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NATIONAL LABORATORY

Nuclear Energy Sensors (NES) website overview

https://nes.energy.gov/

Idaho National Laboratory

NES mission

Pacific Northwest
NATIONAL LABORATORY

Searchable sensors technology database for nuclear applications

- Availability
- Use cases
- Current state of sensor developments
- Identification of needs and gaps for sensor development

- Develop and maintain an open access website serving as database of sensors and instrumentation used in nuclear energy systems and related applications
- NES Database accessible at https://nes.energy.gov/ as part of the Nuclear Energy Enabling Technologies (NEET) Advanced Sensors and Instrumentation (ASI) program
- Scope include sensors for operating nuclear power plants, advanced reactors under development and nuclear materials and fuels qualification test
- The objective is to provide reliable and easily accessible reference data for designers of advanced reactors and related demonstration facilities
- NES is an interactive database – users can suggest modifications or request additions based on their needs

NES Technical Content

- Sensors grouped by type of reactor and parameter measurements (e.g. Neutron Flux, Primary Flow, Temperature, Pressure, etc.)
- Parameters may be linked to multiple technologies depending on the measurement range (e.g. for neutron flux measurement, different sensors can be used for source range, intermediate range, wide range, power range)

High-level descriptions of the following sensor properties:

- Requirement for measurement
- Physics of sensor measurement process
- Sensor environment
- Sensor installation in and around the reactor
- Sensor measurement electronics
- Sketches and specifications of sensor and cable, if available
- Availability of sensor and electronics from vendors
- Development needs

Objective: NES Database Describes Relevant Sensors with Appropriate Level of Detail

