



# Complete high temperature test of neutron flux sensors in NRAD

September 2022

*Changing the World's Energy Future*

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# **Complete high temperature test of neutron flux sensors in NRAD**

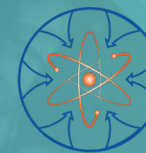
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**Completion of M2CT-22IN0702084:  
*Complete high temperature test of neutron flux  
sensors in NRAD***

INL is conducting a series of neutron sensor tests in various test reactors. The purpose of this testing program is as follows:

- Characterize sensors in representative environments for reactor developers and reactor experiment engineers
- Determining maximum operating temperature of Self Powered Neutron Detectors (SPNDs) and fission chambers
- Identify temperature effects in SPNDs and fission chambers
- Develop compensation techniques to minimize the consequences of temperature dependencies

# An insulated heated test rig was developed to enable this high temperature testing

- The purpose of this test was to characterize operation of Self Powered Neutron Detectors (SPNDs) at high temperature and shake out any bugs in the data acquisition equipment prior to testing at higher flux in MITR

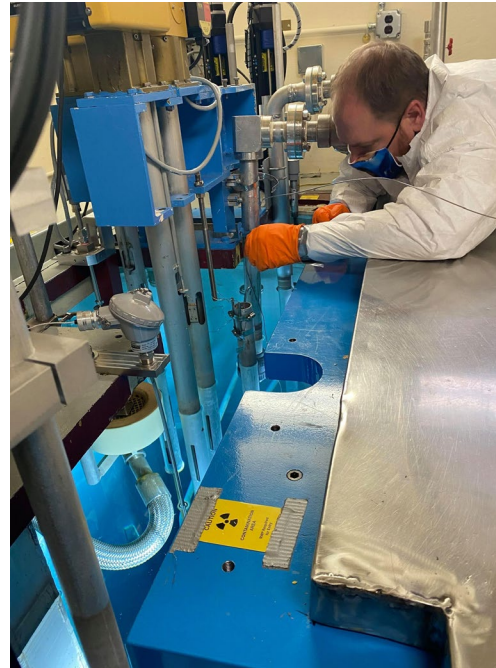


Insulated Core Section of Test Rig for NRAD



# NRAD Heated Sensor Test Conducted Oct 27, 2021

- Five-hour test run with temperatures varying between 100°C and 850°C
- Good signal to noise ratio for SPNDs even at moderate neutron flux available in NRAD

