U.S. ARMY RESEARCH, DEVELOPMENT, AND ENGINEERING COMMAND

U.S. ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

AMC

CRYOFRACTURE DEMILITARIZATION PROGRAM UPDATE

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GENERAL ATOMICS

ACKNOWLEDGEMENTS

- **Project Sponsors:**
  - » Product Manager for Demilitarization
  - » US Army Defense Ammunition Center

- **Project Team:**
  - » PM Demil - Project Oversight
  - » DAC – Project Integration and Coordination
    - – Robotics Integration
  - » ARDEC – Project Execution and Technical Supervision
  - » MCAAP – Facility Support and Process Operations
  - » GA – Process Design, Construction/Installation, and Proveout

PRESENTATION OUTLINE

- **Background**
- **Project History**
- **Prototype Facility**
  - » Process Design Basis
  - » Facility Development
  - » Equipment Upgrade Status
  - » Schedule
  - » Summary

BACKGROUND

- There is a potential requirement to demilitarize 6 to 9 million ADAM antipersonnel landmines as well as a variety of other small explosive loaded munitions in the demil inventory (e.g., grenades, mines and submunitions in ICMs and CBUs)
- Conventional methods are not acceptable for the ADAM mine:
  - » Components include explosives (in the overlay/kill mechanism, gas generator, Safe & Arming Device), an ammonia battery and an epoxy housing containing a small amount of DU
  - » OB/OD yields DU/explosives mixed waste which contaminates the soil, air and water and is not exempted under Federal Regulation 10CFR40
  - » Disposal sites will require long-term care, monitoring and maintenance to protect the public health and safety
  - » Incineration in a deactivation furnace will result in contamination of the furnace and ultimately require its disposal
- For other small explosive-loaded munitions, there is a hazard associated with detonation in the furnace.

OBJECTIVE

- Develop a safe, cost effective, environmentally sound technology for the demilitarization of the ADAM mine and other small, explosive-loaded munitions in order to:
  - » Phase out Open Burning/Open Detonation
  - » Increase the throughput in deactivation furnaces
  - » Minimize risk to personnel and equipment
  - » Reduce operator exposure to DU/explosive materials during the demilitarization operation
  - » Demonstrate automated projectile download operations

TECHNICAL APPROACH

- Use an existing large-scale cryofracture test facility at Dugway Proving Ground (DPG) to determine feasibility of process and confirm the proposed prototype design

- Design, procure, install and proveout a high rate prototype cryofracture demil facility at McAlester Army Ammunition Plant (MCAAP), Oklahoma

CRYOFRACTURE PROJECT HISTORY

- **Project has evolved through 5 phases**
- **Phase I: Proof of Principle for Conventional Ammunition**
  - » 1994-1999: Inert and live testing of various munitions at DPG
  - » 1997: ADAM mine selected as primary candidate item
- **Phase II: Design of Prototype Facility at McAlester AAP**
  - » 1997: Cryofracture process conceptual design completed
  - » 1999: Detailed process design completed
  - » 2000: Building and support equipment design completed
- **Phase III: Facility Construction and Equipment Procurement/Fabrication/Installation/Proveout and Manual Demonstration/Validation**
  - » 2000-2004
- **Phase IV: Addition of Automated Robotically-Based Projectile Disassembly/Downloading Capability**
  - » 2001-2005
- **Phase V: Process Equipment and Safety Upgrades/Integrated (including robotics) Dem/Val**
  - » 2004-Present

