Status of Transient Testing Capabilities in the United States

Dan Wachs
Scientific Coordinator for Transient Testing
Nuclear Fuels and Materials Division
Idaho National Laboratory

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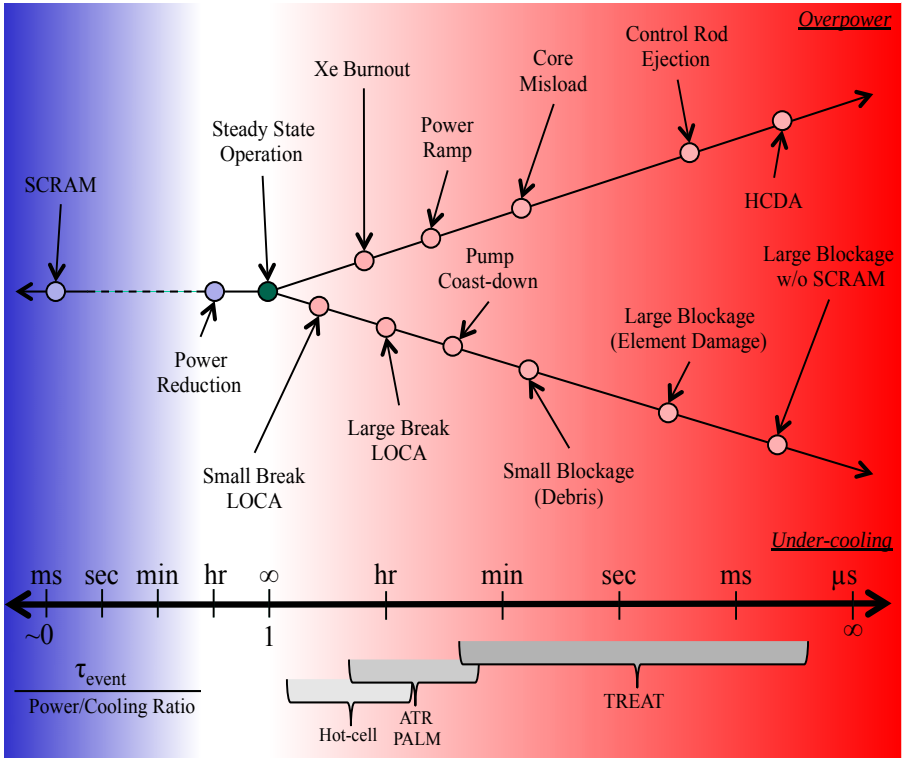
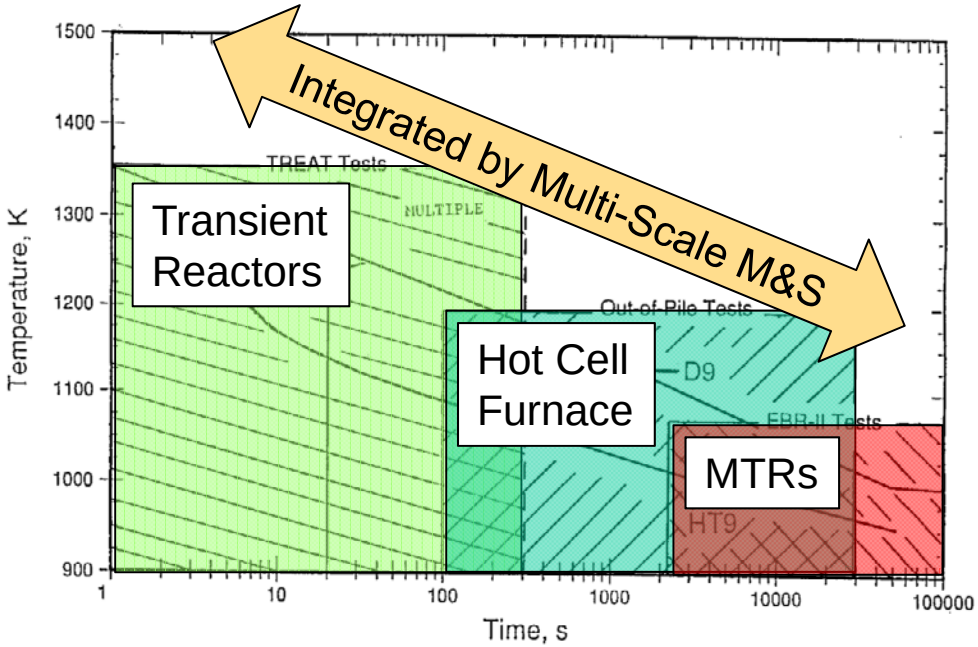
Idaho National Laboratory

