YUCCA MOUNTAIN PROJECT

Studies

Engineering Development

Presented to:
Nuclear Waste Technical Review Board

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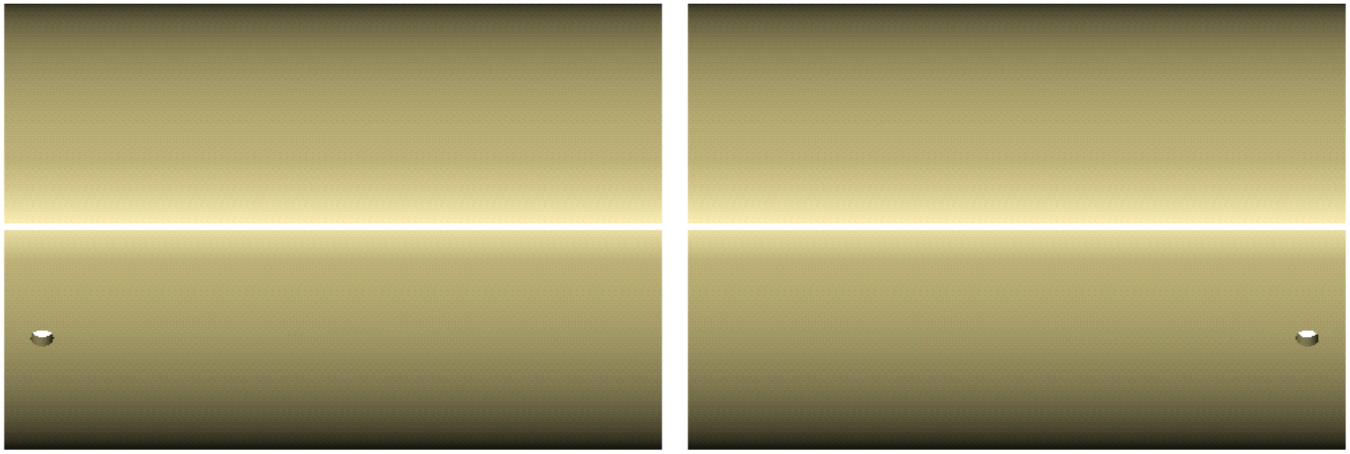
U.S. Department of Energy
Office of Civilian Radioactive
Waste Management

