SAND # 2013-4398 C
SAND2013-4398C

Explosive Destruction System Phase 3 and Future Designs

John E. Didlake, Brent L. Haroldsen, Robert W. Crocker
Sandia National Laboratories, Livermore, CA

W. Venner Saul, Lloyd R. Payne, David L. Cole,
Jerome Stofleth, John Rudolphi
Sandia National Laboratories, Albuquerque, NM

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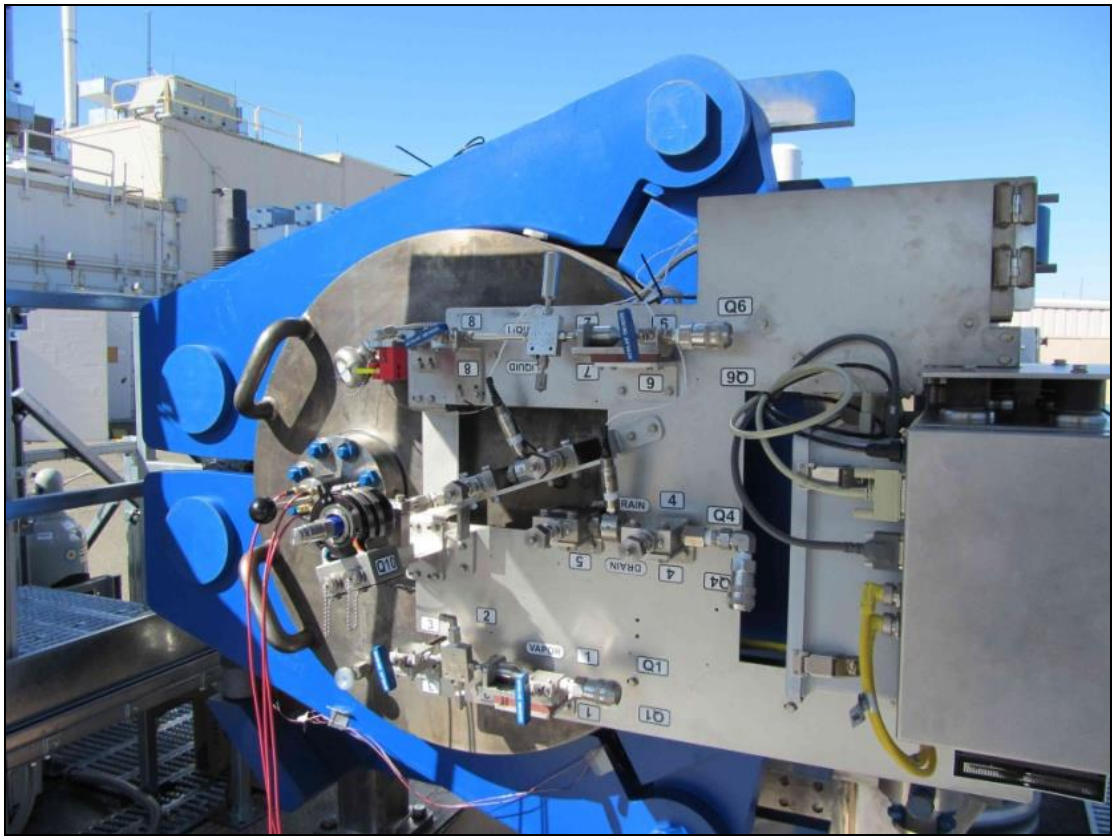
EDS Phase 2 Pilot system demonstrated one-day processing

- Brent Haroldsen will cover the Phase 2 Pilot (P2P) testing in a following session.



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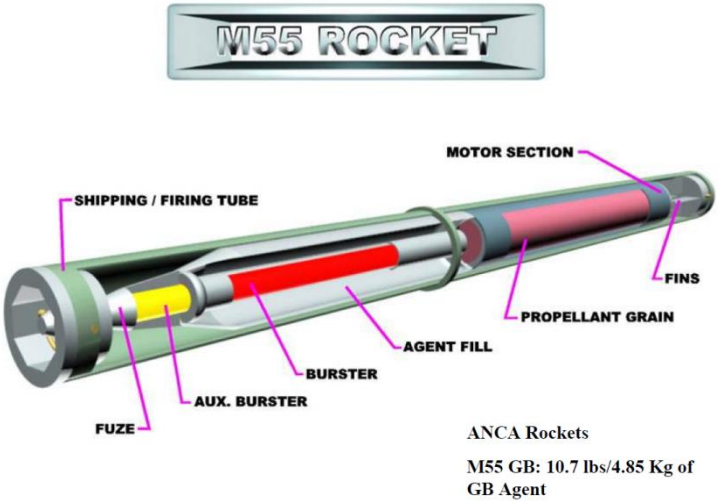
EDS Phase 3 requested

- Sandia was asked by the US Army Non-Stockpile Chemical Material Project (NSCMP) at the end of FY12 to develop a larger EDS that can:
  - Process over-packed, leaking M55 rockets,
  - Complete a process cycle in one day (using process upgrades demonstrated in the P2P), and
  - Be operational by mid-2014.



