued of table 2-1 first two items under the column "Basis of Emissions Rates): There is no explanation for the statement "*default upset correction factors incorporated into ERs' I*t is not clear what the upset default is.

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12-117 (cont)

(pg. 11 section 3.3.1): "The fate, transport and toxicity of GB, VX and sulfur mustard were quantitatively evaluated with parameter values available in the TOCDF Screening Risk Assessment (A .T. Kearney [Feb.]1996)." It is not clear why the "new" toxicity levels for VX are not included when the Army has "provisionally accepted" them. The "draft human health risk assessment" uses other "draft" reports, documents, etc. The increased toxicity level has been known for over a year.

(pg. 12; table 3-1): Why does the table state "*not applicable"?*

(pg. 15; third dotted area): "The values for several emission rates were updated to address minor calculation and classification errors. The changes had no significant effect on the magnitude of the risk and hazard estimates reported in the draft human risk assessment report." These calculation and classification errors should be stated specifically. A clarification should be given as to why these errors did not affect the draft human health risk assessment.

(pg. 15: forth dotted area): "Similar to initial assessment of the units at CAMDS, the simple addition of unit-specific risks and hazards for each agent campaign at TOCDF resulted in vast overestimation of cumulative risks and hazards. Therefore, weighted-average, unit-specific emission rates were used to assess cumulative risks and hazards associated with emissions at TOCDF. Emissions rates were weighted based on the duration of each agent campaign compared with total duration of all campaigns." It is unclear what cumulative risks and hazards for unit-specific have been overestimated and why. There needs to be a detailed explanation of this so that the public can be sure that the reason was not simply that the cumulative risk exceeded the acceptable exposure levels for various scenarios.

(pg. 15: statement before the last dotted area): "In addition to modifications to emission rates, several exposure parameters differ from the values listed in the protocol or are not reported in the protocol." This statement implies that the protocols that were the methodology used for this "draft human health risk assessment" will now not be used. There is no data to justify why the protocols will not be used; nor is there data to support that some other methodology is better to establish protective levels for human health and the environment.

(pg. 18 section 4.1; par 1) "Éassessment of all COPCs, which includes those compounds detected in emission and the non-detected compounds evaluated at the analytical detection limit in the stack gas." It is unclear what is meant by "non-detected"? If non-detected means the compounds did not exist it is one thing, but it is another if the detection equipment was not capable of detecting a compound actually present due to limitation of equipment, or if the compound was not tested for (was not a target analyte).

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12-117 (cont)

(pg. 18 last par.): "The 1E-05 value is within the range outlined in the national Contingency Plan and is consistent with existing DSHW rules and policies." It is not clear what rules and policies are being referenced here. The NCP is a set of Superfund regulations, not RCRA. Clarification is needed.

(pg. 19 first par.): "Although no adverse health effects are predicated if the HQ [hazard quotient] or HI [hazard index] is less then 1ÉÓ If the HQ is single chemical compounds added together to form the hazard index which equals less then one, this makes the assumption that the hazard index in and of it self is protective. It also makes the assumption that background levels are in and of themselves, equal to less than one. There is also the assumption that background levels are protective, which is a fallacy. In fact some background levels are already too high such that adding any more would increase the body burden, increasing cancers and non-cancer effects, meaning the increase would not be protective of human health and environment. For example: dioxin-like compounds.

(pg. 19 first par last sentence):"A calculated endpoint that exceeds the target level does not indicate an unsafe action or unacceptable risk, but indicates that additional evaluation or mitigation is warranted." There seems to be some obfuscation here. The target levels are EPA and reporting levels are the Division of Solid and Hazardous Waste. Target levels would mean that there is unacceptable risk and mitigation is warranted. The "draft human health risk assessment" implies that reporting levels would be an added protective level, which would give time to evaluate and mitigate warranted action before a target level was reached. The statement should read: "*A calculated endpoint that exceeds* ***reporting levels*** *does not indicated an unsafe action or unacceptable risk, but indicates that additional evaluation or mitigation is warranted."*

(pg. 20 second par.): "Dioxin emission (based on a 2,3,7,8-TCDD TEQ value) from TOCDF for the sulfur mustard campaign present a cancer risk of 3E-06 for the subsistence adult, which exceed the DSHW reporting level of 1E-06." That is not considering that cancer risk is only one of the dioxin problems. EPA and WHO date indicate that the national adult average intake for dioxin TEQ is estimated to be 1-6 picograms per kilogram of body weight per day. Data has established that in rats a single low dose of TCDD on day 15 of pregnancy affected the sexual development behavior and functions of their male offspring. Doses of TCDD as low as 2.5 parts per quadrillion-- equivalent to a mere 10 molecules per cell, completely abolish the ability of cultured immune cells to respond to signals to proliferate and mount an immune defense. (Source: Thornton, Joe, "Pandora's Poison: Chlorine, Health, and a New Environmental Strategy," copyright 2000, Massachusetts Institute Technology, page 92). This would imply that current background levels of dioxin TEQs are too high, and any additional dioxin dose would be an excessive body burden and unacceptable risk.

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12-117 (cont)

(pg. 20 section 4.1.1.1 first par.): "The cancer risk associated with treatment of GB at one or more TOCDF sources exceed the DSHW reporting levels of 1E-06 for adult and child subsistence rancher scenarios, the adult and child resident scenarios and the on-site worker scenario." There was no mitigation to protect the public for excessive risk during the GB campaign. Additional risks were present not addressed in the HRA such as the May 2000 agent release incident, the DFS HDC waste agent releases etc..

(pg. 25 section 4.1.1.2 "VX Campaign" second par.): "Emissions form the TOCDF present the highest cancer risk (7E-05 for the adult) and the highest HI (1,400 for the child) for the adult and child subsistence rancher scenarios." It is ironic that the facility and Division Solid and Hazardous Waste staff claim that this "draft human health risk assessment" has no regulatory implications and are in the process of granting the trial burn plans for VX campaign. Yet the "draft human health risk assessment" states on page one that: "*DSHW has the authority and the responsibility to establish permit conditions that are protective of human health and the environment."* There is no discussion of what is the "warranted mitigation" for this highest cancer risk and/or the highest hazard index. This statement implies that there is currently a violation of state and federal regulatory requirements in that based on the HRA the trial burns themselves are not protective of human health and the environment.

(pg. 27 section 4.1.1.3 second par.): "For the subsistence rancher adult and child scenarios, emissions from the DFS, LIC 1, MPF, and LIC 2 units at TOCDF present cancer risk and HI values that exceed the DSHW reporting level and the U.S EPA target levels." Same as the prior comment.

(pg. 35 section 4.1.3.5): "The DFS and MPF present HI values for the adult scenario that exceed the DSHW reporting level of 0.025 as well as U.S EPA target level of 0.25." This statement implies that there already is an exceedance and that further processing at TOCDF and CAMDS would not be protective of human health and the environment.

(pg. 38 Table 4-13, and pg. 39 Table 4-14): The tables should be further clarified and explained. They seem to imply that there are several units that are exceeding in cumulative cancer risks.

(pg. 40 section 4.1.5 first par.): "Risk to nursing infants was evaluated by comparing the modeled intake rate 2,3,7,8-TCDD TEQ in breast milk to the 6 picograms per kilogram body weight per day (pg/kg BW-d) reporting level established by DSHW. The value is 10 percent of the average background exposure level reported by U.S.EPA." This is not the same formula used for other chemicals for the reporting levels based on toxicity. If the same formula was used for other chemicals for the reporting levels based on toxicity the 6 picograms per kilogram body weight per day would be too high by 60 to 100 times or more. It is ironic that the Division uses some "draft" reports, documents, etc. from other governmental agencies, but will not use the

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12-117 (cont)

final Agency for Toxic Substances and Disease Registry (ATSDR) Tox profile for dioxin. ATSDR has a final report where the MRL is six times lower (1pg/kg BW-d) and more protective of the breast feeding infant. ATSDR's purpose is to protect public health and the environment. It is mystifying why the Division of Solid and Hazardous Waste will not take this more conservative approach to breast feeding infants.

(pg. 40 section 4.1.5 par. 2): "The calculated intake rates for 2,3,7,8-TCDD TEQ for each source are less then the DSHW reporting level of 6pg/kg BW-d for all scenarios evaluated, indicating dioxin emissions do not present a risk to a nursing infant." This statement is scientifically indefensible and is an attempted fraud on the public.

(pg. 42 section 4.1.7): The discussion in this section is some what misleading. (1) There is no accounting for the increased toxicity level for VX. (2) There is no information for the determination for error factors, margin of error, safety factor for approximately 30 times or more increase for toxicity of VX. (3) There is no analysis for upset conditions, power outages, etc. for inhalation hazards. (4) There is no analysis for evaluation of inhalation hazardous for VX and another chemical agent (eg., GB contaminated secondary waste).

(pg. 43 section 4.1.9); "For the sulfur mustard campaign at the TOCDF, dioxin risk slightly exceeds the DSHW reporting level for the subsistence rancher adult for the LIC 1 unit (1E-06) and LIC2 unit (1E-O6)." The word "*slightly*" is propaganda. The fact is there is an exceedance.

(pg 44 the first full paragraph and all dotted sections prior to the section 4.1.10): "In 2000, the Science Advisory Board of the U.S. EPA proposed new dioxin cancer slope factor "which is ***6.67 times more stringent the the current cancer slope factor*** *[emphasis added]Énew proposed slope factor indicates exceedances."* This statement is true. This cancer slope factor also reflects, taken with the dioxin dose the infant receives, that the breast fed infant is subjected to an unacceptable cancer risk as well as unacceptable non-cancer health risk from dioxin. There is no discussion of what will be done for warranted mitigation if the new dioxin cancer slope factor is adopted. RCRA requires that the most protective methods be used. The Division of Solid and Hazardous Waste is required to investigate implementation time lines for alternative technologies for TOCDF that pose less risks. TOCDF and CAMDS must be required at a minimum to mitigate the unacceptable cancer risks reflected in the use of the new slope factor.

(pg. 44 section 4.1.10): "The maximum concentration of lead in on-site and off-site soil were identified from the cumulative risk and hazard analysis described in section 4.1.2" Section 4.1.2 only discusses COPC; no heavy metals were include in the discussion in section 4.1.2. Clarification is needed.

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12-117 (cont)

(pg 45 section 4.2): "The uncertainty analysis was performed to (1) identify major uncertainties associated with the risk and hazard estimates, (2) evaluate the effect of the time period of combustion on the estimates of the risk and hazard, and (3) evaluate the significance of COPCs that exceed the DSHW reporting levels and the US EPA target levels." The section needs to be made more lay person user friendly.

(pg. 45 section 4.2.1): "Major uncertainties associated with the risk estimates were identified the three main parts of the risk assessment: (1) estimates of emission rates, (2)exposure assessment, and (3) toxicity assessment." This requires clarification. What are the major uncertainties? Why are these considered major and other factors not?

(pg. 47 section 4.3.1): This section has many of the same problems as the above two sections on uncertainties. Clarification is needed.

(pg. 51 section 4.3.1.6): This section make a big assumption that the TOCDF and CAMDS will be operating within their permits. Also, this section makes the assumption that there are no fugitive emissions that are being released directly into the ambient environment, which is false. There needs to be some ambient air monitoring for mercury such that background levels can be determined, to assure that both TOCDF and CAMDS will not be exceeding the ambient air limits for mercury. All waste streams (as RCRA requires) need to be characterized before being processed. Neither TOCDF nor CAMDS should be allowed to estimate, average, guess, etc., via use of historical data what is in the waste that is being processed at these facilities.