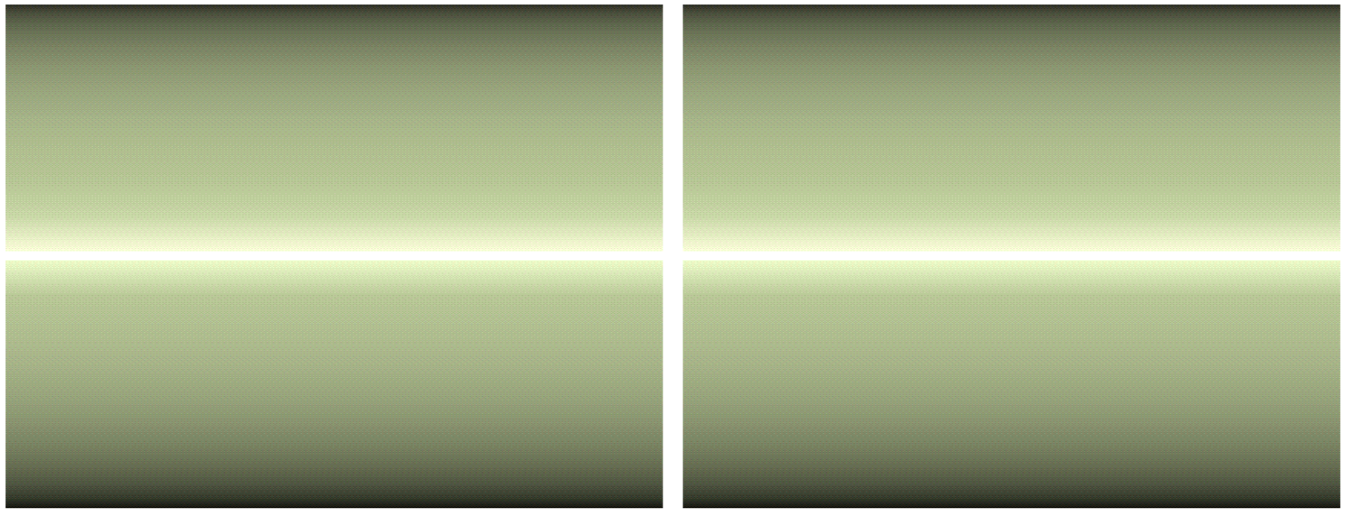
Outer Barrier



Fabrication of the Cylinders

- **Outer barrier**
  - **Formed in two cylinders made of rolled and welded plate**
  - **One longitudinal weld seam on each piece**
  - **All seams radiographic and ultrasonic inspected**
  - **All seams magnetic particle inspected**

Inner Barrier



Fabrication of the Cylinders

- **Inner barrier**
  - **Formed in two cylinders made of rolled and welded plate**
  - **One longitudinal seam on each piece**
  - **All seams radiographic and ultrasonic inspected**
  - **All seams dye penetrant inspected**

Inner and Outer Barrier Shrink Fit

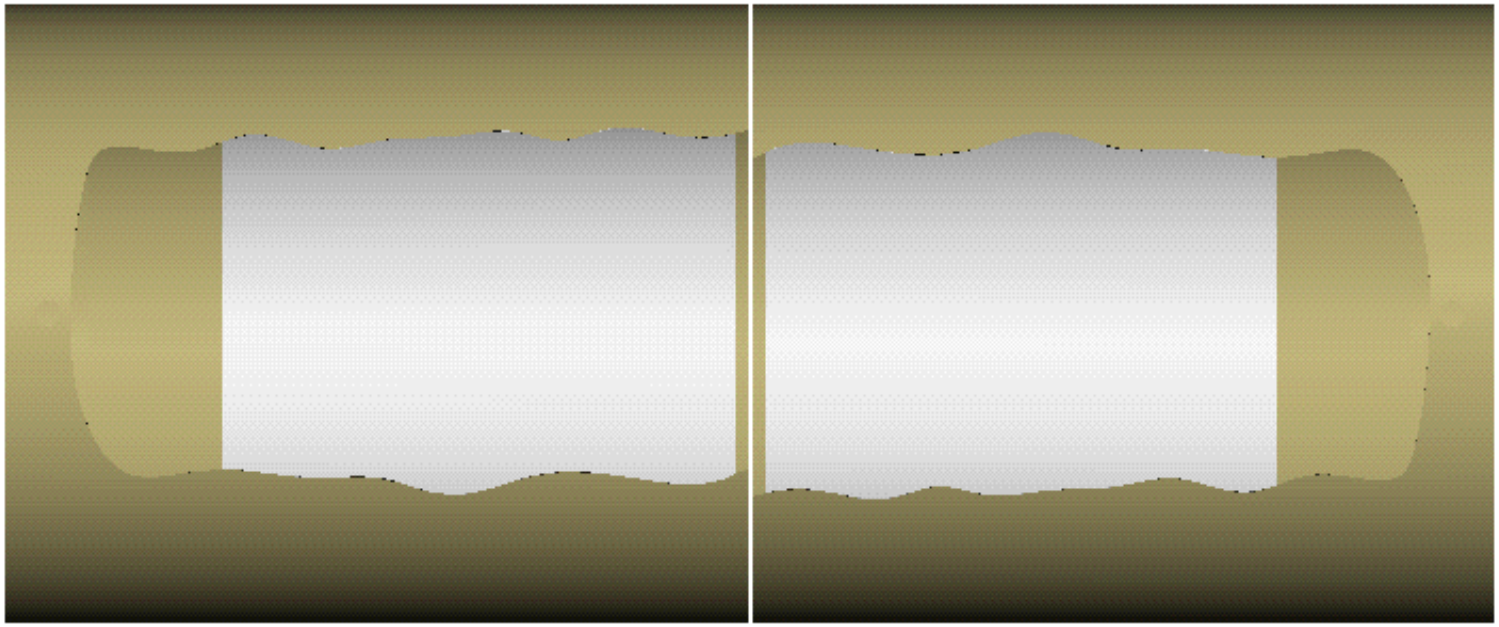
Assembly of Cylinders

- Machine the inner surface of each outer barrier cylinder
- Machine the outer surface of each inner barrier cylinder
- Heat both outer barrier cylinders
- Assembly
  - remove the outer barrier cylinders from the furnace
  - insert each inner barrier cylinder
  - return the assemblies to the furnace
  - allow to slowly cool

