



U.S. DEPARTMENT OF  
**ENERGY**

**Nuclear Energy**

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

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Office of Nuclear Energy  
U.S. Department of Energy

**FY2017 Consolidated Solicitation Webinar**

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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

## ■ Goals

➤ Support DOE-NE R&D programmatic needs and the Gateway for Accelerated Innovation in Nuclear (GAIN) Initiative

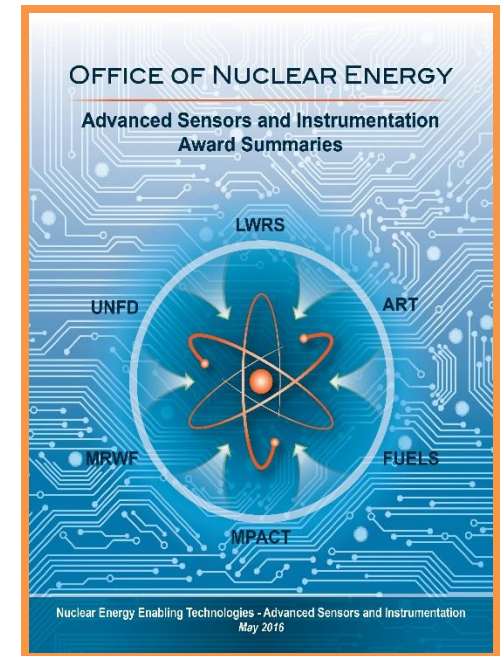
- Fuel & material studies, integral tests

➤ 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



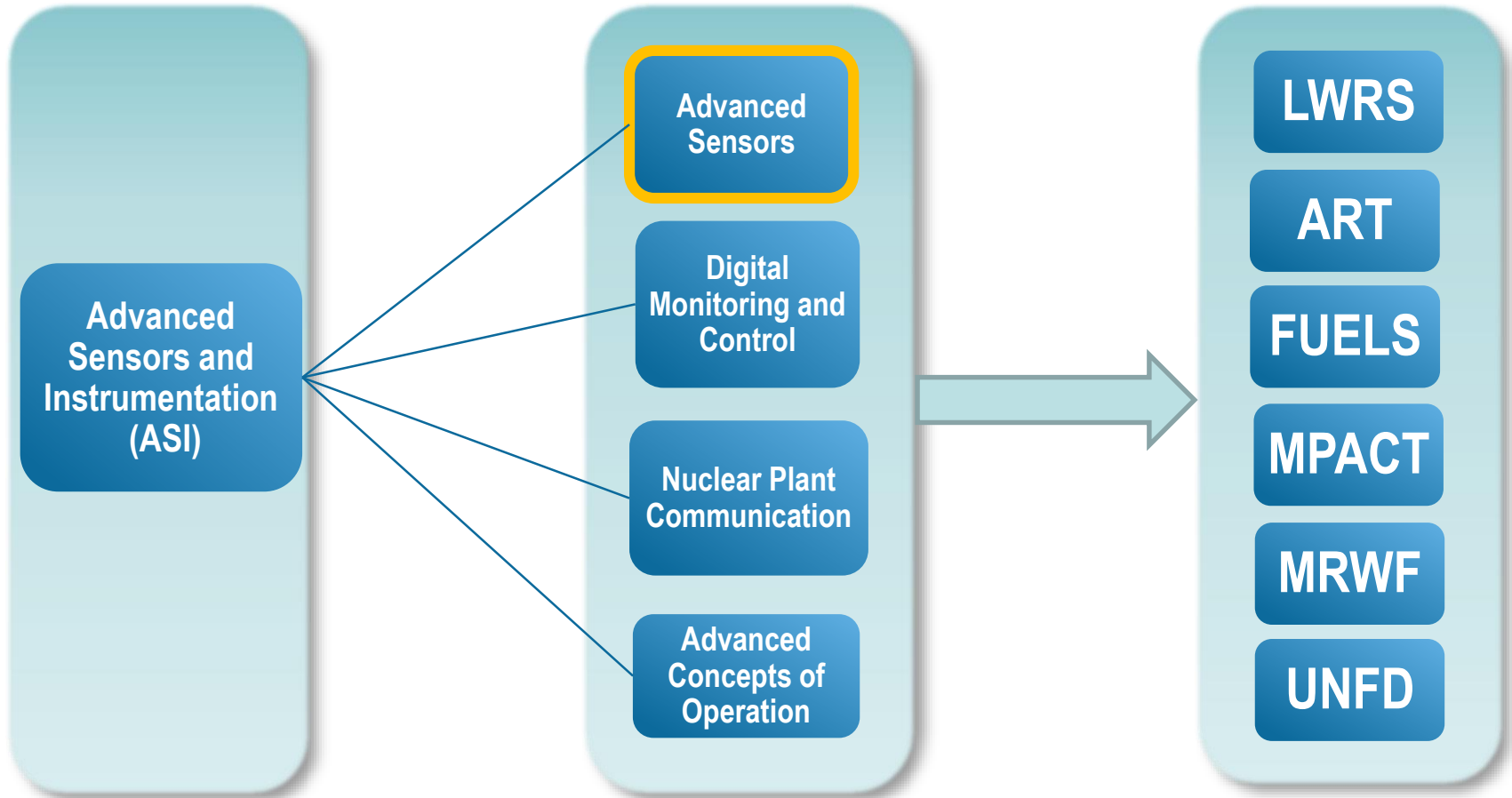


# ASI Program Areas

NEET Program

...divided into...

