

Advanced Sensors and Instrumentation

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Office of Nuclear Energy, U.S. Department of Energy,
August 9, 2018

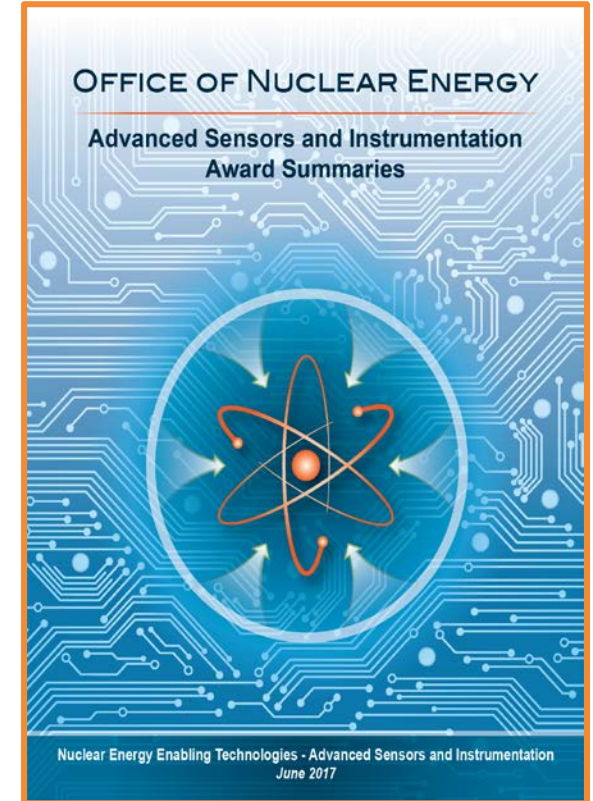
Nuclear Energy Enabling Technologies: Advanced Sensors and Instrumentation

