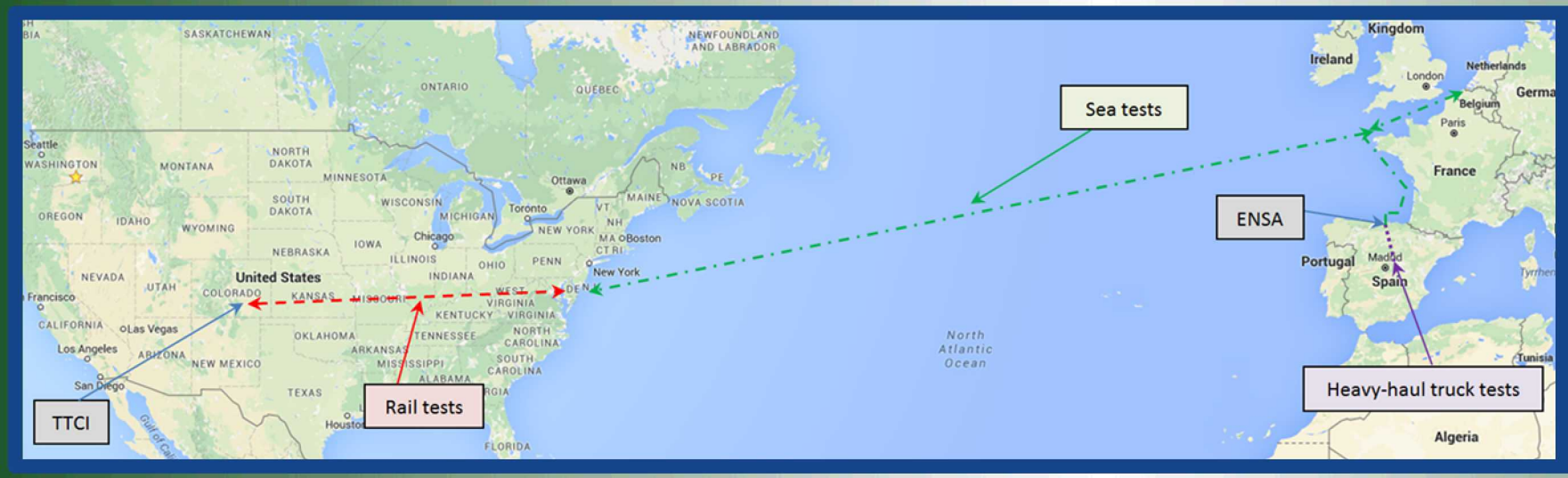
U.S. DEPARTMENT OF ENERGY

Nuclear Energy

Nuclear Energy

SAND2018-7210C

DOE:NE Spent Fuel & Waste Science & Technology



Results and Correlations From Analyses of the ENSA ENUN 32P Cask Transport Tests

Elena Kalinina, Natalie Gordon, Douglas Ammerman, William Uncapher, Sylvia Saltzstein, Catherine Wright

Sandia National Laboratories

ASME Pressure Vessels & Piping Conference

Radioactive Material Storage and Transportation

July 18, 2018, Prague, Czech Republic

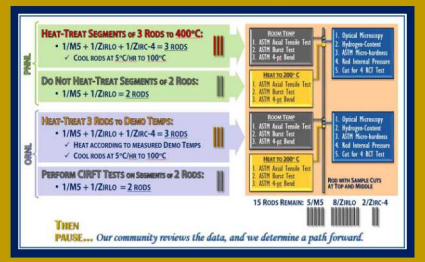
Sandia National Laboratories is a multi-mission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC., a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525. SAND2018-5880 PE

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

DOE Storage and Transportation Research Projects fit together to answer the question, "Can Spent Nuclear Fuel be Stored and Shipped Safely in the Years to Come?"

We have fuel in hot cells.

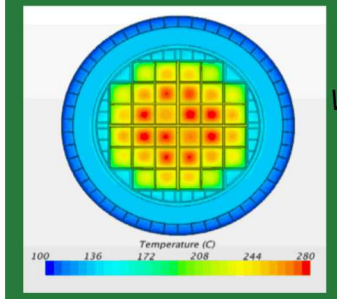
We completed non-destructive tests.



We are starting destructive analysis.

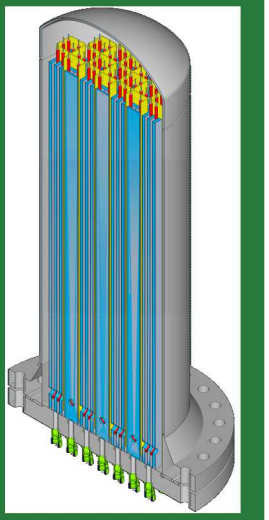
Sister Rod Mechanical Testing Data

We have thermal models.