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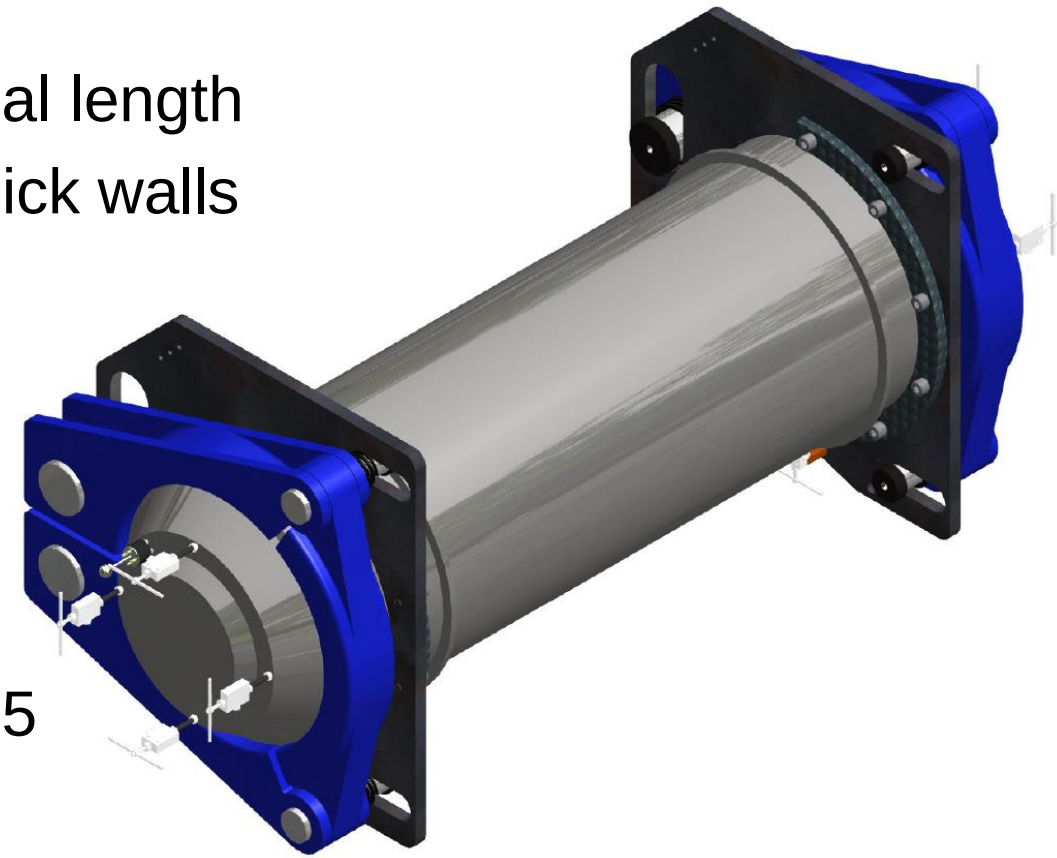
P3 Vessel Design

- 316 stainless steel
- 120 inch (305 cm) internal length
- 5.625 inch (14.29 cm) thick walls
  - Necked down at clamps
  - Existing P2 Grayloc seals
- Door at both ends
- 3-piece clamp design
- Improved hinge design
- Capacity for just one M55
- ASME Code Case 2564
- ~35,000 to 40,000 pounds (16,000 to 18,000 kg)



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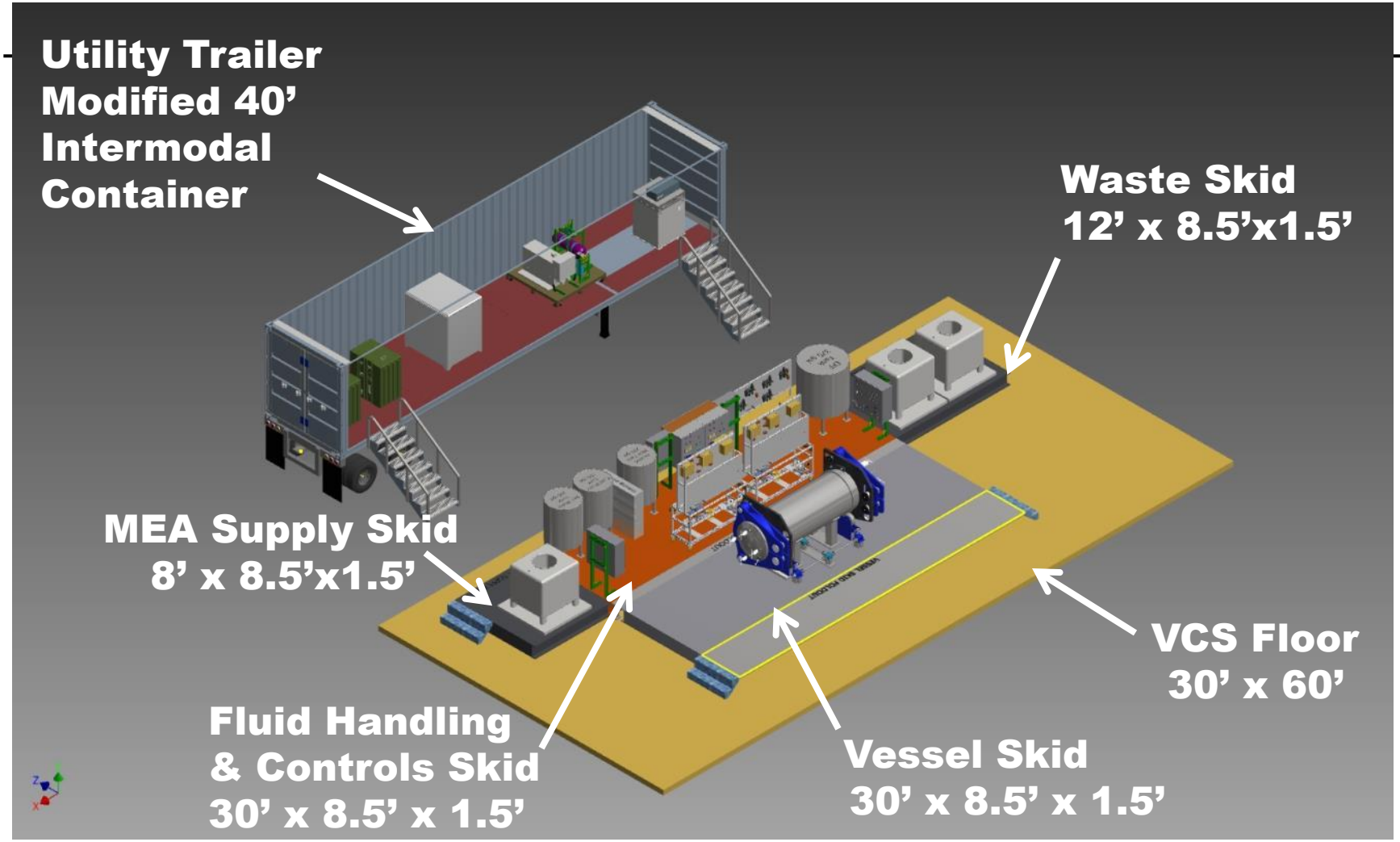
P3 design layout



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Vessel walls driven by explosive capacity

- Treat one M55 rocket inside of an overpack (2 desired)
  - 19.3 lbs (8.8 kg) of propellant (assume it will detonate)
  - 3.2 lbs (1.5 kg) Comp B burster (intentionally detonated with CSC)
  - ~1.5 lbs (0.7 kg) of CLSC and CSC
  - 2 lbs (0.9 kg) contingency (TNT eq, design changes, det cord, etc)
  - 26 lbs (11.8 kg) total
- Treat up to twelve 155 mm M110 shells in UMSCs
  - 0.36 lbs (0.16 kg) Tetryl burster
  - 0.26 lbs (0.12 kg) CLSC (18 inches of 1200 gpf)
  - 0.13 lbs (0.06 kg) contingency
  - 0.75 lbs (0.34 kg) total per munition
  - 9.00 lbs (4.0 kg) total

