Spent Fuel Transportation

Tom Palmisano
Vice President Decommissioning & Chief Nuclear Officer
SONGS Transportation Preparatory Efforts

• NRC-approved transportation casks available for SONGS canisters
  – Transnuclear Transportation Cask MP-187 (not used for high burnup fuel)
  – Transnuclear Transportation Cask MP-197HB (approved for high burnup fuel)
  – Holtec HI-STAR 190 (approved for high burnup fuel)
• Transportation requirements included in canister loading plans
• On-site rail spur provides access to Pacific Sun, BNSF railroads
• More than 100 canisters qualify for transportation by year-end 2020
### Used Fuel Readiness for Transportation

- Some fuel qualified for transport now
- Remaining fuel qualifies over time

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Transportation Preparatory Efforts

• DOE site visit, June 2-5, 2015
  – Review fuel inventory
  – Confirm licensed transportation cask for all canisters
  – Evaluate site infrastructure, such as rail access
  – Documented in Preliminary Evaluation of Removing Used Nuclear Fuel from Shutdown Sites:
Gary Lanthrum
Radioactive Material Transportation and Energy Consulting
RAMTASC

GUEST SPEAKER INTRODUCTION
Background, Perspective and Context for Spent Nuclear Fuel Shipments

Information for SONGS CEP Meeting, Q3
August 9, 2018

Presented by:

Gary Lanthrum
Principal Engineer

Radioactive Material Transportation and Storage Consulting
Spent Nuclear Fuel (SNF) was never intended to stay where it was produced indefinitely

- SONGS’ stakeholders have expressed interest in moving SNF away from San Clemente and the Pacific Coast;
- After years of federal delays, private sector options for consolidated storage of SNF are going through the licensing process;
- SONGS is actively engaged in long-range planning for potential shipments of its SNF to an off-site location;
- SNF is included in one of nine classes of hazardous material (Class 7). Stakeholders should be aware of the safety provisions and relative risks of hazardous material transportation through their communities.
Spent Nuclear Fuel Transportation has an enviable safety record

- 4,336 casks of spent nuclear fuel were shipped from power plants and research reactors between 1964 and 2010\(^1\).

- Internationally, there have been more than 25,000 shipments of used fuel (over 87,000 metric tons) by land and sea.

- Although there have been accidents, none of those shipments have ever released any of their radioactive cargo, and there have been no injuries, fatalities or environmental damage as a result of the SNF being shipped.

\(^1\) This data comes from the 2016 report: *Historical Review of the Safe Transport of Spent Nuclear Fuel* published by Oak Ridge national Laboratory. The full report is available at: https://www.energy.gov/sites/prod/files/2017/03/f34/Enhanced%20safety%20record%20report%20-%20final%20public%20release_0.pdf
Background Information

Pictures of Past shipments of SNF
In 2006, The National Research Council’s Committee on Transportation of Radioactive Waste found:  

- There is no fundamental technical barrier to the safe transport of spent fuel in the U.S.
- U.S. regulations are adequate to ensure package containment effectiveness over a wide range of transport conditions.
- The accident fatality risk associated with spent fuel shipments is more than three orders of magnitude less than for some other common hazardous materials.

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Shipments of SNF are lower risk than other hazardous material shipments, and there are far fewer of them.
There are 3 pillars for SNF shipment safety:

1. Stringent & Effectively Enforced Regulations Focused on Public Safety;
2. Robust Transport Package designs that are required to survive severe transportation accidents intact;
3. Enhanced Personnel Requirements and the NRC monitored safety conscious work environment.
Pillar 1, Stringent & Effective Regulations Focused on Public Safety.

a) Unique to all hazardous material shipments, SNF shipments are required to withstand severe accident conditions;

b) Notification of state and tribal public safety officials before each shipment through their jurisdictions. In addition, SNF Shipments are required to have a security force escort and real time tracking;

c) Rail Shipments of SNF are Speed Limited and Special Rail Cars are Required for These Shipments;

d) DOT requires rail shipment routes for SNF to be established based on a railroad safety and security review that considers 27 explicit criteria.

e) The regulator reviews and approves the transportation plan for security prior to allowing the shipment to proceed.
Pillar 1d: Rail Shipments of SNF are Speed Limited and the AAR Requires Special Rail Cars for These Shipments

The Association of American Railroads (AAR) has implemented special operating standards (AAR S-2043) for rail cars carrying SNF & HLW.

- Special modeling and on-track testing to demonstrate stability and resistance to derailment before use. 100,000 miles of operations are required to fully qualify a rail car to this standard.
- Enhanced performance “trucks” (a railroad term for suspension)
- Reduced stopping distance;
- Real-time monitoring of truck hunting, bearing temperature, acceleration, wheel flats, and ride quality.
Pillar 2: Robust package designs required to survive severe transportation accidents. In both an 84 MPH crash into a concrete wall & an 81 MPH impact of a locomotive with a truck cask parked across the tracks, the transport casks survived intact, without leakage.

https://archive.org/details/nuccasktest1
WHAT IS SNF SHIPMENT SAFETY BASED ON?

Pillar 2: Robust package designs for SNF shipments are significantly better able to withstand accidents than other hazardous material shipping containers. The cost/benefit calculation is different for SNF transportation.

**Generic 150 Ton Cask for SNF Transport**
- Stainless Steel Outer Shell = 1/2”
- Neutron Shield = 6”
- 2” Stainless Steel Structural Shell
- Gamma Shield = 4”
- Lid thickness = 6”
- Overall wall thickness 14.5”
- 8.5” metal thickness

**Generic 90 Ton Chlorine Tanker Car**
- The pressure tank side walls are 0.787” thick steel
- The pressure tank head uses 0.8125” thick steel
- ~ 4” of ceramic & fiberglass insulation
- The insulation jacket is 11 gage steel (0.1796”)

AAR’s Casualty Prevention Circular 1187 only requires tanker cars to withstand a 9 MPH rollover without breaching!
Pillar 3, Enhanced Personnel Requirements & Training

- Training and qualification of all nuclear workers is done under a safety conscious work environment;
- The security escorts travelling with the train also receive training on emergency response procedures;
- Alcohol and drug testing for railroad engineers and truck drivers transporting these shipments;
- Enhanced training on spent nuclear fuel shipments is available through the Department of Energy’s Transportation Emergency Preparedness Program, TEPP\(^3\).

\(^3\) Information on TEPP can be found at: https://www.energy.gov/em/services/waste-management/packaging-and-transportation/transportation-emergency-preparedness
A licensed site is required to receive the SNF. Two private storage facilities are being developed. 2022 is the earliest date for initial operations;

Special rail cars that meet the S-2043 standard are being developed. Procurement of these rail cars takes 2-3 years once they are certified;

Special transportation casks are licensed by the NRC. Lead time for procuring a transportation cask is 2-3 years.

Approval of transportation routes depends on the mode of transportation (rail, truck, barge or a combination of the three). Route approvals can take from 6 months to 2 years.

Who will own the fuel when it leaves the power plant is an issue that needs to be resolved.

SONGS is developing plans that will help it prepare to ship SNF when a commercially reasonable opportunity arises.
As the National Academy of Sciences’ Research Council aptly noted in 2006, there are no fundamental technical barriers to the safe transport of spent fuel in the U.S.

- The unparalleled safety record for spent fuel transport is not a fluke. It is the result of a carefully constructed set of requirements;

- SNF is currently shipped safely every year by truck and by rail;

- SONGS is positioning itself to ship SNF offsite when a commercially reasonable opportunity arises.
Questions?