

Replacing the 6M Containers



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History of DOT 6M Container

- U.S. DOT specification 49CFR178.354.
- 6M containers have been the workhorse for Type B shipments for almost 30 years.
- In 2004, U.S. DOT revised the regulations and eliminated the 6M specification.
- The 6M effectively expired on October 1, 2008.
- U. S. DOE committed to replace two popular sizes.

Replacements



6M



ES-3100



6M



ES-4100

55 - gallon

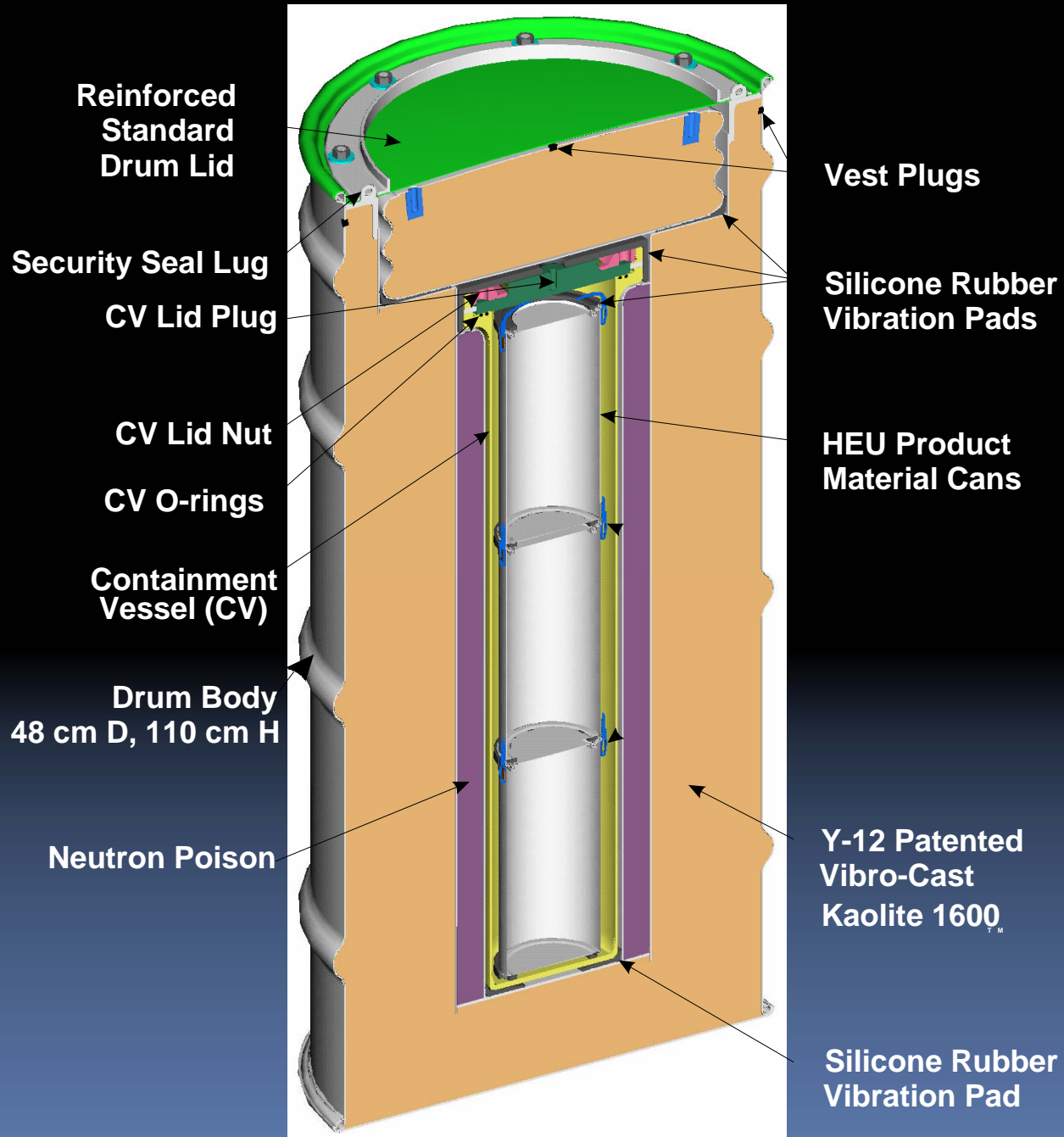
110 - gallon

Model ES-3100

ES-3100 Program History

- **Sponsor - U. S. DOE, National Nuclear Security Administration**
- **Initiated in May 2003; licensed in 2006**
- **Primary Objective - replace the DOT 6M 55-gal container for bulk HEU and other materials**
- **Secondary Objective - maximize efficiency in DOE Transportation Safeguards System**

