





# **TN-32B High Burnup (HBU) Demonstration Cask**

***A Presentation to the  
US Nuclear Regulatory Commission***

**December 13, 2016**



# Agenda



- ▶ **Introduction**
- ▶ **Meeting Objectives**
- ▶ **TN-32B HBU Payload and Cask Description**
- ▶ **As-Fabricated Configuration of Cask Containment Boundary**
- ▶ **Pre-Use History of Cask**
- ▶ **Technical Approach for Demonstrating ANSI N14.5-2014 Compliance**
- ▶ **Planned Submittal of License Application**
- ▶ **Conclusion**

# Meeting Objectives



- ▶ Describe the TN-32B HBU payload and cask design
- ▶ Present as-fabricated configuration of containment boundary
- ▶ Pre-use history of cask
- ▶ Discuss approach for demonstrating compliance to ANSI N14.5-2014 fabrication leakage rate test requirement
- ▶ Plan for submittal of transportation license application

# TN-32B HBU Payload



- ▶ **Cask selected to support the EPRI High Burnup Cask Research and Development Project**
  - ◆ **Spent nuclear fuel assemblies with burnup greater than 45 GWd/MTU**
  - ◆ **Three different cladding types: M5™, ZIRLO™, and Low Sn Zr-4**
- ▶ **Store & monitor (32) PWR fuel assemblies for a 10-year period**
- ▶ **Monitoring temperature of assemblies by seven (7) thermocouple lance assemblies installed through the lid**
  - ◆ **Not part of containment boundary**
  - ◆ **Penetrations sealed by a 1-inch thick welded steel plate for transport**

# TN-32B HBU Cask Design



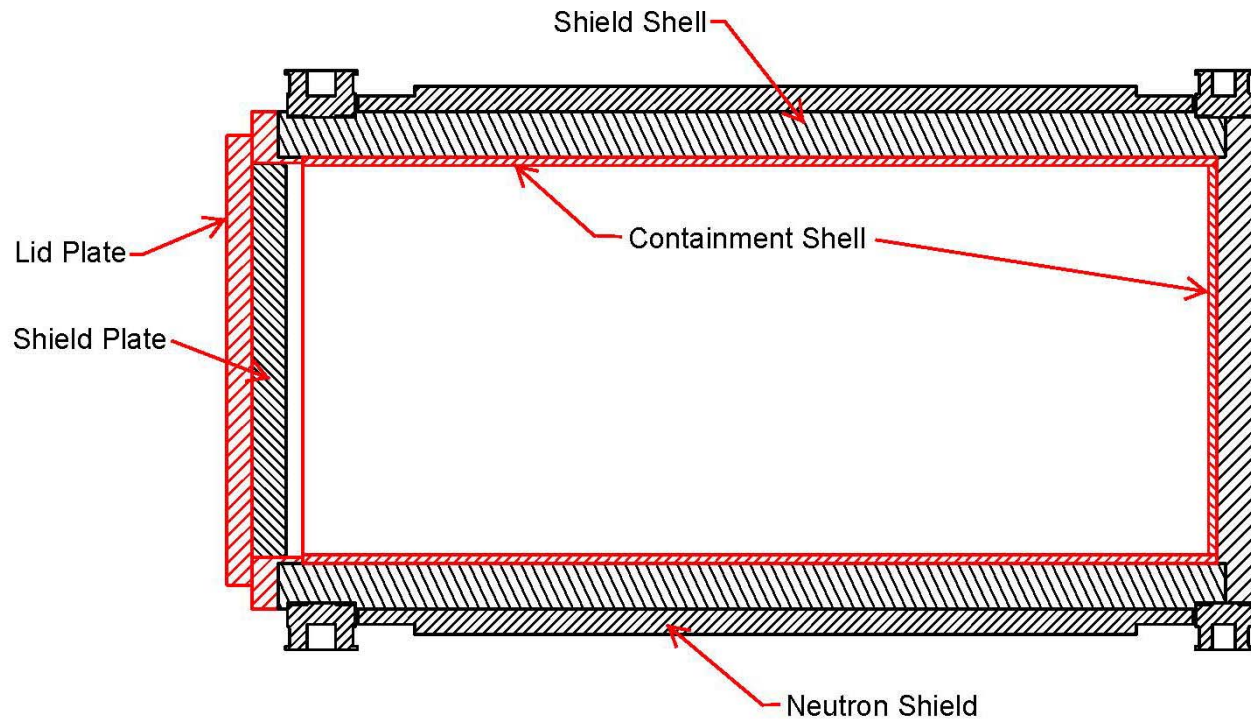
- ▶ **Metallic storage cask, welded construction**
- ▶ **Overall dimensions:  $\varnothing$ 97.75 inch  $\times$  184.0 inch length**
- ▶ **1.5-inch thick inner containment shell and bottom plate**
- ▶ **4.5-inch thick lid containment plate with 6-inch thick shield plate welded to inner surface**
- ▶ **8-inch thick outer shield forging surrounding containment shell**
- ▶ **8.75-inch thick shield plate covering bottom containment plate**
- ▶ **4.5-inch thick neutron shield surrounding outer shield shell**