The Division of Solid and Hazardous Waste should have their staff (Chris Bittner) stay consistent with page one of "draft human health risk assessment" which states: "*The objectives cumulatively to provide a basis for evaluating the protectiveness of the operating conditions in the Resource Conservation and Recovery Act (RCRA) hazardous waste permits for TOCDF and CAMDS..."* and not claim there is no regulatory requirement. There seems to be no reason for the Division of Solid and Hazardous Waste to have spent approximately $200,000 of TAXPAYERS' MONEY for something that did not have a bearing on the Division's regulatory and statutory requirements.

Consistency in methodology of calculations of compounds is very important. By not using the protocols consistently it causes a lack of faith in and presumption of bad faith by the Division of Solid and Hazardous Waste. The use of some "draft" documents, reports, etc., versus the use of other "draft" documents, reports, etc., is also bad faith. The Division has no policy on the use of "draft" reports, documents, etc. It is also bad faith by the Division of Solid and Hazardous Waste to use some "new proposed" limits and not other "new proposed" levels.

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The use of reporting levels and target levels is obfuscated by not discussing what type of warranted mitigation will be done. There is no discussion that some of US EPA targets levels are default levels. There is no mention of the fact that some of the compounds mentioned in the "draft human health risk assessment" are already at too high an exposure level, and adding more to the ambient environment would be unacceptable. This means that there will be an increase in cancer and non-cancer effects in the population. **12-117 (cont)**

There is no discussion of how current modifications of both CAMDS and TOCDF affecting this "draft human health risk assessment" and risk. There is the assumption that any modification would have a linear effect, which is a fallacy. There is no mention of upset conditions.

If there are currently risk exceedances, then the Division of Solid and Hazardous Waste must not permit continued operations and/or production of either CAMDS or TOCDF. Additional operations will not be protective of human health and environment.

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APPENDIX C ACWA EIS Comments **12-118**

¤ 7.5 Air Quality --- Criteria Pollutants:

1) Page 7-35 - Line 18 : "The technologies are expected to differ in the amount of fossil fuel they would combust to generate heat."
Comment: Please provide a matrix of the consumption of fossil fuels for each technology under consideration so a comparison can be made.

¤ 7.5.1.2 Emissions :

1) Page 7-39 - Lines 8 - 10 : Concerning the existing sources of criteria pollutants.
Comment : Consideration should be given to curtailing certain operations which create criteria pollutants and their precursors during ACWA operations.

2)Page 7-39 Lines 21-25 : Concerning the BGAD emissions expressed as a percentage of the total Madison County emissions.
Comment : Expressing BGAD emissions as a percentage of Madison County emissions should not be used as a rationale for efforts to curtail the maximum amounts of ACWA pilot plant emissions to the greatest extent possible.

¤ 7.5.1.3 Air Quality:

1) Page 7-41 Lines 2- 31 and Page 7-45 Lines 1-9 : Concerning SAAQS and NAAQS.
Comment : Attainment classification status should not be used as a rationale for efforts to curtail the maximum amounts of ACWA pilot plant emissions to the greatest extent possible.

¤ 7.5.2.2 Emissions from Operations:

1) Page 7-46 - Lines 20 - 25 and 30 -32: Concerning "stacks".
Comment : This section appears to represents as not containing any abatement of air pollutants. Clarification is needed.
2) Page 7-51 - Lines 1 - 12: Concerning "stacks".
Comment : This section appears to represents as not containing any abatement of air pollutants. Clarification is needed.

¤ 7.5.3.2 Impacts of Operations:

1) Page 7-54 - Lines 16 -17 : Concerning "Short term increments for all four ACWA technologies would be almost the same."

Comment 12-118

Response: Although comments on the ACWA Draft EIS are outside the scope of this PMCD Draft EIS, PMCD has reviewed the responses provided by ACWA to these comments to assure consistency between the ACWA document and this EIS.

<u>Comment</u>: Significant differences in the number and quantity of "Estimated Toxic Air Pollutants Emissions" shown in Tables 7.6-2; 7.6-3; 7.6-4; and, 7.6-5 [pages 7-63 to 7-75) and the "...Total Concentrations of Criteria Pollutants.."" in Tables 7.5-10 thru 7.5.13 (pages 7-55 thru 7-7-58). **12-118 (cont)**

Significant differences in one type or emission would seem to negate their being "almost the same" for other types of pollutants.

2) <u>Page 7-59 - Lines 6-8 :</u> Concerning Lead emissions:

<u>Comment</u> : Explain what happens to the Lead contained in the munitions if emissions of this material are considered "negligible".

(1)

3) <u>Page 7-59 - Lines 8-10</u>: Concerning "production of ozone"

<u>Comment</u> : Explain why this process can not be "accurately quantified". Is the scientific capability lacking or is the data on the contributors to such production missing from the ACWA technologies information provided into ACWA?

4) <u>Page 7-61 - Lines 2-3</u> : Concerning releases of "dinitrotoluene".

<u>Comment</u> : Tables 7.6-1 lists the amount of dinitrotoluene emitted at BGAD as a result of OB/OD. Tables 7.6-2 thru 7.6-5 do not show any dinitrotoluene emitted from ACWA CW processing. Are any of the substances listed in Tables 7.6-2 thru 7.6-5 by-products of the ACWA treatment of explosives/energetics containing dinitrotoluene? If so which. Are the emissions of Toluene shown in Tables 7.6-2 thru 7.6-5 a result of the treatment of dinitrotoluene contained in the CW at BGAD?

¤ 7.6.2 ACWA Facility Emissions:

1) <u>Pages 6-63 thru 7-75</u> : Concerning Estimated Toxic Air Pollutant Emissions for ACWA Technologies.

<u>Comment</u> : Table 7.6-4 shows significantly greater numbers of toxic pollutants from the Neutro/GPCR/TW-SCWO technology than from the other ACWA technologies. Is the increased number of emissions a result of the process captured in Table 7.6-4 or has this technology provided more detailed information than the other options?

Provide the reason for the significantly greater number of Toxic Air Pollutants represented in Table 7.6-4 as compared to the other options?

Comparisons of certain Pollutants between technologies also reflects significantly higher quantities of certain emissions of particular concern (ie: PCB's and TCDD's) from Table 7.6-4 than from the other ACWA technologies. This could be technology specific, regarding processing (ie: for PCB's during nerve agent

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processing Neutro/SCWO shows PCB emissions at 1.5x10-9 [μg/s] vs. PCB's during nerve agent processing for Neutro/GPCR/SCWO shows PCB emissions at 9.6X10-2 [μg/s]). Since both are Neurto/SCWO technologies, explain the differences in the emissions of PCB's for each process. **12-118 (cont)**

Another example: using the same two technologies in comparison, there appears a significant difference in Mercury emissions as a result of operating the boiler(s) for each. The Neutro/SCWO Table cites boiler Mercury emissions at 5.2x10-1 (μg/s) , the Neutro/GPCR/SCWO shows Mercury emissions from their boiler at 9.4x10-1 [μg/s] , almost twice the amount of the former option. Please explain this disparity.

All three alternatives applicable for VX treatment show varying amounts of VX emissions leaving the Filter Farm Stack ranging from 2.8 to 3.7 [μg/s]. Although footnoted as "worst-case estimate" - at the detection limit, this raises concerns about the capability of the technologies to contain VX agent. Please provide VX emissions data for normal operations and explain conditions under which "worst-case scenario" VX emissions at the levels cited could occur.

¤ 7.6.3.2 Impacts of Operations

Page 7-77 "Regarding HAP's and NESHAP regulatory action.

Comment: Please provide the quantities of HAP's specifically related to the toxic pollutants emitted via the alternatives under consideration that would trigger NESHAP regulatory action.

(2)

¤ 7.7 Human Health and Safety - Routine Operations

¤ 7.7.1.4 Emergency Response

Page 7-82 Line 27 : Regarding the PAR (Protective Action Recommendation)

Comment: It has come to the attention of Commenters that the PAR (Protective Action Recommendation) will be based on a CSEPP Guidebook, yet to be released for BGAD and the surrounding community. The Guidebook will define procedures to determine the PAR. Information on the Guidebook currently offered for CSEPP at the Anniston, Alabama site has caused significant controversy in regards to assumptions including, but not limited to, the toxicity standards being used to determine the PAR.

If such a Guidebook exists for the BGAD and surrounding community it should be provided in its entirety as part of the Final ACWA EIS.

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Table 7.7-1 Annual Hazard Rates - No Action vs. ACWA

12-118 (cont)

Comment: There is no time frame associated with this Table. The no action option would appear to extend into infinity, while any ACWA option would necessarily have an end point. . The 1988 FPEIS for the CDP (Chemical Demilitarization Program) using baseline incineration, indicated a higher risk for continued storage (ie: no action) than for disposal. The Table referenced shows the opposite. Please explain this disparity.

Provide an equal time frame for the comparison within this Table.

¤ 7.7.2.2 Impacts of Operations

Comment: This section (along with the referenced Tables and Appendix C) represents the best attempt at quantifying risks to Workers, On and Off Post Residents, based on available information.

Appendix C reflects a methodology that conservative in all dimensions of risk estimates and calculations.

It is obvious however that there are numerous assumptions factored into this section due to the lack of specific demonstration or other empirical data.

All additional data gathered through additional demonstration information and/or Engineering Design Studies that can add to the information provided within this section should be incorporated into the ACWA FEIS (or sooner if possible through ACWA Outreach) for public consumption.

Although outside the scope of this EIS, Commenters would also point out the all the ACWA technologies are classified as “non-emissive” treatments when compared to baseline incineration, which is classified as an “emissive” treatment technology.

Commenters also note that none of the ACWA technologies would be regulated by the MACT rule or other regulations specific to combustion facilities (as would baseline).

¤ 7.21 Accidents Involving Assembled Chemical Weapons

Comment: Generally, Commenters are comfortable with the section.

¤ 7.21.1. Scenarios

Page 7-175 Line 21: Comment: We request explanation on the basis for considering the feasibility of using modified ammunition vans instead of ONCs.

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(3)

12-118 (cont)

¤ 7.21.1.2 Methods of Analysis

Page 7-176 Lines 5-6: Regarding the D2PC Model assessment.
Comment : If the CDP adopts the D2-Puff dispersion modeling system (or any other advanced modeling system) it should be captured in the ACWA FEIS with any deviations noted as related to this section.

¤ 7.21.1.3 Exposures and Deposition

Pages 7-176 and 7-177: Regarding the no effects plume
Comment : Revised Acute Exposure Guidance Levels (AGELs) currently under review by EPA for GB and VX (Federal Register Vol 66 No. 85) should be factored into this section upon promulgation.
Proposed AGELs for Mustard currently under consideration by the EPA (CAS Reg. No. 505-60-2) should be factored into this section upon promulgation.

Pages 7-176 and 7-177: Regarding the "no deaths" contour
Comment: See comment on ¤ 7.21.1.2 (D2PC model) revisions required should advanced modeling capabilities be implemented.

¤ 7.21.2.4 Human Health and Safety

Pages 7-181 thru 7-186: Relating to Fatality Estimates (Table 7.21.2)
Comment: Commenters note and appreciate the inclusion of the recommended lower Lct50 standards by the NRC's 1997.
Page 7-185 Line 20: Relating to the "MDB stack"
Comment : It is assumed this refers to the "Filter Farm Stack" cited previously in the EIS. Within the CDP's baseline incineration program, the exhaust stacks from the furnaces are referred to as the "common stack" and the equivalent to the "Filter Farm Stack" is referred to as the HVAC stack.
Using the term "MDB stack" could be misconstrued as something other than the "Filter Farm Stack" This term should be modified to conform with terminology used previously in this EIS (see Table 7.6-2).
Page 7-186 Lines 21 thru 25 : Relating to major process chemicals.
Comment : Progress in containment design achieved during the engineering design studies should be included in the ACWA FEIS.

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¤ 7.21.2.7 Biological Resources

12-118 (cont)

Page 7-200 : Regarding endangered clams
Comment: In each accident scenario previously mentioned in this EIS, the amount of agent released in the worst case model (ie: airplane crash into a storage igloo) would be greater for storage than operations. This section appears to contradict all previous analysis. Please explain (not that clams are Commenters priority, rather for the sake of consistency).

