



# Assembled Chemical Weapons Assessment Program

**Safety**  
**Neutralization/Supercritical Water Oxidation**

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GM-1



## Types Of Hazards

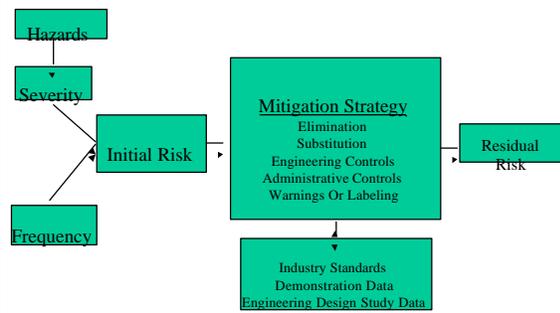
- ◆ **Inherent Hazards**
  - Hazards basic to the process; the process would have to be changed to eliminate the hazard. The effects of the hazard can be mitigated, but the hazard can not be eliminated (i.e., high temperature or pressure ; corrosive chemicals).
- ◆ **Manageable Hazards**
  - Hazards that may be changed, eliminated or mitigated and not affect the basic parameter of the process (i.e., use of a lower concentration or type of caustic in scrubbers).
- ◆ **Residual Hazards**
  - Process hazards left over after mitigation or elimination efforts.

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## Preliminary Hazard Analysis (PHA)



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## Major Unit Operations

- ◆ Munition Unpack
- ◆ Agent Accessing
- ◆ Agent Treatment
- ◆ Energetic Accessing
- ◆ Energetics Treatment
- ◆ Metal Parts Treatment
- ◆ Dunnage Treatment
- ◆ Integrated Material Transport

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## Munition Unpack

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| <ul style="list-style-type: none"> <li>◆ <b>Major Unit Processes</b> <ul style="list-style-type: none"> <li>• Unload truck via forklift</li> <li>• Temporary storage in Munition Storage Building (MSB)</li> <li>• Manual unpacking &amp; handling</li> </ul> </li> <li>◆ <b>Hazards</b> <ul style="list-style-type: none"> <li>• Agent leaks or munitions functioning</li> <li>• Typical industrial material handling ergonomic hazards</li> <li>• Double handling (unpacks &amp; places in Munition Storage Building (MSB) until needed)</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>◆ <b>Major Safety Features</b> <ul style="list-style-type: none"> <li>• Standard Army agent monitors &amp; personal protective equipment</li> <li>• Facility provides vapor containment</li> <li>• Administrative control – standard operating procedures</li> <li>• Projectiles not highly sensitive to mishandling</li> </ul> </li> </ul> |
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## Agent Accessing

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| <ul style="list-style-type: none"> <li>◆ <b>Major Unit Processes</b> <ul style="list-style-type: none"> <li>• Modified reverse assembly</li> <li>• Cryofracture/press</li> </ul> </li> <li>◆ <b>Hazards</b> <ul style="list-style-type: none"> <li>• Extreme low operating temperatures</li> <li>• Liquid nitrogen</li> <li>• Worker environmental stress</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>◆ <b>Major Safety Features</b> <ul style="list-style-type: none"> <li>• Remote operations</li> <li>• Standard industrial equipment</li> <li>• Effective standard industrial monitoring &amp; control</li> <li>• HD frozen munitions not a problem (potential for less worker entries because it eliminated HD heal problems)</li> <li>• Use of personal protective equipment</li> </ul> </li> </ul> |
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## Agent Treatment

- ◆ Major Unit Processes
  - Continuous Stirred Tank Reactor (CSTR) - Hydrolysis (low temperature, ambient pressure)
  - SCWO - Secondary treatment of agent hydrolysate
- ◆ Hazards
  - Leaks
  - Hydrolysate is corrosive
  - High temperature & pressure (Supercritical Water Oxidation)
- ◆ Major Safety Features
  - SCWO - Proven effective treatment of organic compounds
  - Remote operations; vapor containment room
  - Continuous Stirred Tank Reactor (CSTR) is slow controllable process; reaction does not cascade
  - Batch process with hold, test, rework, & release capabilities
  - Effective use of barricades

