ENSA/DOE Transport Shock and Vibration Test Plan

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High Burnup Fuel Technical Gaps

DOE Used Fuel Disposition Campaign addressing the issues associated with storage and transportation of high burnup fuel

▶ Detailed Technical Gap Analysis in 2010

▶ Ranked the identified data gaps from low to very high based primarily on the need, in our opinion, for more data to support licensing activities as well as DOE's long-term storage, transportation, and disposal needs.

▶ Mechanical stressors was identified as one of the program's top priorities.

▶ This effort focuses on continuing the examination of the external stresses that cladding may be subjected to during extended storage and transportation.

▶ Proposed work scope addresses multimode normal conditions of transportation.

▶ Previous work included:

- Truck transport. DOE – U.S. Department of Energy. 2014. Normal Conditions of Transport Truck Test of a Surrogate Fuel Assembly. FCRD-UFD-2014-000066. Revision 0.1, U.S. Department of Energy, Washington, D.C.

- Shaker table analysis - McConnell PE, R Wauneka, G Koenig, W Uncapher, C Grey, C Engelhardt, S Saltzstein, and K Sorenson. 2015. Surrogate Fuel Assembly Multi-Axis Shaker Tests to Simulate Normal Conditions of Rail and Truck Transport, Sandia National Laboratory, Albuquerque, NM. FCRD-UFD-2015-000128.

ENSA/DOE International Multi-transportation Mode Tests with a Transport Cask

Equipos Nucleares (ENSA) will provide an ENUN 32P transport cask, basket, instrumentation lid, mock assemblies, and cradle for an international test program

▶ The ENUN 32P is similar to an existing NRC-licensed cask currently in use in the USA

Testing to be conducted by

▶ DOE laboratories (SNL, PNNL, SRNL) & ENSA

▶ Transportation Technology Center Incorporated (TTCI)

These tests are significantly different than the previous tests:

▶ Instrumented surrogate assemblies will be…
- within a cask basket, within an actual rail cask which will be on…
  1) a heavy-haul truck, then
  2) a barge, and ocean going ship, and then
  3) a railcar
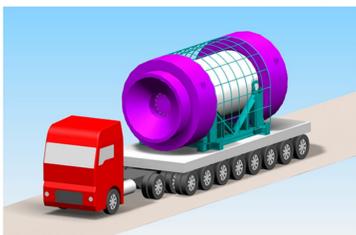
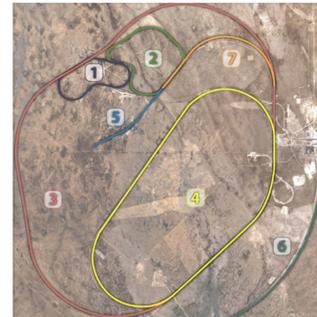**Impact Limiters on a Large Transportation Cask (Courtesy of ENSA)**

Transportation Technology Center, Inc. (TTCI) Captive Track Tests
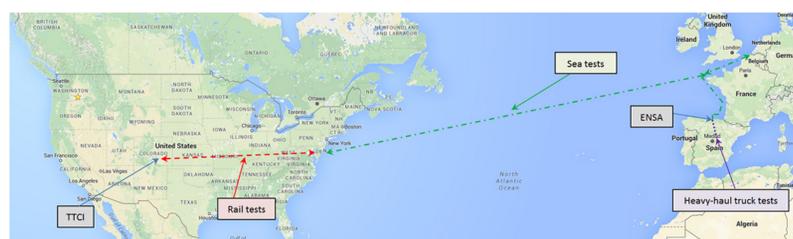
Pictures and details from TTCI website: http://www.aar.com

Facility
52-square mile facility 21 miles Northeast of Pueblo, Colorado, USA
48 miles of railroad track available for testing
Test Tracks

Proposed Routing of the Cask

▶ Heavy-haul truck from within Spain.

▶ Coastal sea shipment from Santander to a large northern European port.

▶ Ocean transport from Europe to an eastern U.S. port (e.g., Baltimore, MD).

▶ Commercial rail shipment from East Coast to Pueblo, CO.

▶ Testing at the Transportation Technology Center, Inc.

▶ Return trip to ENSA will be the same.

Data will be collected throughout all legs of the transport of the cask & assembly

Benefits of Multi-transportation Mode Transport Cask Tests

▶ Provide data for all transport modes
- Heavy-haul truck
- Coastal shipment (e.g., barge)
- Open ocean transport
- Normal rail
- Inter-modal transfers

▶ Add to the library of NCT rail and truck loadings. This data will be used to benchmark our computer codes, thus making it possible to analytically extend our assessments to many types of rail cars.

▶ Reduce uncertainty in the existing data by testing under more real-life conditions

▶ Support future licensing and transport of high burnup UNF
- e.g., High Burnup Spent Fuel Data Project Research Project Cask

▶ Remove many of the compromises inherent to the previous tests

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Specifics of Transportation Tests

Heavy-haul truck tests in Spain
▶ Test time ~ 3 - 5 days
▶ Will instrument surrogate assembly(ies)
▶ Will be a round trip test (~ 1200 km) destination TBD
▶ Strain and vibration data will be collected during the trip and during transloading

8-axle heavy haul trailer

Coastal sea shipment between Santander and northern Europe
▶ Shipment time ~ 3 days
▶ ENSA will use a Roll on – Roll off vessel (RoRo). Ride will be similar to US barge shipments
▶ Strain and vibration data will be collected during the trip
▶ The cask cradle will be instrumented

Ocean shipment between Europe and US East Coast
▶ Shipment time ~ 2 weeks via RoRo vessel
▶ Cask/cradle will be loaded onto a 30' trailer
▶ Strain and vibration data will be collected
▶ The cask cradle will be instrumented

Commercial rail shipment from East Coast to Pueblo, CO, USA
▶ Transit time ~ 3 weeks
▶ Data collection during transit
▶ Rail car will be instrumented
▶ Compare data to track charts

Typical commercial flat deck rail car

Testing at TTCI (~ 3 weeks for all testing) specific tests will be in detailed test plan may include:
▶ Twist and Roll Test
▶ Dynamic curving test
▶ Crossing Diamond test
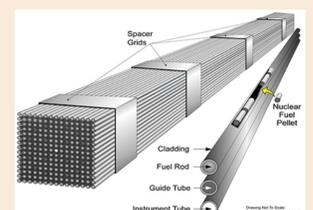▶ Coupling Impact test
▶ Transloading simulation

Return trip
▶ Data collection for the entire return trip is being considered

Collect data during intermodal transfers: truck-to-barge, barge-to-ship, ship-to-rail.

Artist Illustration of ENSA ENUN 32P Cask (Courtesy of ENSA)

PWR Fuel Assembly