



AREVA



TN-55 Updated Licensing

1:30 PM, July 10, 2006

- ◆ **Introductions**
- ◆ **Meeting Objectives**
- ◆ **Payload Scope**
 - **Type A(F) for material in powder form**
 - **Test payload**
- ◆ **Design**
 - **Overpack**
 - **Drum – Lid Options**
- ◆ **Test Program**
 - **Structural – Lock-Ring w/Bolted Closure Lid Design**
 - **Immersion – Clamshell Design**
- ◆ **Thermal Approach**
- ◆ **Criticality Approach**
- ◆ **Acceptance Criteria**
- ◆ **Anticipated Schedule**

▶ AREVA NP, User

- ◆ **Richard Montgomery, Advisory Engineer**
- ◆ **Charlie Sanders, Advisor**
- ◆ **Robert Freeman, Fuel Performance Improvement**

▶ PacTec – TN-55, Certificate Holder

- ◆ **Chuck Temus, Project Manager**
- ◆ **Bryan Flanagan – Project Engineer**

Meeting Objectives

- ▶ **Review Payload Data and Test Payload Properties**
- ▶ **Review Package Design Changes**
- ▶ **Certification Approach**
 - ◆ **Testing and Bases**
- ▶ **Initial Test results**

▶ **TN-55, Proposed payload**

- ◆ **Type A(F) for material in powder form**
- ◆ **Contents is UO_2 powder with U-235 enrichment of 1.2%**
- ◆ **Payload (drum and contents) weight = 725 lb**
- ◆ **650 lbs of powder and about 75 lbs of drum**

- ▶ **Simulate Uranium Oxide Powder**
- ▶ **Based on grain size and distribution using Aluminum Oxide Powder of 150 grit.**
- ▶ **As the sieve data shows the Aluminum Oxide Powder has a slightly smaller grain size which makes it conservative as far as dispersion.**
- ▶ **The Aluminum Oxide Powder is visibly more free-flowing in the dry and wet states than UO_2 powder.**
- ▶ **The test material is tested dry as compared to the slightly moist, 1-2% moisture content of the Uranium Oxide Powder.**

