

Advanced Sensors and Instrumentation

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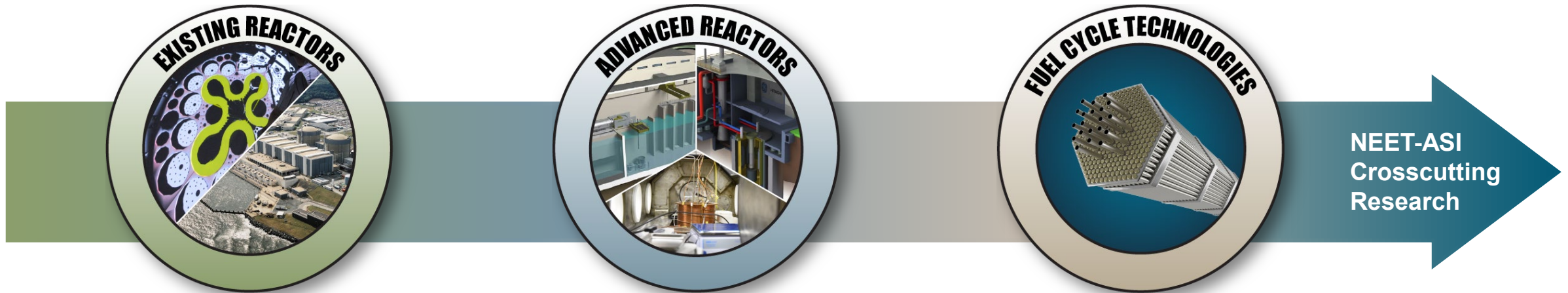
Mission, Vision, Goals and Strategic R&D

Mission

Develop advanced sensors and I&C that address **critical technology gaps** for monitoring and controlling existing and advanced **reactors** and supporting **fuel cycle** development

Vision

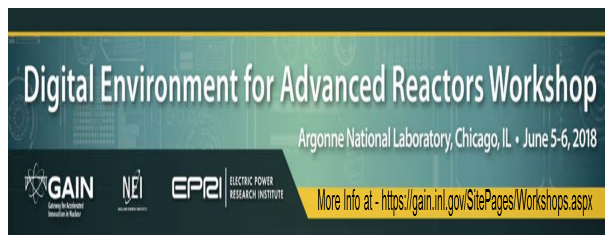
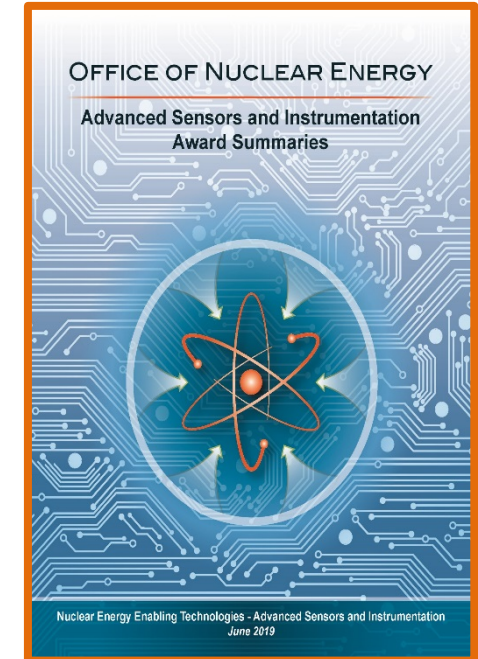
NEET ASI research results in advanced sensors and I&C technologies that are qualified, validated, and ready to be adopted by the nuclear industry



Mission, Vision, Goals and Strategic R&D (Cont.)