R&D Topics ...target gaps in support of... NE R&D Programs Needs



[LWRS-Light Water Reactor Sustainability; ART-Advanced Reactor Technologies; Fuels -Advanced Fuels; MPACT-Materials Protection, Accounting and Control Technology; MRWF- Material Recovery and Waste Form Development; UNFD-Used Nuclear Fuel Disposition]

## NEET- 2 / NSUF 1.2a and 1.2b: Advanced Sensor and Instrumentation Technology for Nuclear Environment

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**Goal:** Develop innovative advanced sensors and instrumentation for use in the nuclear industry and research facilities

### **Research objectives:**

- demonstrate greater accuracy, higher resolution, and be appropriately sized and fitted for the intended nuclear environment
- provide improved measurement capabilities for characterizing a targeted parameter or behavior of interest, for quantifying measurement uncertainty, and for addressing any potential operational issues in the targeted environment
- explain whether and how the proposed technology is or may be applicable to multiple reactors or fuel cycle applications, i.e. crosscutting, and how it could support the Gateway for Accelerated Innovation in Nuclear (GAIN) Initiative

## **NEET- 2.1 TOPIC:** **Embedded / Integrated sensors in components and functional materials**

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**Challenge: Develop and demonstrate embedded or integrated sensors into components or functional material as part of the integral design of functional component or device for a nuclear environment**

### **Objectives:**

- **demonstrate improved system performance and reliability by streamlining control approaches in monitoring and controlling a component or system**
- **perform testing and demonstration of new system performance in nuclear environment**
- **provide description of system metrics that are targeted through sensor and control integration / embedding**

## NEET- 2.2 TOPIC:

### 3-D sensor networks for passive structural system monitoring of critical materials in nuclear energy systems

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**Challenge:** Development and demonstration of 3-D sensor networks for monitoring nuclear energy passive structural systems with an emphasis on monitoring critical material performance

#### **Objectives:**

- demonstrate ability to collect data from critical structural materials that are
  - relevant to their performance overtime
  - relate to major performance attributes of interest
  - relevant to the known modes of aging and degradation
- provide diagnostic and prognostic models of material behavior in target environment of interest



## NEET- 2.3 TOPIC:

### Development of Advanced Transient Irradiation Instrumentation

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**Challenge:** Development and demonstration of advanced sensors and instrumentation for the Transient Reactor Test Facility (TREAT) transient experiments, and the techniques for applying them in a remote environment

#### **Objectives:**

- design sensor and corresponding instrumentation to be qualified and deployed for TREAT reactor in support of transient testing of nuclear fuel samples
- demonstrate ability to use high fidelity instruments positioned in the specific location of interest without disturbing the conditions of the fuel pin before and after radiation

**POC for TREAT: Dan Wachs, [daniel.wachs@inl.gov](mailto:daniel.wachs@inl.gov)**

## NSUF 1.2 a TOPIC:

Advanced manufacturing of instrumentation for in-pile measurement and characterization of nuclear fuels and materials

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**Challenge:** develop and demonstrate new methods and technologies for developing sensors using advanced manufacturing techniques that can be qualified and applied to the measurement and characterization of fuels and material behavior during irradiation in-pile

### **Research objectives:**

- capable of producing fully functional sensors using advanced manufacturing that are sufficiently mature to enable irradiation testing of the resulting design in irradiation facilities up to and potentially including in-pile applications
- successful application of the research to an in-pile application or an irradiation test program must be addressed in the proposal





## NSUF 1.2 b TOPIC:

Developing and testing advanced materials and advanced sensors through in-pile tests

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**Challenge: Development and in-pile testing and post-irradiation examinations for 1) advanced materials for sensors and 2) for advanced sensors**

### **Research Objectives:**

#### **1) Advanced Materials for Sensors**

- a description of the materials
- irradiation and post irradiation examination needs
- the role of the materials in new sensors, controls, communications or associated applications

#### **2) Advanced Sensors**

- a description of the sensor and associated instrumentation and materials
- irradiation and post irradiation examination needs
- the purpose and application of the developed sensor in nuclear energy systems



# Summary of ASI Proposals Expectations

- Research will 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 in support of GAIN**

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

# Contact Information

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