



U.S. DEPARTMENT OF  
**ENERGY**

**Nuclear Energy**

# Knowledge Management at the Fast Flux Test Facility

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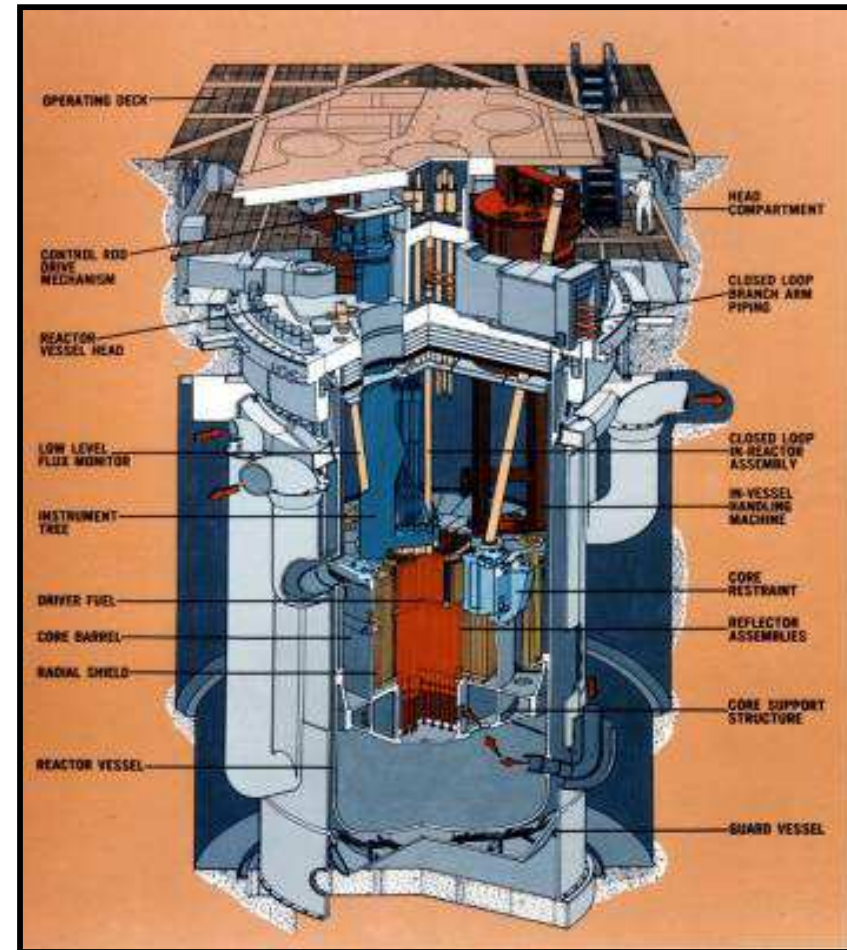
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# DOE LMR Data Preservation Program

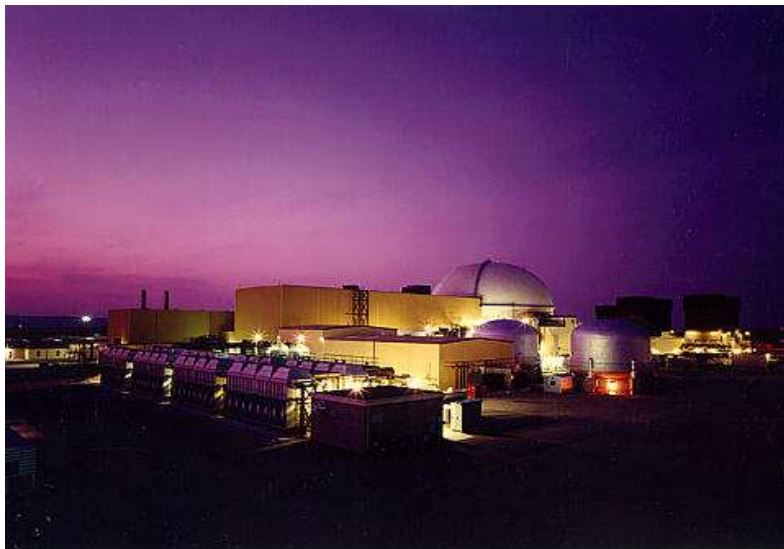
- PNNL program is part of DOE program to protect and preserve LMR design and testing information
- Major objective is data preservation in a form that is useful
- FFTF Is Most Recent SFR to Be Designed, Constructed, and Operated by DOE