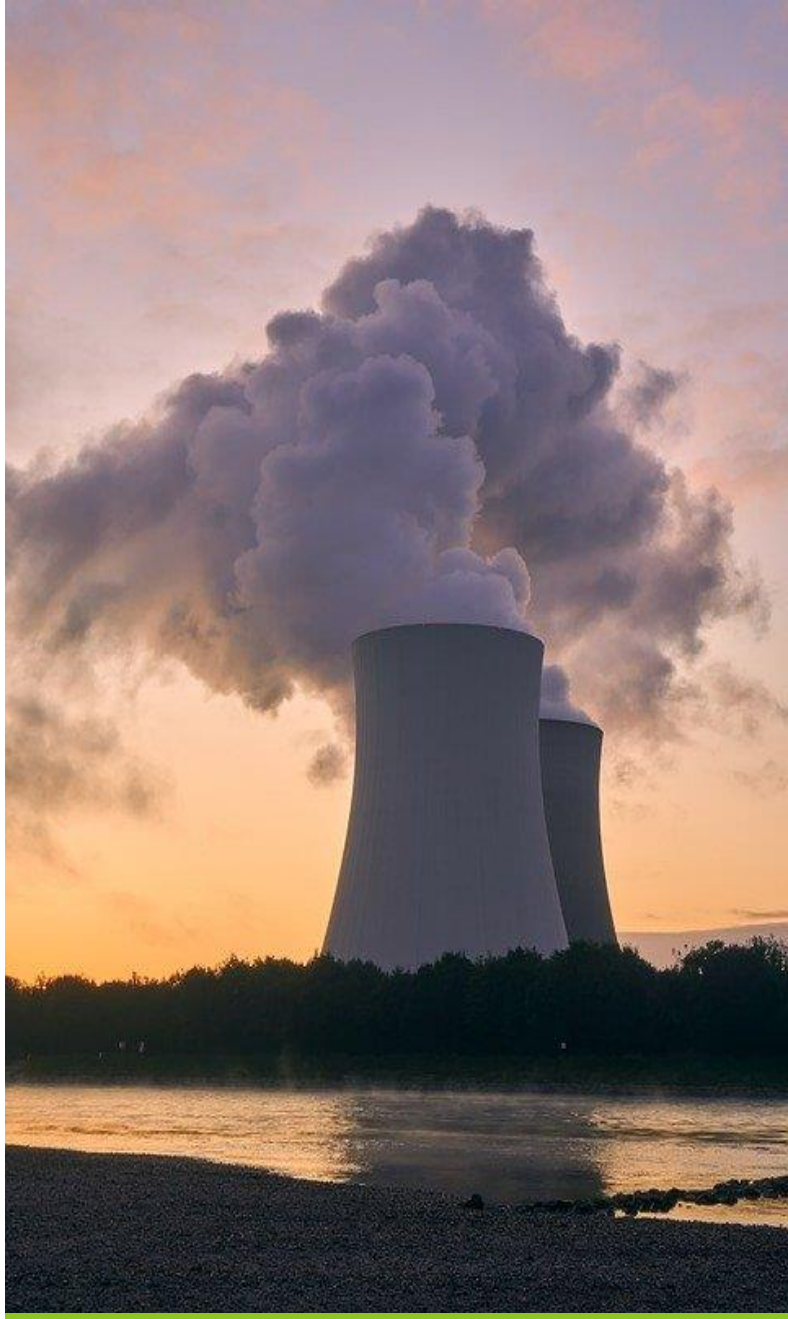
Example – BWR Neutron Flux Monitors

Several BWR In-Core Neutron Flux Monitors

- Startup Range Monitor (SRM)
- Intermediate Range
- Wide Range
- Power Range
- Traversing In-core Probes (TIPs - Neutron and gamma)