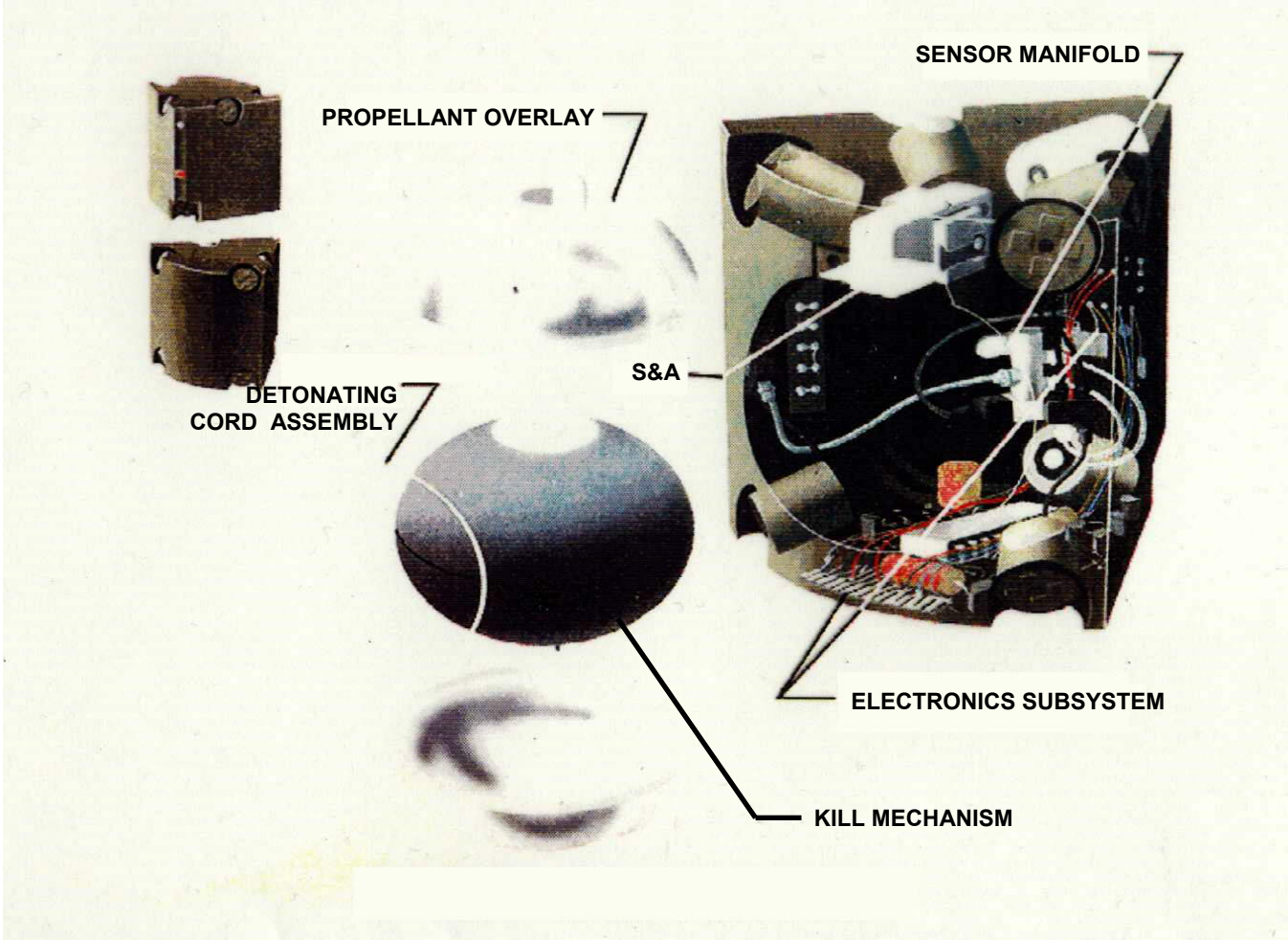
MCAAP MCDF Development
Cryofracture Process Design Basis

- **Process ADAM mines**
- **Process other munitions tested at DPG or at YPG**
- **Process other "yet-to-be identified" munitions**
- **Throughput is one fracture per minute**
- **Each fracture processes multiple munitions**
- **Interface with existing APE-1236 Deactivation Furnace**