¤ 7.21.3 Impacts of Accidents during No Action (Continued Storage)

Page 7-205 Lines 3 thru 4 : Regarding probability of the bounding accident
Comment: As referenced on page 7-174 Lines 22 thru 23, the probability equation of 1x10-8 equals one occurrence in 100 million years. Commenters feel this explanation of the equation should be used throughout the EIS as it puts the equation into terms the public better understand.

(4)

Page 7-205 Lines 10 thru 13 : Regarding fatality estimates
Comment : Does the number of estimated fatalities assume CSEPP procedure implementation ?

¤ 7.22 Cumulative Impacts

Page 7-212 Lines 9 thru 11: Regarding construction and operations time.
Comment : States 34 months to construct; 31 months of operations. In ¤ 7.23.3 Lines 28/29 it states, "Constructing and operating one or more pilot test facilities would be an action of limited duration - up to two years" (emphasis added).
Having one section state approximately 5.4 years for construction/operations and another state approximately 2 years for construction/operations is wildly inconsistent. Please reconcile.

¤ 7.22.3 Infrastructure (All Sections)

Comment: It is assumed that all increased demands on infrastructure cited in this section and referenced to Table 7.3-1 as annual requirements are approximately equal in the number of years the increases would be required for any ACWA pilot thereby allowing an actual comparison of overall increases in electricity, natural gas, process water, potable water and sewage between technologies. Please clarify.

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¤ 7.22.3.3 Water Supply and Sewage Treatment **12-118 (cont)**

Page 7-218: Related to increased water usage.

Comment : Section and referenced chart (Table 7.3-1) and referenced Section (7.3.3) do not explain the percentage of additional water needed for any ACWA technology that would be recycled within any of the options. Do the numbers cited in Table 7.3-1 exclude amounts recycled. If so the actual annual consumption numbers would vary depending on each individual technology's capability to reuse water. Please clarify in a comparative manner between technologies.

¤ 7.22.4 Waste Management and Facilities

Page 7-219 Lines 23 thru 28: Related to hazardous and non-hazardous waste disposal capacities.

Comment: Regarding ACWA created hazardous and nonhazardous waste and the existing disposition of current amounts handled at BGAD it is not clear that the capacity exists based on the referenced chart (Table 7.4-1) as none of these wastes are generated from chemical weapons treatment and therefore might not be applicable to this particular waste treatment stream.

Additionally, those wastes noted on Table 7.4-1 as shipped off site need to be identified as to what types of wastes leave BGAD now, compared to those created by ACWA; what type of treatment would ACWA off site wastes be subject to (ie: deep well injected, incinerated, land filled, etc.); and, where are the current and proposed reception sites located for current and proposed off site waste shipments.

Are the current locations permitted to handle CW treatment waste? Are the communities willing to accept such waste? Are there any "special" processes needed for additional permits (ie: Class I or II permit MOD's) at the proposed reception sites? What is the anticipated public reaction to the information being presented to reception communities that they may be receiving such wastes?

Please address.

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(5)

12-118 (cont)

¤ **7.22.6.2 Impacts of Operations**

Cumulative Impacts with Other Actions, Including a Baseline Incinerator

Page 7-228 Lines 24 thru 26: Related to maximum risk for a baseline incinerator.

Comment: Commenters disagree with the findings referenced as maximum carcinogenic risk as cited in the EIS for PBA (Appendix H of U.S. Army 1997) and believe that corrected methodology and assessment modeling integrated into the cited assessment would put baseline incinerator operations at BGAD over the 1x10-6 standard generally considered representative of negligible risk.

Therefore, an ACWA pilot plant operating simultaneously with a baseline incinerator would represent an increased carcinogenic risk of well over the 6.2x10-7 stated in this section.

Page 7-229 Lines 3 thru 5: related to maximum agent releases from a baseline incinerator.

Comment : Commenters strongly disagree with the assumption stated that the maximum agent releases from a baseline incinerator would be similar to those of the ACWA facility.

ACWA facilities have only one delivery pathway for agent to escape into the environment (via the Filter Farm Stack) during operations. Baseline has the HVAC stack and a Common Stack (furnace stack) both of which vent into the atmosphere.

ACWA technologies: provide significantly greater control of the agents during processing; do not have two competing air flow systems; do rely on automatic waste feed cutoffs to stop agent processing; do not accumulate agent in a common stack PFS (pollution filter system); do not create the risk of such accumulated agent escaping during a process upset (puffs, explosions, etc); do not rely on isolation valves to curtail agent movement during or immediately after processing; do not have agent being injected under pressure into an open-ended treatment system; do not allow treated agent gases (at varying DRE's) to escape directly into the environment; do not process agent in a high velocity air movement system; are not dependent on afterburners, scrubbers and other PAS systems to modify chemical configurations (possibly containing agent - particularly during upset conditions) to prevent agent releases; do not treat agent under high pressure/high temperature (the highest temperature treatment process for agent is the ElchemOx process @ 190 ¼ F with the electrochemical cell

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closed downstream of the feed prior to temperature introduction); and other factors.

Commenters strongly recommend this statement be modified to more accurately reflect the significant difference in the potential maximum agent release from baseline incineration when compared to ACWA applications.

12-118 (cont)

¤ 7.22.12.2 Wildlife

Pages 7-236 thru 7-238

Comment : Commenters disagree with the statement that emissions from an baseline incinerator would be "small". "Small" is an inappropriate term in the context of` emissions and deposition, particularly incineration emissions. "Small" amounts of dioxin, mercury, PCB's etc. can have a profound impact on wildlife and their habitat, reproductive capability and alike.

¤ 7.22.12.3 Aquatic Habitats and Fish

Pages 7-238 thru 7-239: Comment: See comment on "Wildlife" above

(6)

¤ 7.22.12.4 Protected Species

Page 7-239 thru 7-240 : Comment: See comment on "Wildlife" above

¤ 7.22.14 Environmental Justice

Page 7-244 (and referenced Section 7.20) : Comment : Based on comments noted in ¤ 7.22.6.2 Impacts of Operations : Cumulative Impacts with Other Actions, Including a Baseline Incinerator above, Commenters strongly feel the impacts of a baseline incinerator, either in combination with (as exemplified in this Section) or on by itself, would have significant Environmental Justice implications for the 30 mile radius of BGAD.

During the 1979 "Smoke Pot Incident" the majority of impacted citizens were people of color, lending evidence that chronic emissions from a baseline incinerator and/or releases of agent during routine and non routine operations has a potential to disproportionaly impact such populations.

Additionally, since the figures provided on Low-Income populations being well above the national average within the 30 mile radius of BGAD, this aspect of Executive Order 12898 also applies.

[Intentionally left blank]

As witnessed in Anniston , Alabama, where a baseline incinerator is constructed and about to go on line, direct negative economic impacts as a result of this technology are manifesting themselves (ie: lower property values; inability to sell homes within the zone; inability to attract new businesses; population decrease, etc.)

Similar impacts could be expected to be replicated within the BGAD 30 mile radius (possibly larger radius depending on new toxicity standards and improved plume modeling).

Therefore, Commenters feel strongly that high and adverse consequences within the scope of environmental justice would exist should a baseline incinerator be considered in the cumulative impacts of this EIS.

12-118 (cont)

[Intentionally left blank]

From Noel Wheatley
Sent Monday, July 15, 2002 829 PM
To gregory.mahall@pmcd.apgea.army.mil
Cc michael.spritzer@gat.com
Subject Blue Grass Draft Environmental Impact Statement Comments

Mr. Gregory Mahall
Program Manager for Chemical Demilitarization
Public Outreach and Information Office
Building E-4585
Aberdeen Proving Ground, Maryland 21010-4005
Via Fax 410-436-5122

General Atomics has reviewed the Draft Environmental Impact Statement for the Destruction of Chemical Munitions at Blue Grass Army Depot, Kentucky and offers the following comments:

General Atomics believes that the Electrical Power Requirement shown in Table ES.2 "Summary and comparison of the impacts of operations for all alternatives" on page xivi of 60 Gwh/yr for Neut/SCWO is too high and should be adjusted to 26 Gwh/yr. **13-1**

General Atomics has reviewed Table ES.2 "Summary and comparison of the impacts of operations for all alternatives" and notes that the quantity of Hazardous Solid Wastes shown on page xivii for Electrochemical Oxidation is about five times lower than for the other two alternate technologies. All three processes treat the same amount of chemical agents, energetics and other wastes, and it is unlikely that one of the three processes will result in five times less solid waste. We recommend that this solid waste figure for Electrochemical Oxidation be reviewed and verified. **13-2**

Your consideration of these comments is appreciated.

Yours Truly,
Noel Wheatley
General Atomics

Comment 13-1

Response: The Army has relied upon the ACWA Program for data on the ACWA technologies. The electrical power requirement given in Table ES.2 for Neutralization with Supercritical Water Oxidation is consistent with the comparable entry in Table 7.3-1 of the ACWA Final EIS.

Comment 13-2

Response: The Army has relied upon the ACWA Program for data on the ACWA technologies. Although the values in Table ES.2 (and tables 3.3 and 4.7) have been revised in this Final EIS to correct errors in the Draft EIS, the ACWA Final EIS indicates that the quantity of hazardous solid wastes for electrochemical oxidation is approximately five times lower than for other ACWA technologies.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

Program Manager for Chemical Demilitarization
Public Outreach and Information Office
Mr. Gregory Mahall
Building E-4585
Aberdeen Proving Ground, MD 21010-4005

Subject: **Draft Environmental Impact Statement (DEIS) for Destruction of Chemical Munitions at Blue Grass Army Depot (BGAD), KY CEQ # 020215 , ERP # USA-E 11050-KY (dtd February 2002)**

Dear Sir:

Pursuant to Section 309 of the Clean Air Act and Section 102(2)(C) of the National Environmental Policy Act (NEPA), EPA Region 4 has reviewed the subject document, an evaluation of the consequences of the design, construction, operation, and subsequent closure of a facility to destroy the types of chemical munitions stored at BGAD. The BGAD stockpile consists of mustard agent (type H) and nerve agent (VX). Four alternatives technologies are examined, viz., baseline incineration, chemical neutralization followed by super-critical water oxidation, chemical neutralization followed by super-critical water oxidation and gas phase chemical reduction, and electrochemical oxidation. If any of the non-incineration technologies were selected, a test facility would be constructed/operated prior to full scale operation. Two potential sites for constructing the necessary destruction facilities at BGAD are contrasted. While the no-action alternative is examined for comparative purposes, its implementation would be precluded by Public Law 99-145.

On the basis of our review a rating of LO has been assigned. That is, EPA has no significant environmental objections to the proposal to destroy the chemical munitions at BGAD or to the specific technology which will ultimately be used to meet this objective. Attached are a number of suggestions regarding clarifications/improvements to the final NEPA documentation. **14-1**

If we can be of further assistance, Mr. Hugh Hazen (404-562-8499) will serve as initial point of contact.

Sincerely,

Heinz J. Mueller, Chief
Office of Environmental Assessment

Attachment

Comment 14-1

Response: The EPA's highest rating of LO or "lack of objections" for the Draft EIS comment is noted and appreciated.

Attachment

General Comments

Section 2.3.4, page 2-19 14-2

The total estimated time that each of the four technologies is expected to take to destroy the stockpile at BGAD. The time frame for incineration is shown as 22 months operating 24 hrs/day, 6 days/week. The alternative technologies are shown as taking less total time, viz., 12 hrs/day, 6 days/week, 46 weeks/year. Some explanation should be provided as to why there is such a discrepancy in the total operation time for incineration versus the alternative technologies.

Section 3.2.1, page 3-9 14-3

It was noted that the spent carbon from the filter units will be incinerated in the MPF. Since the carbon micronization system (CMS) that was tested at JACADS utilized the DFS for destruction of the carbon, the MPF destruction scenario should be verified.