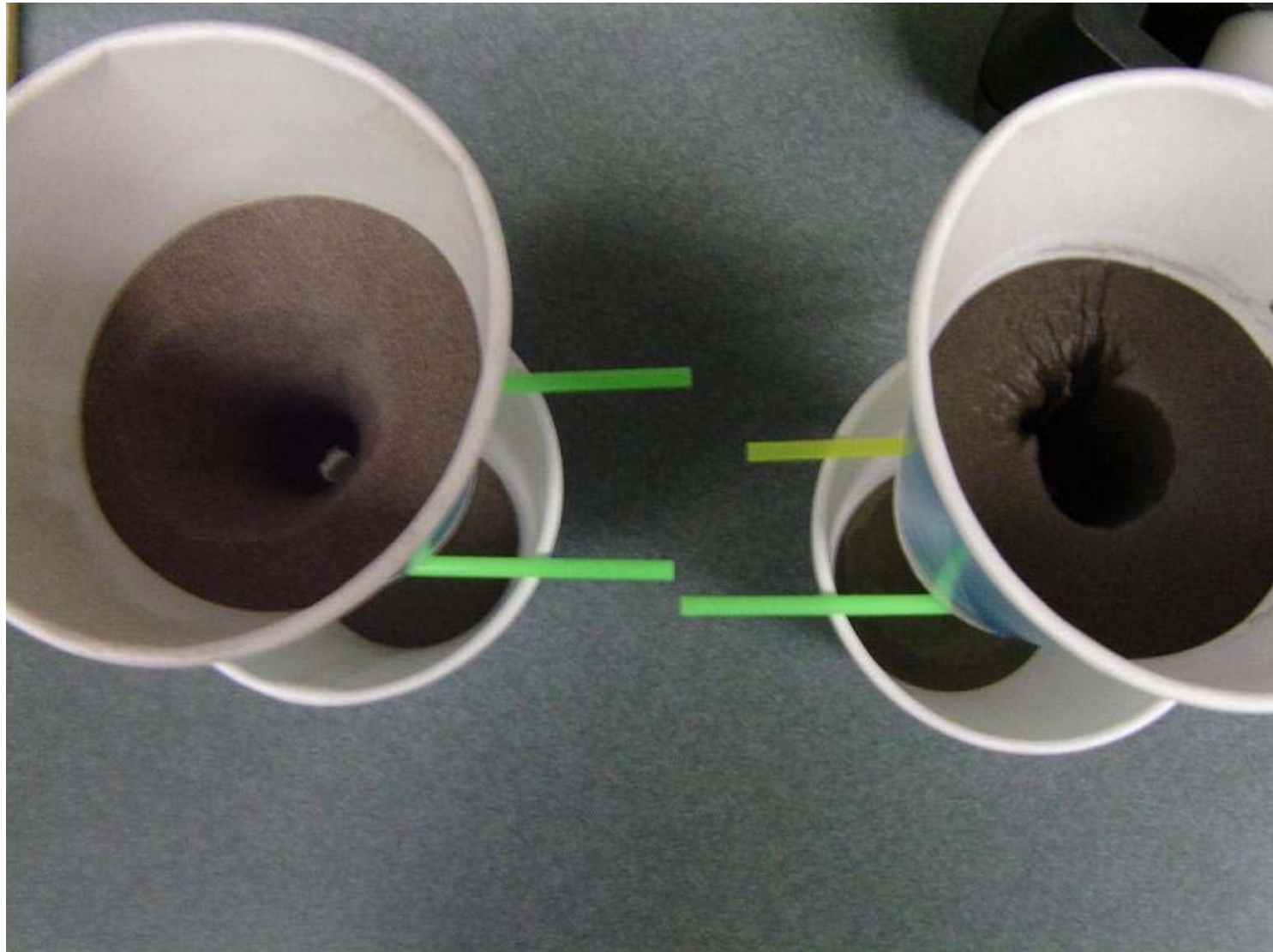
Sonic Sieve Results

Sieve Screen (Mesh Size)	Sieve Screen (microns)	Cumulative Weight (g) on screen for Lot 740-80	Cumulative Weight (g) on screen for Aluminum Oxide 150
40	425	1.1	0.02
70	212	5.0	0.03
100	150	9.1	0.04
325	45	28.56	28.55
635	20	29.91	29.95
1000	10	30.0	30.0
1500	5	0	0