Model ES-3100 Container

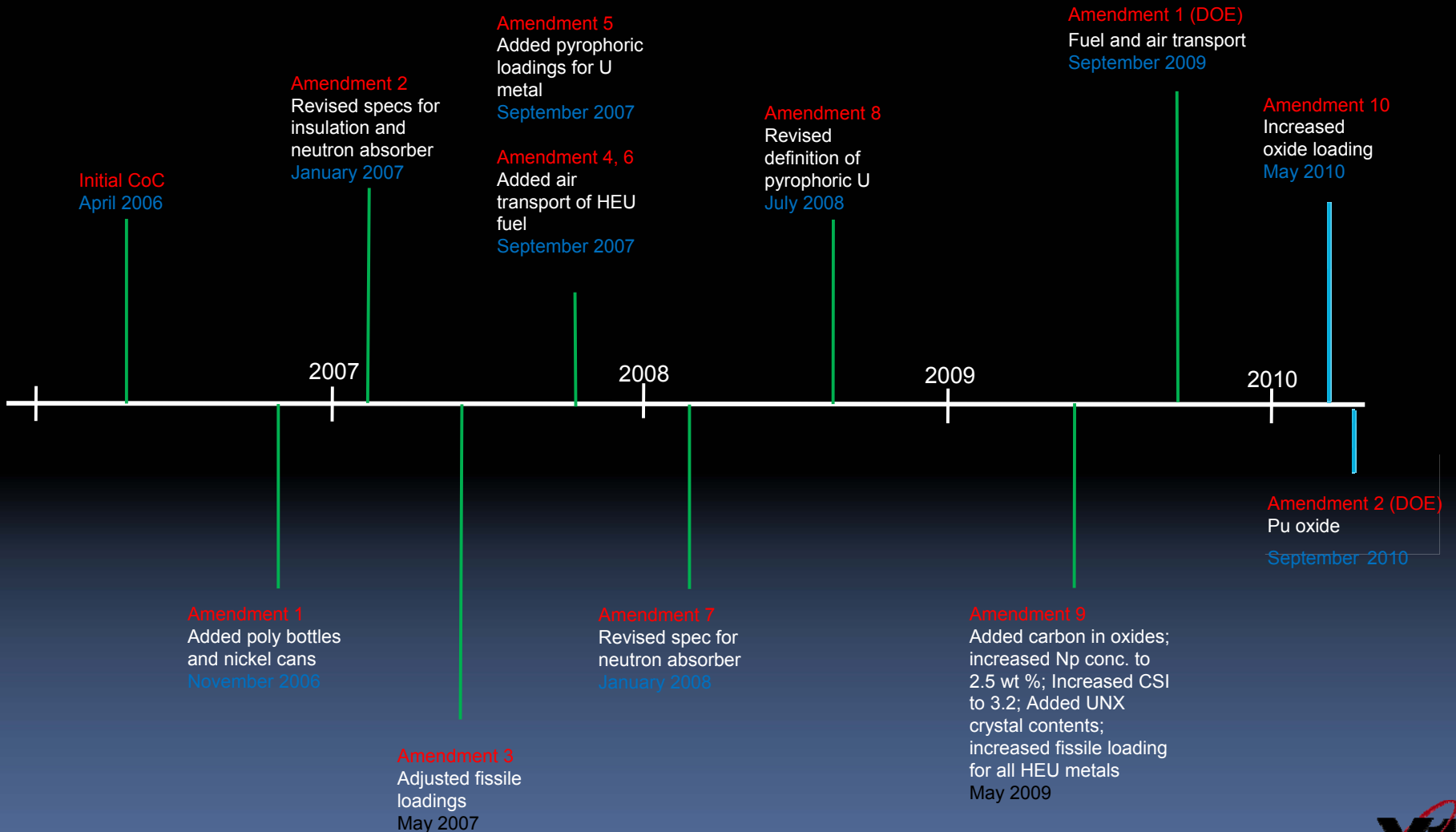


ES-3100 Components



Certificate of Compliance History

No. USA/9315/B(U)F-96



Partial Content List

	Type	Upper Limit (kg U-235)
G R O U N D	HEU metal (shapes and broken metal)	35.2
	HEU alloys (U-Al, U-Mo, U-Zr, U-SS, U-Ti, U-W, U-Nb, U-Si, U-V)	35.2
	HEU oxide (UO ₂ , UO ₃ , U ₃ O ₈ , U ₃ O ₈ -Al, UO ₂ -Mg, UO ₂ -Zr)	9.7
	HEU UNX crystals	7.3