Table 4.24, page 4-56 14-4

Maximum annual average estimated on and off site concentrations of agent during operations at BGAD are approximately an order of magnitude higher for baseline incineration than for the alternative technologies. Since all of the technologies including incineration are designed to provide 99.9999 DRE for agent, some explanation should provided as to why the estimated on and off site concentrations of agent at BGAD would be higher for baseline incineration versus the alternative technologies.

Air Quality

Section 4.7.2.1, Emissions from Construction, Page 4-37, Line 34 14-5

Exhaust emissions from equipment, commuter and delivery vehicles are expected to be relatively small when compared with fugitive dust emissions from earth-moving activities. However, a quantitative estimate of these vehicle emissions should be presented to substantiate their elimination from further evaluation. These quantitative estimates may be obtained by using a mobile source emission model (e.g., MOBILE6, Nonroad).

Section 4.7.4, Impacts of Operations, Pages 4-43 and 4-44 14-6

This section should be revised in the final EIS to address the Kentucky Standards for hydrogen sulfide, gaseous fluorides (expressed as hydrogen fluoride), total fluorides, and odors (see Section 4.7 Page 4-28, Line 24). If the proposed facility (selected option) will not have air emissions of these pollutants, the document should state that these pollutants are not emitted and thus have no impacts. If the

Comment 14-2

Response:The time required to destroy the stockpile at BGAD by the alternative technologies is estimated on the basis of both common and unique processes. Certain processes (e.g., moving agents/munitions from storage to processing locations, accessing the agent, separating components into different feed streams) are common to all four technologies and are assumed to require approximately the same period of time. Other processes are unique to each of the four technology alternatives, and estimates of processing time requirements vary, by technology, according to equipment availability, throughput rates, and stockpile (i.e., feed) mix, and other factors.

The estimates of the time required to destroy the stockpile stored at BGAD, as contained in Section 2.3.4 of the EIS, have been developed based on operational experience at JACADS and TOCDF for the baseline incineration alternative. For the non-incineration alternatives, processing time estimates are based on preliminary engineering analyses and judgments of the vendors [as contained in the engineering design studies (EDS)] for the ACWA Program and as reviewed and validated by the ACWA Program. Detailed schedules for a non-incineration facility at BGAD will not be developed until (and unless) a non-incineration technology is selected by the Department of Defense Defense Acquisition Executive for implementation at BGAD.

Comment 14-3

Response: The comment is correct. Spent carbon would be incinerated in the DFS. The statement in the Draft EIS is in error and has been revised in Section 3.2.1 in this Final EIS.

Comment 14-4

Response: Maximum annual concentrations of agent would be higher for baseline incineration than alternative technologies because, during incineration, agent is destroyed, but is assumed to be present in the stack gases at one detection limit.

Comment 14-5

Response: As an example of mobile emissions, the particulate emissions from a scraper are estimated in EPA's AP-42 report to be 0.4 pounds per hour (a greater rate than any other piece of heavy-duty construction equipment). Assuming that a scraper were operating continuously around the clock, the monthly emissions would be 0.15 tons. This amount is less than 1% of the estimated fugitive dust emissions of 30 tons per month, assuming a disturbance of 25 acres simultaneously. Because a scraper would not operate around the clock, actual emissions would be even less. Although more than one vehicle and/or piece of equipment would often be operating simultaneously, the cumulative mobile emissions would be a small percentage of fugitive dust emissions.

facility will have emissions of these pollutants, they should be modeled and compared to the Kentucky Standards, as was done for the National Ambient Air Quality Standards (NAAQS) criteria pollutants. **14-6 (cont)**

Section 4.7.4, Impacts of Operations, Pages 4-44, Line 26 **14-7**

The Draft EIS has a brief statement that impacts at the nearest Class I area (Mammoth Cave National Park) would be less than one percent of the applicable PSD increments. No other details are provided about an analysis and/or modeling that would support this statement. The final EIS should discuss any modeling that was done for the Class I analysis. Since Mammoth Cave is located greater than 50 km (it is approximately 100 miles away) from the proposed facility, the ISCST3 model that was used for the other modeling analyses would not be appropriate for the Class I impact analysis. The CALPUFF model is typically used for assessing long distance transport for Class I impact analyses.

Appendix K, Section K.1.2, Operational Emissions, Page K-2 **14-8**

This section of the Draft EIS contains a brief description of the emission rates that were modeled for the proposed alternative technology treatment options, but does not include a discussion of the emissions from the baseline incineration option. For completeness, this section should be revised to include a brief discussion of the emission rates modeled for the baseline incineration option. Also, a brief discussion of the hazardous and toxic air pollutant emissions that were modeled should be provided for each proposed technology option.

Appendix K, Section K.2.2, Meteorological Data, Page K-3, Lines 28-31 **14-9**

This section states that the available site-specific meteorological data contains two types of stability class data, i.e., one based on the wind fluctuation statistics methodology and one based on the solar radiation/delta-T (SRDT) methodology. This section further states that EPA has not expressed any preference between the two and the wind fluctuation statistics methodology was used to determine stability class. While it is true that EPA guidance does not express a preference between the two methodologies discussed above, Section 9.3.3.2(k) of EPA's *Guideline on Air Quality Models* (40 CFR Part 51, Appendix W) states that the Turner method is recommended for determining stability categories. It further states that in the absence of requisite data to implement the Turner method, the SRDT method or wind fluctuation statistics may be used. The final EIS should indicate why EPA's recommended method was not used for the analysis. If there is no valid justification, the modeling should be re-done using stability categories based on the Turner method.

Appendix K, Section K.2.2, Meteorological Data, Table K.1, Page K-4 **14-10**

Comment 14-6

Response: Section 4.7.4 of this Final EIS has been revised to address issues raised in the comment. The maximum annual off-post concentration of hydrogen fluoride is estimated to be less than 0.02 $\mu g/m^3$ (Table I.1), which is much less than 1% of Kentucky's annual primary standard of 400 $\mu g/m^3$ (Table 4.11). Similarly, the maximum 24-hour off-post concentration of hydrogen fluoride would be much less than 1% of Kentucky's 24-hour primary standard of 800 $\mu g/m^3$ (Table 4.11). The use of conversion factors given for EPA's SCREEN3 model yields an estimate of 0.25 $\mu g/m^3$ for a maximum 1-hour average of hydrogen fluoride. Because estimates of the maximum off-post concentrations corresponding to Kentucky's secondary standards for averaging times between 12 hours and 1 month would range between the annual estimate of 0.02 $\mu g/m^3$ and the 1-hour estimate of 0.25 $\mu g/m^3$, the estimates would be less than the corresponding Kentucky secondary standards, which range between 0.82 and 3.68 $\mu g/m^3$ (Table 4.11). Similarly, total fluorides are not expected to exceed Kentucky standards, which are set nearly two orders of magnitude greater than Kentucky's primary hydrogen fluoride standards. Because of the composition of the fuel and agent and the high temperatures experienced during combustion, negligible emissions of hydrogen sulfide are expected and no detectable odors are expected.

Comment 14-7

Response: Section 4.7.4 of this Final EIS has been revised to address issues raised in the comment. For the Class I analysis, the predicted concentration increments using the ISCST3 model are less than 1% of the corresponding PSD Class I increments at a receptor located 30 mi (50 km) away from the proposed facility in the direction of Mammoth Cave National Park. A distance of 50 km was used because it is the maximum distance at which the ISCST3 model would be appropriate to estimate concentrations. Actual concentration increments at Mammoth Cave National Park, which is located about 100 mi away, would be much lower.

Comment 14-8

Response: Appendix J in this Final EIS has been revised to include a brief discussion of these emissions.

Comment 14-9

Response: Section J.2.2 of Appendix J of this Final EIS has been revised to indicate that the wind fluctuation statistics methodology was used because the available site-specific meteorological data do not include cloud cover and ceiling height, which are necessary to use the Turner method.

Comment 14-10

Response: Section J.2.2 of Appendix J of this Final EIS has been revised to indicate that meteorological data from 1999 were used in the modeling because this year was the most recent period with readily available, quality-assured data when the air quality analysis began for the EIS.

Table K.1 indicates that meteorological data from 1999 was used for the modeling. Section 9.3.1.2(a) of EPAs *Guideline on Air Quality Models* (40 CFR Part 51, Appendix W) indicates a preference for use of the most recent, readily available period of representative meteorological data. The final EIS should discuss why 1999 meteorological data were used. **14-10 (cont)**

Appendix K, Section K.2.3, Receptor Location Data, Page K-4 **14-11**

This section of the Draft EIS describes the receptor grids that were used for the modeling and refers to Figures K.1 through K.4 for a graphical representation of the receptor grids. However, Figures K.1 through K.4 were not included in the electronic version (compact disc). Without these figures, it is difficult to evaluate fully whether the receptor grids used in the modeling were adequate for the analysis. The final EIS should be revised to include these figures. For the receptor grids to be adequate, they must resolve the maximum impact locations to within 100 meters (328 feet) (minimum receptor grid spacing of 100 meters). If the maximum impact locations do not occur in an 100 meter spacing grid, additional modeling should be performed.

Appendix K, Section K.2.5, Other Assumptions, Page K-5, Line 10 **14-12**

This section of the Draft EIS states that the modeling did not include wet or dry deposition of particulate emissions. For the hazardous and toxic emissions analysis, deposition of particles may be significant for evaluating adverse impacts. The final EIS should include deposition modeling (e.g., use of the deposition option in ISCST3) or provide additional justification for not including deposition modeling.

Appendix K, K.1.2

The method used to calculate emissions from boilers and emergency generators was discussed in the draft EIS. However, there is no discussion on the emissions' calculation method used to evaluate the base incineration process. The final EIS should include a discussions clarifying the basis of this determination. **14-13**

The final EIS should provide an estimate (ton per year) of emissions generated by the selected neutralization technology before application of control device(s) as well as the assumed efficiencies of proposed control devices. It appears that air quality modeling was performed based on the post-control emissions. Hence, there should be a discussion regarding how control device(s) will be operated/maintained together with their estimated effectiveness. This information is necessary to ensure that the quantity of post-control emissions are within reasonable parameters and that compliance with National Ambient Air Quality Standards will be achieved. **14-14**

Comment 14-11

Response: Appendix J of this Final EIS has been revised to include Figure J.1 (Figures J.2 through J.4 have not been included because they apply to receptor grids at other sites). The grid intervals range from 164 ft around the facility to 3.1 mi outside the 6.2-mi radius from the center of the facility. This methodology of using nested grids ensures that the receptor grid is relatively dense in locations corresponding to expected maximum concentrations (maximum concentrations occur within 3 mi of the facility). Additional receptors were set at 328 ft apart along the site boundary near the facility and 984 to 1,640 ft apart along the site boundary far from the facility. For construction-related impacts, the estimated maximum concentrations occur north and north-northeast of the proposed facility at the installation boundaries, where the receptors are 328 ft apart. For operational impacts, the estimated maximum concentration increments due to operation of the proposed facility would contribute less than 4% of applicable NAAQS (Tables 4.19-4.22). Because of the very small contribution of the proposed facility to total concentrations that are substantially less than the NAAQS (except for PM2.5), additional modeling including a denser receptor grid would not increase total concentrations enough to result in any additional exceedances of NAAQS; therefore, additional modeling is not necessary.

Comment 14-12

Response: The proposed facility would not be a major source of hazardous and toxic emissions and would not fall into any of the source categories regulated by EPA National Emission Standards for Hazardous Air Pollutants (NESHAP) (see Section 4.8.4). No regulatory action under NESHAP would be necessary for the hazardous and toxic emissions from the facility. Air dispersion modeling has estimated maximum ground-level concentrations associated with each of the emissions (Appendix I). All of the maximum concentrations are less than 1 $\mu g/m^3$, and most are orders of magnitude less. Given these extremely small values and the large uncertainty inherent in deposition modeling, the latter modeling has not been conducted.