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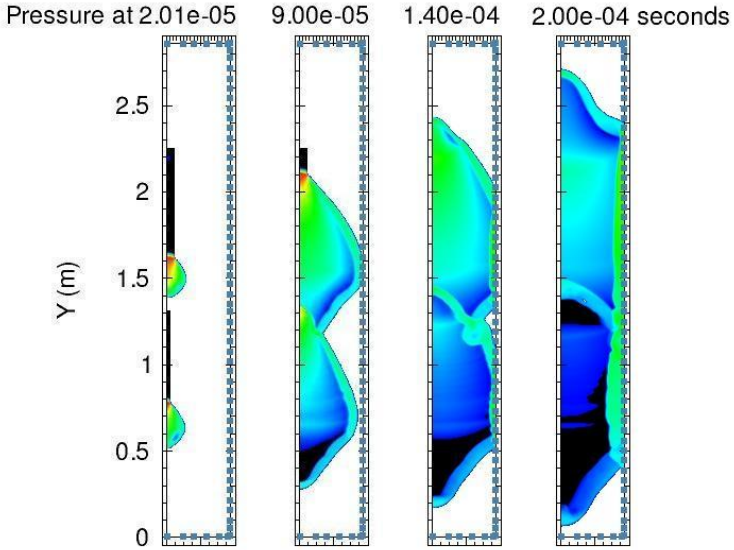
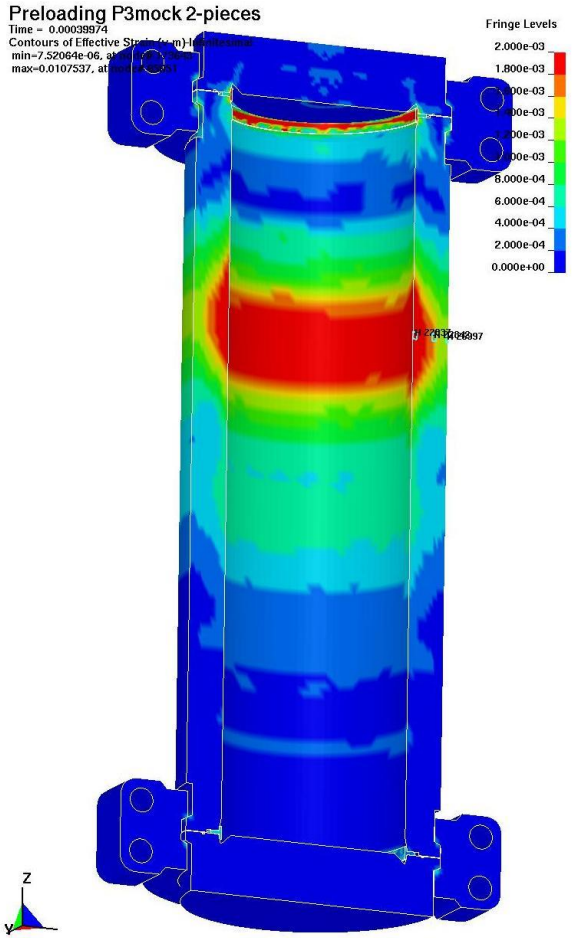
P3 vessel response to an M55 Rocket (26 lbs)





ASME Code Case 2564 limit is 0.2% through the wall average

	Current Vessels 316 stainless		Possible Vessels 25-5 stainless*
	1 M55	2 M55	2 M55
inside wall	0.26%	1.81%	0.25%
mid wall	0.04%	0.15%	0.06%
outside wall	0.01%	0.07%	0.05%
average	0.14%	0.94%	0.15%

* Will need additional analysis and testing

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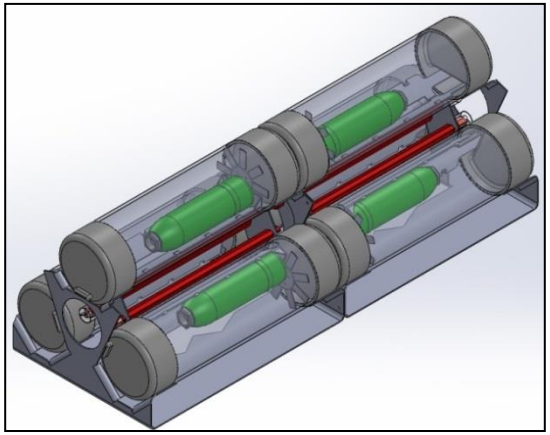
Vessel length driven by several factors

- Must handle M55 in overpack
  - 7.5 feet
  - Doors must be stood off from blast
- Up to twelve 155 mm shells
  - Overpack will be ~34 inches long
  - Ogives cannot overlap
  - Four sets of 3 will require 140 inches
  - Three sets of 4 will require 105 inches
- Minimize fluid and waste volume
- Minimize vessel weight and cost
- Keep Advanced Fragments Suppression System bars reasonable



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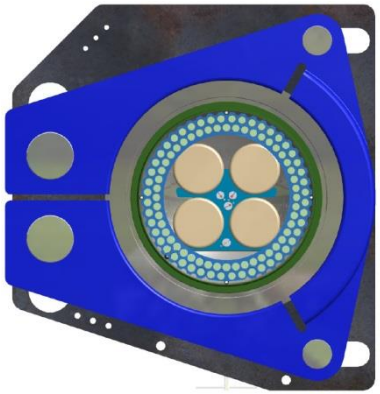
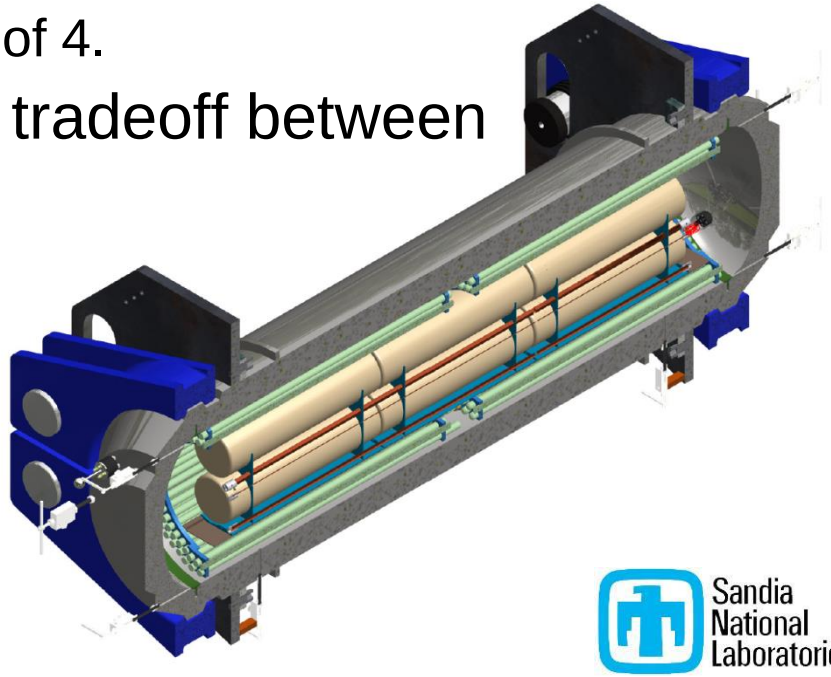
Selected vessel length is 120 inches