Discussion of Shrink Fit

- **Current industrial uses**
  - **Draw bridge hinges**
  - **Copper foil pick up rolls**
  - **Shipping casks**
  - **Extreme contour changes**
- **Advantages**
  - **Reasonably tight fit without close tolerance machining**
  - **Economical**
  - **Simplistic**

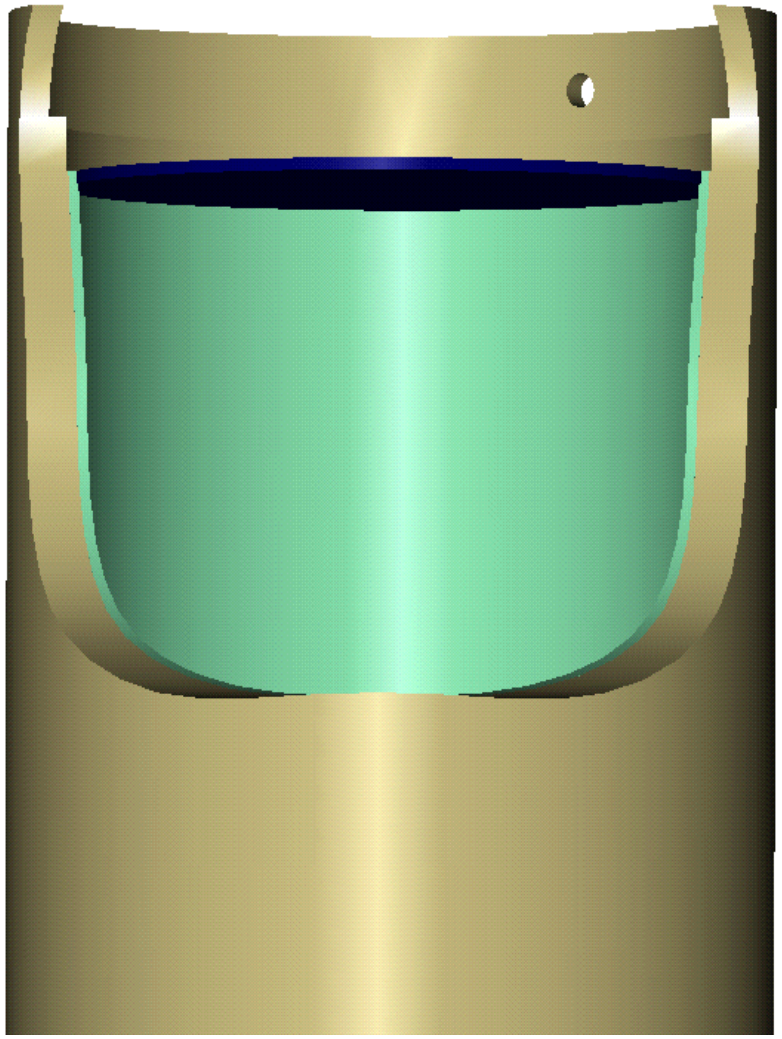
Barrier Assembly



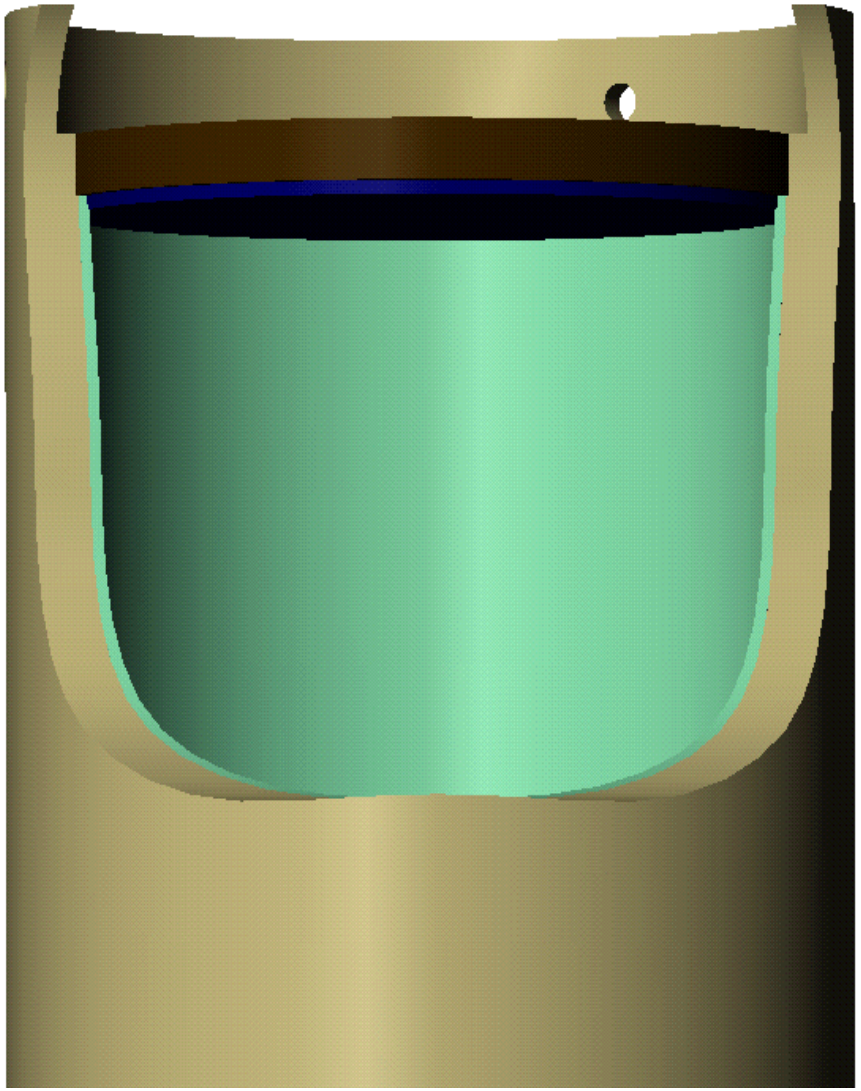
Assembly of Cylinders
(continued)

- **Weld the outer barrier circumferential seam, magnetic particle, radiographic, and ultrasonic inspect the seam**
- **Weld the inner barrier circumferential seam (this will in effect weld the inner barrier to the outer barrier in this area.) Ultrasonic and dye penetrant inspect the inner barrier weld.**

Inner Lid Assembly



Outer Lid Assemblv



Assembly of Lower Lids

- **Weld the inner lower lid, ultrasonic and dye penetrant inspect the weld**
- **Weld the outer lid, ultrasonic and magnetic particle inspect the weld**
- **Stress relieve the entire assembly**
- **Ultrasonic, radiographic, dye penetrant, and magnetic particle inspect all the welds to the maximum extent possible**
- **Machine the inner barrier to clean up, machine lower lid flat and machine a register on the lower end of the outer barrier**
- **Install basket**