## TN-32B HBU Cask Design (con't)



- ▶ Lid secured with (48) 1½-inch high-strength hex bolts
- ▶ Aluminum-stainless steel basket for PWR fuel assemblies
- ▶ Gross weight
  - ◆ Approximately 230,000 pounds
  - ◆ Excludes impact limiters
- ▶ Two (2) penetrations through lid containment boundary
  - ◆ Vent port
  - ◆ Drain port
- ▶ All containment closures (lid, vent, & drain) have double O-ring metallic seals

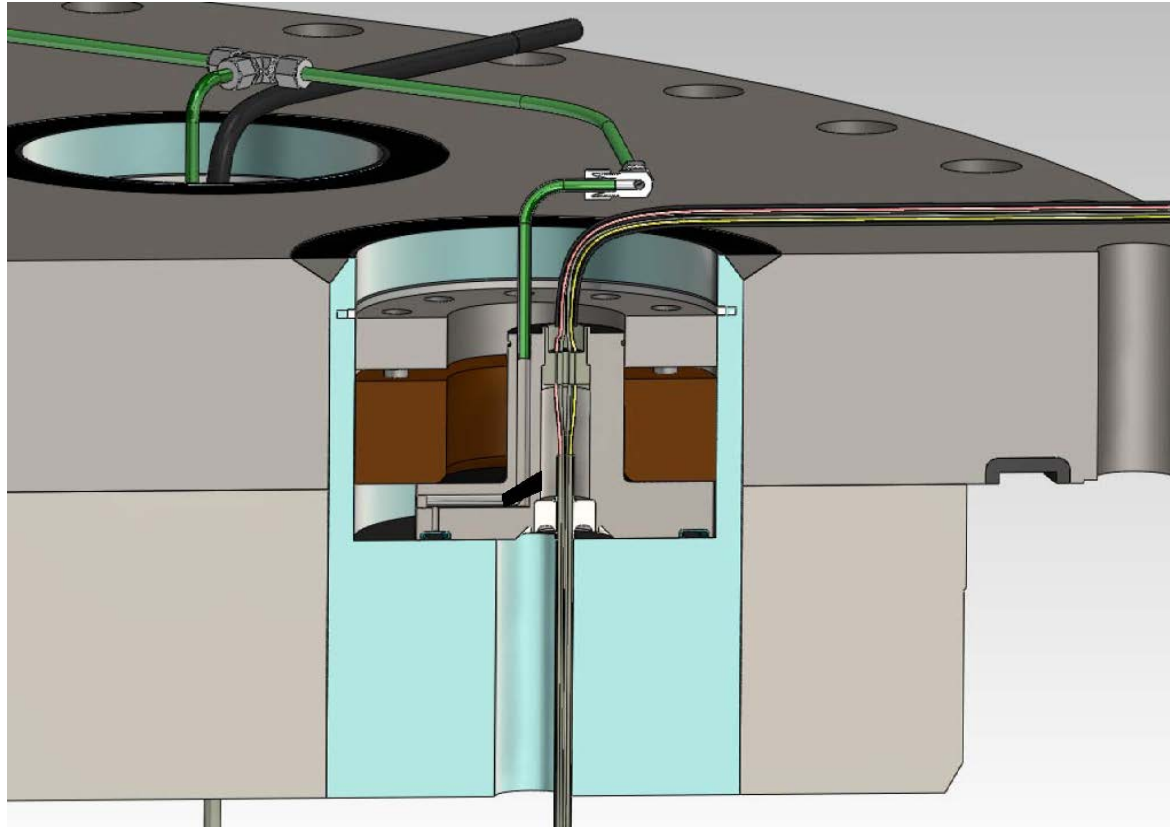
# TN-32B HBU Cask Design (con't) Sectional View