Goals

- Support **DOE-NE R&D** programmatic needs
 - Fuel and material studies, integral tests
- Provide **new capabilities** for measurement, control, and operation
 - Sensors for harsh environments, advanced control capabilities, semi-autonomous and fault-tolerant operation, and predictive analytics
- Address R&D needs for **successful deployment**
 - Digital technology and instrumentation qualification



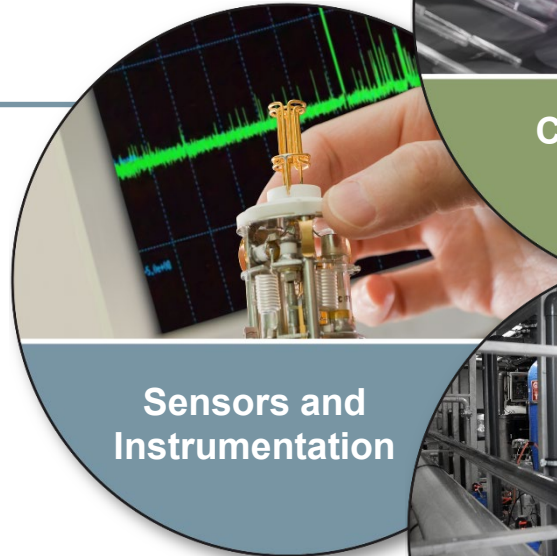
Advanced Sensors and Instrumentation (ASI) Webinar
Oct. 31, 2018 - Nov. 1, 2018



Mission, Vision, Goals and Strategic R&D (Cont.)

Strategic R&D Areas

Reliable, cost-effective, real-time, accurate, and high resolution measurement of the performance of existing and advanced reactors core and plant systems



Sensors and Instrumentation



Communication

Resilient and enable real-time transmission of sufficient data for online monitoring and advanced data analytics



Big Data, Machine Learning, Artificial Intelligence

Machine learning and artificial intelligence processes to enable semi-autonomous operations and maintenance by design



Advanced Control Systems

Enable near real-time control of plant or experimentation process variables to enhance plant thermal performance

NEET-2.1: ADVANCED CONTROL SYSTEMS

Challenge: Design, develop, and demonstrate advanced control for semi-autonomous and remote operation of advanced reactor designs

Objectives:

- Streamline and simplify the advanced control system design process to automate and enhance plant operation. Design should result in reduced long term Operations and Maintenance costs and include a cost benefit analysis.
- Reduce I&C testing, validation and verification efforts associated with licensing requirements through developing verifiable architectures (hardware and software) using novel test methodologies that would enable use of smart digital devices in both safety related and non-safety related applications for nuclear power plants.

NEET-2.2: BIG DATA, MACHINE LEARNING, AND ARTIFICIAL INTELLIGENCE

Challenge: Develop and demonstrate advanced analytics for nuclear plant operation and maintenance systems that support semi-autonomous and remote monitoring of advanced reactor designs. Cost-benefit analysis should be conducted as part of the project to demonstrate technology or product viability.

Objectives:

- Demonstrate an optimal balance between cost and plant performance to achieve reliability, availability, maintainability, and security.
- Develop and demonstrate a transformational approach to monitor and analyze semi-autonomous operation of advanced reactors through real time integration of predictive analytics and risk informed condition monitoring.

NEET-2.3: ADVANCED SENSORS AND COMMUNICATION

Challenge: To enable deployment of sensors, instrumentation, and supporting electronics for advanced reactor concepts, with a particular interest in technologies that would enable semi-autonomous and remote operation.

Objectives:

- Assess and demonstrate the impact of the selected technology towards remote and semi-autonomous operation of advanced reactor concepts.
- Develop radiation hardened electronic systems to support wired and wireless communication of data from sensors and instrumentation located in-vessel and near-vessel in high temperature and high radiation environments found in advanced reactors.
- Develop sensor performance models for the initial calibration, routine operation, radiation degradation, in-situ re-calibration, and predictive failure mechanisms to understand sensor performance for the lifetime of operation in advanced reactors.

NSUF 1.1 TOPIC: Testing of Advanced Materials for Sensors or Advanced Sensors for Nuclear Applications

Challenge: Conduct irradiation testing and post-irradiation examinations of 1) advanced materials for sensors, or 2) advanced sensors for nuclear applications

Successful Applications will include:

- A description of the materials/sensors
- Irradiation and post irradiation examination needs
- The role of the materials in new sensors, controls, communications or associated applications
- The purpose and application of the developed sensor in nuclear energy systems

Note: This funding does not support research and development activities to develop materials or sensors, but rather the cost associated with the irradiation of sensors and materials

Summary of ASI Proposals Expectations

- Research shall improve and advance ASI technologies to
 - enable advances in nuclear reactor and fuel cycle system development
 - enhance economic competitiveness for nuclear power plants
- 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

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