

# Potential Reconfiguration of High Burnup Fuel and Its Implications to Transportation Package Safety

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# Presentation Outline

1. Potential reconfiguration of high burnup fuel during transportation
2. Transport of fuels with potential to reconfigure vs transport of damaged fuels
3. Implications to safety
4. Regulatory compliance
5. Summary

# Potential Reconfiguration of High Burnup Fuels

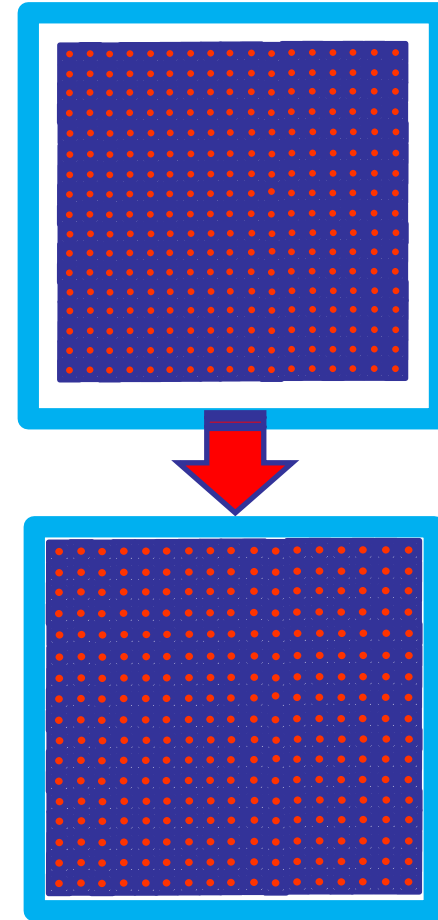
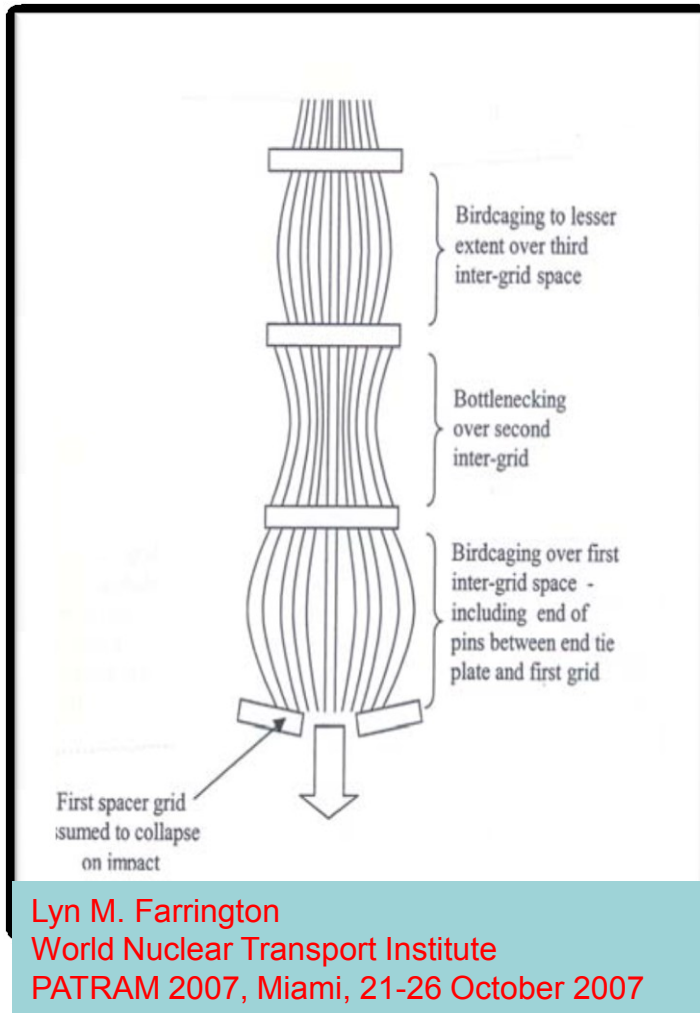
## 1. Cladding material property