- This length will accommodate:
  - One M55 with generous standoff from the ends
  - Nine overpacked 155 mm shells in standard clusters of 3
  - Twelve overpacked 155 mm shells in clusters of 4
    - Requires minor tweaking of the AFSS support rings
  - Twelve bare munitions in clusters of 3
  - Sixteen bare munitions in clusters of 4.
- We believe this is a reasonable tradeoff between capacity and other factors





SAND # 2013-43

Vessel door has several design factors

- Minimize mass
  - Reduced heating and cooling loads
    - Less effluent
    - Faster
  - Reduced shipping weight
  - Easier for crew
- Minimize crevices that can trap agent
  - Eliminate/simplify dip tubes and blast plates
  - Locate penetrations so they are submerged
- Accommodate hinge arm attachment
- Accommodate attachment of door hardware
  - Flat surfaces
  - Accessible locations

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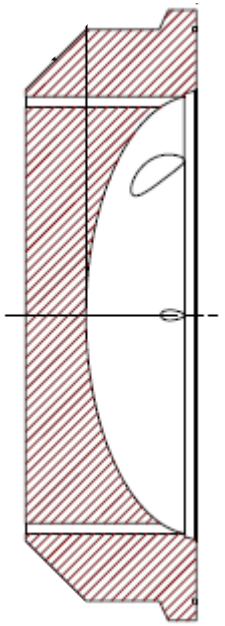
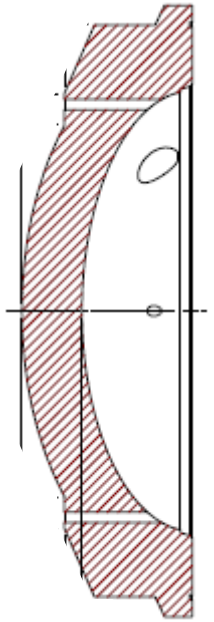
Several door options were considered

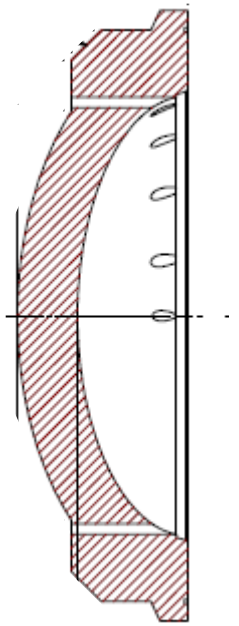
- Flat head
  - Same as P2
- Ellipsoidal heads
  - Stronger
    - membrane vs bending
  - Reduced impulsive load
  - Less weight
  - More difficult attachments
- Eliminate feedthrough flange



2804 lbs

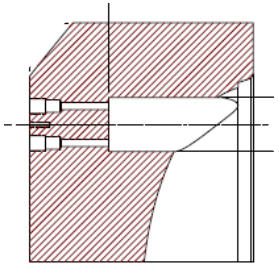


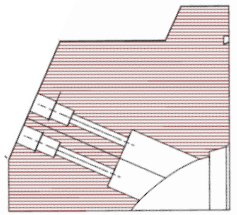
2003 lbs



1949 lbs

3067 lbs





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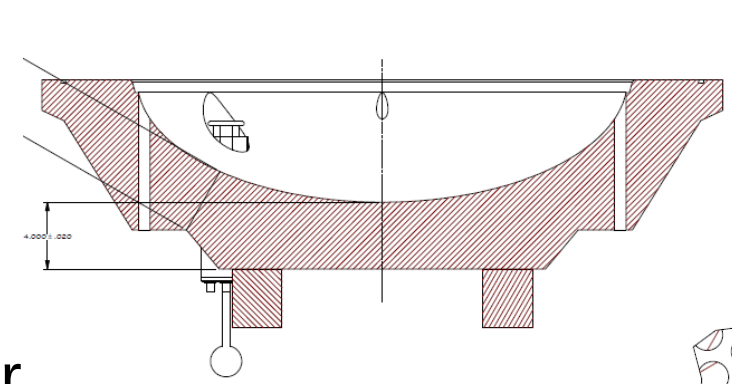
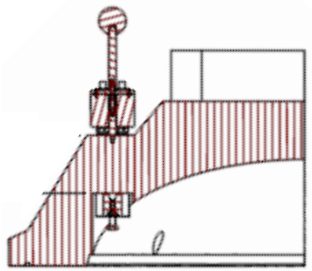
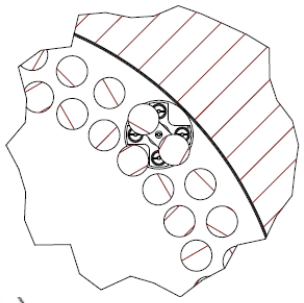
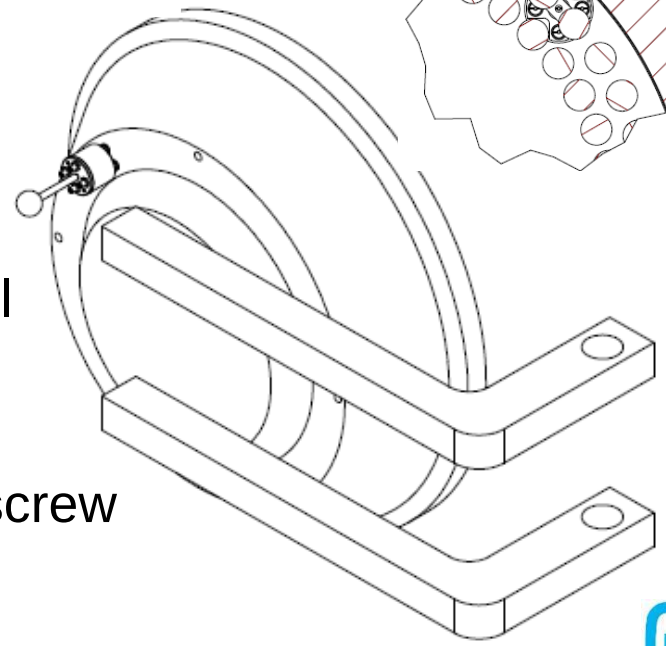
Ellipsoidal design is proposed