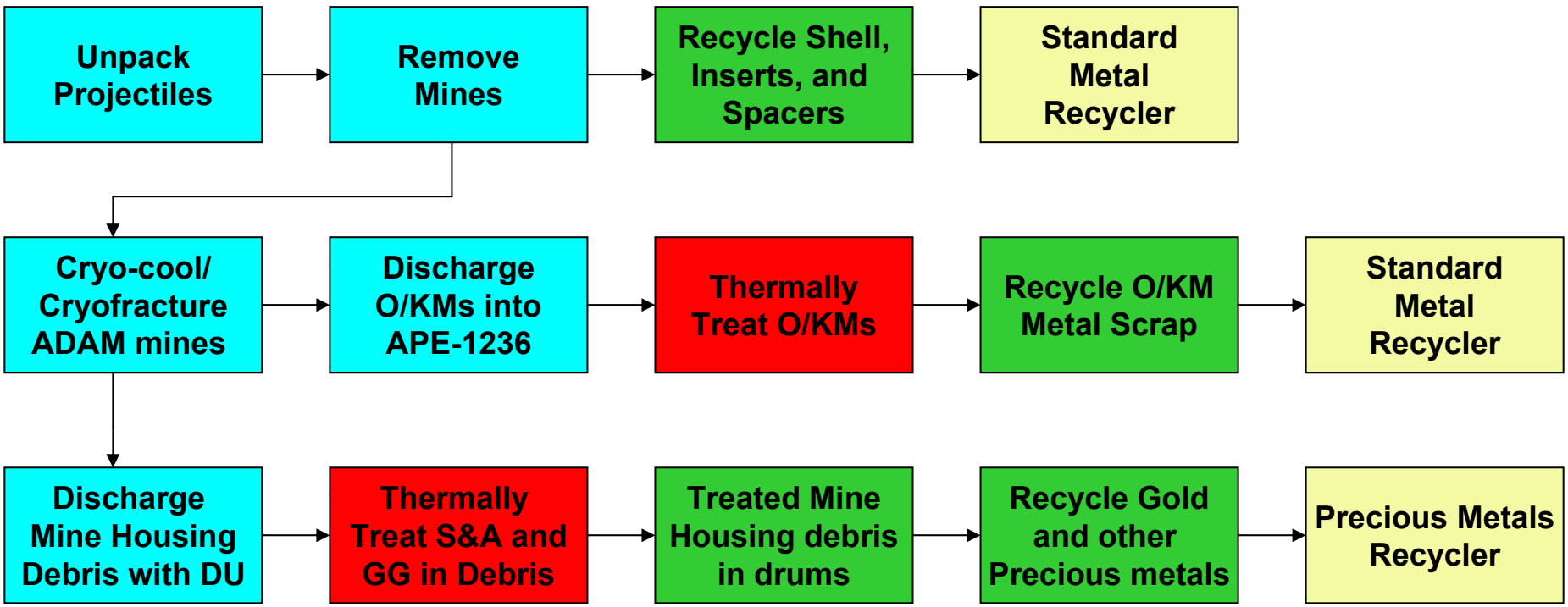
MCAAP MCDF Development
Projectile Download Design Basis

- Accept fully loaded M732 and M692 projectiles containing 36 ADAM mines
- Remove the ADAM mines from the projectiles
- Collect/segregate all scrap material (metal