Fuel Safety Research

- **Objective:**

  Conduct the experimental activities required to help the industry describe how fuel systems respond to relevant transients (both operational and off-normal)

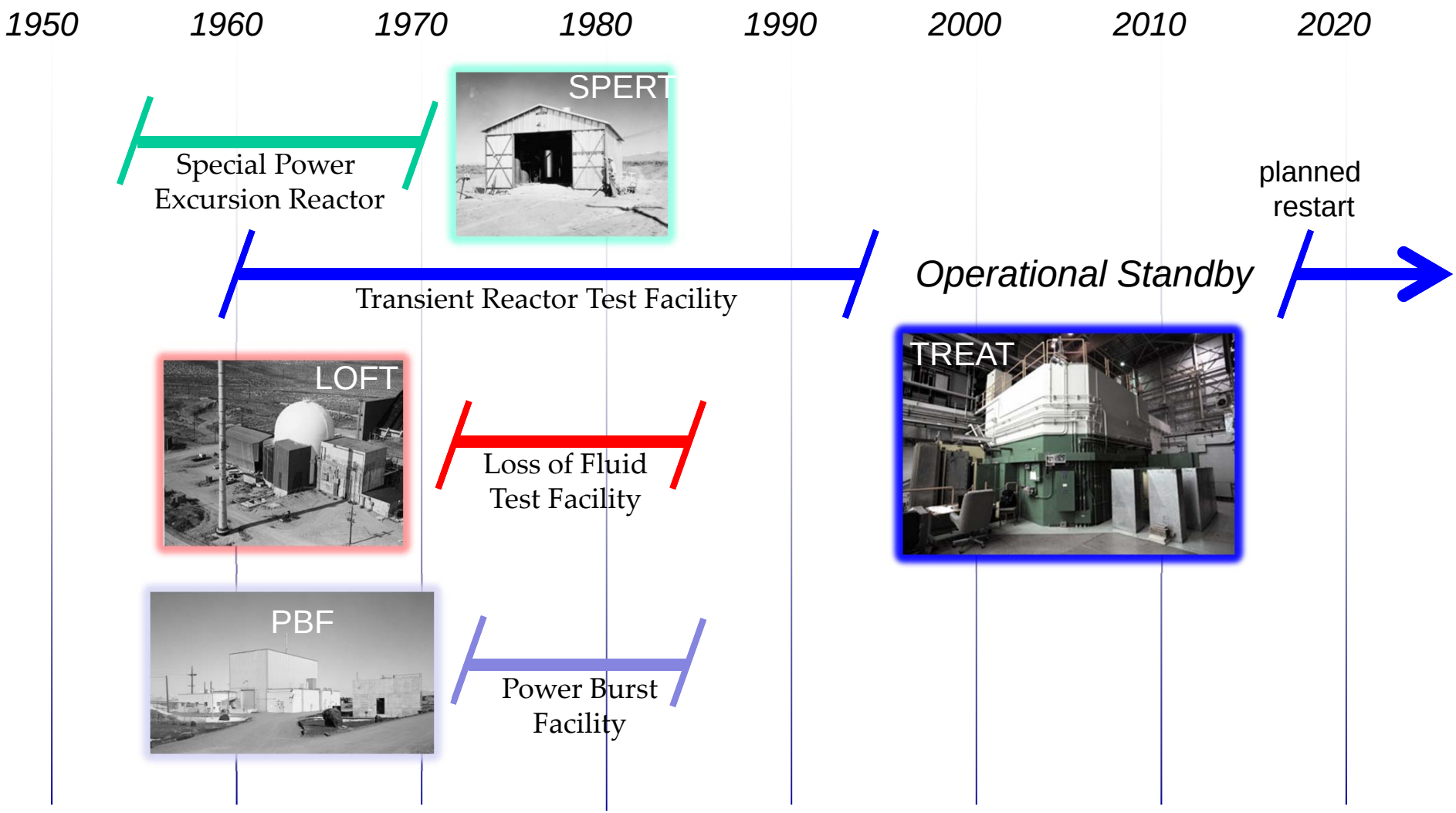




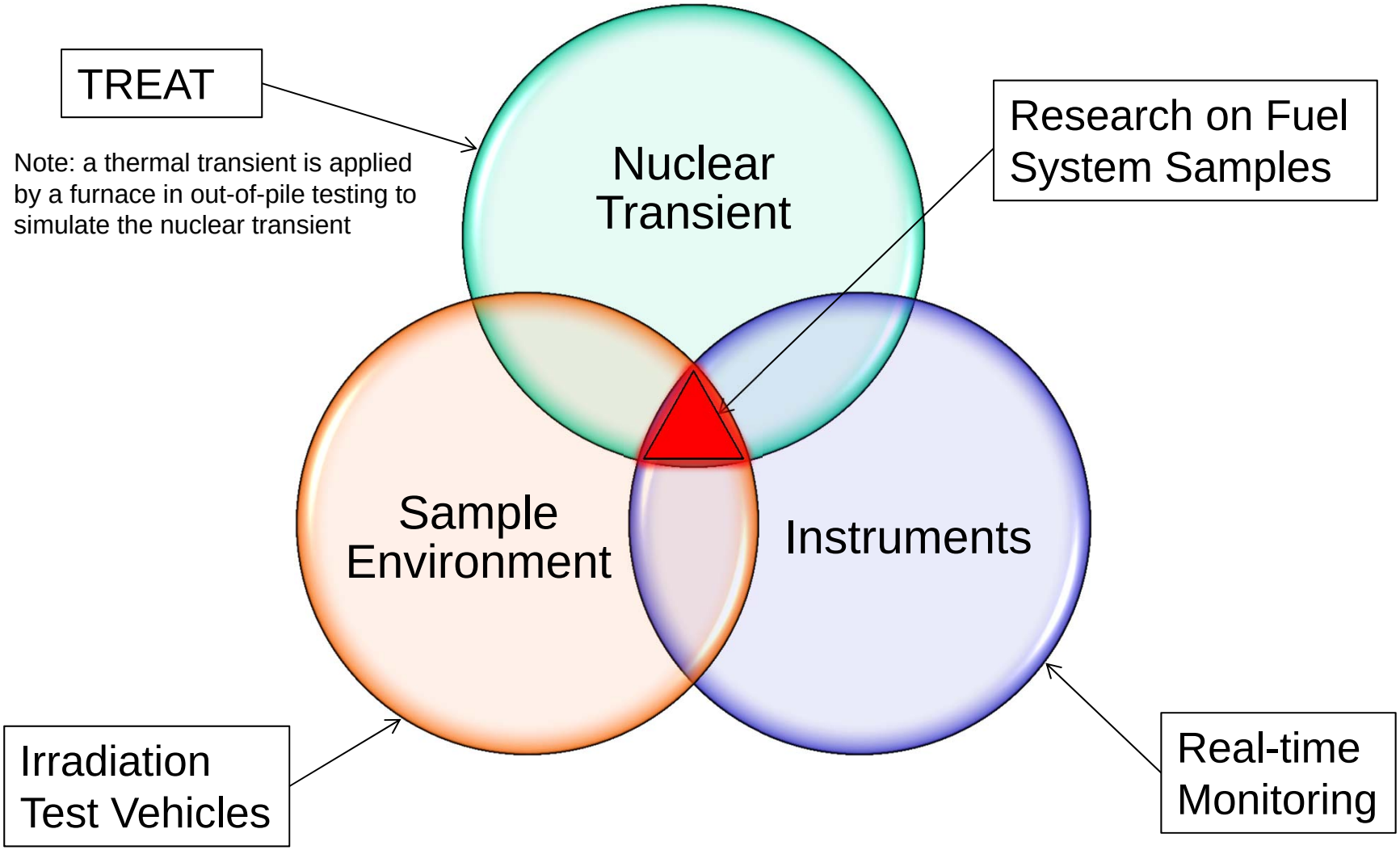
History of Transient Testing at the INL

- Since its inception as the US *Nuclear Reactor Testing Station* (NRTS) in the 1950's, researchers at the INL have been conducting experimental programs to establish the limits of nuclear system performance