Comment 14-13

Response: Appendix J of this Final EIS has been revised to include a brief discussion of the method used to calculate these emissions.

Comment 14-14

Response: Appendix J of this Final EIS has been revised to include a brief discussion of emissions prior to application of the control equipment, the expected effectiveness of the equipment, and how the equipment would be operated and maintained.

The final EIS should include a discussion regarding the applicability of recently promulgated (February, 2002) National Emissions Standards for hazardous air pollutants(NESHAP) from Hazardous Waste Combustors (HWC), 40 CFR 63 Subpart EEE. If the proposed project is subject to the requirements of HWC NESHAP, the final EIS should include a discussion on how BGAD is planning to comply with the above NESHAP requirements. If the proposed project is not subject to the above HWC NESHAP, there should be a discussion clarifying same. **14-15**

The final EIS should address the applicability of Compliance Assurance Monitoring (CAM), 40 CFR Part 64. There should be a discussion indicating applicability of CAM. If applicable, BGAD should indicate how it is planning to comply with CAM. If not applicable, there should be a detailed clarification supporting this position. **14-16**

Waste Issues

Table ES.2., page xlvii of the Executive Summary (also Table 3.3 in Chapter 3 of the document) **14-17**

Under the Hazardous solid wastes and Nonhazardous wastes categories, there is no indication as to whether the quantities listed are totals for the entire project or quantities generated over some other time period. The quantities of other categories of potentially affected resources are presented on an annual basis (e.g., water supply and use). So we assume that the values presented for the various waste categories are also supposed to be annual quantities, but this should be verified in the final document.

The values of hazardous solid wastes and nonhazardous wastes (and in Table 3.3 in Chapter 3) are inconsistent with those shown in Table 4.7 (page 4-24) of the text (with the exception of the estimated amount of sewage from baseline incineration). Whereas the values shown in Table ES.2 do appear to be consistent with the values shown in Tables 7.4-3 and 7.4-4 of the ACWA DEIS for the alternative technologies. This apparent discrepancies between Table ES.2. and Table 4.7 (page 4-24) of the text should be corrected in the final document. **14-18**

Under the Hazardous solid wastes from baseline incineration - anolyte-catholyte wastes are included in the listing. This is probably a mistake, since there should be no anolyte-catholyte waste resulting from the incineration process. **14-19**

Under the Hazardous solid wastes text and Table 4.7 (page 4-24) - there is no mention of spent charcoal filters for any of the alternative technologies. Charcoal filters will presumably be used to filter ventilation air from process areas and some of the PAS discharges associated with the alternative technologies (just as is the case for baseline incineration)., Hence, this waste should be included for the alternative technologies or an explanation provided as to why it is not applicable for the alternative technologies. **14-20**

Comment 14-15

Response: The Draft EIS was prepared after the District of Columbia Circuit Court of Appeals vacated the Final Standards for Hazardous Air Pollutants for Hazardous Waste Combustors promulgated in September 1999. In February 2002, EPA responded to the Court's decision with an Interim Standards Rule and a Final Amendments Rule. This standard applies to several categories of hazardous waste combustion facilities including incinerators, cement kilns, and lightweight aggregate kilns. Accordingly, the standard applies only to the incineration technology at BGAD.

NEPA documentation (including this EIS) does not serve as a compliance plan. The purpose of an EIS is to provide decision-makers and the public with an objective evaluation of significant environmental impacts resulting from a proposed action and all reasonable alternatives. Section J.1.2 discusses the alternative technologies; the HWC NESHAP is not applicable to these technologies because they do not involve an incinerator, cement kiln, or lightweight aggregate kiln.

Section 4.8.4 of the EIS has been revised to indicate that the incineration technology would comply with the Hazardous Waste Combustors (HWC) NESHAP requirements. Because the permit for the BGAD incinerator operations would incorporate the standards as permit conditions, the facility would meet the terms of the standards through permit compliance.

Comment 14-16

Response: Section 4.7.2.2 of this Final EIS has been revised to discuss the applicability of Compliance Assurance Monitoring (CAM).

Comment 14-17

Response: The quantities presented for hazardous and nonhazardous wastes are total amounts. The ACWA Final EIS (Tables 7.4-3 and 7.4-4) presents the amounts of wastes generated per year by each of the ACWA technologies. These annual values in the ACWA Final EIS were multiplied by the total year equivalents of operations for each technology. The periods of operations for all alternatives are found in Section 2.3.4 of this EIS.

The Executive Summary in this Final EIS has been changed to make it clear that these are total waste quantities.

Comment 14-18

Response: The commenter is correct; Tables ES.2 and 3.3 are inconsistent with Table 4.7. The tables in this Final EIS have been changed to assure internal consistency and consistency with Tables 7.4-3 and 7.4-4 of the ACWA Final EIS.

[Intentionally left blank]

Comment 14-19

Response: The commenter is correct; baseline incineration does not produce anolyte catholyte wastes. Table ES.2 in this Final EIS has been corrected to remove mention of aluminum oxide and anolyte-catholyte wastes from hazardous wastes produced by baseline incineration.

Comment 14-20

Response: The commenter is correct; the ACWA technologies would have spent carbon filters. In Sections 7.5.2.2 and 7.6.3.3 of the ACWA FEIS, it states that ventilation air would pass through a filter farm consisting of multiple carbon filter banks. The Army has relied upon the ACWA Program for data on the ACWA technologies and the ACWA FEIS does not provide this waste quantity. To provide a bound, it will be assumed that the ACWA technologies would each produce as many spent carbon filters as baseline incineration, 65 tons. The text in Sections 3 and 4 and Tables ES.2, 3.3, and 4.7 has been modified in this Final EIS to reflect this change.

PROJECT SUMMARY

Project -**Draft Environmental Impact Statement (DEIS) for Destruction of Chemical Munitions at Blue Grass Army Depot (BGAD), KY CEQ # 020215 , ERP # USA-E 11050-KY (dtd February 2002)**

Agency - U.S. Army

Type - DEIS

CEQ Number -020215

Reviewer - Gerald Miller/Hugh Hazen

Region - R4

State - KY

County -Madison

Main Issues - Environmental consequences attendant to chemically altering (de-militarization) war gases as well as the final selection of the specific technology which be used to neutralize these chemical munitions

Other Issues - controversy surrounds the process of this demilitarization, per se (various citizen interests just want this material to remain unaltered in existing storage igloos)

Wetlands Tracking - nominal amount (less than 1 acre) involved
Terrestrial Tracking - approximately 90 acres of upland (pasture and woodland) necessary for construction of facilities

Due Date -07/15/02

Completion Date - 07/15/02

Rating -LO

Summary Paragraph: EPA has no significant objections to the demilitarization proposal or the various technologies which will be used to accomplish this objective.

Key Words - Air quality, chemical weapons, hazardous waste disposal,

[Intentionally left blank]

Section 309 Measures

Draft Environmental Impact Statement (DEIS) for Destruction of Chemical Munitions at Blue Grass Army Depot (BGAD), KY CEQ # 020215 , ERP # USA-E 11050-KY (dtd February 2002)

Significant Environmental Issues Highlighted in Comment Letter

(specify # of comments in each blank)

Draft / Final	Draft / Final
Air Issues:	**NEPA Issues:**
Air (General Issues) 1	Alternatives/Modify
Air Toxics 1	Cumulative Impacts
General Conformity 1	Mitigation
Transportation Conformity	Purpose/Need
Radiation	Indirect Impacts
Water Issues:	Impact Assessment Methodology
Contaminated Sediment	Monitoring)
Estuarine	Conclusions Not Supported
Ground/Drinking Water	**Other Media/Multimedia:**
Marine	Biodiversity
Riverine	Endangered Species
Water Quality	Environmental Justice
Wetlands	Historic Preservation
Waste Issues:	Noise
Solid Waste 1	Pesticides
Hazardous Waste 1	Toxics
Terrestrial Habitat Issues:	Other

Performance Measures

• Aquatic Habitat Impacted (number of acres):at EPA's Initial Involvement:

Draft: less than 1 acre

[Intentionally left blank]

Final:

• Terrestrial Habitat Impacted (number of acres): at EPA's Initial Involvement:

Approx. 75-90 acres

Draft:

Final:

• Other Quantifiable Impact (specify): at EPA's Initial Involvement:

Draft:

Final:

Success story/Explain significance of habitat or other measure above/ROD improvement:

[Intentionally left blank]

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Program Manager for Chemical Demilitarization
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TE 4585B Parrish Road
Gunpowder Falls, Maryland 21010-0057

Comments for the Draft Environmental Impact Statement for the Disposal of Chemical Munitions at Blue Grass Army Depot

My comments are based on comments I made to the ACWA Draft Environmental Impact Statement. Those comments are recorded in Document #00103, pp.3-426 to 3-438 of the Final Environmental Impact Statement Responses to Comments of Draft EIS, April 2002.

The management of PMCD has been subjected to serious criticism over the years incineration has been the technology of choice for chemical weapons destruction. The criticism has come from within the Department of Defense, Congress, and from the public. Management problems are related to cost overruns, time delays, and, in my opinion, lack of transparency in regard to health and safety issues at the Tooele, Utah facility. I believe these management problems are a consequence certain social organizational characteristics of baseline incineration technology. Furthermore, I believe these characteristics and the management problems to which they contribute have lead to, as yet, unacknowledged human health and safety issues. These "certain characteristics" are discussed in detail in the previously mentioned document. Essentially those comments maintain that baseline incineration is a complex and tightly coupled system, which has a high potential of producing *complex interactions among failures* of multiple components in the overall technology. Managers of tightly coupled systems with such potential interactions among failures face contradictory *social organizational* requirements. The technology sets up organizational conditions that make it sociologically necessary for management authority to be *simultaneously* centralized and decentralized. It is impossible to maintain a stable social 15-1

EDUCATION PAYS

Comment 15-1

Response: The comments are noted.

order within such contradictory social organizational demands on the structure of management authority. This impossibility ~~contributes significantly to production delays, added expense~~, and to the continual emergence of technological "incidents" during routine operations. More importantly the organizational contradictions increase the possibilities that operational failures will escalate into significant and even catastrophic accidents. Personally, I believe the threat of catastrophic accident is greater from this condition than the movement of munitions from storage to treatment facilities. Any management team faced with both a volatile technological system and a structurally unstable social system will be faced with a continual stream of technological and social organizational problems requiring contradictory management conduct. Thus, even competent and well-intentioned personnel will often find both their routine work and their problem solving attempts during emergencies difficult and frustrating because of the social organization of the workplace. **15-1 (cont)**

For these social organizational reasons I am opposed to the choice of incineration as a technology for disposing of chemical weapons at the Bluegrass Army Depot. My opinion is that all of the alternative technologies under consideration for BGAD reduce the characteristic of "tight coupling". Tight coupling is reduced by "hold-test-release" features and by reducing reliance on high-temperature and high-pressure components. I believe these differences are significant enough to remove the social structural contradictions inherent in baseline incineration. I think that all of the alternative technologies can be well managed. I do not think baseline technology can be well managed even by competent and well-trained personnel. **15-2**

Finally, if incineration is to continue to be used as a disposal technology at some sites, I think sites using neutralization technologies should be under separate management. I say this because I think the effects of social organizational contradictions on management practices at incineration sites would aversely effect management of neutralization sites. **15-3**

Thank you for your consideration of these comments.

Sincerely,

[signature]

Dr. Richard Futrell

Comment 15-2

Response: The preference in the comment for non-incineration technologies is noted. Both incineration and non-incineration technology alternatives use various hold-test-release strategies for liquid and solid wastes (see Sections 3.4.2 and 4.6 and Appendices D and G of this EIS). These residues would be disposed of off-site rather than on-site. There are also gaseous emissions from the incineration and non-incineration systems, and these are addressed in this EIS (see Sections 4.7 and 4.8 and Appendices D and G of the EIS). There is a limited hold-test-release capability for gaseous emissions for the non-incineration technology alternatives.