Dry 150 Grit - 0.25 in. hole



Dry and Wet Comparison - 0.25 in hole

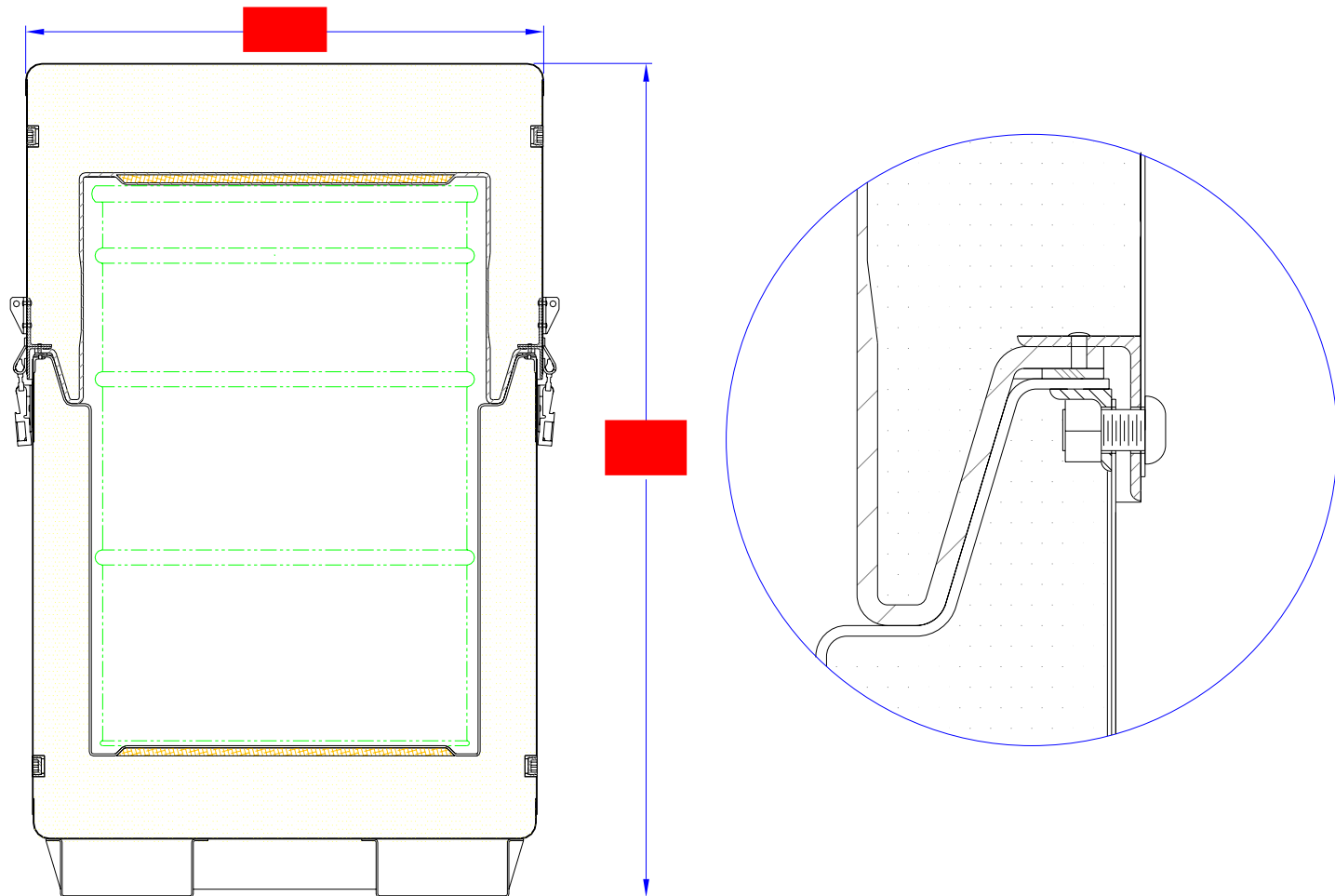


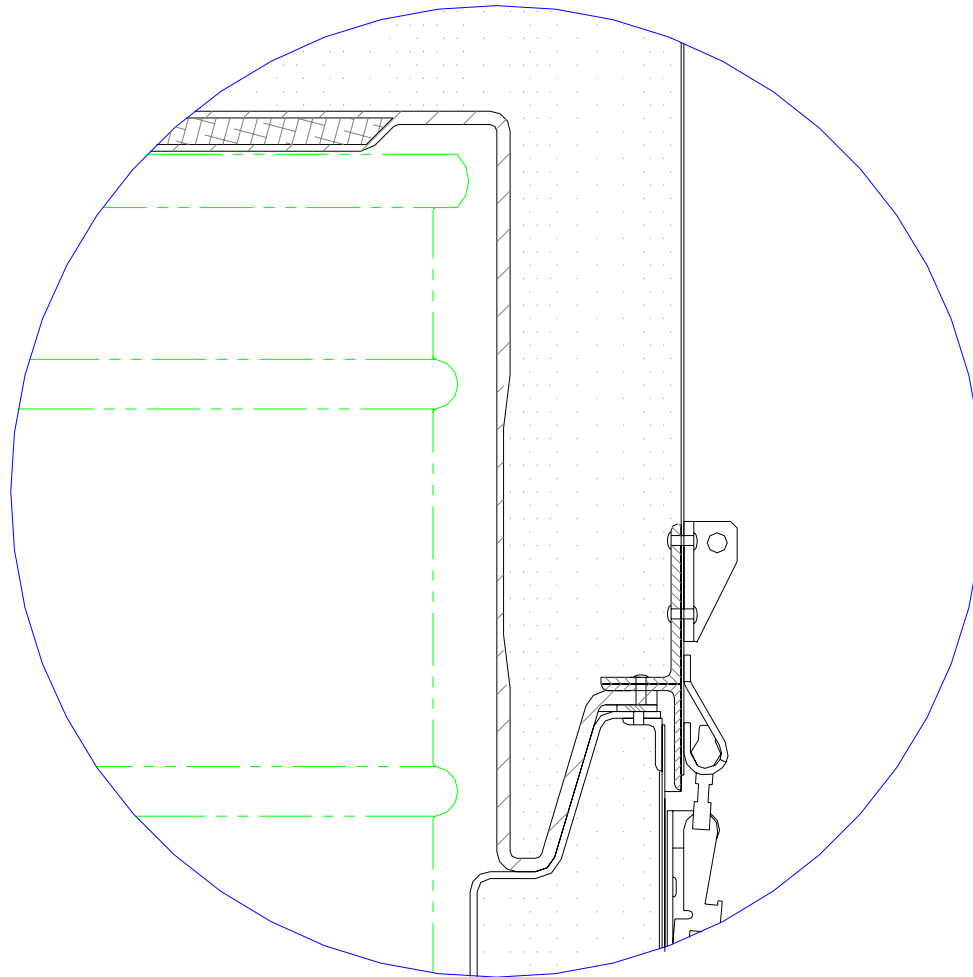
Overpack

-  Gauge Galvanized Shell
- Bolted Closure and latches
- 3 lb/ft³ Polyurethane Foam
-  inch Kevlar Reinforced Fiberglass
- Additional Angle Stiffeners
- Strengthened Rivet Attachments
- Fully welded connections
- Forklift Pockets
- Gaskets non combustible