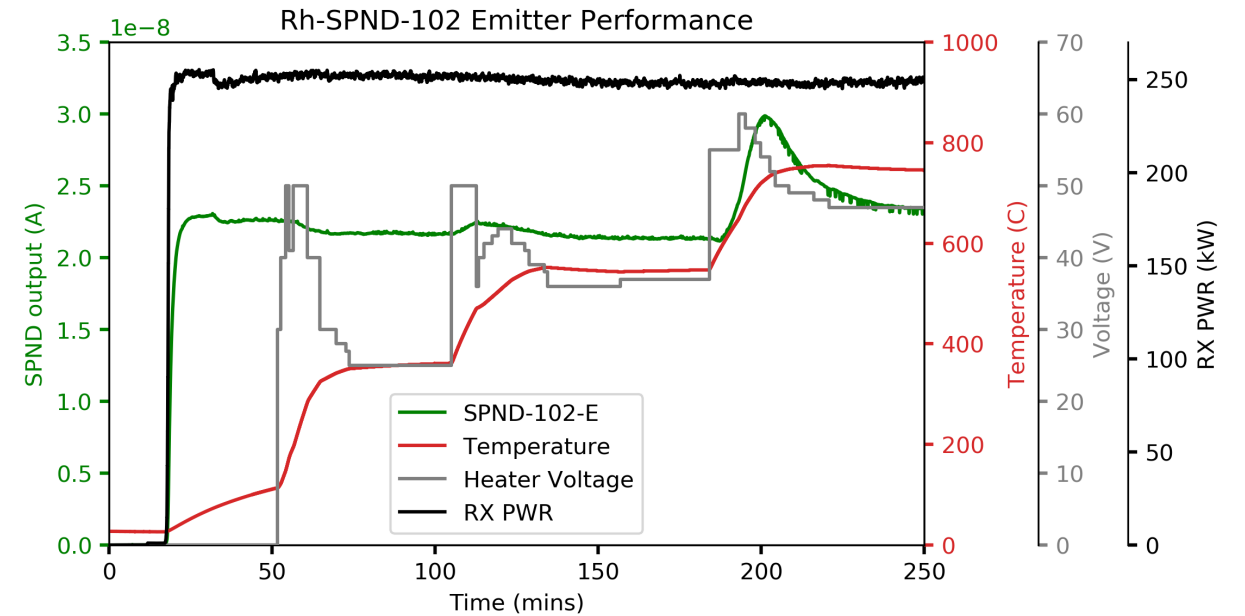
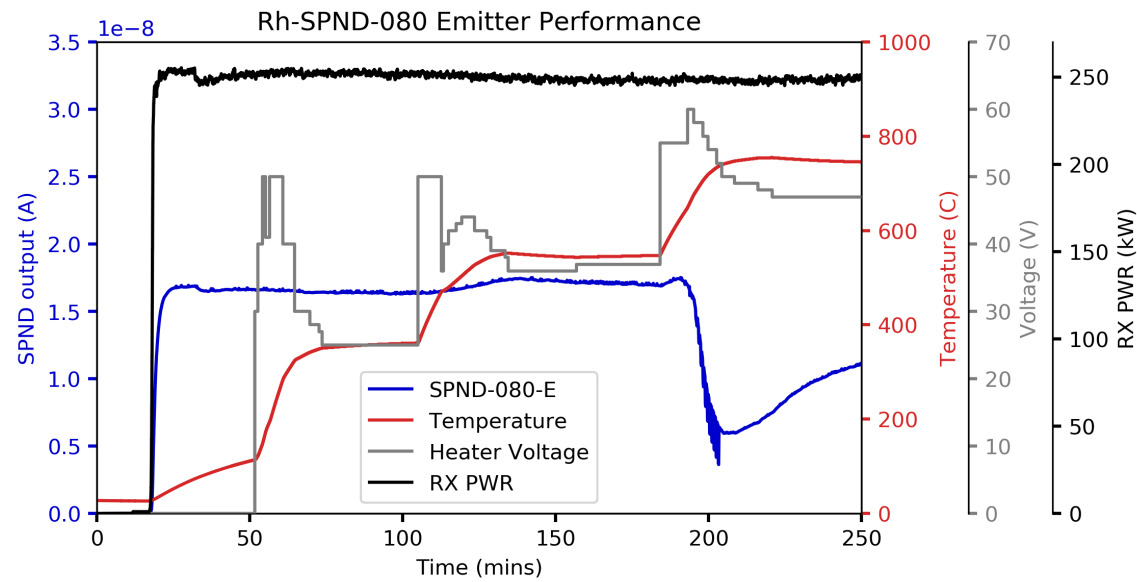


Installing sensors



Gathering data in cask tunnel

# Data Gathered





## This milestone in context

- This was the second of two heated neutron sensor tests conducted in NRAD (the first was conducted August 25, 2021)
- The first test identified some anomalies in the emitter current when the sensor (SPND) was heated above 500°C
- This second NRAD test substituted a DC heater for the AC heater for a portion of the high temperature heating but the anomalies persisted
- This test preceded a high temperature/high flux test in MITR and was used to ensure all data acquisition equipment was operating as expected
- The test in MITR (Jan/Feb 2022) used nuclear heating only and demonstrated that most of the current anomalies were due to interference from the electric heaters, however some temperature effects were still noted
- A fourth high temperature neutron sensor test is planned for the Ohio State Research Reactor in September 2022. This test will focus more on fission chambers vs SPNDs.