



Transportation of Spent Nuclear Fuel

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State Liaison Officer Meeting
October 27, 2015

Division of Spent Fuel Management
NMSS

Overview

- US DOT/US NRC Memorandum of Understanding
- Regulatory Structure
- Package-specific Requirements
- Advance notification
- Physical protection of irradiated fuel in transit
- Spent Fuel Transportation Risk Assessment
- Questions

DOT/NRC Memorandum of Understanding (MOU) July 1979

DOT

- Regulates Carriers
- Regulates Type A and Low Specific Activity (LSA) Packages
- Issues Certificates of Competent Authority for International Shipments

NRC

- Certifies the design of Type B and Fissile material packages
- Transportation Safeguards
- Investigates Accidents/Incidents
- Technical Advisor to DOT

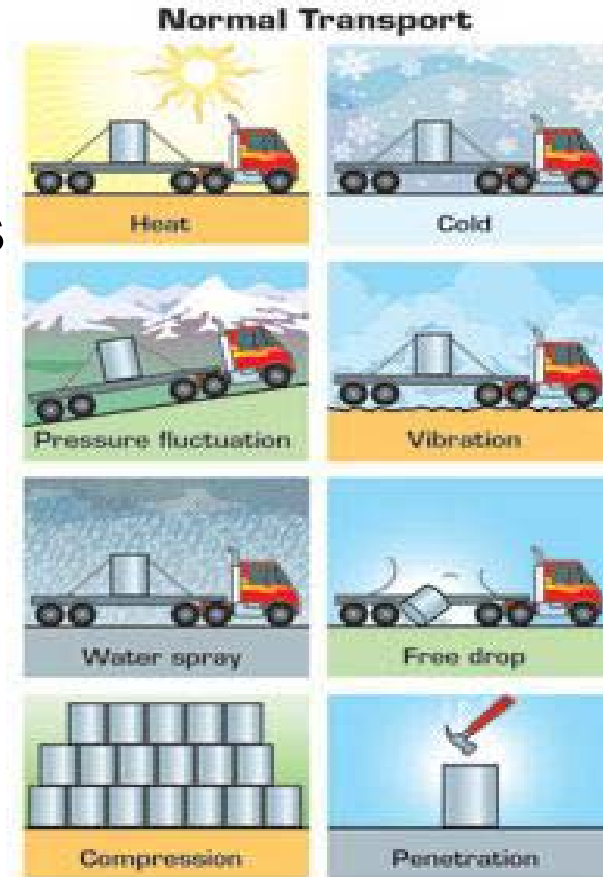
Regulatory Structure

- 10 CFR part 71 – Transportation
 - Type B Fissile packaging required for transport of spent fuel
 - Subject to Normal Conditions of Transportation and Hypothetical Accident Conditions tests
 - Conditions that are typical in transportation
 - Packages are designed to be accident resistant
 - Acceptance criteria after the accident conditions tests
 - Remain subcritical
 - No escape of radioactive material exceeding a total A_2 in one week
 - External dose rate may not exceed 1 rem/hr at 1 m from the external surface of the package
 - Harmonized with IAEA requirements for transportation
 - New US DOT and US NRC final rules went into effect on July 13, 2015
 - Compatible with the IAEA Safety Standard Regulations (SSR-6, 2009)



