# **Nuclear Energy**

# Nuclear Energy Enabling Technologies (NEET) Advanced Sensors and Instrumentation (ASI)

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Office of Nuclear Energy U.S. Department of Energy

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# **Nuclear Energy Enabling Technologies: Advanced Sensors and Instrumentation**

#### **■** Vision

Develop advanced sensors and instrumentation technologies that address critical technology gaps for monitoring and controlling advanced reactors and fuel cycle facilities

#### ■ Goal

#### To provide crosscutting research that:

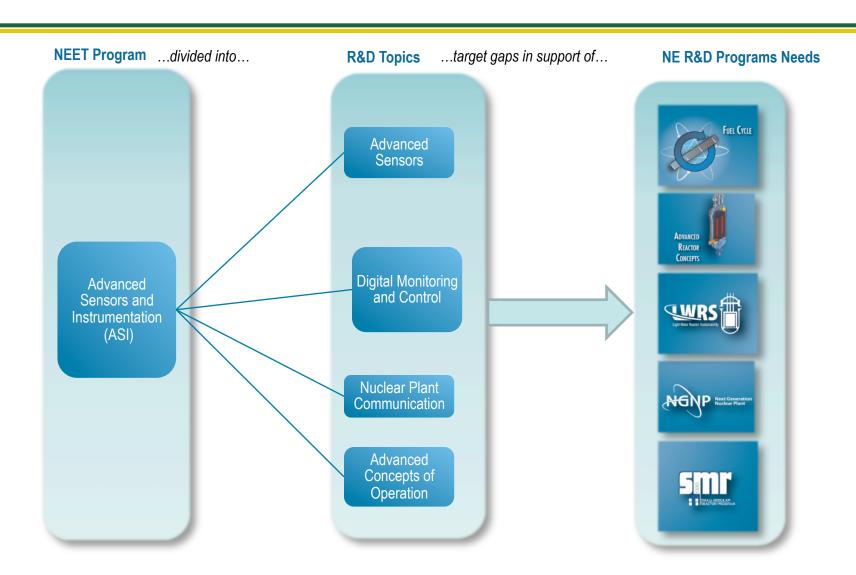
- ➤ Contributes to the success of the DOE-NE R&D programs
- Supports common I&C technology development needs
- Overcomes current and future I&C barriers to nuclear energy system deployments

A new model of I&C innovative RD&D to overcome nuclear power's impediments to new I&C technology usage



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# **ASI Program Areas**





#### **NEET- 2 ASI FOA TOPICS**

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#### **NEET-2.1 Power Harvesting Technologies for Sensor Networks**

Development and demonstration of a "truly wireless" power harvesting technologies to power sensor networks in a nuclear environment.

- develop sensor requirements and sensor simulator
- design power efficient solid-state devices
- demonstrate survivability in intended environment

Ref.: Power Harvesting Practices and Technology Gaps for Sensor Networks (ORNL/TM-2012/442)

#### **NEET-2.2 Recalibration Methodology for Transmitters and Instrumentation**

Development and demonstration of online calibration methodology to extend instrumentation calibration intervals.

- provide virtual sensor estimates and high-confidence signal validation and integrate with uncertainty quantification methodology
- evaluate the effects of emerging sensors and digital instrumentation
- demonstrate methodology in an appropriate test-bed or facility Ref.: A Review of Sensor Calibration Monitoring for Calibration Interval Extension in Nuclear Power Plants (PNNL-21687)



## **NEET-2 ASI FOA TOPICS (Cont.)**

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#### **NEET-2.3 Design for Fault Tolerance and Resilience**

Development and demonstration of control system technologies that are resilient to anticipated faults and transients and can achieve high plant and system availability and improvements in safety.

- fault-diagnosis algorithms.
- computer-enabled implementation of control algorithms
- fully-integrated operator-support system
- full-scale simulator shakedown tests

Ref.: Design to Achieve Fault Tolerance and Resilience (INL/EXT-12-27205), Description of Fault Detection and Identification Algorithms for Sensor and Equipment Failures and Preliminary Tests Using Simulations (ANL/NE-12-57)

#### **NEET-2.4 Embedded Instrumentation and Controls for Extreme Environments**

Development and demonstration of embedded instrumentation and control technologies in major nuclear system components.

- bench-scale and a loop-scale component with embedded controls.
- methods and metrics for assessing performance in a test bed or representative facility environment.

Ref.: Embedded Sensors and Controls to Improve Component Performance and Reliability Conceptual Design Report (ORNL/TM-2012/433)



## **NEET-2 ASI FOA TOPICS (Cont.)**

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#### **NEET-2.5 High Temperature Fission Chamber**

Fabrication and characterization of high temperature fission chamber that provides high-sensitivity, high-temperature neutron flux monitoring technology.

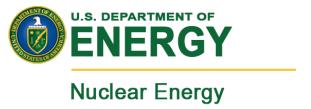
- capable of operating from start-up to full power at 800°C.
- demonstrates sensitivity, mechanical/thermal robustness, and enables path to safe high-temperature reactors.

Ref.: Materials Selection for a High-Temperature Fission Chamber (ORNL/LTR-2012/331)

#### **NEET-2.6 Advanced Measurement Sensor Technology**

Development and fabrication of advanced sensors for improved performance measurement technology that provides revolutionary gains in reactor and fuel cycle systems.

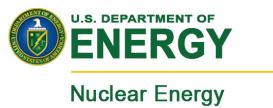
- greater accuracy and resolution
- detailed time-space, and/or energy spectrum dependent measurements
- reduced size
- long-term performance under harsh environments



# Summary of ASI FOA Expectations

- Improvements and advancements in ASI technologies will
  - > enable advances in nuclear reactor and fuel cycle system development
  - right enhance economic competitiveness for nuclear power plants, and
  - promote a high level of nuclear safety.
- Organizations performing this research will be expected to produce concepts, techniques, capabilities, and equipment that are or can be demonstrated in simulated or laboratory test bed environments representative of nuclear plant applications.
- Successful applications will describe **truly innovative and crosscutting** sensors and instrumentation that offer the potential for **revolutionary gains** in reactor and fuel cycle performance and that can be applied to **multiple reactor designs and fuel cycle concepts**.

I&C technologies are a vital key to enabling the expansion of clean, safe and economical nuclear power.



### **Contact Information**

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