Comment 15-3

Response: The comment is noted. The Army's decision regarding alternative management organizations for destruction of the chemical weapons stockpile is outside the scope of this EIS.

July 14, 2002

~~U.S. Army Program Manager~~
For Chemical Demilitarization
P.O. Box 57
TE 4585B Parrish Road
Gunpowder Falls, Maryland 21010-0057

Reference: Draft Environmental Impact Statement for Destruction of Chemical Munitions at Blue Grass Army Depot, Richmond Kentucky

To Whom It May Concern:

In general I found the Draft Environmental Assessment to provide a reasonable discussion of the four alternatives under consideration and believe the appropriate criteria have been identified to apply to each alternative. However, I do not concur with the conclusion given to each potentially affected resource. Each alternative should be evaluated on its own merit, and not base line (incineration). In the comparison tables (table 3 & ES) the impacts should be listed for each alternative rather than compared to baseline. Under Potentially Affected Resource, the summary conclusions for groundwater and surface water should be reevaluated. Both neutralization and electrochemical oxidation should have a much higher potential to impact these resources, due to the operation and incoming and out going shipments of liquid items. **16-1**

Without archaeological, cultural and historic survey completed, it is unclear how a potentially affected resource can be evaluated. An archaeological, cultural and historic survey should be completed before the final determination is made. **16-2**

The document should include a table or listing of all inputs (including fuel), and all outputs for each of the proposed Demil technologies. The document should also specify how and where the secondary waste will be handled and treated. The listing should take into account the final destruction of the secondary waste, including whether it will be onsite or offsite. All environmental output should be accounted for, whether it be onsite or offsite. For example, should the secondary waste be shipped off site for treatment, then the cost of the treatment should be considered, as well as the impact/outputs to the environment at the offsite location. Air should not be part of the matrix because it is readily available and low cost, and skews the matrix. The cost of each input and output should be addressed. The document should furthermore include impacts on the output variances for each agent and the variances should the agent be solidified vs. maintained in a liquid state. Treatment of all byproducts must be included. A block flow diagram showing this matrix should be included. **16-3**

The documents should identify the EPA and Kentucky hazardous waste codes for each input and output stream. Each Demil technology should identify when the waste streams will no longer be regulated by EPA and/or Kentucky (N001, N002, and N003). Without this information, it is unclear how a schedule or proper cost analysis may be derived. **16-4**

Comment 16-1

Response: Each alternative was examined on its own merits in the body of the EIS, and quantitative data relevant to each alternative were examined and analyzed to support conclusions reached for each environmental resource examined. The summary tables referenced in the comment (i.e., Tables ES.1, ES.2, ES.3, 3.2, 3.3, and 3.4 in the EIS) used the impacts of the baseline incineration technology alternative as a means to facilitate comparing the impacts of one alternative to another and not as a substitute for the detailed analysis shown in the remainder of the EIS.

Comment 16-2

Response: Section 4.19.2 of this EIS states that archaeological surveys of any previously unsurveyed portions of the selected facility, access road, and utility corridor locations must be conducted prior to the start of any project activities, and a report documenting the findings must be submitted to the State Historic Preservation Officer. The discovery of any sites that are eligible for the *National Register of Historic Places* would require the mitigation of potential adverse impacts before ground-breaking could begin.

Comment 16-3

Response: Mass balances, block flow diagrams, and other engineering tools and studies are beyond the scope of this EIS, but as required, such tools and studies are utilized and documented in the preparation of other environmental documents (e.g., RCRA and Clean Air Act permit applications). Costs, although certainly important, are beyond the scope of this document, but would be considered by the decision maker. Inputs and outputs for the alternative systems are discussed in Section 3.4. The potential impacts from disposition of secondary wastes are discussed in Section 4.6. The method of and location for secondary waste (byproduct) disposition depend upon the hazardous status of the wastes; decisions would be made depending upon the outcome of laboratory analyses and positions taken by the regulating entities. The potential impacts to people and the environment surrounding off site disposition facilities would be considered in site-specific environmental documentation and/or permits for those facilities.

Comment 16-4

Response: Identification of all alternatives' input/output streams with the appropriate EPA and Kentucky hazardous waste codes is beyond the scope of this document. General agreement on hazardous waste regulation practices will be reached with regulatory authorities prior to initiation of agent destruction. It may be necessary to address the reclassification of some wastes after detailed analyses have been performed. All specific hazardous waste decisions will be conducted within the scope of other publicly available environmental documentation including RCRA and Clean Air Act permit applications. Costs and detailed schedules are beyond the scope of this document, but they are among the elements the decision maker will consider in preparing the record of decision.

With each proposed technology, identify the potential hazards and outputs should an upset occur during the process. For example, what would be the hazards and output should an explosion ~~or ignition of a rocket motor occur during~~ separation, incineration, neutralization, or electrochemical oxidation. **16-5**

I disagree with the statements in the local paper, quoting /stating that the high temperature and high-pressure treatment of agent would most likely be unacceptable to Kentucky's general public. Safety, minimum impact to the environment, full destruction of chemical agent (stockpile and non-stockpile), and a proven technology should be the top priorities in the final Demil-technology selection. **16-6**

J Walters

J. Walters
4426 Spear Road
Lexington, KY
40515

Comment 16-5

Response: Process upsets can result from two situations (1) process fluctuations, such as might occur during start-up or shutdown activities and (2) accidents. Section 4.8.5 of this Final EIS describes an evaluation of process fluctuations. In regard to accidents, no detailed risk assessments currently exist for the ACWA technologies. The results of a detailed "quantitative risk assessment" for incineration are presented and described in Section H.3 in Appendix H of this Final EIS.

Comment 16-6

Response: The comment is noted. The criteria that will be considered in making a Record of Decision are discussed in Sections 1.4.5 and 1.4.6 of the EIS.

JAMES E. BICKFORD
SECRETARY

PAUL E. PATTON
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FRANKFORT OFFICE PARK
14 REILLY RD
FRANKFORT KY 40601

August 5, 2002

Program Manager for Chemical Demilitarization
Public Outreach and Information Office
ATTN: Mr. Gregory Mahali
Building E-4585,
Aberdeen Proving Ground (EA) MD 21010-4005

Re: Draft EIS for Destruction of Chemical Munitions at Blue Grass Army Depot, KY (SERO 2002-53)

Dear Mr. Mahall:

The Natural Resources and Environmental Protection Cabinet (NREPC) serves as the state clearinghouse for review of environmental documents generated pursuant to the National Environmental Policy Act (NEPA). Within the Cabinet, the Commissioner's Office in the Department for Environmental Protection **coordinates** the review for Kentucky State Agencies. **17-1**

The Kentucky agencies listed on the attached sheet have been provided an opportunity to review the above referenced report. Responses were received from 9 (also marked on attached sheet) of the 14 agencies that were forwarded a copy of the document. Attached are the comments from the Kentucky Divisions of Water and Air Quality, and the Kentucky Transportation Cabinet.

If you should have any questions, please contact me at (502) 564-2150, ext. 112.

Sincerely,

Alex Barber
State Environmental Review officer

Enclosure

Comment 17-1

Response: The comment is noted. Although the comments received from the Commonwealth of Kentucky were received approximately three weeks following the close of the public comment period, they are addressed in the following comments and responses.

17-1 (cont)

NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
ENVIRONMENTAL REVIEW

Draft EIS for Destruction of Chemical Munitions at Blue Grass Army Depot, KY

The following agencies were asked to review the above referenced project. Each agency that returned a response will appear below with their comments and the date the project response was returned.

C denotes Comments
NC denotes No Comment
IR denotes Information Request
NR denotes No Response

REVIEWING AGENCIES:

Division of Water	comments
Division of Waste Management	nc
Division for Air Quality	comments
Department of Health Services	
Economic Development Cabinet	ns
Division of Forestry	ns
Department of Surface Mining Reclamation & Enforcement	nc
Department of Parks	
Department of Agriculture	
Nature Preserves Commission	nc
Kentucky Heritage Council	nc
Division of Conservation	nc
Department for Natural Resources	ns
Department of Fish & Wildlife Resources	nc
Transportation Cabinet	comments
Department for Military Affairs	

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The Kentucky Transportation Cabinet, Department of Highways, has made the following advisory comments pertaining to **Environmental Review SERO2002-53**
Draft EIS for Destruction of Chemical Munitions at the Blue Grass Army Depot 17-2

The proposed alternate sites for the construction of a chemical weapons destruction facility would require access from a state maintained facility. Therefore, please be advised any firm, individual, or governmental agency desiring access to a State road or desiring to perform any type of work, improvements or impacts, on State maintained facilities, must obtain an encroachment permit from the Department.

Access onto US25 would not only require an encroachment permit, but would also impact the proposed widening and reconstruction of US 25 between US 421 and the Richmond Bypass (KY 876) (Highway Project, Item No. 7-251.00). The design phase for this project is scheduled to begin in FY 2006.

Please contact our District 7 Office at the following address as soon as possible to coordinate these issues in order to avoid any unnecessary conflict:

Willie Whittamore, Planning Branch Manager
David Treadway, Permits Engineer
Kentucky Department of Highways
763 W. New Circle Road, Bldg. 2
P. O. Box 11127
Lexington, Kentucky 40512
Telephone (859) 246-2355
Fax (859) 246-2354

Julie Ryan
6/24/02

Comment 17-2

Response: The Army notes the comments regarding the requirement for an encroachment permit from the Department of Highways of the Kentucky Transportation Cabinet for development of the access road to either of the sites being considered for the destruction facility at BGAD. The Army will consult with the Kentucky Division of Highways, coordinate issues involved in developing an access road on either Highway 52 or US Highway 25/421, and pursue the appropriate permit(s) when more information is available.

JAMES E. BICKFORD
SECRETARY

PAUL E. PATTON
GOVERNOR

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FRANKFORT OFFICE PARK
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FRANKFORT KY 40601

NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
ENVIRONMENTAL REVIEW

Title: Comments on the Draft EIS for Destruction of Chemical Munitions at Blue Grass Army Depot, KY from the Division for Air Quality

Project Number: SERO2002-53

The Division for Air Quality (DAQ) has reviewed the Draft Environmental Impact Statement (EIS) prepared by the United States Army Chemical Stockpile Disposal Program. This EIS addressed three alternatives and the baseline technologies for possible use in the destruction of chemical munitions at Blue Grass Army Depot in Richmond (Madison County). The Division has found that the information submitted in the draft EIS appears to address most Air Quality issues. However, upon thorough review, the Division has found that the following Kentucky Administrative Regulations apply to this proposed project: **17-3**

1. Regulation 401 KAR 63:020, *Potentially hazardous matter or toxic substances*, requires that "No owner or operator shall allow any affected facility to emit potentially hazardous matter or toxic substances in such quantities or duration as to be harmful to the health and welfare of humans, animals, and plants". Any of the four proposed alternatives at BGAD would be an affected facility.

2. Regulation 401 KAR 51:017, *Prevention of significant deterioration of air quality* (PSD) would apply should emissions from any of the alternatives reach 250 or more tons per year. Information provided for the baseline incineration system indicates an emission rate of 249.2 tons per year of NO_x from the incinerator and an additional 22 TPY from a steam generator. At 271.2 tons of NO_x this amount will trigger PSD regulations and the submittal of a PSD permit application would be required.

3. Regulation 401 KAR 63:002, *National emissions standards for hazardous air pollutants*, 40 CFR 63 Subpart EEE, *Hazardous Waste Combustors* shall most likely apply to the baseline incineration technology.