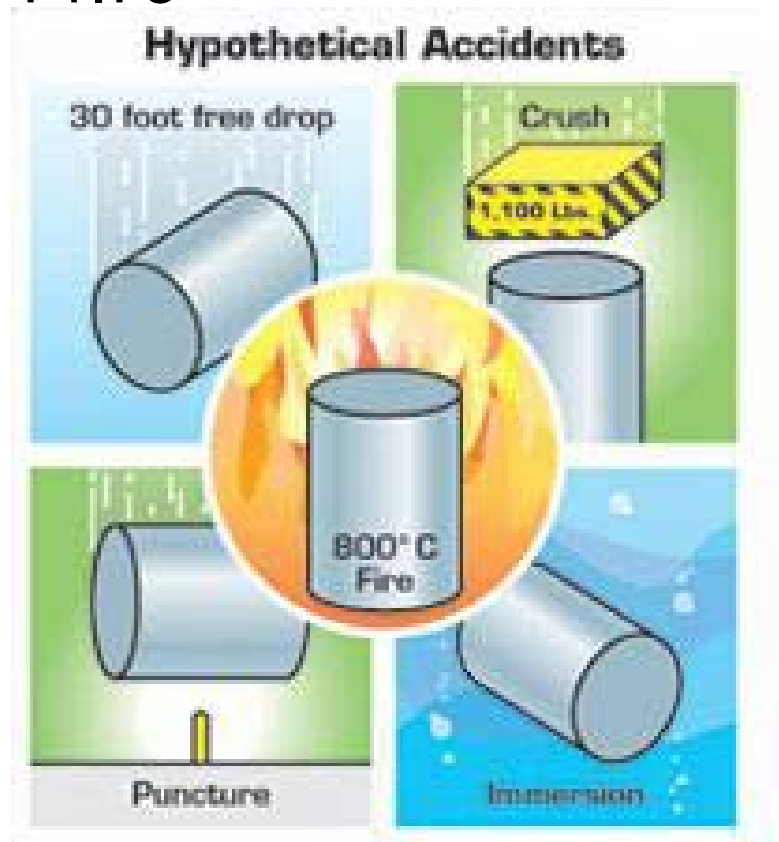
Normal Conditions of Transport 10 CFR 71.71

1. Heat
2. Cold
3. Pressure changes
4. Vibration
5. Water spray
6. Free drop
7. Compression
8. Penetration



Hypothetical Accident Condition Tests for Type B Packagings 10 CFR 71.73

1. Free Drop
2. Crush
3. Puncture
4. Thermal
5. Immersion - fissile package
6. Immersion - all packages



Package-specific Requirements - Transportation

Transportation is performed in the public domain

- Subcriticality
 - Transportation regulations require analysis of multiple packages (limiting the number of packages that can be shipped together)
 - Transportation regulations require consideration of water in-leakage
- Radiation Protection
 - During transportation, the radiation limit is 10 mrem/hr at 2 meters from the outer lateral surfaces/vertical planes of the vehicle
- Temperature
 - The temperature of accessible surfaces may not exceed 185° F as prepared for transport

Advance Notification 10 CFR 71.97



- Required for shipments of irradiated reactor fuel
- Made in writing to the appropriate governor or designee and Tribal official or designee
- Timeline required for coordination
- The updated list published on/before June 30 each year

Physical protection of irradiated fuel in transit

10 CFR 73.37

- Objectives
 - Minimize the potential for theft, diversion, or radiological sabotage
 - Facilitate the location and recovery of shipments that may have come under unauthorized control
- Physical protection system must be established
 - Pre-plan and coordinate
 - Advance notifications
 - Transportation physical protection program
 - Contingency and response procedures

NUREG-2125, Spent Fuel Transportation Risk Assessment

- Investigates safety provided by regulations during spent fuel transportation under both routine and accident conditions
- NRC's fourth investigation over the last 35 years
- Improvements in accident analysis
 - finite element analysis of NRC-certified rail and truck cask designs
 - direct loaded and canistered fuel contents
 - example U.S. cross-country truck and rail routes with updated accident statistics

NUREG-2125, Spent Fuel Transportation Risk Assessment

- Results
 - Routine conditions: collective doses are about four to five orders of magnitude less than collective background radiation dose over the same time period and exposed population as the shipment.
 - Accident conditions: contents would not be released in any U.S. historical accident if the fuel is contained in a welded canister inside the cask.

NUREG-2125, Spent Fuel Transportation Risk Assessment

- Radiation emitted from a cask during transportation is a fraction of the natural background radiation
- The risk from accidental release is extremely low
- Regulations are adequate to protect the public against unreasonable risk