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## Energetic Accessing

- ◆ Major Unit Processes
  - Modified reverse assembly
  - Energetics Rotary Hydrolyzer (ERH)
- ◆ Hazards
  - Leaks involving caustic process chemicals (NaOH) and products
- ◆ Major Safety Features
  - Remote operations – total containment provided in the Explosive Containment Room (ECR)
  - Controllable process
  - Chemical reaction in Energetics Rotary Hydrolyzer (ERH) should not cascade

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## Energetics Treatment

- ◆ Major Unit Processes
  - Treatment in Energetics Rotary Hydrolyzer (ERH) followed by Batch Continuous Stirred Tank Reactor (CSTR) (Hydrolysis reactions)
  - Secondary treatment by Supercritical Water Oxidation (SCWO)
- ◆ Hazards
  - Caustic Process Chemical (NaOH) and Products
  - Supercritical Water Oxidation (SCWO) – high temperature & pressure
- ◆ Major Safety Features
  - Remote operations
  - Energetics Rotary Hydrolyzer (ERH) & Continuous Stirred Tank Reactor (CSTR) are slow, controllable process reactions that do not cascade; low temperature (100-110oC) & ambient pressure
  - Batch process with hold, test, rework, & release capabilities
  - Secondary treatment (Supercritical Water Oxidation) can effectively treat organic compounds

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## Metal Parts Treatment

- ◆ Major Unit Processes
  - Modified reverse assembly & cryofracture
  - Primary treatment in Projectile Rotary Hydrolyzer (PRH)
  - Secondary treatment in the Heated Discharge Conveyer (HDC)
- ◆ Hazards
  - Hot water (194°F)
  - Heated Discharge Conveyer (HDC) – high internal temperatures (1000 ° F)
  - N<sub>2</sub> blanket
- ◆ Major Safety Features
  - Remote operations; containment at equipment level
  - Projectile Rotary Hydrolyzer (PRH) is slow controllable process reaction that does not cascade
  - Secondary treatment by Heated Discharge Conveyer (HDC) provides 5X level metal
  - Facility provides secondary containment

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## Dunnage Treatment

- ◆ Major Unit Processes
  - Commercial wood shredder & hydropulper
  - Treatment in Supercritical Water Oxidation (SCWO)
- ◆ Hazards
  - Noise (>140 dBA)
  - Moving mechanical parts
  - Dust generation
  - High internal temperatures & pressures (SCWO)
  - Heat stress
- ◆ Major Safety Features
  - Remote operations
  - Proven controllable industrial process

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## Integrated Material Transport

- ◆ Major Unit Processes
  - Pumping of hydrolysate
  - Use of conveyers
- ◆ Hazards
  - Hydrolysate leaks (almost neutral pH; agent neutralized; energetic deactivated)
  - Hot metal
- ◆ Major Safety Features
  - Remote operations or very limited attended required
  - Few potential initiations catalyses during transport
  - Standard industrial equipment
  - Effective standard industrial monitoring & control

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## Conclusions

- ◆ Primary agent & energetics destruction units provide excellent containment of low temperature & ambient pressure processing parameters at the equipment level.
- ◆ Secondary treatments (Supercritical Water Oxidation, Catalytic Oxidizer & Heated Discharge Conveyor) can effectively destroy organic compounds.
- ◆ The facility heating, ventilation, and air conditioning (HVAC) system & filters provide secondary effective containment.
- ◆ Primary destruction (hydrolysis) is a batch process. Mitigate or eliminate the potential for down stream exposures.
- ◆ Standard industrial practices & procedures proven to control hazardous process chemicals.
- ◆ Potential for an external agent release - highly improbable.