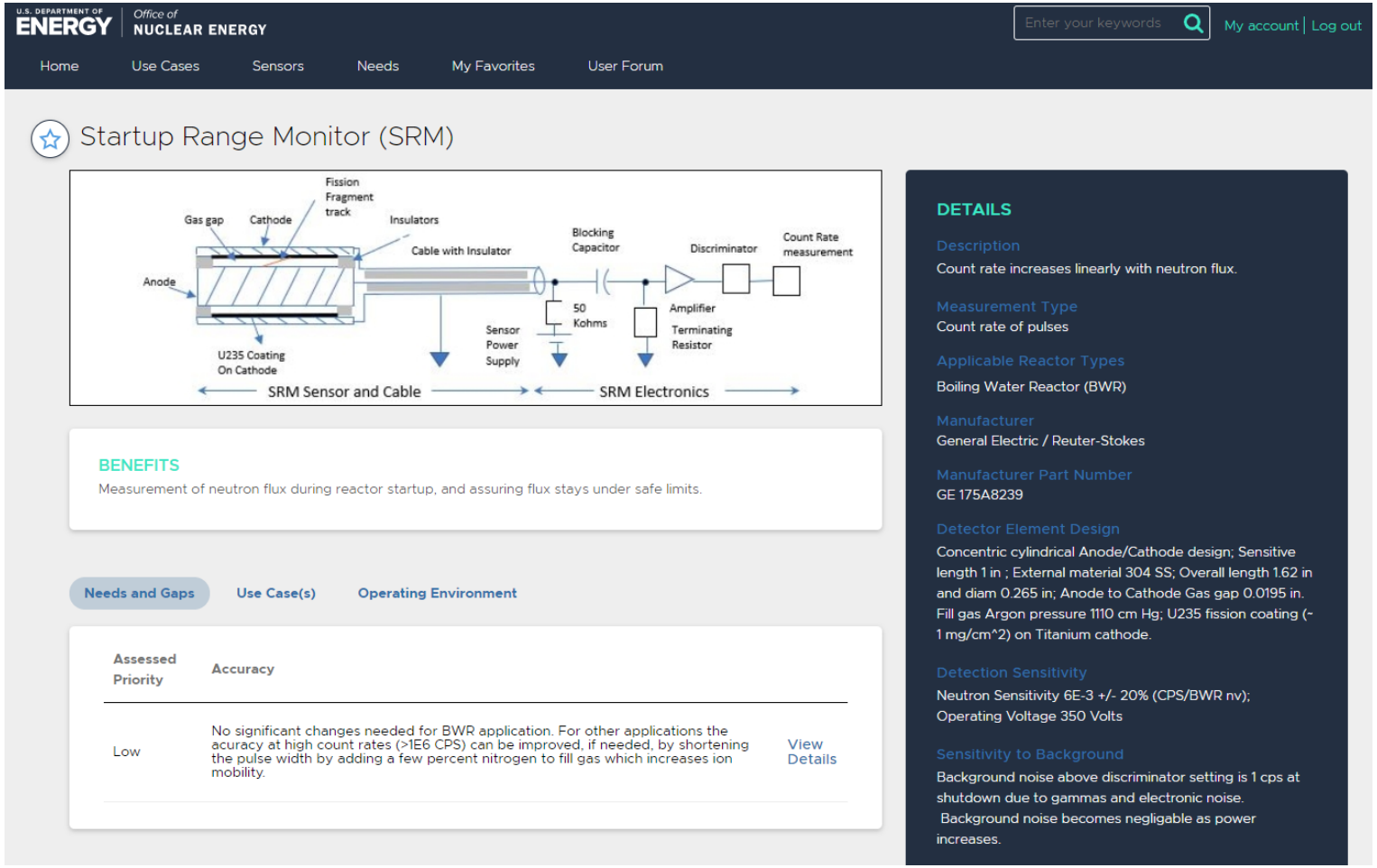
https://nes.energy.gov/sensors

BWR Neutron Flux Monitors extensively used – Significant Level of Detail Available



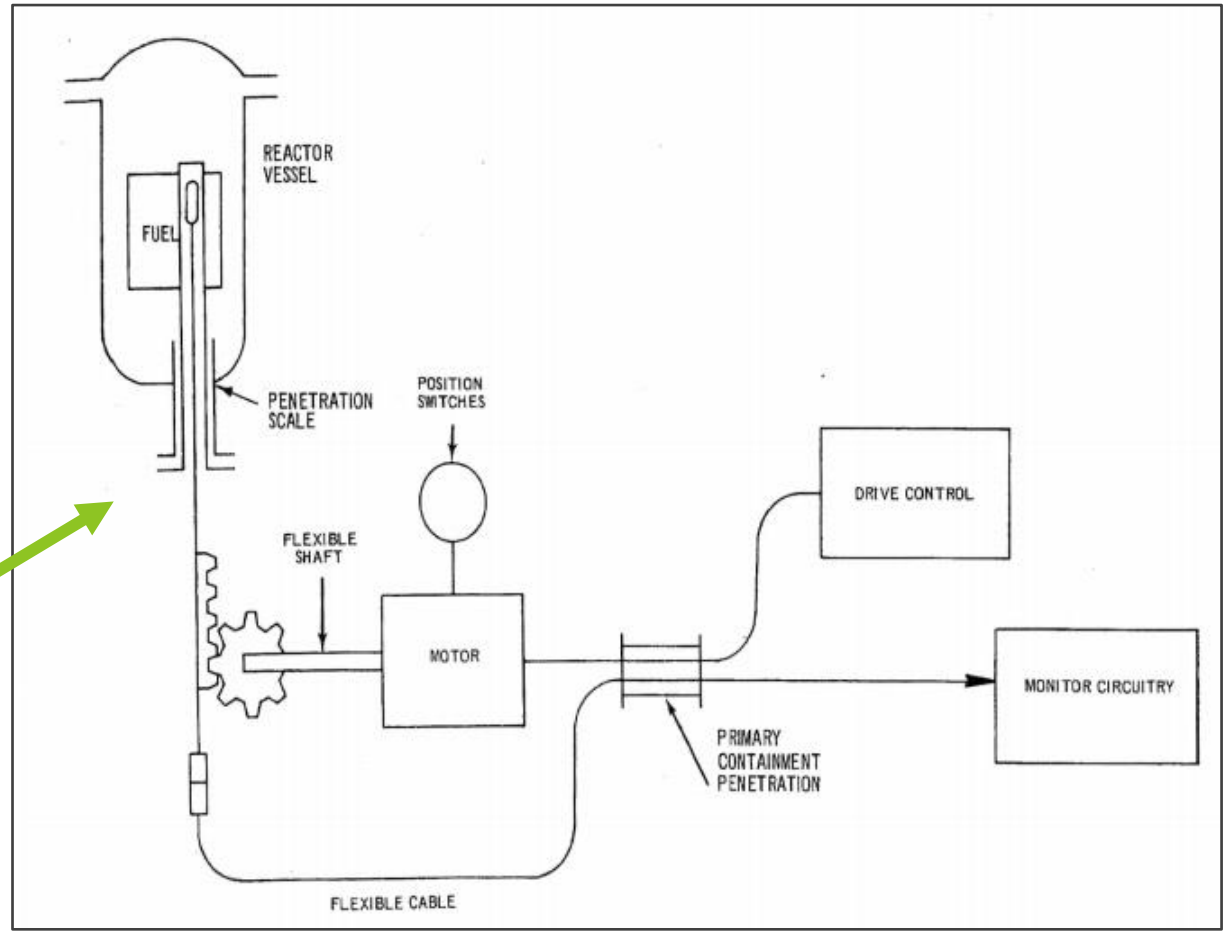
Example – BWR Startup Range Monitor (SRM)