projectile, spacers, projectile base plate, ogive, pushout rod, etc.)
- Place the ADAM mines in cryofracture transport fixtures for introduction to the cryofracture process

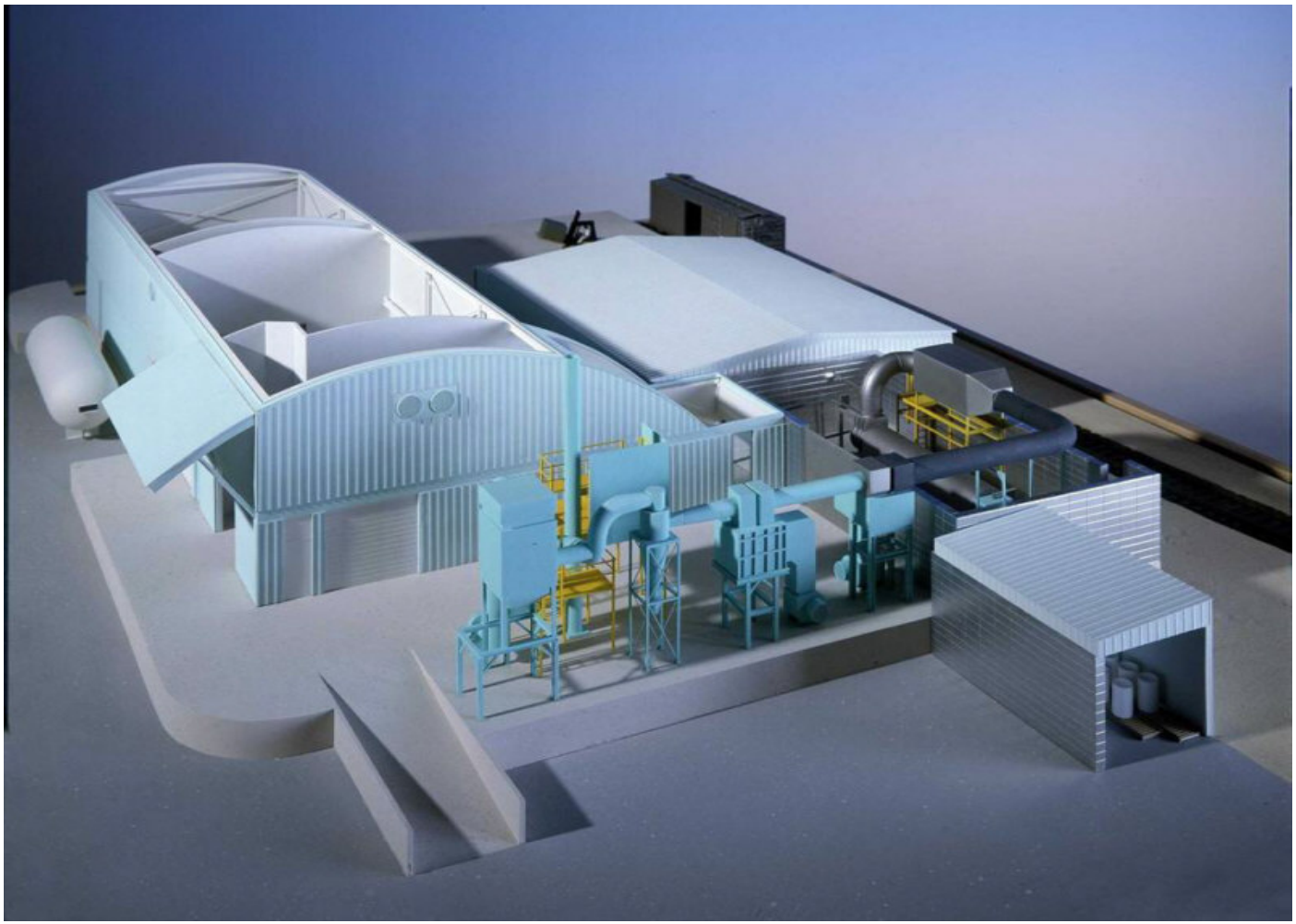
Area Denial Artillery Munition (ADAM) Mine