4. The baseline incineration system information identifies Nitrogen Oxide (NO_x) emissions of 271.2 tons per year. Regulation 401 KAR 53:010 *General provisions*, precludes any person from interfering with the attainment or maintenance of ambient air quality standards as specified in 401 KAR 53:010, *Ambient air quality standards*. There are a number of ozone maintenance areas that BGAD could negatively impact.

Comment 17-3

Response: The list of applicable regulations is appreciated. The proposed facility would comply with applicable Kentucky Administrative Regulations.

5. In 1997 U.S. EPA promulgated a new, more stringent, standard for particulate matter. This standard, commonly referred to as the fine particulate standard or the $PM_{2.5}$ standard, addresses those particles equal to or less than 2.5 microns in size. Although no designations have been made for this standard at this time, monitoring is taking place to make those designations. Information provided in this draft EIS indicated emissions of levels of $PM_{2.5}$ in excess of the standard. BGAD should take whatever steps are necessary to ensure that any affected facilities will meet emissions standards. **17-4**

6. Fugitive emissions would be released during construction of any of these alternatives. Regulation 401 KAR 63:010, *Fugitive emissions*, states that "No person shall cause, suffer, or allow any material to be handled, processed, transported, or stored; a building or its appurtenances to be constructed, altered, repaired, or demolished, or a road to be used without taking reasonable precaution to prevent particulate matter from becoming airborne". BGAD has not identified what they consider to be reasonable precautions to preclude fugitive emissions from becoming airborne during construction of the chosen alternatives. BGAD shall prepare and submit to DAQ a fugitive emissions control plan to ensure compliance with this regulation. **17-5**

7. If the project will cause BGAD to have, in any containers or processes on site, regulated amounts of any of the 140 hazardous chemicals that are covered by the Clean Air Act (CAA) §112(r), then a Risk Management Program must be developed and documented in a Risk Management Plan before the chemicals can be located onsite and/or used in a process at BGAD, per 40 CFR 68. **17-6**

8. A monitoring plan would be required to be submitted and approved pursuant to 401 KAR 50:050, and such plan would have to meet the requirements of the Policy Manual of the Division of Air Pollution Control incorporated by reference in 401 KAR 50:016. **17-7**

The Division has the following comments:

9. On page 1-15, line 19, the statement that the ACWA has determined that biotreatment is not a total removal option for VX and GB is somewhat misleading. The proposed Parson/AlliedSignal biotreatment process did demonstrate degradation of agent hydrolysate but was recommended by ACWA that further investigation for scale-up would be required to optimize the system. Several technical papers from outside sources have also demonstrated reasonable agent hydrolysate degradation. **17-8**

11. From page 3-19 Section 3.5, the Division agrees that the "no-action" alternative is not an option. **17-9**

12. From page 3-7, Section 3.2, the Division notes that all alternatives from baseline incineration will require some incineration capacity to destroy metal parts and dunnage. If the metal parts and dunnage are contaminated, 40 CFR 63 Subpart EEE may still apply. **17-10**

Comment 17-4

Response: The proposed facility would meet all applicable emissions standards.

Comment 17-5

Response: A fugitive emissions control plan will be submitted to DAQ.

Comment 17-6

Response: A Risk Management Program would be developed and documented in a Risk Management Plan, if the proposed facility would have regulated amounts of any of the 140 hazardous chemicals that are covered by the Clean Air Act.

Comment 17-7

Response: The proposed facility would comply with applicable Kentucky Administrative Regulations.

Comment 17-8

Response: The comment is noted. PMCD has relied on the Program Manager for ACWA for its determination that biotreatment would not be a viable option for destroying assembled chemical weapons containing nerve agent.

Comment 17-9

Response: The comment is noted.

Comment 17-10

Response: The comment is noted. Section 4.27 of the EIS provides a summary discussion of permit requirements for the proposed action. The Army will comply with all relevant and appropriate environmental regulations, including 40 CFR Part 63 (National Emission Standards for Hazardous Air Pollutants for Source Categories), Subpart EEE (National Emission Standards for Hazardous Air Pollutants from Hazardous Waste Combustors).

13. From page 2-18, Section 2.3.4, emissions from baseline incineration were based on 8760 hours per year of operation, yet emissions from alternative technologies were based on 3312 hours per year, or 3744 hours per year, depending on numbers used for calculation. Unless the lower hours of operation were a physical limit, this would have to be considered a permit operating limit. Additional information will be necessary in order to evaluate whether the alternative technologies would have to be permitted as a conditional major. **17-11**

14. From page 3-18, line 30 (Table 3.1), emergency generators would be operated for 600 hours per year. EPA has provided guidance for emergency generators to allow for up to 500 hours per year. Additional information regarding the emissions from these generators will be necessary in order to determine if any other air quality requirements would be triggered. **17-12**

15. From page 4-54, Section 4.8.5, the percent control of an accidental release or a leaking munition from the MDB must be specified within a permit application. The control device (carbon adsorber) and efficiency shall become federally-enforceable permit conditions. **17-13**

16. From page K-3, Section K.2 (Appendix K), the meteorological data used for the ISCST3 model should come from the nearest weather station site (such as Cincinnati airport, etc.) and consist of 5 years met. data. This standard is necessary only for PSD issues, but could be required depending on further concerns brought forth from this Division. **17-14**

17. From page K-4, line 20, figures K.1 through K.4 (receptor locations) are missing. **17-15**

18. Within Appendix K, the Division recommends that an analysis be performed using the ISCST3 model to indicate the dispersion of agent in the unlikely event of an accidental release (from the MDB, incinerator, etc.). This should be followed by an impact analysis and risk assessment. **17-16**

Comment 17-11

Response: Additional information will be developed as part of the permitting process for the proposed facility.

Comment 17-12

Response: Additional information will be developed as part of the permitting process for the proposed facility.

Comment 17-13

Response: Additional information will be developed as part of the permitting process for the proposed facility.

Comment 17-14

Response: The on-site meteorological tower at BGAD satisfied EPA siting criteria, and the meteorological data were checked using quality assurance/quality control procedures (Appendix J). Five years of data are not yet available. On-site wind data were compared with wind data at Lexington Airport (Section 4.7.1.1). The wind patterns are similar, but the predominant wind direction is slightly different. The prevailing wind direction using on-site data is from the south-southwest, whereas it is from the south at Lexington Airport. Because the wind data used in the EIS should represent local meteorological conditions as closely as possible, the on-site data were selected for the air dispersion analysis. It is recognized that procedures established for the air permitting process may recommend using other data from more distant locations.

Comment 17-15

Response: Appendix J in this Final EIS has been revised to include Figure J.1 (Figures J.2 through J.4 have not been included because they apply to receptor grids at other sites).

Comment 17-16

Response: If the incineration technology is selected for implementation at BGAD, the RCRA permitting process requires the preparation of a detailed human health risk assessment. A protocol for the development of this risk assessment, including a discussion of the selected air dispersion model(s), would need to be provided to and approved by the Commonwealth of Kentucky (in conjunction with EPA) before the actual risk assessment could begin. It is not known at this time whether a human health risk assessment would be prepared if a non-incineration technology is selected for implementation at BGAD. EPA only requires that health risk assessments be prepared for combustion technologies.

JAMES E. BICKFORD
SECRETARY

PAUL E. PATTON
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COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
FRANKFORT OFFICE PARK
14 REILLY RD
FRANKFORT KY 40601

MEMORANDUM

TO: Alex Barber
State Environmental Review Officer
Department for Environmental Protection

FROM: Timothy Kuryla TK
EIS Coordinator
Division of Water

DATE: July 30, 2002

SUBJECT: DEIS, Facility for Chemical Weapons Destruction, BGAD (Madison County), SERO 020530-053

The Division of Water has reviewed the Draft Environmental Impact Statement Supplement (DEIS) prepared by the by U.S. Army Program Manager Assembled Chemical Weapons Assessment regarding the facility for chemical weapons destruction at the Blue Grass Depot (BGAD, Madison County). The Division reviewed the PDEIS (SERO 011008-85) for this facility at the Blue Grass Depot. The Division notes the State Environmental Review Officer's (SERO's) coordinated state response was not included in the DEIS. The SERO's PDEIS and DEIS comments need to be included in the Final EIS. **17-17**

The Division of Water reviewed the DEIS (SERO 020530-053) to ascertain if the Division's January 14, 2002 PDEIS comments were addressed.

WATER QUALITY **17-18**

4	**EXISTING CONDITIONS AND ENVIRONMENTAL IMPACTS**	
4.13	**Ground Water**	**Pages 4-83 to 4-87**
4.14	**Surface Water**	**Pages 4-87 to 4-91**
4.18	**Wetlands**	**Pages 4-113 to 4-119**

If the project can result in a discharge of dredge or fill material into:

- 200 linear feet of any "blue line" stream (as shown on the U.S. Geological Survey 7.5 minute topographical map for the project area), or

Comment 17-17

Response: The Army has no record of receiving comments from the Division of Water on the preliminary Draft EIS for this proposed action at BGAD. The comment indicates that the review was conducted on the ACWA Draft EIS and not on this site-specific EIS.

Comment 17-18

Response: The comment is noted. Section 4.27 of the EIS provides a summary discussion of permit requirements for the proposed action. The Army will comply with all relevant and appropriate environmental regulations, including, as appropriate, 33 USC Section 1341 ("401") water quality certification by the Division of Water for the U.S. Army Corps of Engineers and a 33 USC Section 1344 ("404") dredge or fill permit.

At this time is does not appear that either of the action forcing items identified in the comment would occur for the proposed activities at BGAD. As discussed in Section 4.18 of the EIS, a small (less than one acre) wetland would be destroyed by construction of facilities in proposed Area A and three small (each less than 0.5 acre) wetlands might be adversely affected by construction of the access road and of facilities in alternative Area B.

SERO 020530-053
Page 2

- One acre or more of any wetland, **17-18 (cont)**

then a 33 USC § 1341 ("401") water quality certification by the Division of Water for the U.S. Army Corps of Engineers and a 33 USC § 1344 ("404") dredge or fill permit must be obtained. The DEIS does not state whether the above is encountered. The Division of Water desires a statement regarding the above in the FEIS.

17-19

4 <u>EXISTING CONDITIONS & ENVIRONMENTAL IMPACTS</u>
4.6 WASTE MANAGEMENT & FACILITIES
4.6.2 <u>Construction Impacts</u> **Pages 4-21 to 4-23**

The Division of Water recommends that in the construction of the project Best Management Practices (BMPs) be utilized to prevent nonpoint sources of water pollution and, thereby, control stormwater runoff and sediment damage to water quality and aquatic habitat. For technical assistance on the kinds of BMPs most appropriate for this type of construction, please contact the Madison County Soil and Water Conservation District or the Division of Conservation of the Natural Resources and Environmental Protection Cabinet. The Division of Water, also, has available BMP construction manuals. The FEIS needs to address BMPs proposed to be used.

WASTEWATER TREATMENT **17-20**

4 <u>EXISTING CONDITIONS & ENVIRONMENTAL IMPACTS</u>
4.6 WASTE MANAGEMENT & FACILITIES
4.6.1 <u>Current Waste Management & Facilities</u>
4.6.1.2 Non Hazardous Wastes **Page 4-21**
4.14 SURFACE WATER
4.14.2 <u>Releases to Surface Water</u> **Pages 4-89**

The sanitary wastewater issues were addressed.

The Division of Water observes that Muddy Creek is a reference reach stream. This means that it is one of the Commonwealth's streams least impacted by pollution. The Division is concerned about toxic chemicals (dioxins, polychlorinated byphenols [PBCs], etc.) entering a reference reach stream.