# FFTF Information

- ~ 80,000 Drawings
- ~ 500,000 Records
- Records Range from Top-Level System Design Descriptions to Procurement Specifications





# Uniquely Instrumented

- FFTF was designed as the most instrumented test LMR in the world
  - *Primary and secondary loop hot and cold leg temperatures and flow rates, neutron detectors, pump speed indications*
  - *Thermocouples for assembly outlet temperatures for each core location (response time of minutes)*
  - *Fast response thermocouples for assembly outlet temperatures for 2 core locations (response time of seconds)*
  - *2 fuel tests with high response wire wrap thermocouples on fuel pins during natural circulation tests at startup*
  - *Reactor vessel temperatures*
  - *Plant Data System (PDS) recorded 2000 variables at 1-60 second intervals*
  - *Experimenters Data System (EDS) recorded at up to 0.1 second intervals*

# Categories of FFTF Data (1/2)

- Acceptance Test Program
  - *Documented the design and startup of the reactor*
- Reactor Characterization Program
  - *Detailed in-core and ex-core neutron and gamma ray environments*
- Passive Safety Program
  - *Steady state and dynamic measurements of reactivity feedback with changes in power, coolant flow rate, and temperature*
  - *Detailed test data recorded on plant data tapes*

# Categories of FFTF Data (2/2)

## ■ Operational Data

- *Performance of liquid sodium as coolant*
- *Reliability and efficiency of pumps, valves and other vital components*

## ■ Irradiation Tests

- *Advanced fuels (MOX, metal, carbide, nitride)*
- *Blankets*
- *Control and shim absorbers*
- *Structural materials*
- *Reflectors*
- *Spectral tailoring assemblies*





# Examples of Information Preserved

- Plant and Component Drawings
- Technical Specifications
- Control Room Operating Procedures
- Reactor Development and Technology (RDT) Standards
- Equipment and Component Procurement Specifications
- Chief Operator Control Room Log Books
- System Design Descriptions
- Acceptance Test Plan Reports
  - *Pre-operational tests*
  - *System startup tests*
  - *Hot functional tests*
  - *Nuclear startup tests*
  - *Power ascension tests*



# FFTF Reactor Characterization Program Elements

- Zero power testing (at  $\sim 10^{\circ}\text{C}$ ) of passive and active neutron and gamma detectors in special central assembly with access through reactor head
- Full power neutronic characterization with  $\sim 2000$  dosimeters in fuel, shim, radial reflector, and in-vessel storage locations
- Thermal hydraulic and in-reactor vibration characterization
- Gamma ray measurements and shield characterization



# Passive Safety Testing Program Retrieval (1/2)

- **FFTF Passive Safety Program Data Successfully Extracted from 137 Plant Data Tape Records**
  - Steady State Reactivity Feedback Tests
    - *Separation of component reactivity feedbacks*
  - Delayed Pony Motor Trip Test
    - *Verify transition to natural circulation performance*
    - *Verify performance of fast response thermocouples in two assemblies*
  - Steady State Natural Circulation tests
    - *Demonstrate natural circulation performance*



# Passive Safety Testing Program Retrieval (2/2)

- **FFTF Passive Safety Program Data Successfully Extracted from 137 Plant Data Tape Records**
  - Controlled Flow Transient Test
    - *Decrease in flow rate with no CR movement to confirm dynamic reactivity feedback models under loss of flow conditions*
  - LOFWOS Tests with GEMs
    - *to Pony Motor Flow from up to 50% Power and 100% Flow*
    - *to Natural Circulation Flow from up to 50% Power and 100% Flow*
  - Inadvertent Pump Start with GEMs