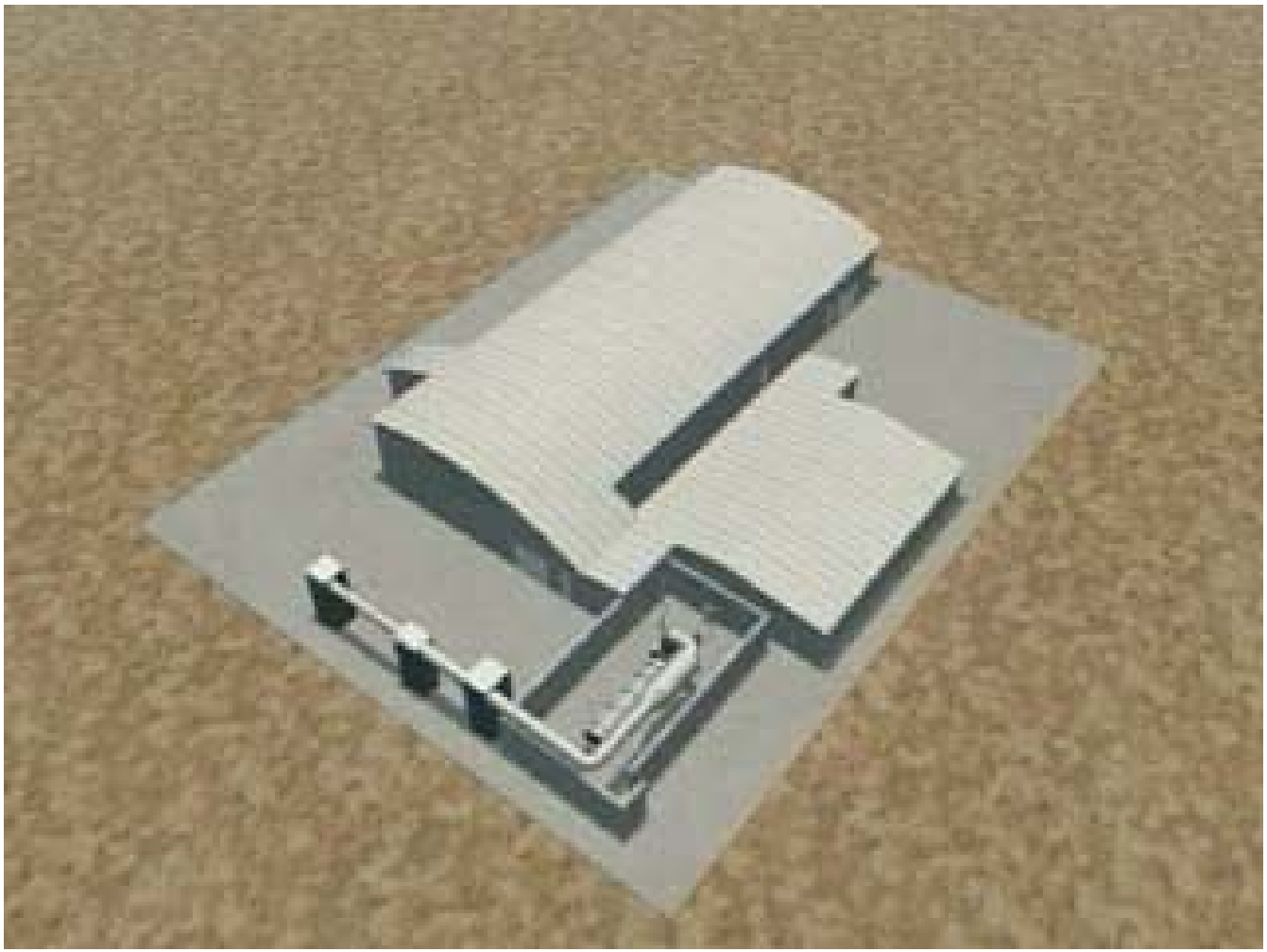
ADAM Mine Cryofracture/Thermal Treatment PFD