Payload

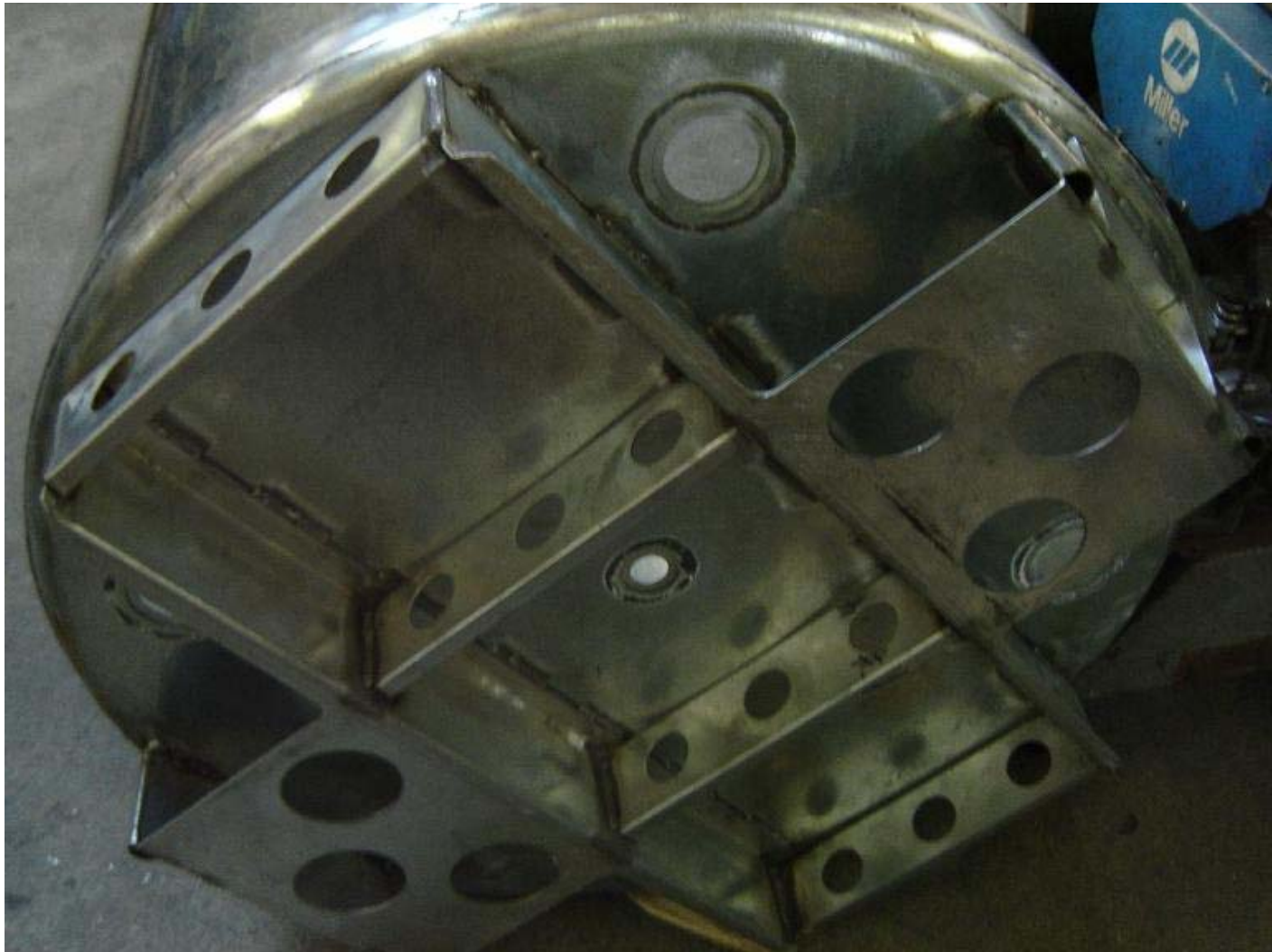
- 650 lb of Powder
- 75 lb Drum






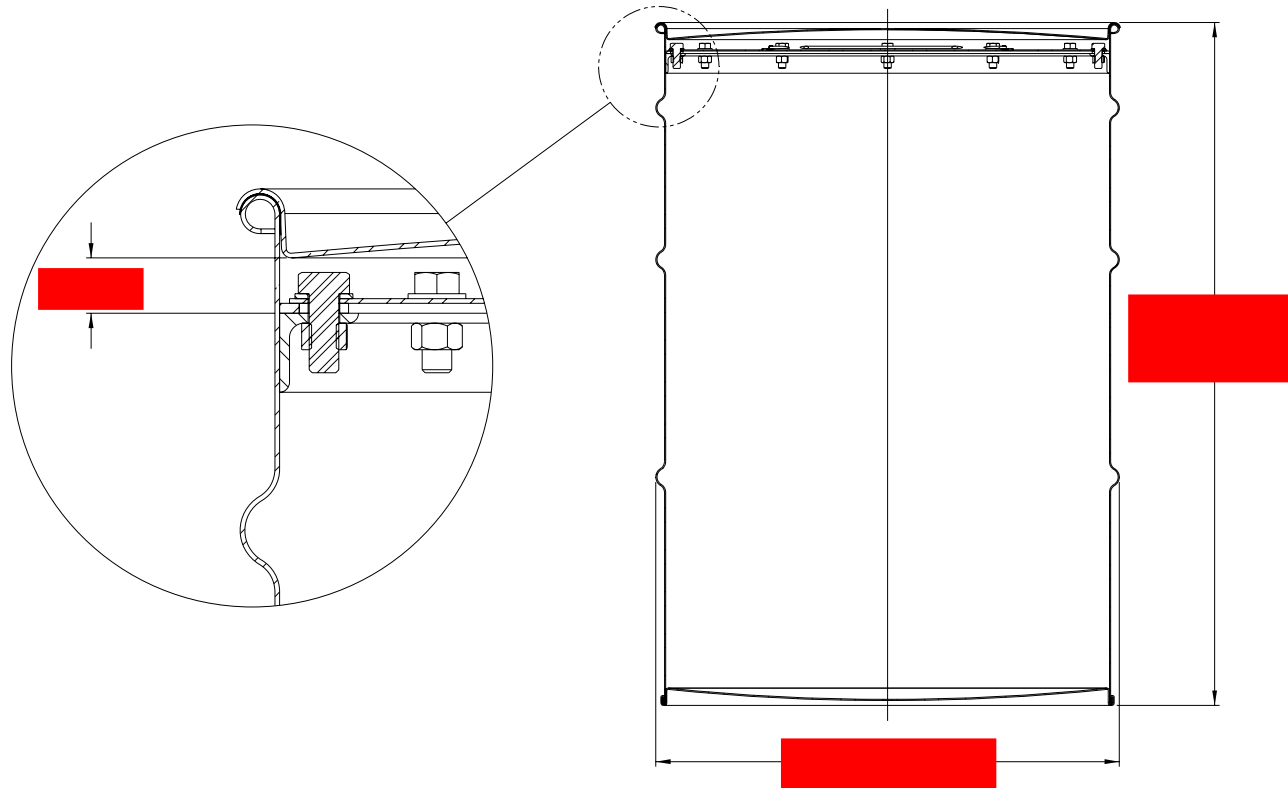


Forklift Pockets



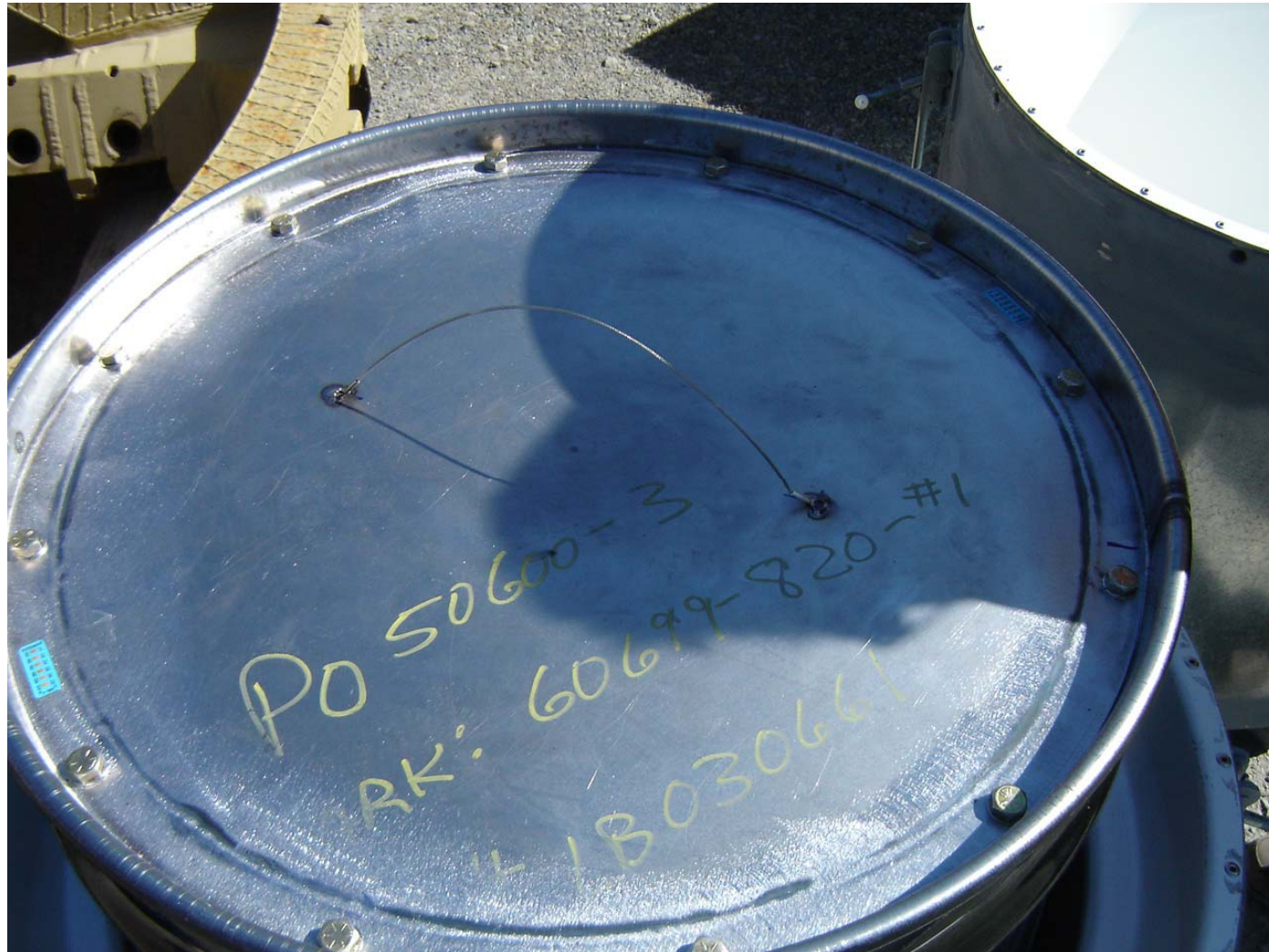


- ▶  gage heavy duty drum
- ▶ Evaluating two closure options
 - ◆ Double lid design
 - Lock ring with inner bolted lid
 - ◆ Clamshell closure
 - Heavy duty clamp ring with two bolts developed Savannah River
- ▶ Both have non combustible gaskets
 - ◆ Rated to 2300 F continuous service
 - ◆ Made from fibrous ceramic material
 - ◆ Coated with a thin layer of RTV to prevent fibers from contaminating Powder
 - ◆ No change when burned