- Direct load transport
  - ❖ Unknown cladding material property
- Transport after storage
  - ❖ Unknown environments
  - ❖ Unknown cladding material property

## 2. Potential reconfiguration during transportation

- Impact under normal conditions of transport
- Impact under hypothetical accidents

# Fuel Lattice Deformation – Examples



# Fuel Reconfiguration and Impacts on Package Safety



Impact on Reconfiguration	Criticality (Applicable Regulations)	Shielding (Applicable Regulations)	Containment (Applicable Regulations)	Thermal (Applicable Regulations)	Operational Needs (71.89)
Lattice Deformation (no breakage of fuel rods)	<b>Yes</b> (10 CFR 71.55(b), (d), and (e))	<b>Possible</b> (Depending on assumptions in Shielding Analysis)	<b>None</b>	<b>Possible</b> Elevated local temperature (71.43)	<b>Yes</b> (Retrievability special equipment, facility)
Rod/assembly slide out (no breakage of fuel rods)	<b>Yes</b> (10 CFR 71.55(b), (d), and (e))	<b>Yes</b> Source relocation (71.47, 51)	<b>None</b>	<b>Yes</b> Thermal Source relocation (71.43)	<b>Yes</b> (Retrievability special equipment, facility)
Rod break/ Loss of Assembly Structure Integrity	<b>Yes</b> (10 CFR 71.55(b), (d), and (e))	<b>Yes</b> Source relocation (71.47, 51)	<b>Yes</b> > Assumed NCT release fraction (71.51, 61)	<b>Yes</b> Thermal Source relocation (71.43)	<b>Yes</b> (Retrievability, special equipment, facility)

# Transport of damaged fuels vs fuels with potential to reconfigure



<b>Fuel Status</b> <b>Package</b>	<b>Damaged Fuels</b>	<b>Fuels with potential to reconfigure</b>
Fuel conditions as loaded	Damaged	Loaded as intact, with high expectation to remain intact under NCT
Canned	Yes	No
Normal Conditions of Transport	Analyzed as damaged fuel for criticality, shielding, containment, and thermal	Analyzed as damaged fuel for criticality, shielding, containment, and thermal
Hypothetical Accident Conditions	Analyzed as damaged fuel for criticality, shielding, containment, and thermal	Analyzed as damaged fuel for criticality, shielding, containment, and thermal
Receiving facility and equipment requirements	Retrieve as individual can	Determine fuel status Capable of retrieving reconfigured fuel if fuel deform

# Transport of fuels with potential to reconfigure – a path forward



1. Basic assumptions for high burnup fuel transport
  - ❖ Fuels are loaded as intact and remain intact prior to and during normal conditions of transport
  - ❖ Fuel may reconfigure during transportation
2. The licensing basis: intact fuel
3. Analyze package with reconfigured fuel
4. The license holders should make every effort to preserve the integrity of the fuels during storage (dry or wet)

# Studies on Reconfiguration and its impacts to package safety



## Current studies

1. [ORNL is performing studies to further understand fuel reconfiguration and its impact to package safety](#)
2. [NUREG/CR-6835, Effects of Fuel Failure on Criticality Safety and Radiation Dose for Spent Fuel Casks, ORNL, 2002](#)
3. [Fuel Relocation Effects for Transportation Packages, EPRI Report 1015050, EPRI, June 2007](#)
4. [Spent-Fuel Transportation Applications – Normal Conditions of Transport, EPRI Report 1015049, EPRI, June 2007](#)



# Summary



1. License based on intact fuel
2. Fuel may reconfigure during transportation
3. Analyze impact of fuel reconfiguration – defence in depth
4. Spent fuel license holders make every effort to preserve cladding integrity
5. Addressing the concerns on the safety and regulatory compliance