MCAAP Cryofracture Facility

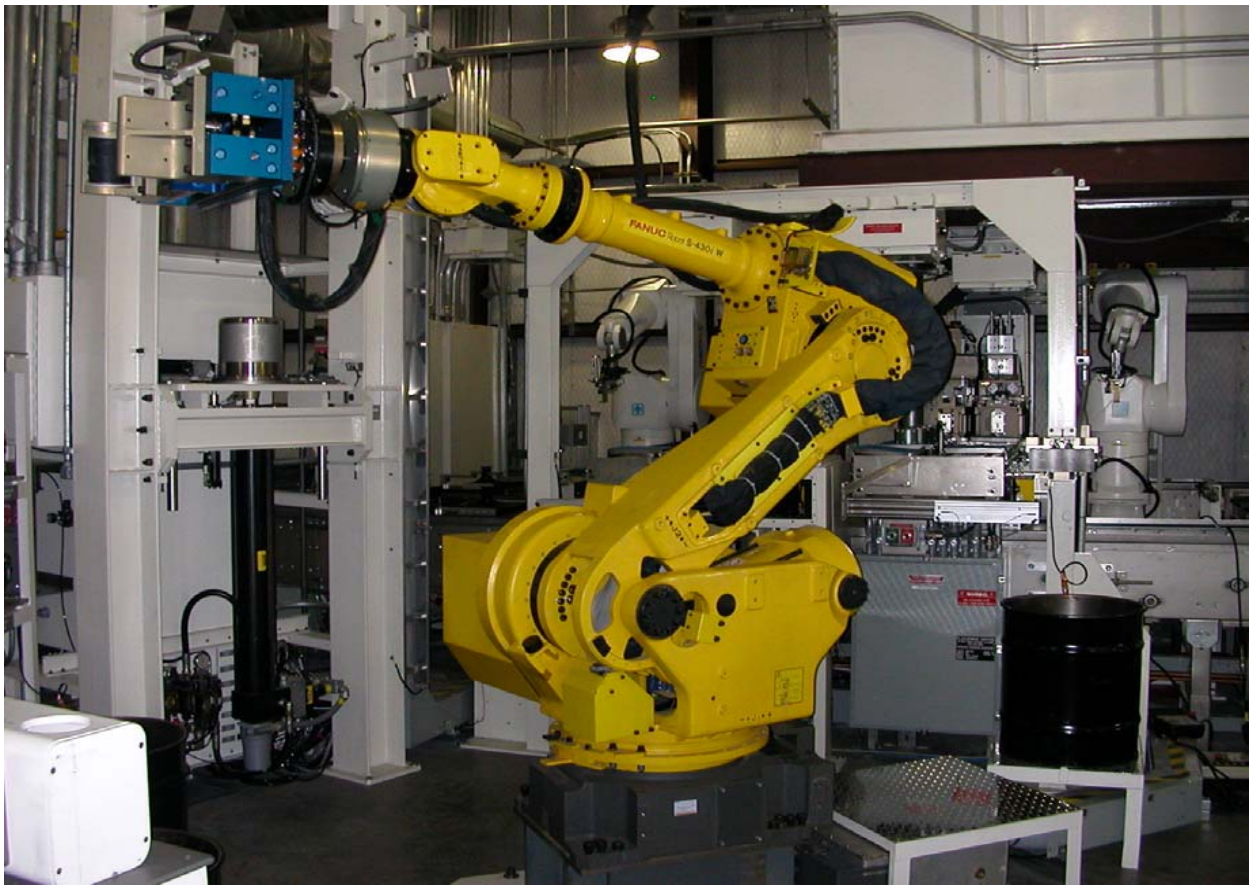


Cryofracture Demilitarization Facility Animation Video



Manual Loading of ADAM Mines on Conveyor

Automated Download of ADAM Mines