	HEU research reactor fuel elements and components (UZrHx [TRIGA, SNAP], U-Zr, U-Al, U ₃ O ₈ -Al, UO ₂ , UO ₂ -Mg)	35.2
	HEU compounds (UF ₄ , UO ₂ F ₂ , UC, UN, TRISO)	2.3
A I R	HEU metal (broken metal)	7.0
	HEU alloys (U-Al, U-Mo, U-Zr, U-SS, U-Ti, U-W, U-Nb, U-Si, U-V)	7.0
	HEU research reactor fuel elements and components (UZrHx [TRIGA, SNAP], U-Zr, U-Al, U ₃ O ₈ -Al, UO ₂ , UO ₂ -Mg)	0.92

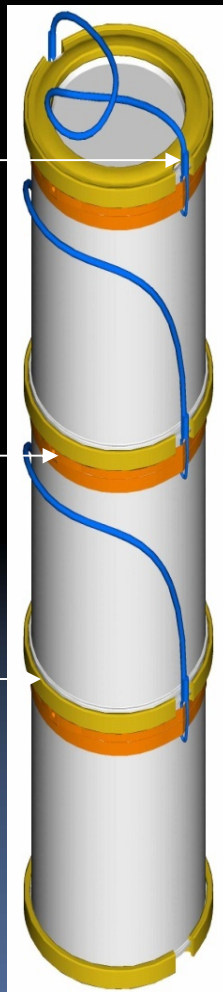
Content Configuration

Any configuration of cans up to 31-in total length.