The Division of Water PDEIS comments noted that the Division had much biological data that was not used to characterize the creek's resources. The DEIS did not address adequately the characteristics of Muddy Creek. The preparers did not avail themselves of the Division's data. The Division invites the preparers to avail themselves of these data. **17-21**

c: Tom Van Arsdall, Water Quality Branch

Comment 17-19

Response: The comment is noted. As discussed in Section 4.12 of the EIS, the Army would apply Best Management Practices (BMPs) during construction (e.g., sedimentation basin, soil fences, berms, liners, revegetation of disturbed land following construction) to minimize the potential for increased soil erosion. Many of these practices would also have a beneficial effect in terms of preventing nonpoint sources of water pollution and controlling stormwater runoff and sediment damage to water quality and aquatic habitat. Relevant language has been added to Sections 4.6.2 and 4.14 in this Final EIS to clarify this issue. See also Section 4.26.7 of this EIS for a discussion of ecological mitigation for implementation of the proposed action.

Comment 17-20

Response: As pointed out in Section 4.14.2 of the EIS, there would be no releases of liquid process effluents from any of the proposed alternatives for the facility. The alternatives do include a new sewage treatment facility that would discharge treated effluent to Muddy Creek. This wastewater would be treated and the effluent would have to meet the requirements of KPDES. If a new sewage treatment facility is constructed, a new KPDES permit would have to be negotiated and issued. This effluent would not be expected to be a source of the toxic chemicals referenced by the commenter.

The most likely potential source of these toxic chemicals would be via atmospheric transport and deposition from operations of the various facility alternatives. The estimated toxic air pollutant emissions for the various alternatives are given in Appendix I of the EIS, and are low. As explained in Sections 4.15.4 and 4.16.4.1 of the EIS, the levels of toxic chemical emissions would be expected to be well below levels that would affect ecosystems, even through bio-uptake and biomagnification in the food chain. In addition, screening level ecological risk assessments (SLERAs) will be conducted for emissions from the agent destruction facility technology alternative selected. The SLERAs would be part of the RCRA permitting process and would be expected to indicate if toxic emissions could produce potential effects in Muddy Creek. Previous SLERAs for other agent destruction facilities have shown that there is little such potential. For comparison purposes, the dioxin emissions from an existing agent disposal incinerator are similar to the combined dioxin emissions of four residential wood burning fireplaces (see Appendix E).

Comment 17-21

Response: We appreciate the offer of additional data to characterize Muddy Creek. The Army has requested and will consider the additional data, when provided by the Commonwealth, during the permitting process. However, as explained in the previous response, and in the Draft EIS and this Final EIS, there would be no releases of liquid process effluents to Muddy Creek, only potential input of sewage treatment plant wastewater that would have to meet the requirements of a KPDES permit that would have to be negotiated and issued. Aerial deposition from operations would be small, and construction impacts due to sediment- or contaminant- laden runoff to the creek could be minimized through implementation of appropriate measures (best management practices).

K.4 ORAL COMMENTS AND RESPONSES

About 60 people offered comments at the public meetings. Many of these speakers expressed a preference for agent neutralization technologies or against incineration. They stated their belief that neutralization is safer and has fewer environmental impacts than incineration. None of the commenters offered specific, direct support for the incineration alternative unless it could clearly be shown to be safer and more effective than the alternatives. Twenty-five commenters expressed a specific preference for a non-incineration alternative: neutralization (23 commenters), or electrochemical oxidation (2 commenters). Twenty-six commenters specifically opposed incineration but did not state a preference for an alternative. The Army notes these statements of preference—and they will be considered in making the record of decision—but they are not part of the scope of the EIS.

In addition, the speakers offered several comments—listed below, with responses—that are similar to those found in the written comments on the DEIS.

1. **Comment:** Non-incineration technologies can be implemented as quickly as incineration. ***Response:*** As noted in the response to written Comment 12-45, schedule projections for all of the alternatives are currently being verified for the Defense Acquisition Board.

2. **Comment:** An incinerator will affect the local land values and will cause negative public perception of the BGAD area.
Response: As noted in the response to written Comment 6-2, any effect on land values or public perception resulting from any of the alternatives would be limited to the duration of the stockpile destruction activities. In addition, to the extent that property values and other socioeconomic factors may have been negatively affected by the presence of the BGAD stockpile, it is possible that those values could increase in the future as a result of the stockpile's destruction, regardless of the destruction technology selected.

3. **Comment:** After the BGAD stockpile is destroyed, an incinerator would be used to destroy other hazardous and toxic wastes, some of which may be brought in from other localities and states.
Response: As noted in the response to written Comment 4-1, as discussed in Section 4.25 of the EIS, Congress has mandated, through Public Law 106-79, the dismantlement of any destruction facility unless the administration of a state in which the destruction facility is located determines that future use of the facility is desirable. As also stated in Section 4.25 of the EIS, the Army currently intends to dismantle and close the BGAD facility upon completion of the stockpile destruction activities regardless of the destruction technology selected and implemented.

4. **Comment:** Incinerators emit dioxins, furans, carcinogens, heavy metals, and other toxic substances. Also, the projected incinerator emissions for the stockpile destruction activities have not been adequately characterized.
Response: For the baseline incineration system, multiple controls would be incorporated to minimize emissions. Scrubbers, HEPA filters, and charcoal filters would be used to control emissions to the air (Section 3.2.1). Ventilation exhaust air from potentially contaminated areas of the MDB and the CHB would be filtered extensively before being discharged. In addition, a PAS has been developed for the incinerator exhaust gases. The purpose of the PAS filter system is to improve the performance of the pollution control equipment by further reducing low level emissions of products of incomplete combustion and metals. The three incinerators with their associated PASs would be required to meet RCRA

requirements. The DFS and MPF would be required to destroy agent to a destruction and removal efficiency (DRE) of 99.99% and meet the allowable stack concentrations set by the U.S. Army Surgeon General (Appendix D). The LIC would be operated to destroy agent to a DRE of 99.9999% and meet the agent emission limits established by the U.S. Army Surgeon General (Appendix D). Trial burns at JACADS and DCD have demonstrated that the baseline incineration technology achieves or exceeds a DRE of 99.9999% for PCBs (Section 4.8.4). The ventilation and incinerator exhaust stacks would be monitored continuously for the presence of agent (Section 3.2.1). Carbon filter replacement would be rigorously controlled to protect the workers and to prevent release of agent. The incinerators would also be required to meet air pollution control requirements for conventional pollutants (Appendix D).

5. **Comment:** Neutralization technologies are inherently safer because they are “closed” systems, and they operate at much lower temperatures and pressures than incineration.
Response: Because of the significant differences in the level of detail available for the various technologies under review in this EIS, a direct comparison of the potential risks of accidents, particularly accidental agent releases, is not possible at this time. In addition, comparing the risk of accidents among cannot be based solely on the “closed” nature of neutralization technologies or their operating temperatures and pressures. Similarly, incinerators cannot be held to be “safer” than neutralization if the comparison is limited to design features it does not share with the alternatives.
Also, as noted in the response to written Comment12-79, the potential for process upsets exists for both incineration and non-incineration technologies. While the highest process temperature is associated with incineration, the pressures sustained in the Super Critical Water Oxidation (SCWO) technologies are much higher than those during incineration. As noted in the response to written Comment 15-2, both incineration and non-incineration technology alternatives use various hold-test-release strategies for liquid and solid wastes (see Sections 3.4.2 and 4.6 and Appendices D and G of this EIS). These residues would be disposed of off-site rather than on-site. There are also gaseous emissions from the incineration and non-incineration systems, and these are addressed in this EIS (see Sections 4.7 and 4.8 and Appendices D and G of the EIS). There is a limited hold-test-release capability for gaseous emissions for the non-incineration technology alternatives.

6. **Comment:** The Army has a history of accidents with incinerators at other sites and has not reported these events accurately, quickly, and honestly. Also, the Army’s experience with incinerators cannot be used to support the use of an incinerator at BGAD because of the significant type and number of design changes that have occurred since the construction of those facilities.
Response: The comment regarding accidents at other incinerators is noted. Appendix C of the EIS includes discussion of operational experience at other baseline incineration facilities (JACADS and TOCDF), including process upsets and incidents and releases. An additional quantitative risk assessment (QRA) of the facililty design and operation would be conducted if an incineration facility is selected at BGAD. The accidents and operational upsets at other Army chemical agent incinerators, as well as the extensive history of successful destruction of large quantities of chemical agent at other sites, would be considered in the preparation of that QRA. Also, as noted in response to written Comment 12-56, the design changes were based on the change from theoretical operations to actual operational experience and with full attention to worker risk and safety.

7. **Comment:** An incinerator would use more water than neutralization processes.
Response: As noted in Section 4.3.2 of the EIS, water use by baseline incineration is essentially equivalent to that of ncutralization/GPCR/SCWO, about 3 times that of neutralization/SCWO, and about 18 times that of electrochemical oxidation. As noted in this EIS and the ACWA FEIS, these water use levels are well within the available capacity of BGAD to provide water from its on-site, man-made lake, Lake Vega. The EIS contained a discrepancy between water use statistics given in the text compared with the data in Table 4.2. The table contains the correct information, and the text has been corrected.

8. **Comment:** Incinerator emissions would be added to existing contaminants in the area and may, by interacting with those pollutants, cause adverse human health and ecological effects.
Response: Section 4.7.7 of the EIS, which addresses the cumulative impacts of atmospheric emmissionis of criteria pollutants, indicates that, for all of the alternative technologies considered, the only criteria pollutant that would exceed NAAQS levels is PM2.5, and that increment would amount to approximately 0.7% of the NAAQS level of 15 $\mu g/m^3$. Section 4.7 of the EIS further notes that the Commonwealth of Kentucky already exceeds NAAQS levels for PM2.5. Section 4.8.7 of the EIS, which addresses the cumulative impacts of atmospheric emissions of hazardous and toxic substances, indicates that the cumulative impacts of these emissions are important for their potential impacts on human health and biological resources. These cumulative impacts are addressed in Sections 4.9 (human health), 4.15 (terrestrial habitats and wildlife), 4.16 (aquatic habitats and fish), and 4.17 (protected species) of the EIS; minor to negligible cumulative impacts are expected for each of these resources.

9. **Comment:** Risk assessments for incinerators have not considered the frequent shutdowns "that are a regular part of the operation of a chemical weapons incinerator."
Response: As indicated in response to written Comment 12-43, prior to being issued a permit for operations, any incineration facility would be required to complete a human health risk assessment, which would evaluate the potential impacts to defined receptors produced by chemicals from the facility, even for chemicals that are substantially within regulatory limits. The protocol for the human health risk assessment would include a study that mimics upset or non-standard operating conditions by increasing the quantities of chemicals released. No such documents currently exist for BGAD. Appendix E of the EIS does include summaries of human health risk assessments prepared for other chemical weapons disposal incinerators (at Tooele, Utah; Umatilla, Oregon; Pine Bluff, Arkansas; and Anniston, Alabama).

10. **Comment:** The carbon filters proposed for the incinerator increase rather than decrease risk to workers.
Response: As indicated in response to Comment 12-58, the carbon filters incorporated into the design of the incineration system are used to identify releases of agent and products of incomplete combustion (PICs) to protect worker health and safety as well as public (i.e., off-site) health and the environment. Generally, the facility performs multi-agent monitoring on the common stack for current agent campaign and previous processed agent campaigns. As indicated in response to written Comment 12-96, the monitoring plan would designate monitoring locations and sampling areas. The plan would stipulate the installation of three ACAMS units to monitor the common stack with two monitoring at a staggered

configuration and the third as a spare. The second unit would have an offset cycle start time from the first unit.

K.5 COMMENT CARDS

At the public meeting, 18 individuals submitted comment cards. With only a couple of exceptions, the remarks on the comment cards expressed opposition to the baseline incineration alternative and/or support for the non-incineration alternatives. Some additional comments were provided on these comment cards expressing appreciation for the opportunity to participate, for the work of and comments from others participating in the technology choice deliberations, and generalized concerns about the need to protect public health and the environment. No comments were made on these comment cards addressing any specific information or analyses included in the Draft EIS.