- These studies were critical to establishing the *fuel safety criteria* required to develop, design, and deploy nuclear technologies that form the basis of today's nuclear energy industry
- A similar effort is required to realize the advanced nuclear technologies of tomorrow's nuclear energy industry

History of Transient Testing in Idaho

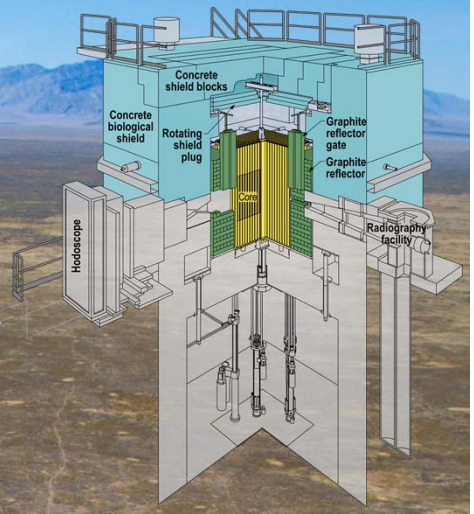


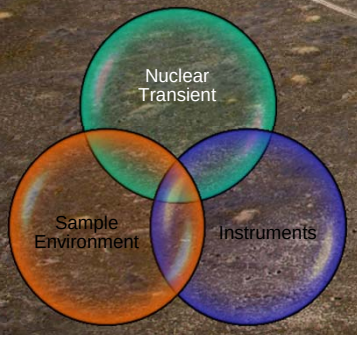
Scientific Instruments for Fuel Safety Research