Lifting bale

Stainless band

Silicone spacer



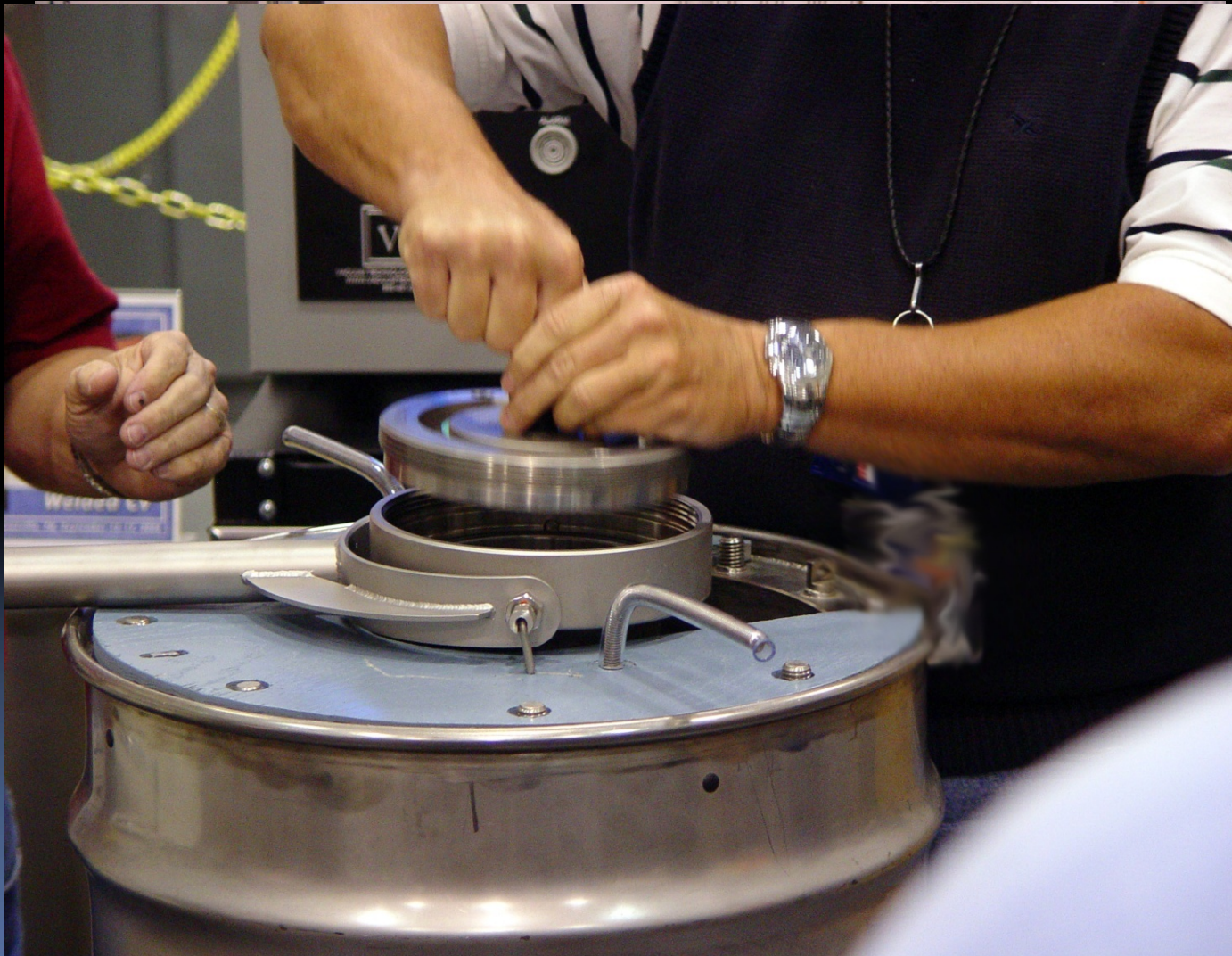
Drum Handling



Containment Vessel Handling



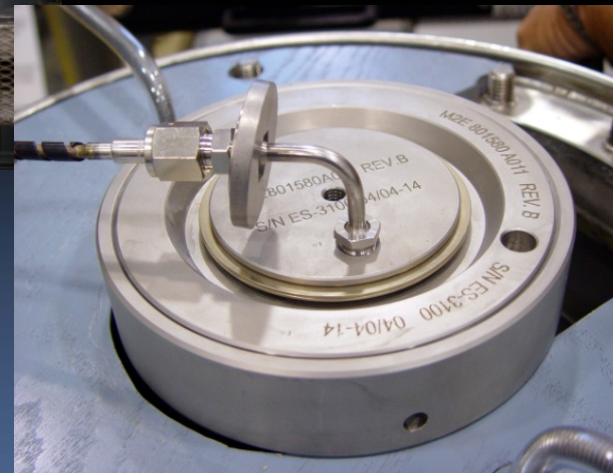
Opening the ES-3100



Closing the ES-3100



Leak Testing



Acceptable post-load leak rate:

$$\leq 1 \times 10^{-4} \text{ cc/sec air}$$

Special Condition

- Pyrophoric uranium must be shipped in a sealed and inerted condition
- Y-12 Solution – modified Swagelok® fittings