- 1920 pounds
- Ellipsoidal interior
  - ASME standard 2:1
- Double coned exterior
  - Flat surface for external hardware
  - Flat surface for hinge attachment
- Penetrations
  - Moved radially out from the vessel centerline to provide maximum emersion in reagent
  - Simplified to reduce or eliminate screw threads and trapped volumes









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P3 Fluid Handling Design Strategy

- Maintain traditional process flexibility
- Design for overpacked M55 Rocket mission
- Optimize for higher throughput of overpacked 4.2-inch mortars, 105mm projectiles, 155mm projectiles
- Include P2P improvements (One Day Process)
- Upgrade supply and waste drums to Interim Bulk Containers (350 gal)
- Include secondary process vessel
- Introduce of new liquid sample adapter
- Introduce fluid recovery and re-use operations

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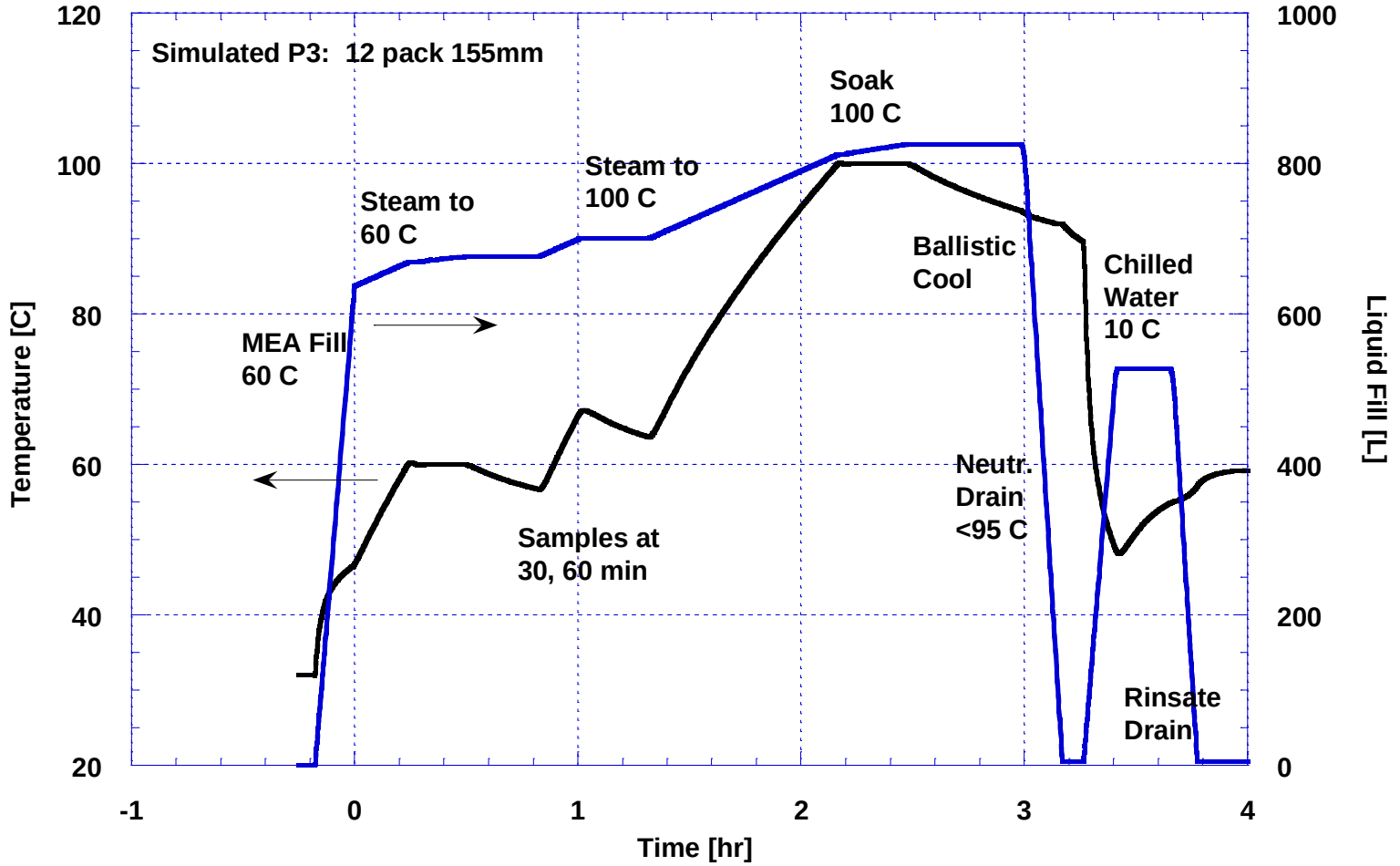
P3 Thermal/Fill Simulation



Optimization steps: Cool-off from 100 °C soak, 10 °C rinse water

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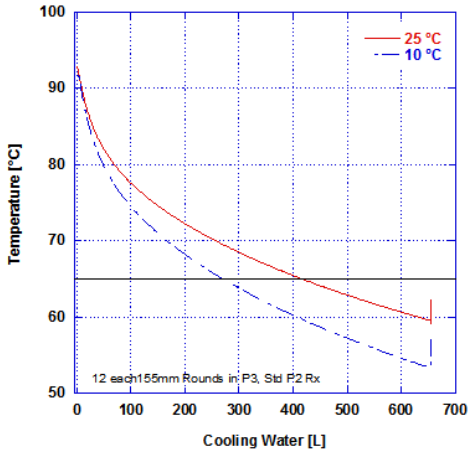
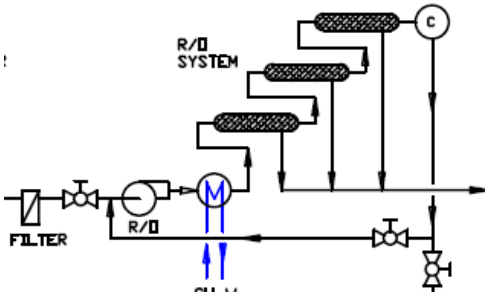
Several waste minimization options are available