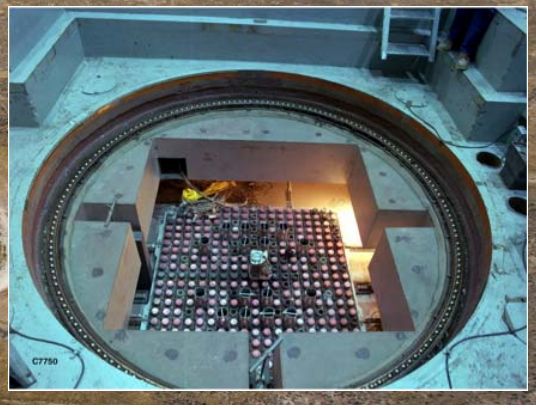


Nuclear Transient

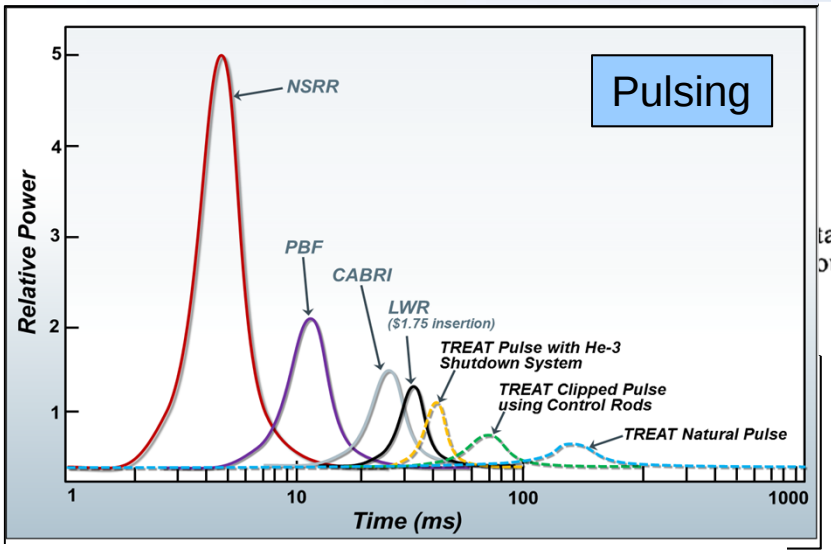
- TREAT's unique design delivers the nuclear environment required to meet fuel safety research needs
  - 19 GW Peak Transient Power (with 100 kW Steady-state power option)
  - Core: ~1.2 m high x 2 m. dia19 x 19 array of 10 x 10-cm. fuel and reflector assemblies
  - Instantaneous, large negative temperature coefficient (self protecting driver core)
- Resumption of Operations
  - *'Mission Need Statement for Resumption of Transient Testing'* issued by DOE in January 2010
  - TREAT Selected as '*preferred option'* in February 2014 and restart activities were initiated at the beginning of FY15
  - Commitment to restart by the end of 2018 (to support the Accident Tolerant Fuels Program)
  - First operations anticipated in November this year