Model ES-4100

ES-4100 Program History

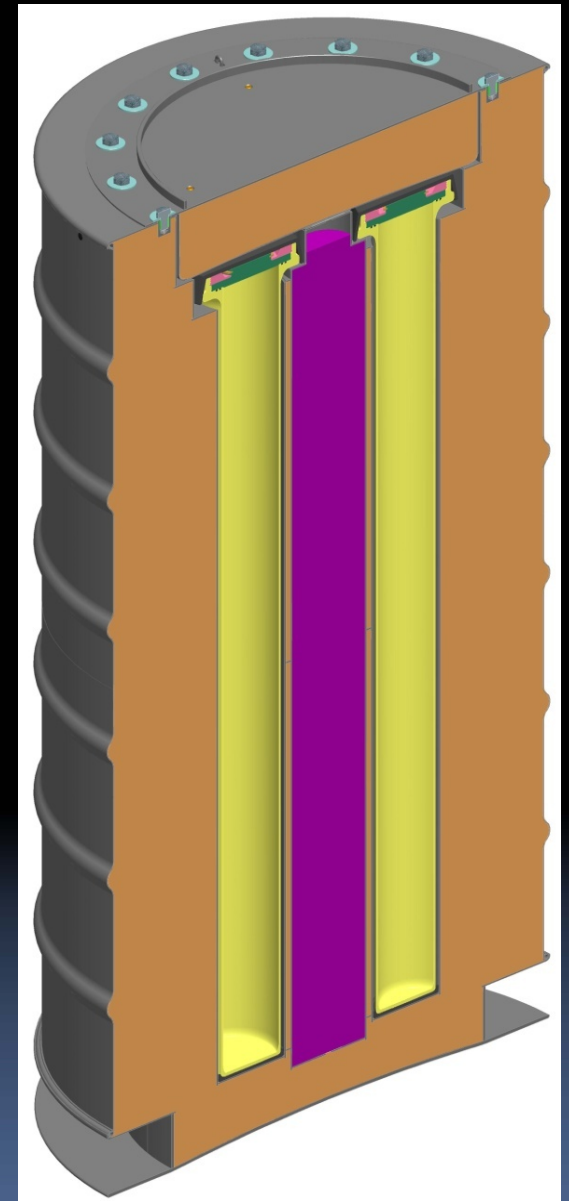
- **Sponsor - U. S. DOE, National Nuclear Security Administration**
- **Work started in 2007; license in 2012**
- **Objective – replace the DOT 6M 110-gallon container for HEU reactor fuels**

Projected Contents

- **Univ of Missouri Reactor Fuel - MURR**
- **Engr Test Reactor Fuel – ETR**
- **GE Test Reactor Fuel – GETR**
- **Mass Inst of Tech Reactor Fuel - MIT**
- **Loose ATR Fuel Rods**
- **Research Reactor Fuels - World-wide**

Prototype Design

- Multi-pack – 4 CVs per drum
- CV inner diameter – approx 12.7 cm
- CV inner length – approx 147 cm
- CV head design – identical to ES-3100
- Outer drum size – 86 cm dia x 183 cm
- Drum head attachment – 16 bolts
- Insulation – cast Kaolite 1600™
- Neutron absorber – cast ceramic w/B₄C
- Gross weight – approx 2000 lb (909 kg)
- Content weight allowance – 4 X 40 kg
- Built-in fork pockets