Double lid with Powder



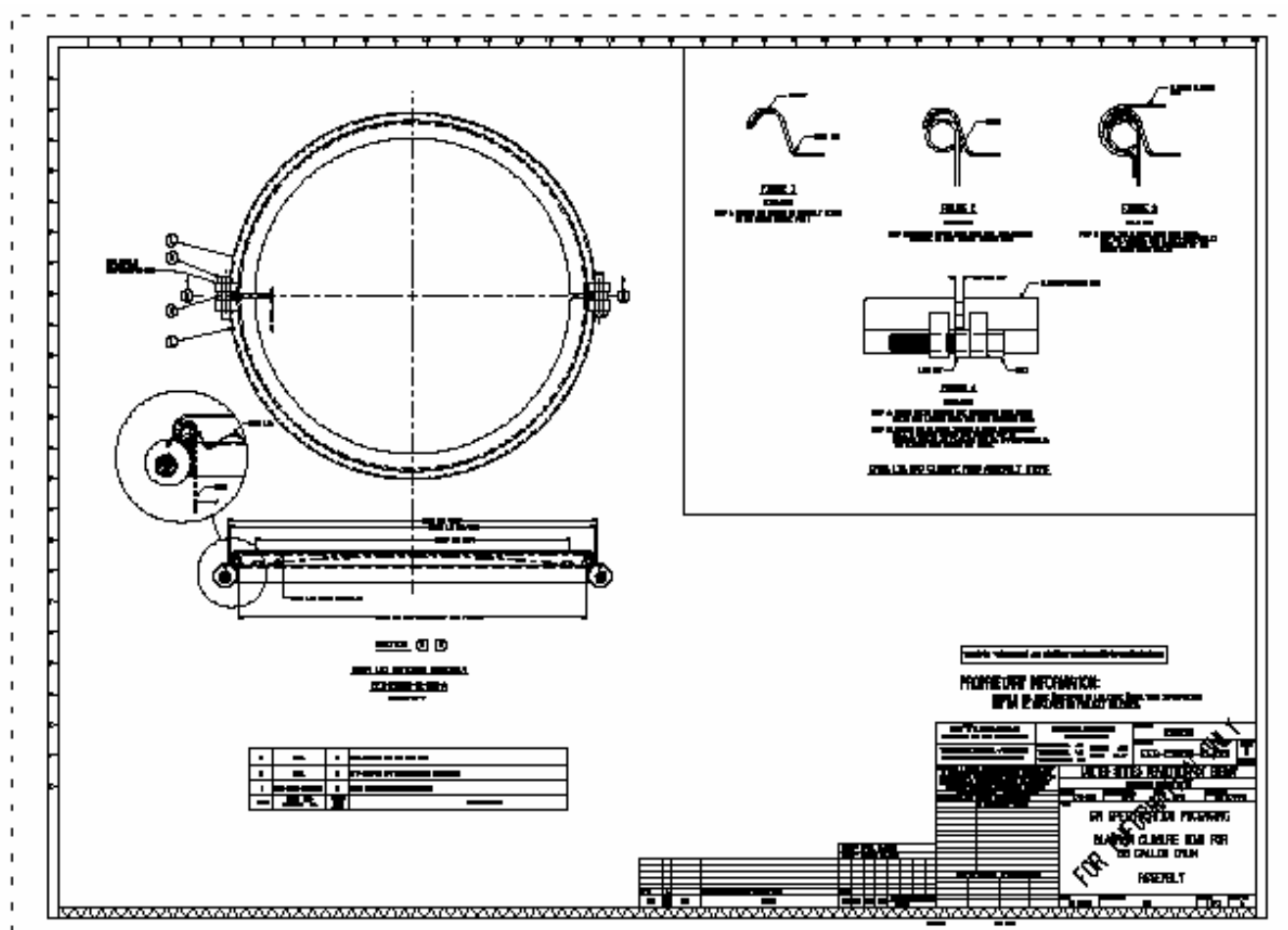




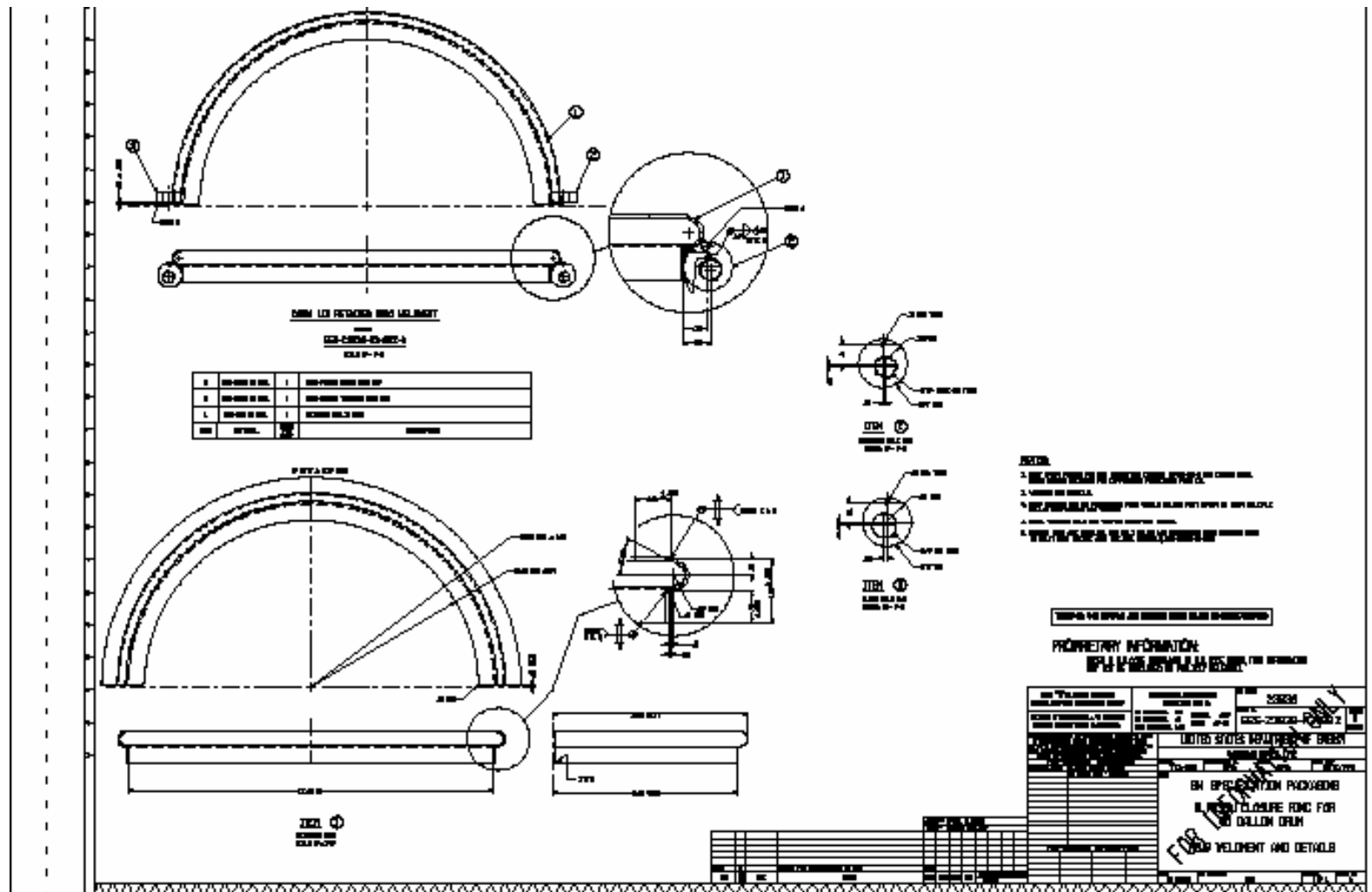
Drum Lid with inner lid angle



Clam Shell Closure



Clam Shell Closure



- ▶ **Ceramic fiber**
- ▶ **Continuous Service Temperature – 2300 F**
- ▶ **Coated With RTV**

Gasket Half Burned



- ▶ **NCT by comparison using DOT 7A Type A drum**
- ▶ **Certification by test**
 - ◆ **Full scale test article**
 - ◆ **Sequential application of HAC tests (3 test units)**
 - ◆ **CTU 1**
 - **NCT Free Drop on Side (Horizontal) on latch**
 - **HAC Free Drop on Side (Horizontal) on latch.**
 - **HAC Side Crush Drop with plate edge below drum lid.**
 - **HAC Oblique Puncture Drop with impact just below drum lid/CTU damage under c.g.**

► Certification by test

◆ CTU 2

- NCT Free Drop c.g. over top corner.
- HAC Free Drop c.g. over top corner.
- HAC Side Crush Drop with plate edge at top edge of CTU.
- HAC Oblique Puncture Drop with impact at drum lid/CTU damage under c.g.

◆ CTU 3

- NCT Free Drop c.g. over top corner.
- HAC Free Drop c.g. over top corner.
- HAC Top Crush Drop with plate centered over CTU top.