# TN-32B HBU Cask Design (con't)

## Thermocouple Lance Assembly



# As-Fabricated Configuration of Cask Containment Boundary



- ▶ **All weld joints in the 1.5-inch thick containment boundary shell are full penetration, examined, and accepted IAW ASME B&PV Code, Section III, Section NB requirements**
  - ◆ **Multi-layered welds for each joint**
  - ◆ **Magnetically (MT) inspected**
  - ◆ **Radiographically (RT) inspected**
- ▶ **Containment boundary shell is surround by shield shell forging**
  - ◆ **Shield shell forging shrunk fit around containment shell to promote heat transfer**
  - ◆ **Assembly results in minimal or no gap between containment boundary shell and shield forging enclosure**

# As-Fabricated Configuration of Cask Containment Boundary (con't)



## ▶ Lid Plate

- ◆ 4.5 inches thick continuous plate with no weld joints
- ◆ Containment boundary welds that join the lance assembly sleeves are pressure tested and leakage rate tested to be leaktight per ANSI N14.5-2014
- ◆ Lid shield plate covers over 99% of lid inner containment surface

## ▶ Storage Licensing Requirements for Confinement Boundary Leakage Rate Testing

- ◆ Seals and sealing surfaces leakage rate tested per ANSI N14.5-1997
- ◆ Weld joints and base materials not required to be tested
- ◆ NRC accepted testing of seals only for metal casks (circa-1996) when initial TN-32 storage application was submitted

# Pre-Use History of Cask



- ▶ **Previously fabricated 2002-2004 under NRC 10 CFR 72 Certificate No. 1021 as a spent fuel storage cask**
- ▶ **Containment boundary tested during fabrication**
  - ◆ 45 psig structural pressure test
  - ◆ Leakage rate tested of sealing surfaces & metallic seals → leaktight
- ▶ **Stored at fabrication facility from 2004 to May 2016**
- ▶ **Containment boundary pressurized with helium gas at 25 psig for over a decade with no apparent loss of pressure**
- ▶ **Cask is new, unused, and never loaded with SNF assemblies**
- ▶ **Lid currently being modified and retrofitted for the EPRI High Burnup Cask Research and Development Project**

# Technical Approach for Demonstrating ANSI N14.5 Compliance



- ▶ For the Fabrication leakage rate test, §7.3.3, *Components*, of ANSI N14.5-2014 states:

*“The entire containment boundary, including base material, welds, seals, closure, valves, rupture disks, or other boundary elements shall be tested.”*

- ▶ TN-32B HBU Cask As-Fabricated Conditions

- ◆ All containment seals & sealing surfaces have been tested to be leaktight
- ◆ Containment welds for thermocouple lance sleeves have been tested to be leaktight
- ◆ Full penetration containment boundary welds w/ MT and RT NDE/acceptance per ASME B&PV Section III standards provide assurance of leak tightness
- ◆ Containment boundary pressurized with helium gas for over a decade with no apparent loss of pressure provide assurance of leak tightness

# Technical Approach for Demonstrating ANSI N14.5 Compliance (con't)



- ▶ **NRC Interim Staff Guidance ISG-18, Rev. 1 for austenitic stainless steel dry storage canisters (DSCs) identifies criteria for exempting large welds from leakage rate testing:**
  - ◆ **Weld must be multi-layers, with a minimum weld depth of at least 3 distinct weld layers**
  - ◆ **Each layer of weld may be composed of one or more adjacent weld beads**
  - ◆ **Layer must be complete across width of weld joint**
  - ◆ **At least three different weld layers must be examined**
  - ◆ **The weld cannot have been executed under conditions where the root pass might have been subjected to pressurization from the helium fill in the DSC itself**
  - ◆ **Containment boundary of TN-32B HBU cask satisfies these criteria**
- ▶ **ISG-18 criteria provide assurance of leak tightness of weld joints**

# Planned Submittal of Transportation License Application



- ▶ **Modification of the cask will be completed in early 2017**
- ▶ **Work is underway to perform the necessary calculations to support license application**
- ▶ **Site-specific license amendment for storage is currently in NRC review, anticipated to be issued shortly**
- ▶ **Completion of all required calculations and preparation of application estimated to be ready for submission mid- to late-2017.**



# Conclusion