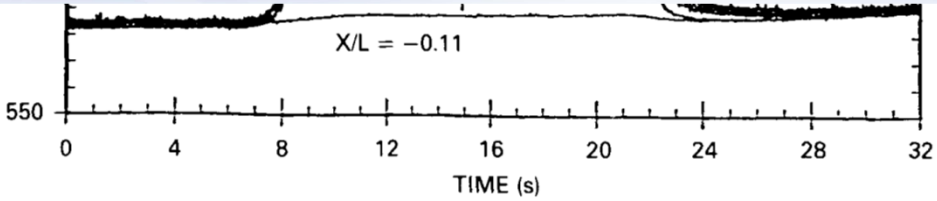






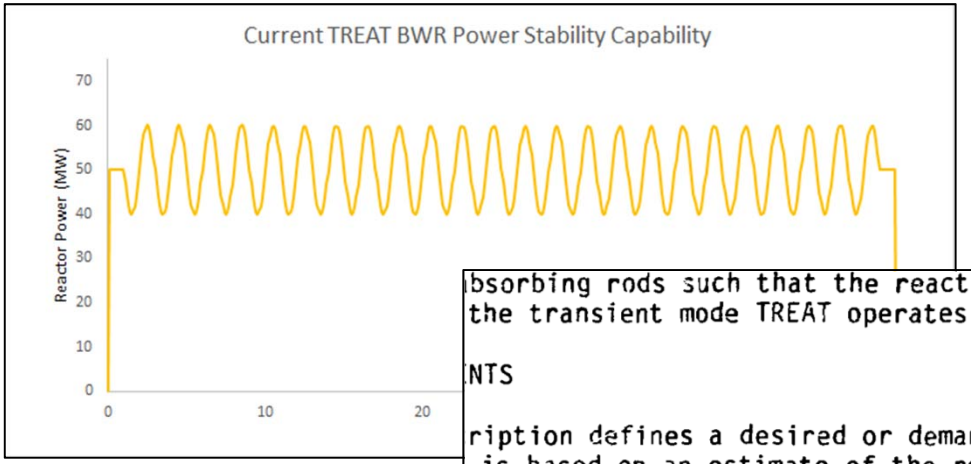
TREAT Transients



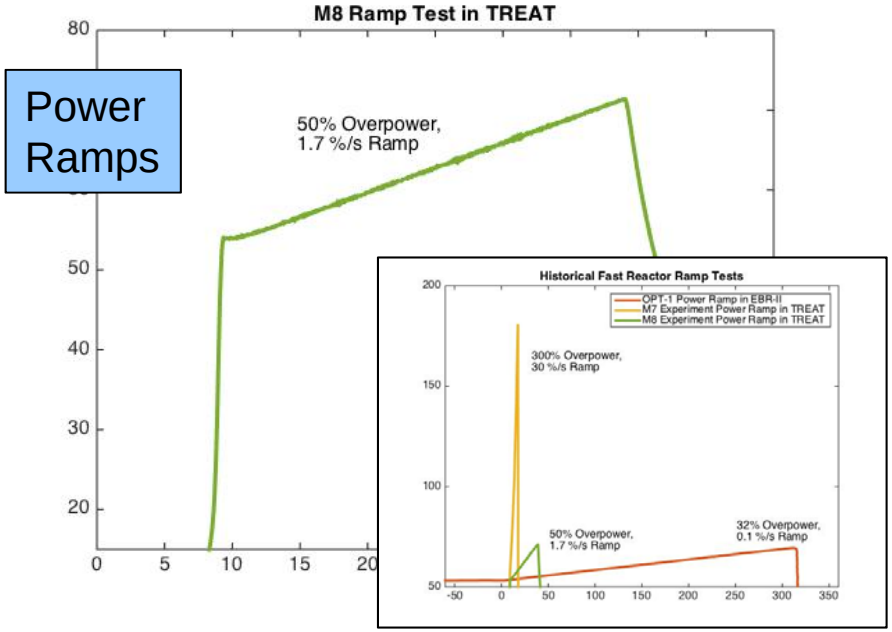


tained during performance of a typical M-series heat balance (M7) used to determine test pin
oupling.

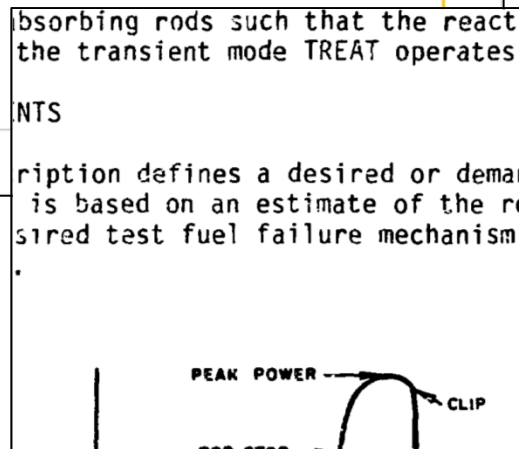
Continuous Power (e.g. 'Flattop')



Power Ramps

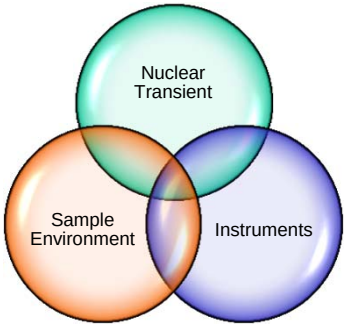


Complex Transients

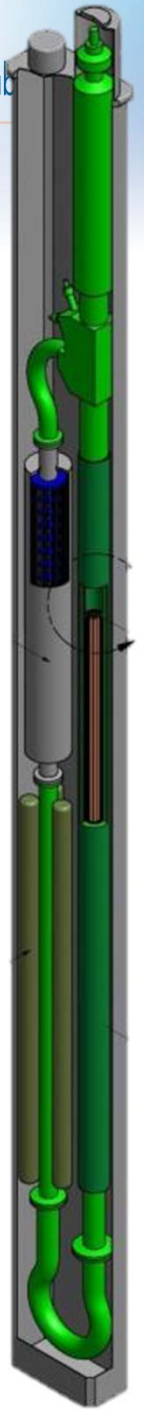


Sample Environment

- The irradiation test vehicle used in TREAT are cartridge type devices operated independently of the reactor.
- These devices deliver the experiment specific thermal-hydraulic environment. Systems can be developed to deliver a wide range of conditions
  - Prototypic pressure/temperature/flow for LWR, SFR, LFR, GR or MSR applications
  - Specialized or simplified environments for separate effects studies