- HAC Oblique Puncture Drop with impact at the CTU parting plane

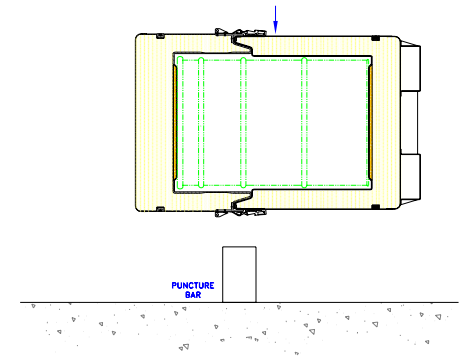
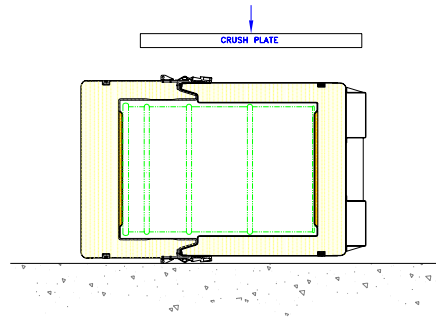
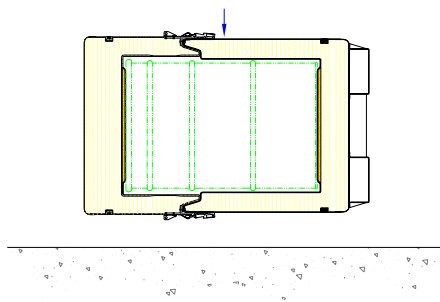
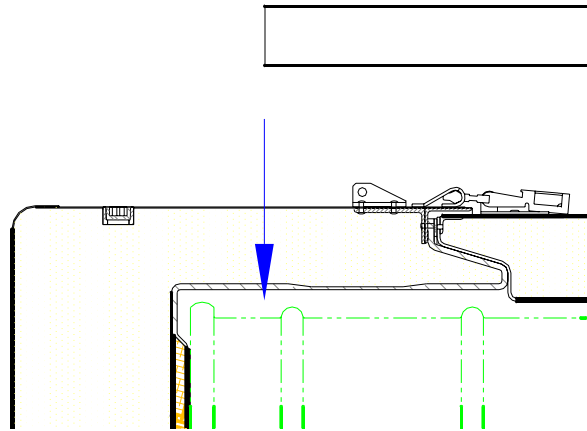
► Certification by test

- ◆ 50-ft Immersion Tests
- ◆ 21.7 psig exterior water pressure applied to drum for 8 hours
 - Test #1 – Inverted empty drum
 - Test #2 – Upright 50% fill
 - Test #3 – Upright 80% fill
 - Test #4 – Inverted 50% fill

► Certification by analysis

- ◆ Thermal
- ◆ Criticality

Qualification by Test for Structural Requirements



CTU 1 Post 30 ft Horizontal Drop



CTU 1 Crush



***Crush plate
recoil shown
after horizontal
impact,
package also
recoils off test
pad***

CTU 2 Post Crush



Post Puncture Test CTU 1



Fiberglass liner intact











CTU 3 Drum



No dispersal of contents



Inner bolted lid

- ▶ **50 ft immersion test (21.7 psig) tested and passed on drum.**
 - ◆ No leakage of contents
- ▶ **0.9 m (3 ft) post test immersion not performed since full water in-leakage is assumed for criticality analysis and the leakage of powder is more severe when dry than wet.**