- Chilled water versus ambient water for vessel cooling: >25% reduction in water required (baseline design)
- Rinse water recycle (process decision)
  - 1% MEA addition each use
  - 3 to 4 reuse cycles possible
- Water recovery from rinsate (permit mod)
  - Three stage reverse osmosis process
  - 40% to 80% rinsate recovery
- MEA recovery (permit mod)
  - 10 to 1 stoichiometric MEA to agent process
  - 50% to 60% MEA distillate recovery possible





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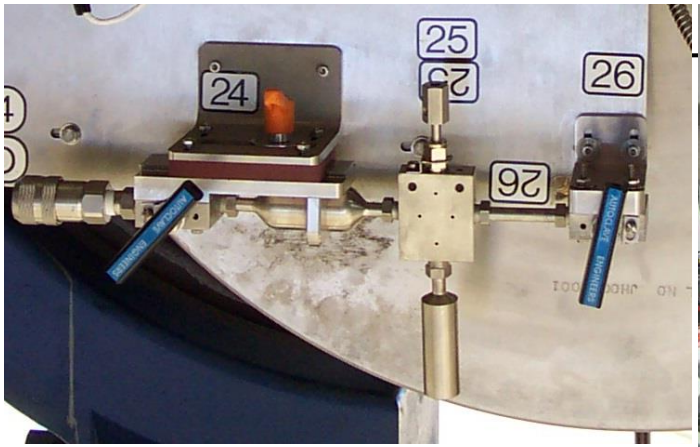
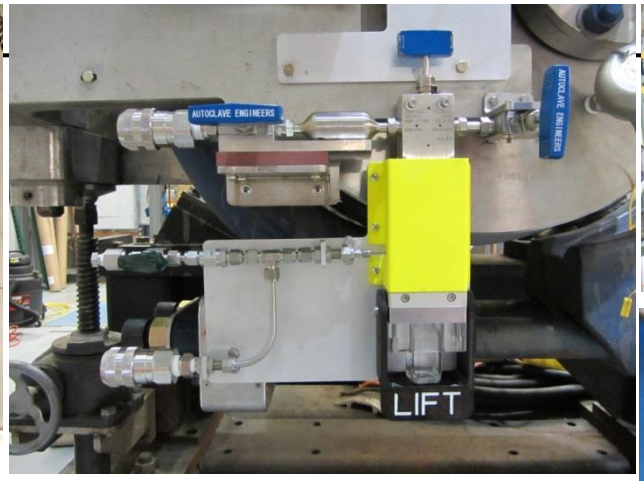
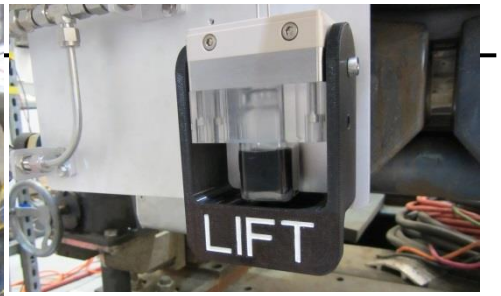
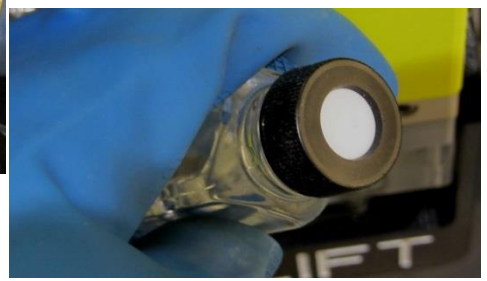
Faster, easier liquid sample adapter proposed









- Sample vial manifold attaches to existing 3-way valve.
- Liquid sample adapter can be reverted to sample bottle during operation.
- Vacuum line and bypass to waste drum eliminates sample pressure and provides overflow protection.
- Faster samples
  - No torque wrenches
  - No disassembly
  - No empty fills
- Much easier and safer to handle in the laboratory
  - No pressure
  - No wrenches

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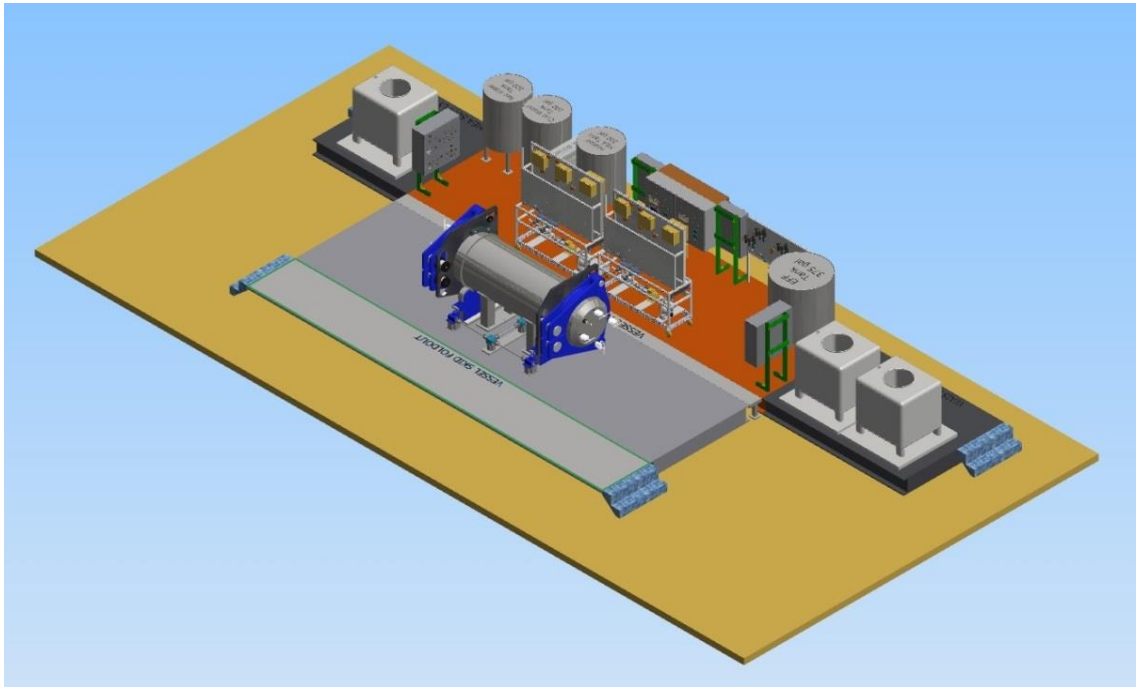
P3 system delayed

- The initial P3 initial design phase is complete, but further work has been delayed until FY14 due to:
  - US federal budget sequestration issues and
  - Reprogramming of funding.