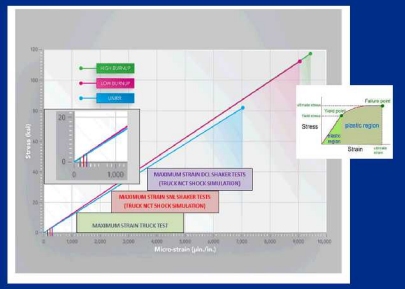
We are getting new thermal data from the Demo.

We will build a test apparatus to identify thermal conservatisms & develop more realistic assumptions.



Thermal Behavior

Provides Knowledge about Spent Fuel Integrity Which is Compared to Data from the Transportation Tests



Spent Fuel Triathlon: Quantification of Normal Transport Shocks & Vibrations

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Cask Test Participants

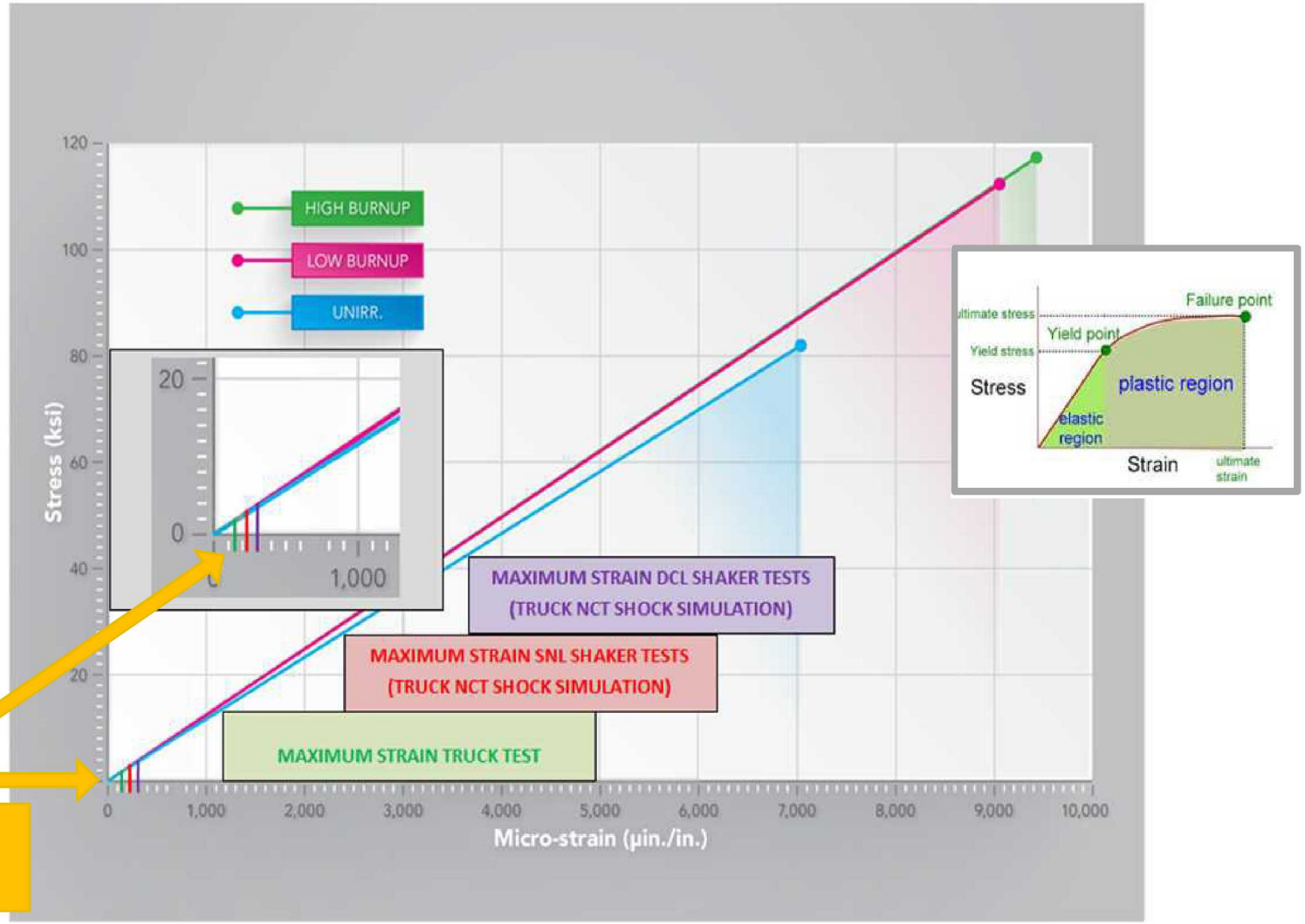
- U.S. Department of Energy
- Equipos Nucleares Sociedad Anónima (ENSA)
- Empresa Nacional de Residuos Radiactivos S.A. (ENRESA)
- ENUSA Industrias Avanzandas S.A.
- Coordinadora Internacional de Cargas, S.A.
- Sandia National Laboratories (SNL)
- Pacific Northwest National Laboratory (PNNL)
- Transportation Technology Center, Inc.
- Korea Radioactive Waste Agency (KORAD)
- Korea Atomic Energy Research Institute (KAERI)
- Korea Nuclear Fuel Company Ltd. (KNFC)
- Argonne National Laboratory (ANL)