https://nes.energy.gov/sensors



Example – BWR SRM Installation

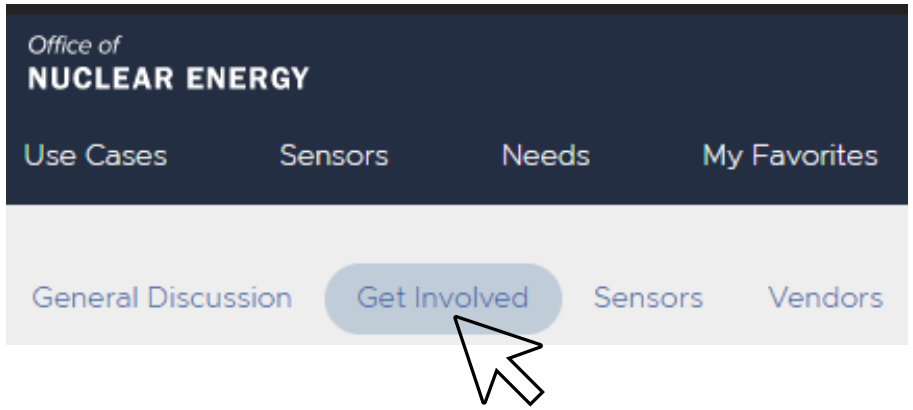
https://nes.energy.gov/sensors



A functional installation sketch of the SRM system in a BWR

Current Status

- Current Scope FY20 accomplishments
  - Developed NES framework (PNNL)
  - Content development: example only



- FY21 planned activities
  - Neutron Flux Sensors
    - BWR, SFR completed
    - PWR, HTGR next
    - Molten Salt and other Advanced Reactors
  - Temperature Sensors
  - Flow Sensors

- Future Scope
  - Other reactor parameter measurement sensors
  - Document sensor qualification process

Key Challenges

Solutions

- State of the art I&C technology is not sufficient to fulfill advanced reactors design requirements in terms of:
  - operating conditions
  - accuracy
  - reliability
- Sensor development and demonstration is needed but programs and nuclear vendor cannot take on development risk (cost, schedule) and the business case is limited for instrumentation supplier engagement

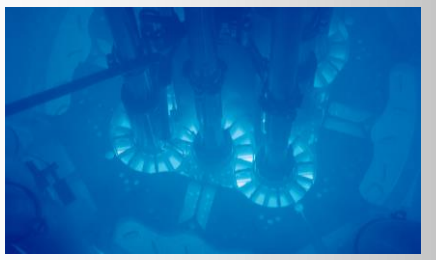
Gap assessment:
the scope of this webinar

Key Challenges

- For advanced reactors operation (i.e. autonomous control) measurement system development should be integrated in early phases of system design and demonstration
- A standardized qualification process for advanced I&C technologies must be defined in compliance with all stakeholder requirements (ie, DOE, NRC, etc.)

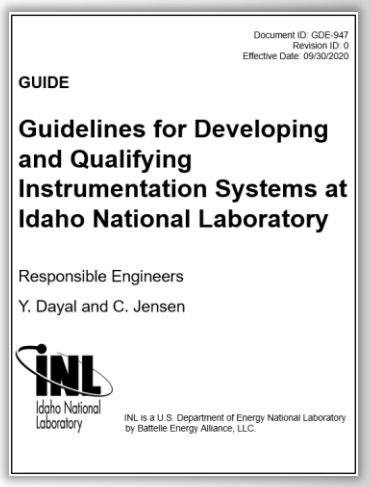
Solutions

Deploy advanced I&C in demonstration testing facilities



Advanced Test Reactor (ATR)

Microreactor Agile Non-Nuclear Testbed (MAGNET)


Document ID: GDE-947
Revision ID: 0
Effective Date: 09/30/2020

GUIDE

Guidelines for Developing and Qualifying Instrumentation Systems at Idaho National Laboratory

Responsible Engineers

Y. Dayal and C. Jensen

Idaho National Laboratory

INL is a U.S. Department of Energy National Laboratory by Battelle Energy Alliance, LLC.

Guidelines for qualification of developmental sensors have been developed (GDE-947) and are being used for HTIR-TC qualification