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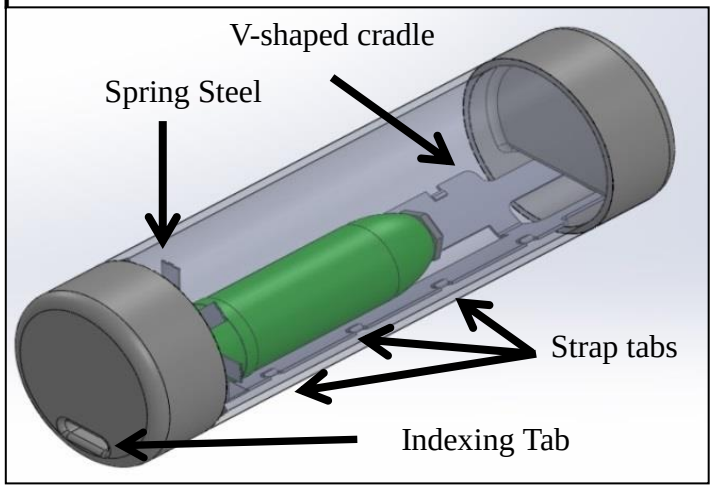
Sandia has been working on a Universal Munitions Storage Container

- Purpose: Create a storage container to overpack leaking munitions or recovered munitions that can then be processed without opening
  - UMSC is made of High Density Polyethylene (HDPE)
  - Increases operator safety treating leakers
  - Reduces level of personnel protective equipment
  - Reduces processing time because it is not opened
  - Lightweight – reduces operator handling hazards
  - Inexpensive



- HDPE end cap is thermally heat welded to HDPE tube using off the shelf technology

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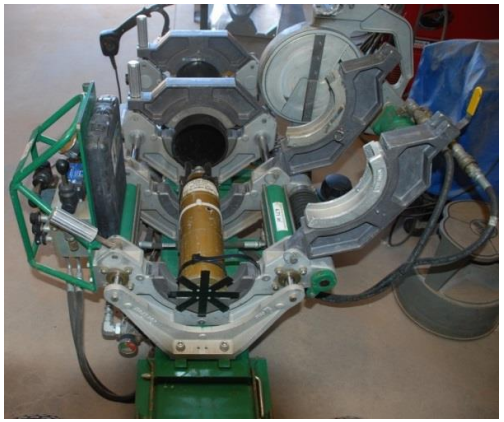
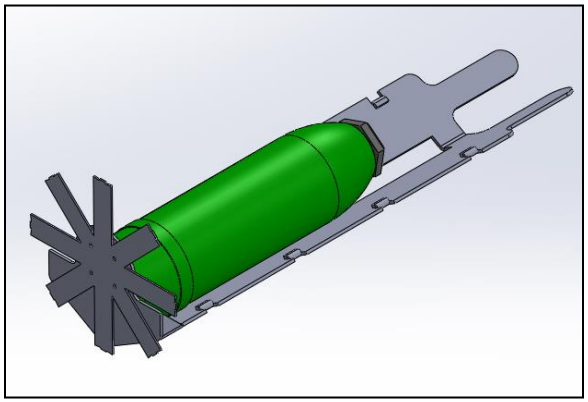
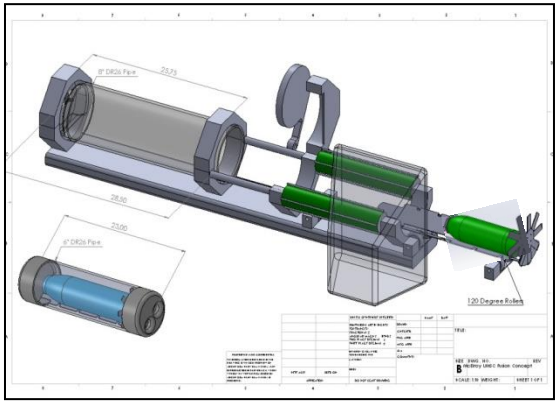
UMSC process is straight forward

- Munition is secured in v-shaped cradle with straps with flat end of munition against spring steel
- Cradled munition is placed in modified Commercial-Off-The-Shelf (COTS) plastic fusion machine to insert cradle into UMSC and thermally heat-weld end caps







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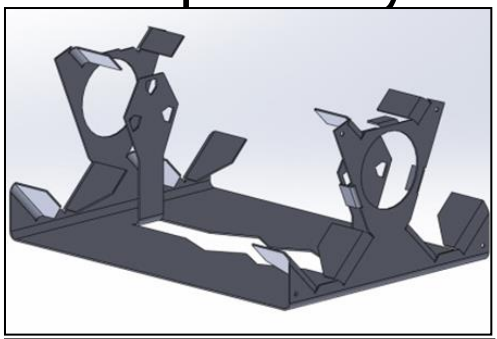
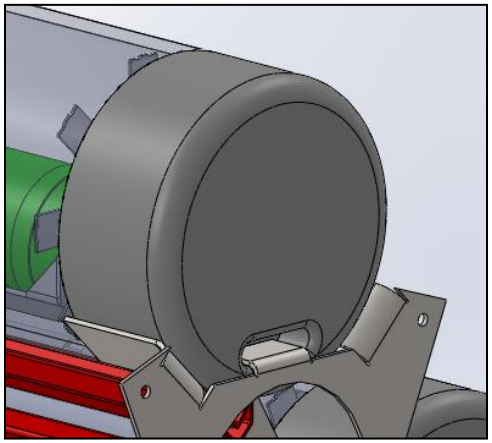
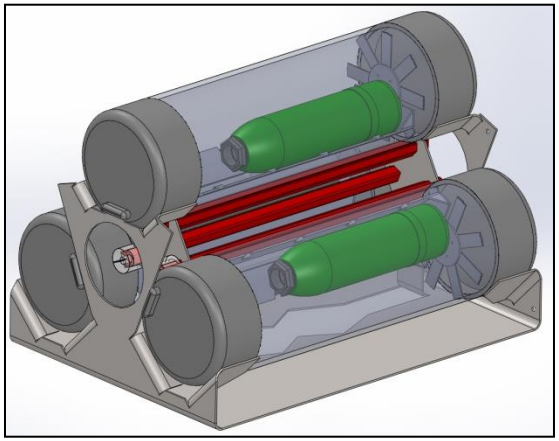
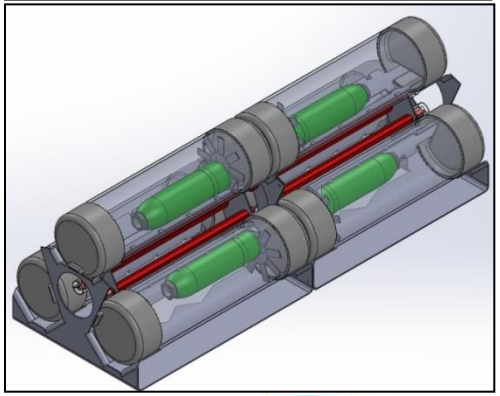
UMSC is tailored to EDS, but applicable to other systems

- UMSC has location features for the munitions and the containers for easy EDS orientation in three- or six-packs
- However, UMSC is currently being tested for compatibility in the Dynasafe SDC in Anniston, Al.
- Intent is that the UMSC will be compatible with the other destruction technologies.