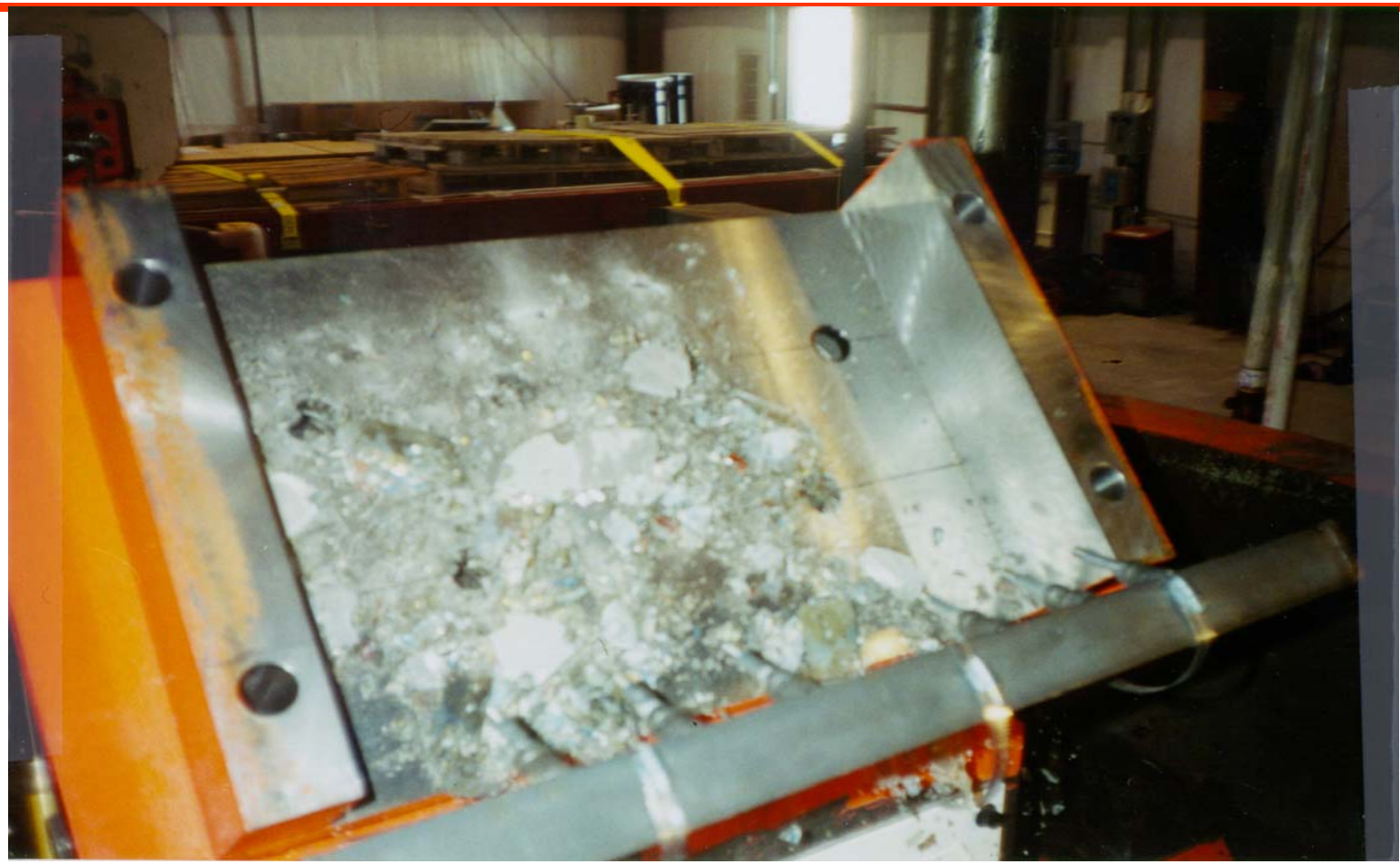


ADAM Mines Cooling in Cryobath

ADAM Mines Ready for Cryofracture

ADAM Mines after Cryofracture

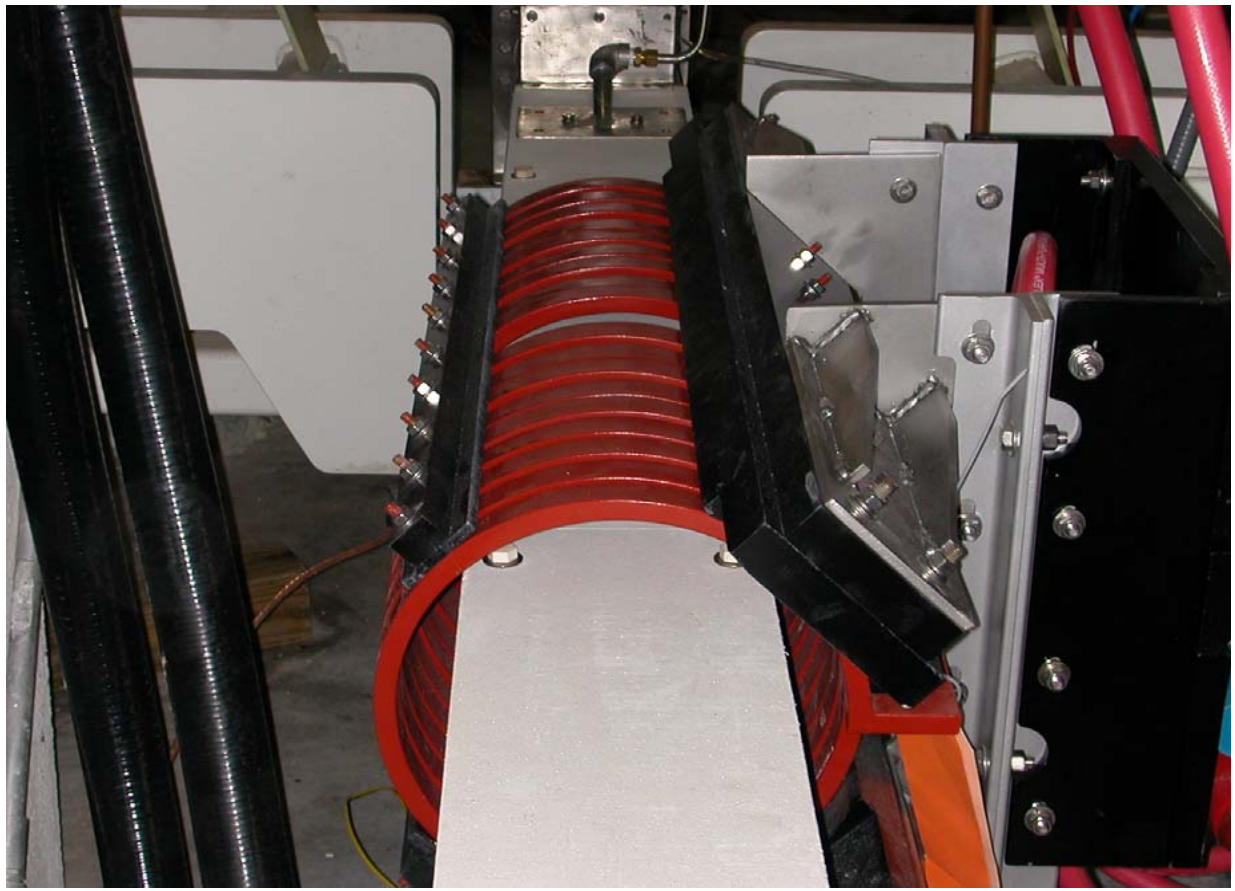
Cryofracture Debris Discharge – Tilt Table