MARCH Vehicle for Separate Effects Studies



Sodium Loop for Prototypic Fuel Performance Tests

Instrumentation

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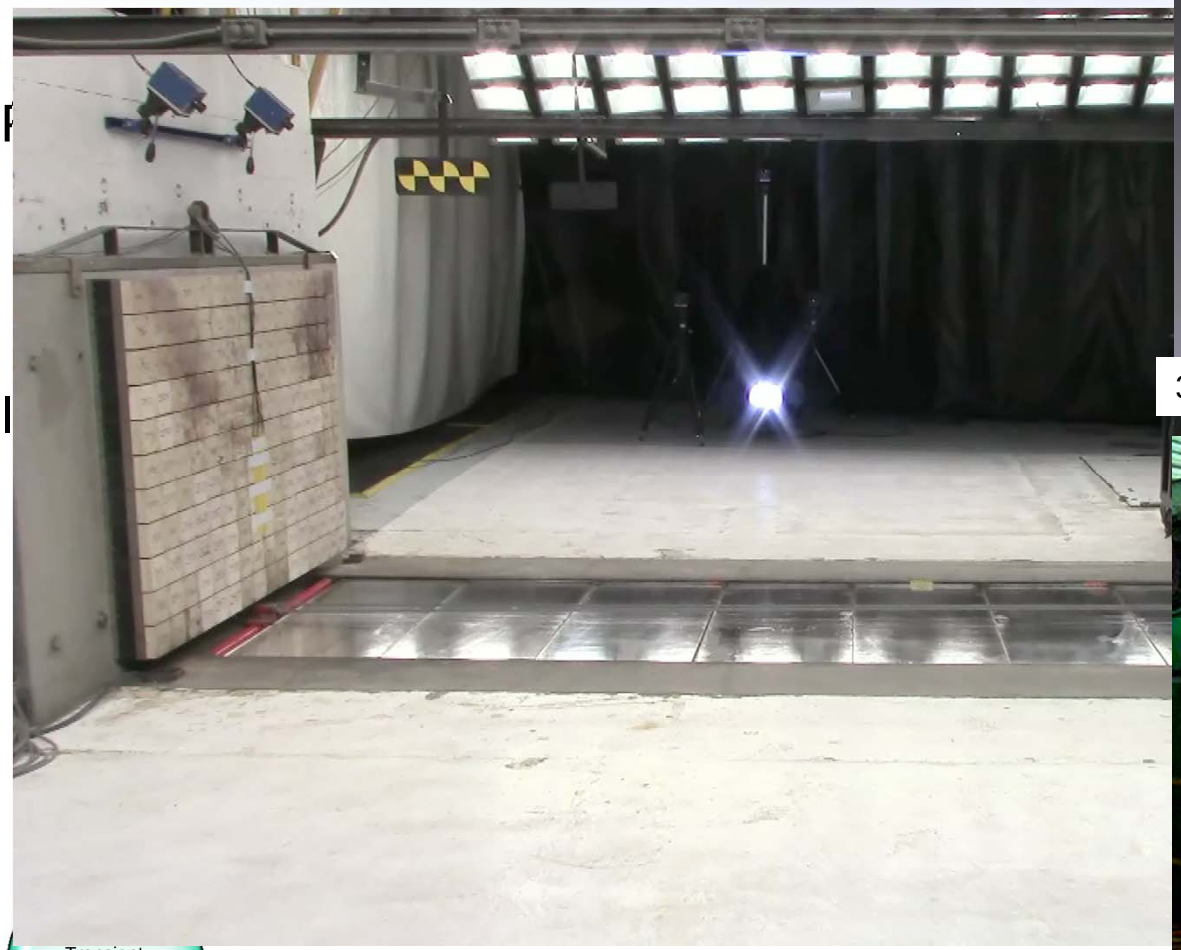
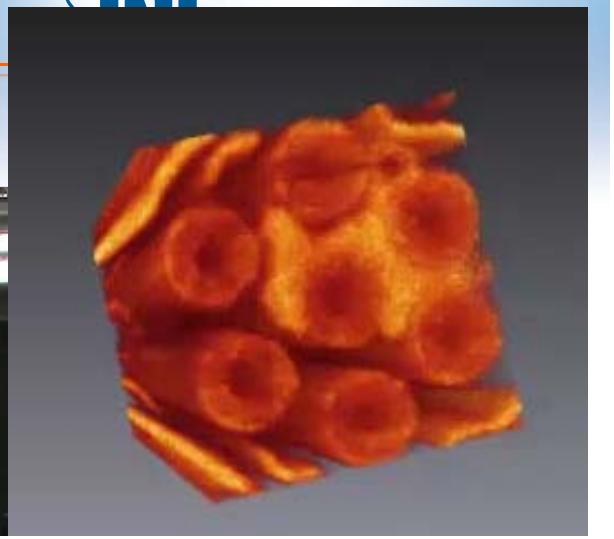
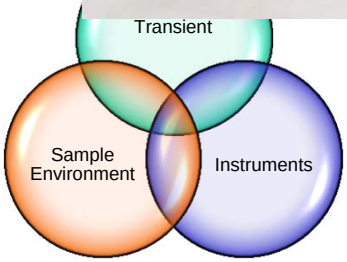
- I