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UMSC is now Sandia priority 1

- Specialized fusion bonder on order
- Agent compatibility testing in process
- Delivery to NSCMP scheduled for October 2013
- Planned initial uses include:
  - Repack leaking projectiles and mortars at Pueblo, Co.
  - Pack recovered munitions at Redstone Arsenal in Alabama

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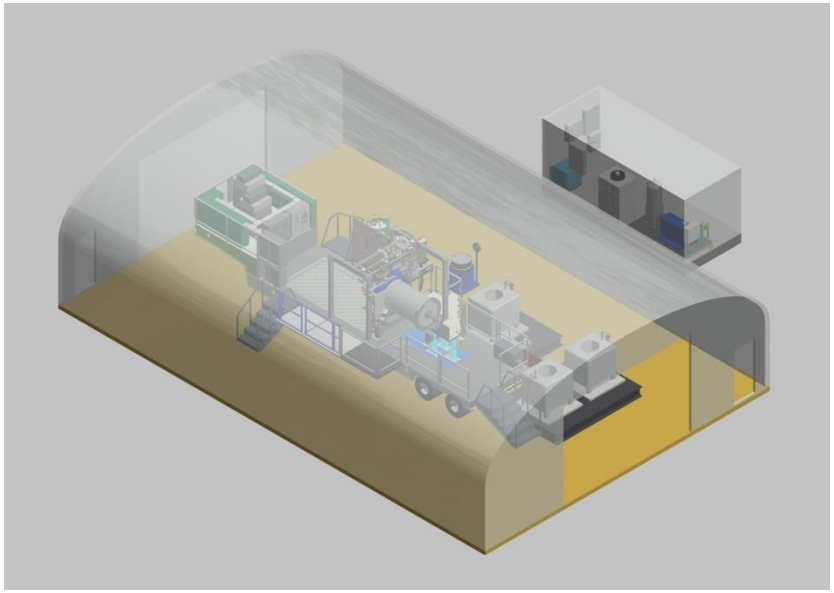
Next retrofit EDS P2U3 for Pueblo

- Retrofit the existing P2U3 trailer for 1-day processing:
  - Mechanical nut runners (15 to 20 minute door closure),
  - Chilled water supply, and
  - P2 Pilot 1-day processing upgrades:
    - Larger, faster high pressure pumps,
    - Steam processing,
    - Larger receiver tanks for effluents.
- Baseline processing is 6 UMSCs with:
  - Three 155mm and
  - Three 4.2-inch mortars or three 105mm projectiles.
- Delivery to NSCMP by the end of this calendar year
- Retrofitted system designated as P2R



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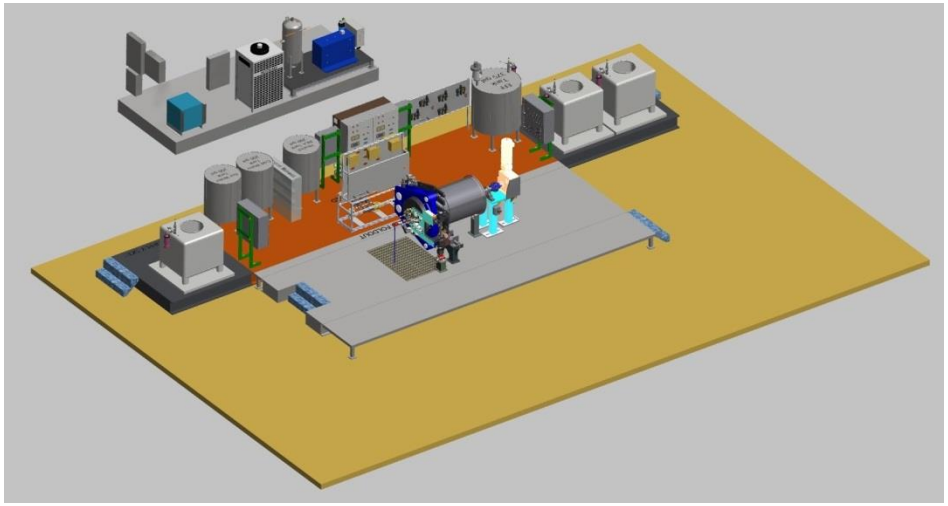
Then build a new P2 system

- Designated as the P2A, the new system will:
  - include the P2R upgrades, except
  - incorporate an existing, ASME Code Case 2564 P2 vessel modified with a three-piece clamp (5-minute door closing) and
  - on skids versus a trailer, i.e., closer to the P3 design than the existing P2 designs.
- Deliver to NSCMP in the middle of calendar year 2014.



Skid layout

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The conclusion is that EDS continues to evolve

- The P2 Pilot system demonstrated one day processing – Brent Haroldsen will cover the P2P testing in a later session – don't miss it!
- Next up is an existing EDS P2 trailer retrofitted with the one day processing modifications that can be implemented quickly.
- Followed by a new EDS P2 system with a modified existing vessel incorporating all the upgrades of the P2P system.
- Ultimately a new larger EDS P3 system.
- Also, a Universal Munitions Storage Container

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Acknowledgements

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Sandia California
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Sandia New Mexico
David Cole
W. Venner Saul
Jerome Stofleth
Edward Vieth
Lloyd Payne
John Rudolphi
Weldon Teague
Steven Bayley
Gilbert Gonzalez
Michael Heister
John Lavasek
James Mansfield
Peter Montoya
Mark Naro
Edward Virostko

US Army Non-Stockpile Chemical Materiel
Allan Caplan
William Adams
Lucille Forrest

Other
Bud Salsbury

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