Immersion Tank



Pressure regulator and calibrated gauge



Test #1



***Inverted empty drum,
22-23 psig for 8 hrs***

***½ oz of water entered
drum, vacuum noted
during lid removal***



Test #2/Test #4



***Test #2 - Upright
drum after removal***

***Two separate eight
hour tests on 50%
fill of single drum,
minor water in-
leakage, no leakage
of contents***

***Test #4 – Inverted drum
after removal***





Test #3 - Upright drum

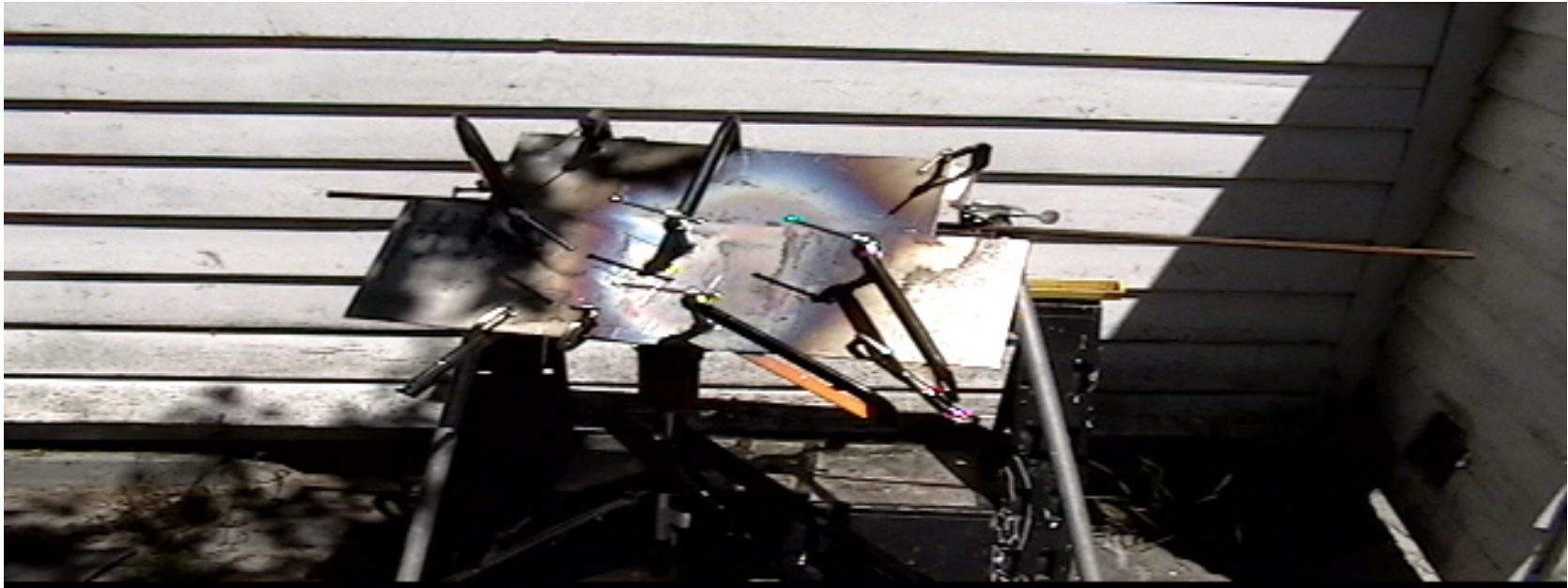
***Eight hour test,
minor water in-
leakage, no leakage
of contents, no
deformation of
drum***



- ▶ **Acceptable thermal performance of the packaging shall be shown through evaluation.**
- ▶ **All components of the confinement are non combustible and have service temperatures of 2300 F or greater;**
 - ◆ **Carbon steel drum**
 - ◆ **Gaskets ceramic with a service temperature of 2300F.**
 - **Gaskets are coated with a thin film of RTV to minimize powder contamination from the fibers.**
 - **Consumption of thin layer in fire does not affect package confinement capabilities.**



Fire test of gasket



Gasket post thermal test



Criticality Approach

- ▶ **60 package array in a 4 x 5 x 3 orientation**
- ▶ **Search for optimum moderation in the evaluation**
- ▶ **Variable drum fill height and powder density**
- ▶ **No dispersal of contents**
- ▶ **Square and triangular arrays**
- ▶ **Vertical and horizontal orientations**
- ▶ **Results show that a minor separation between packages (1 cm) conservatively meets the criteria**
- ▶ **Significant margin**

Acceptance Criteria

- ▶ **Goal is to maintain confinement in 55 gallon drum**
- ▶ **Minimum requirement is to maintain confinement within the fiberglass shell**

- ▶ **Tested Packages meet the acceptance criteria of 10 CFR 71**

Anticipated Schedule

▶ **Certification Test Units**

- ◆ **Testing Complete by July 30, 2006**

▶ **SAR**

- ◆ **Submit to NRC Mid-August 2006**

▶ **NRC Licensing**

- ◆ **Initial RAIs by October 15, 2006**
- ◆ **Issue CoC by February 15, 2007**

▶ **Canadian Validation**

- ◆ **Canadian CoC Validation by March 27, 2007**

▶ **Production**

- ◆ **Begin Fabrication by December 1, 2006**