Primary Components

Containment vessels



Drum assembly



Drum lid



Open drum view

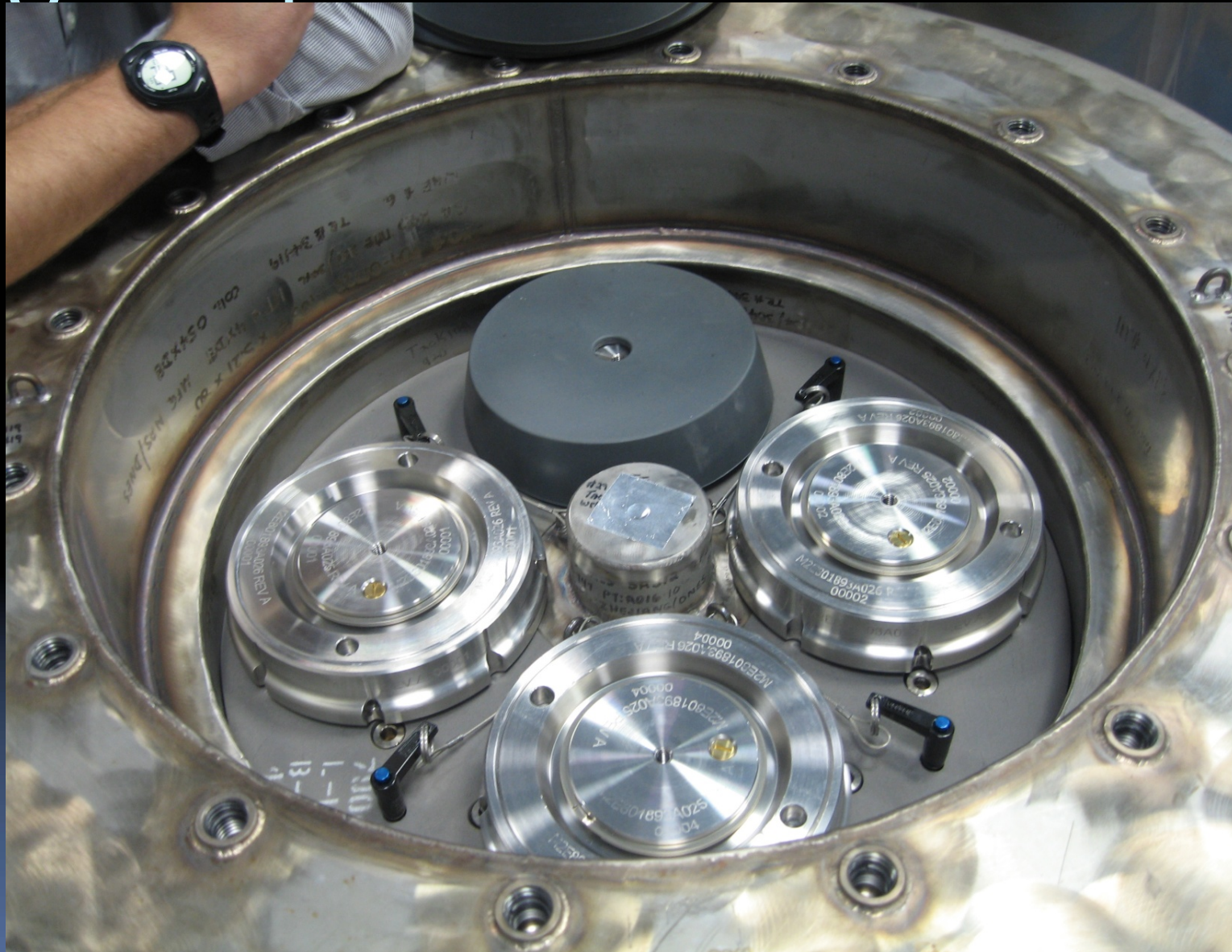
Inner Liner Details



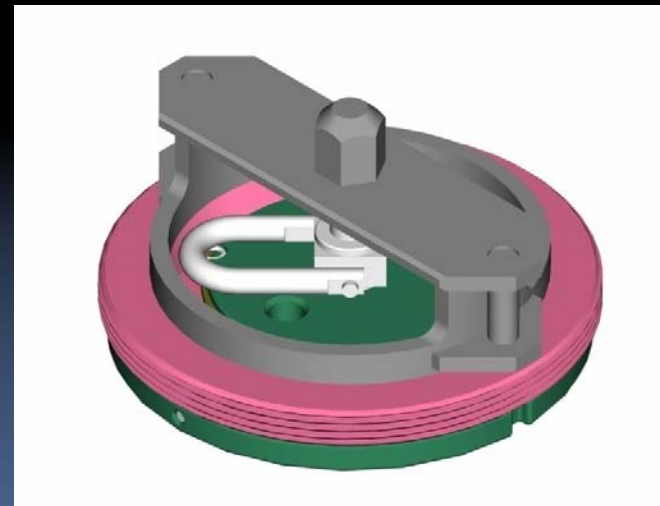
Containment Vessel Insertion



Inside View Showing 4 CVs



Containment Vessel Details



Torque tool engaged

Prototype Testing at ORNL



Prototypes in NTRC Test Lab



Forward Schedule

Prototypes delivered	August 2010
Full scale testing starts	October 19, 2010
SARP submittal to NNSA regulators	February 2011
Certificate expected	February 2012
Productions begins	October 2011
Implementation expected	July 2012