

# Online Prognostic Health Management for Plant Monitoring and Control

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Online monitoring technologies provide rapid, robust diagnostic and prognostic information on reactor operations. Research at PNNL has resulted in high-sensitivity techniques for online monitoring in advanced reactor environments, enabling early detection and diagnostics.

## Sensors and Measurements

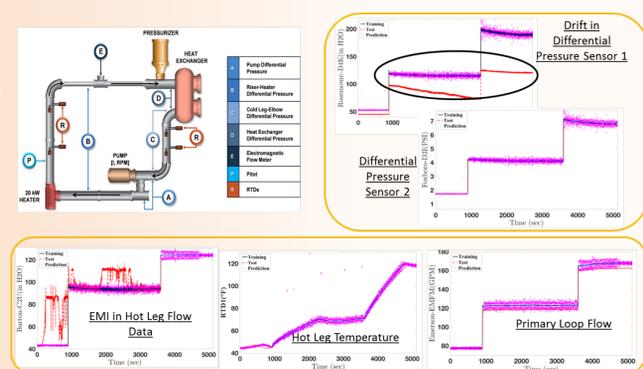
### Ultrasonic Monitoring Of Pressure, Flow, And Temperature



Simulation models were used to understand measurement physics for reliably monitoring radioactive material flow and pressure at elevated temperatures.

### Model-based Algorithms for Online Monitoring of Sensor Calibration

Algorithms are robust to uncertainty and noise in measurements and compute confidence bounds for model-prediction estimates.

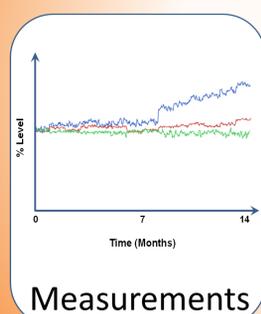


## Data Analysis

### Approach

- Leverage measurement physics to use acoustic, optical, electromagnetic, and radiographic approaches
- Research at PNNL on technologies for process, chemistry, and component condition monitoring.

Models (Data Driven, First Principles)



System Diagnostics

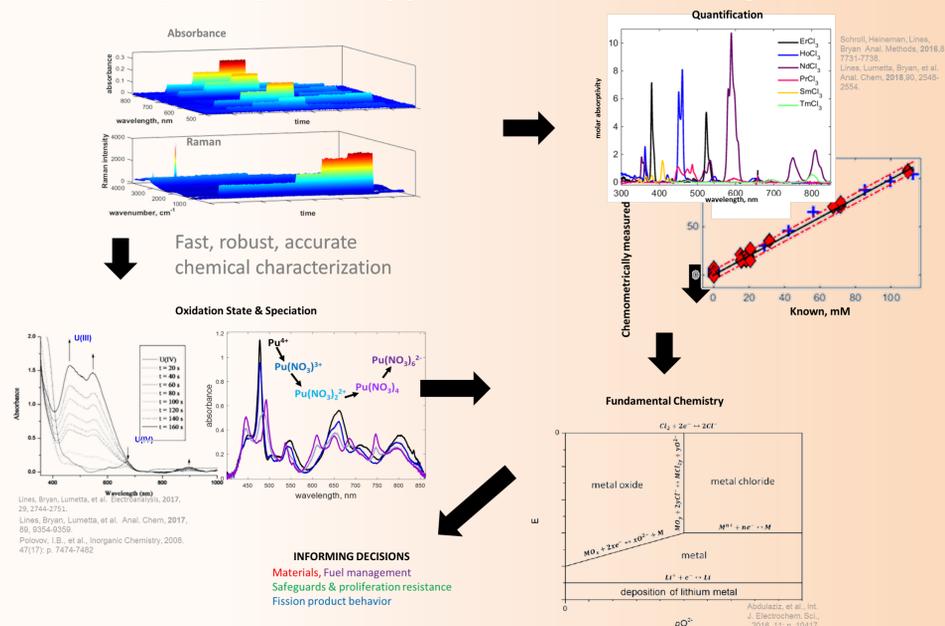
Predictive Condition Estimates

Uncertainty Bounds

### Approach

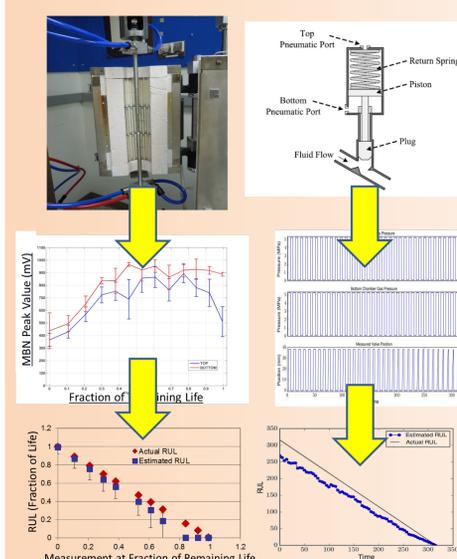
- Model-based analysis critical to interpreting OLM data to distinguish sensor failure from system failure
- Research at PNNL focuses on analysis for diagnostics and prognostics.

### Optical Spectroscopy Based Online Monitoring



Optical measurements and model-based analyses have enabled high-sensitivity in situ monitoring of oxidation state, speciation, and chemical composition.

### Bayesian System Health Diagnostics and Prognostics



## ABOUT Pacific Northwest National Laboratory

The Pacific Northwest National Laboratory, located in southeastern Washington State, is a U.S. Department of Energy Office of Science laboratory that solves complex problems in energy, national security, and the environment, and advances scientific frontiers in the chemical, biological, materials, environmental, and computational sciences. The Laboratory employs nearly 5,000 staff members, has an annual budget in excess of \$1 billion, and has been managed by Ohio-based Battelle since 1965.

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