Closure Weld

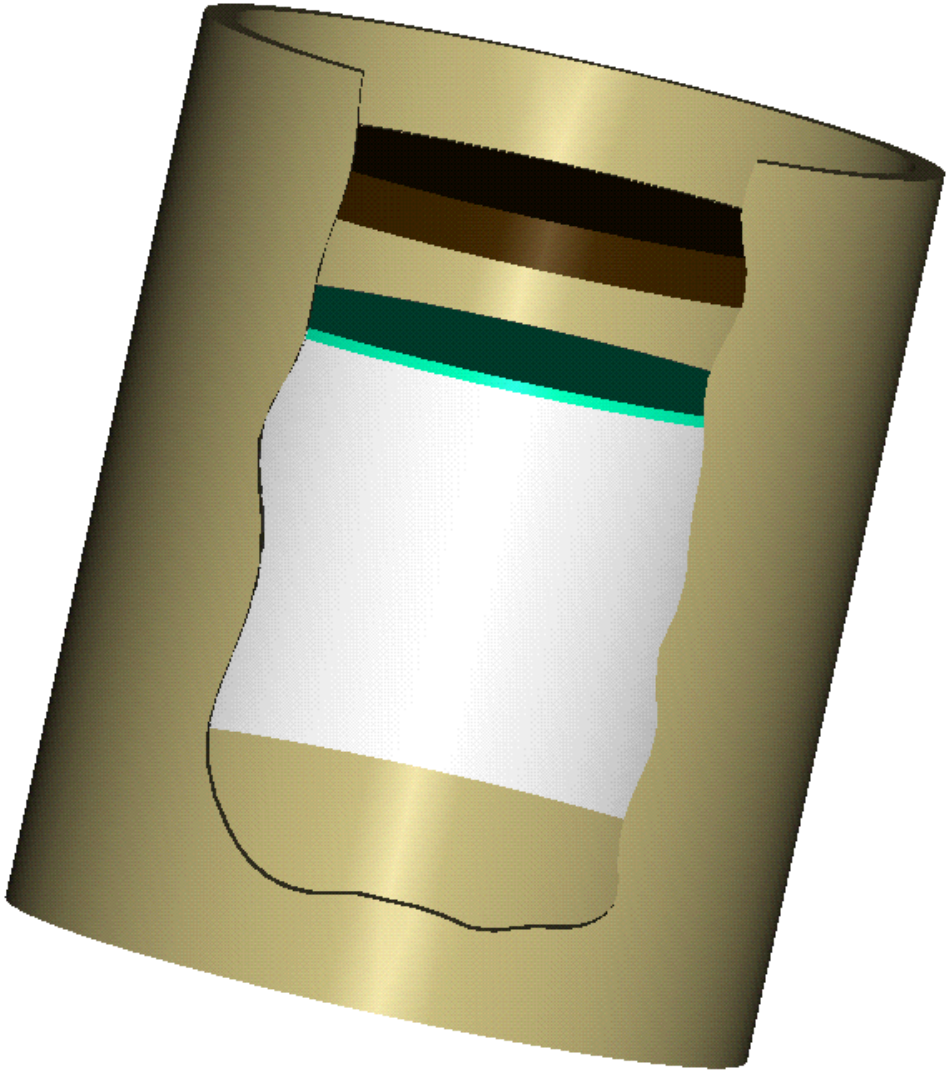
- **Waste package is placed upright on a turn table**
  - **Stable base**
  - **Low maintenance**
  - **Easier to track the weld groove**
- **Weld the inner lid using Hot Wire Automatic Gas Tungsten Arc Process**
- **Ultrasonic inspect the weld when complete**

Closure Weld

- **Weld the outer lid using the Hot Wire Automatic Gas Tungsten Arc Welding Process**
- **Ultrasonic inspect the weld when complete**

Development Programs

- **1996**
  - **Performed weld process comparison and chose cold wire Automatic Gas Tungsten Arc Welding Process**
  - **Produced straight line mock up using the narrow groove configuration**
  - **Used A516 Carbon Steel and Alloy 825**
  - **Did bend and tensile strength tests, all were acceptable**



Development Programs
(continued)

- **1997**
  - Produced a mock up approximately 44 inches long and 68 inches in diameter
  - Fabricated using the shrink fit method
  - Welding performed using the hot wire Automatic Gas Tungsten Arc Welding Process
  - Used A516 Carbon Steel and Alloy 625
  - Used ultrasonics to test area of contact between the cylinders
  - Tested the weld with ultrasonics
  - Performed thermal test
  - Recorded residual stress measurements
  - Shipped mock up to LLNL for further testing

Development Programs
(continued)

- **1998**
  - Test the mock up made in FY 97 at LLNL
  - Plans to build another mock up using the shrink fit method
  - More development for ultrasonic inspection of the interface
  - Stress relieve of the vessel after the welding of the lower lids
  - Remote welding and ultrasonic inspection
  - Dimensional inspection to determine effects of shrink fit
  - Inner barrier made using Alloy C22 and Alloy 625