Vision

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

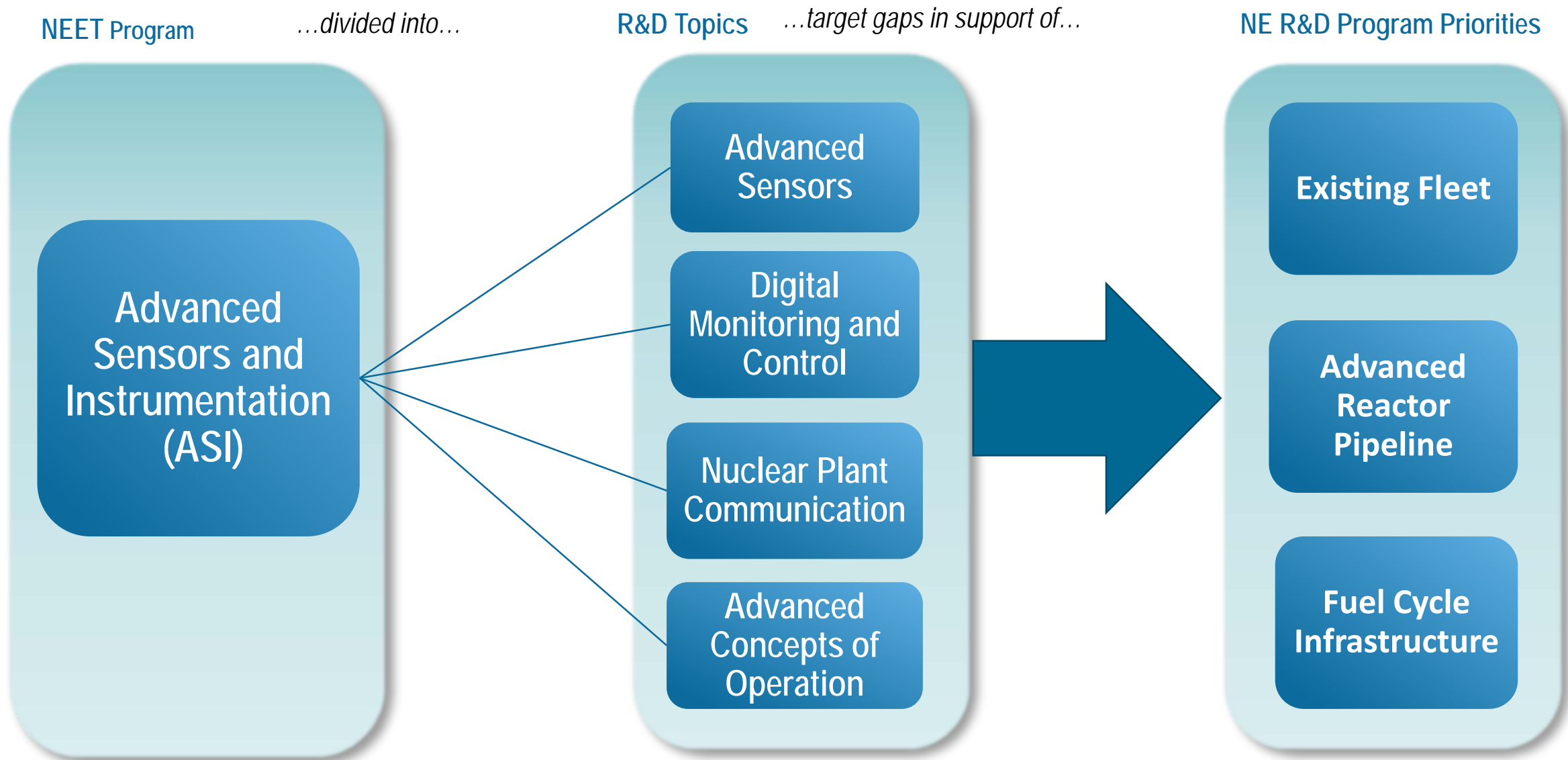
Goals

- Support DOE-NE R&D programmatic needs
 - Fuel & material studies, integral tests
- Provide new capabilities for measurement and control
 - Sensors for harsh environments, advanced control capabilities, fault tolerant operations
- Address R&D needs for successful deployment
 - Digital technology qualification, advanced operational concepts



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Advanced Sensors and Instrumentation Program Areas





NEET-2.1: STATE OF THE ART I&C TECHNOLOGIES

Challenge: Design and develop state of the art I&C technologies for advanced control rooms and plant control and protection systems

Objectives:

- **Reduce I&C testing, validation and verification efforts associated with licensing requirements for common cause failure, design basis accidents, and cybersecurity, through methods that would support advance reactor safety features, such as passive safety.**
- **Rad-Harden electronics for digital based components. (e.g. PLC and FPGAs)**
- **Automate and enhance plant operation, such as remote operations or single control room workstation.**

NEET-2.2: ADVANCED ONLINE MONITORING AND DIAGNOSTICS TECHNOLOGIES

Challenge: Develop and demonstrate advanced online monitoring for nuclear plant operation and maintenance to be integrated into advanced nuclear reactor designs

Objectives:

- **Demonstrate an optimal balance between cost and plant performance through a cost-benefit analysis for achieving reliability, availability, maintainability, and security.**
- **Integrate predictive analytics and risk informed condition monitoring, with business process applications, which would enable a transformational approach to supply chain and asset management.**

Challenge: Develop and demonstrate new sensors and instrumentation for advanced plant control, data analytics, and nuclear applications for advanced reactors

Objectives:

- **Develop advanced instrumentation and communication of data located in high temperature, high radiation reactor cores found in advanced reactors.**
- **Develop smart multimodal measurement devices to measure unique and complementary parameters simultaneously.**
- **Develop new or unique application of materials for sensor development that support monitoring, controls, and communications within harsh nuclear reactor environments.**

- **Develop new radiation resistant sensors, not currently under development, for measurement of:**
 - Local radiation and temperature (e.g. solid-state detectors, diamond thermistors)
 - Dimensional changes (specifically diameter and volume) and crack propagation,
 - Material properties, such as thermal conductivity, mechanical properties, thermal expansion, etc.)
 - Fission gas release (pressure and composition).
 - Other in-core parameters important to reactor safety and/or fuel performance.



NEET-3 Digital/Electronic Nuclear Field Support Technology

Challenge: Conceptual design applications for innovative technology for digital/electronic field support systems for nuclear facilities

Objectives:

- **New integrated and seamless technologies able to enhance current state of the art at nuclear facilities for real time measurements such as:**
 - Visual inspections and accountability
 - Area radiation monitoring via remote monitoring or as part of personnel dosimetry
 - Access and location monitoring – personnel access and security tracking
 - Field worker “Head Up Display” to provide design/engineering information
- **Provide a plan for technology development and demonstration**

NSUF 1.1 TOPIC: Testing of Advanced Materials 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
 - 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

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