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Assembly Strains in Rail-Cask Tests

Demo Sister Rod Tests Will Confirm Post-drying High-burnup Cladding Yield Points

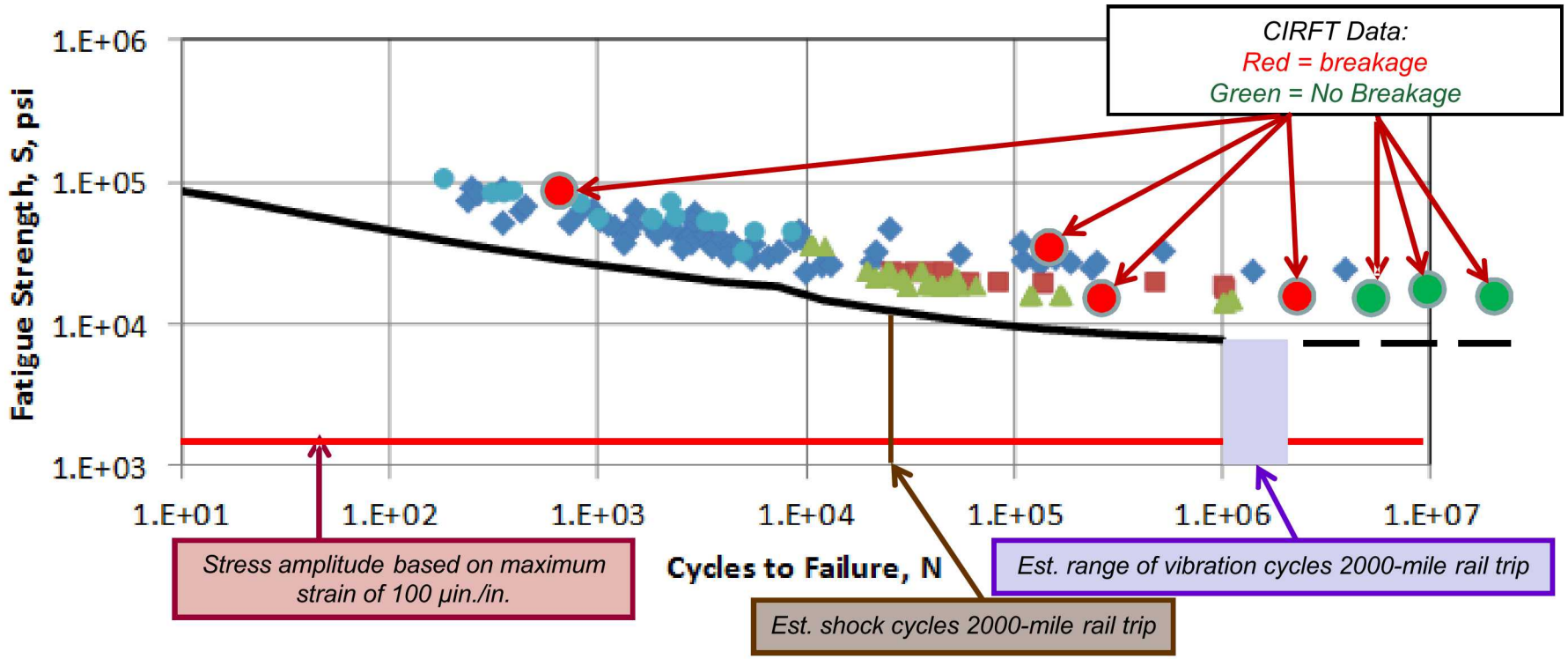
Realistic stresses fuel rods experience due to vibration and shock during normal transportation are below yield and fatigue limits for cladding.



Past Tests Max. Strain

U.S. DEPARTMENT OF ENERGY
Nuclear Energy

Could Vibrations or Shocks Result in Fatigue Failure?



Fatigue design curve (——): O'Donnel and Langer, "Fatigue Design Basis for Zircaloy Components," Nucl. Sci. Eng. 20, 1, 1964. (cited in NUREG-0800, Chapter 4)

Data plot courtesy of Ken Geelhood, PNNL
The large circles are ORNL HBR data

The Shocks and Vibrations we measured are well below the failure points found in Spent Fuel past tests.

Concluded ...thank you.

QUESTIONS ?

Sandia National Laboratories is a multi-mission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC., a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525. SAND2018-4192 C