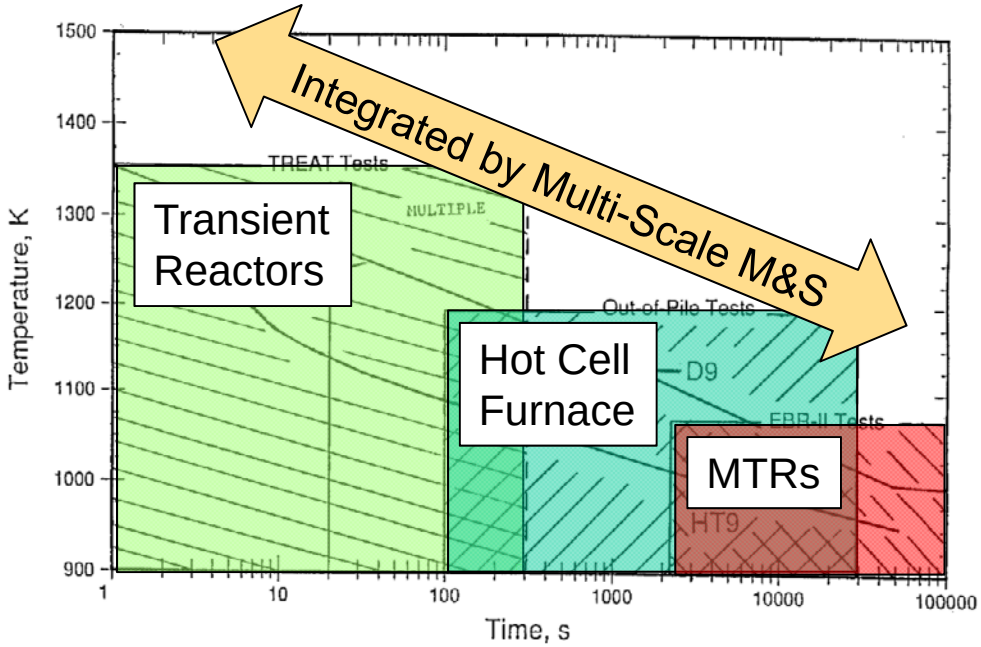
3D Reconstruction of 7-pin TREAT Test

TREAT Fast Neutron Hodoscope



More than just TREAT …

- Additional capabilities are available at the DOE hot cell facilities and Material Test Reactors. See the latest during the poster session.



Summary

- Fuel Safety Research plays a crucial role in maintaining and developing nuclear energy technology
- The TREAT facility is being reactivated by the US DOE to serve as a cornerstone scientific instrument in this field. Optimal development of this instrument will require engagement with the nuclear technology community to prioritize development in several key areas including
  - Transient capability
  - Sample environment
  - Instrumentation
- This instrument will be integrated with existing out-of-pile fuel safety research infrastructure to provide the nuclear industry with a comprehensive domestic capability