Cryofractured Overlay Kill/Mechanisms

RKS Feed of Accessed O/KMs

Deactivation by Induction Heating



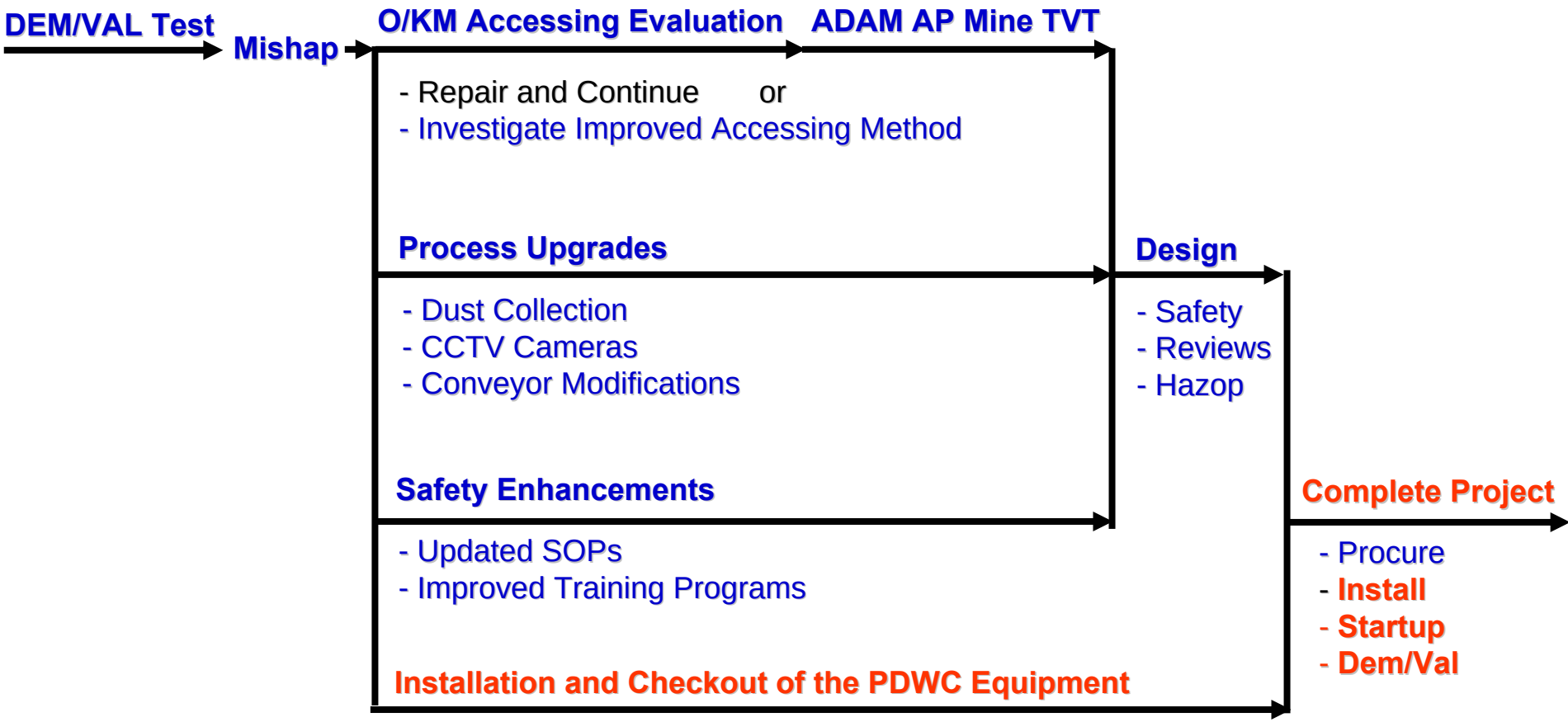
ADAM Mine Debris in Drum

Control Room Workstations

MCDF Munitions Processed To-Date

- 958 Simulants (plastic inerts)
- 1,832 Previously functioned ADAM QA mines from YPG
- 2,655 ADAM QA mines
- 9,384 ADAM AP mines

Project Status



MCAAP MCDF DEVELOPMENT
Accomplishments Since 2004 Mishap

- **Design Effort (Press tooling and process upgrades)**
- **Design Reviews**
- **Detonation Analysis**
  - **Detonations are not likely due to controlled orientation of O/KM on toolset**
  - **Detonations are possible and the press and frame are designed to survive**
  - **Fragment shields and tooling are designed to survive (blast analysis simulation) but can easily be replaced**
- **HAZOP (process is safe)**
  - **No design changes**
  - **A number of changes to the SOPs**
- **Procurement**

MCAAP MCDF DEVELOPMENT
Current Schedule

Mar 07 **Procure Safety and Upgrade Equipment for Cryofracture**

Jul 07 **Equipment Installation**

Sep 07 **Checkout/Startup complete**

Nov 07 **Integrated tests complete**

Dec 07 **Dem/Val Testing Complete (MCDF and PDWC)**

Feb 08 **Transition to Support ADAM mine demil workload**

SUMMARY

- **Cryofracture technology has been shown to be an effective means for demilitarizing a variety of small explosive-loaded conventional munitions**
- **Cryofracture provides a solution to the ADAM mine mixed waste demilitarization problem**
- **Automated robotic process will demonstrate an effective means for disassembling/downloading cargo-carrying 155mm projectiles**
- **The SEAS press incident, while disappointing and impacting the schedule, has led to operational and safety improvements**
- **Prototype facility at MCAAP will provide a safe, cost effective and environmentally sound alternative to OB/OD and significantly enhance deactivation furnace processing**