# Preservation of Irradiation Testing Data

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- **FFTF Library has been secured**
- **Irradiation Testing Examples include**
  - HT-9 cladding with both MOX and metal fuel
  - Metal fuel tests themselves

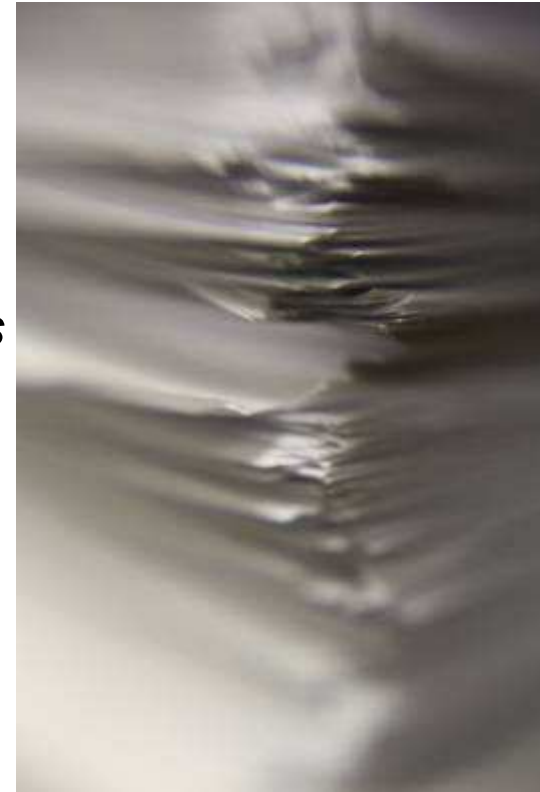


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# The Problem One Faces When Capturing Knowledge

- Documents currently stored in Multiple Libraries or Repositories
- Just One FFTF Library Contains
  - *1,629 boxes*
  - *2,100 vertical feet (640 meters) of documents*
  - *~ 6.3 million pages!*
  - *Also thousands of documents on microfiche*
- Many of these documents
  - *Have no electronic counterpart*
  - *Are difficult to fully digitize*





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# Just One FFTF Library Contains

## ■ Contents of the library includes information for

- *Driver Fuel Evaluation Program*
- *Core Demonstration Experiment*
- *Fuel, cladding, duct tests*
- *High Burnup metal and mixed oxide fuel tests*
- *Core management and test analysis physics codes, data, and reports*

## ■ Information includes

- *Procurement and fabrication records*
- *Disassembly records*
- *Dimensional profilometry*
- *Gamma spectrometry*
- *Neutron radiography*
- *Fission gas analysis*
- *Metallography*
- *Photomicrographs*
- *Test reports*

# The Importance of Tacit Knowledge...

- The tacit knowledge surrounding these documents goes far beyond what's printed on the pages
  - Understanding of how these documents relate to one another
    - *Historically*
    - *Programmatically*
    - *Technically/scientifically*
  - Understanding of the context is important
    - *In navigating this document collection*
    - *In understanding it*
- This tacit knowledge is *not* reproducible from electronic scans
  - *Knowledge capture must involve the actual experts involved at the time*





# Lessons Learned

- FFTF documentation was rigorous and immense
- Document storage process was not designed for easy retrieval
- A systematic and consistent method for storing records, such as sequential or special box numbers, would have greatly increased the efficiency of later retrieval
- Information critical to interpreting raw data should be stored along with the data

# Conclusions

- Accessibility of information from FFTF has been substantially increased
- FFTF Startup Test information available
  - FFTF had a disciplined, organized approach
- Extensive Startup Characterization program data available
- Extensive Passive safety testing data available

*Thank You for Your  
Time and Attention*

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