Analysis & Measurement Services Corp.

partnered with

Oak Ridge National Laboratory

RFA-17-14612, Radiation Aging of Nuclear Power Plant Components

YEAR AWARDED: 2017

TOTAL PROJECT VALUE: $260K (DOE funding, $208K; awardee cost share, $52K)

STATUS: Completed

PRINCIPAL LAB INVESTIGATOR: Robert Duckworth (duckworthrc@ornl.gov)

DESCRIPTION: Analysis & Measurement Services Corp.'s (AMS's) business involves advising utilities and nuclear manufacturers on matters pertaining to the durability of process measurement and reactor control equipment. Under this voucher, AMS performed radiation aging of two temperature and two pressure sensors at the Gamma Irradiation Facility of the High Flux Isotope Reactor at the Oak Ridge National Laboratory. During the irradiation, the resistance temperature detector and thermocouple output signals were continuously monitored from a remote location. After the irradiation, AMS was able to retrieve the sensors and perform a calibration check to quantify drift relative to baseline measurements collected prior to irradiation. There was no appreciable drift in output for either of the two resistance temperature detectors. Although there was some drift for the thermocouple elements, these deviations were relatively insignificant when considering the general accuracy of a standard thermocouple. The pressure sensors failed to operate normally after exposure to substantial radiation.

BENEFIT: The evaluation of these sensors' parameters forms an important part of AMS's approach to monitoring and forensic interrogation of sensors in nuclear plants. This data will provide foundational information as AMS explores best practices as similar sensors are deployed in next-generation nuclear reactor systems.

IMPACT: Through subsequent laboratory evaluation, the manufacturer has established preliminary plans to modify the design of these devices to make them more robust to radiation exposure.

LESSONS LEARNED: The pressure and differential pressure sensors both failed to operate normally after exposure to 150 MRad of gamma irradiation. While these sensors were ultimately not able to withstand such extreme conditions, the results obtained here are useful to the sensor manufacturer and the small modular reactor (SMR) industry as a whole.

SIGNIFICANT CONCLUSIONS: Although the sensors would need to be redesigned and qualified for expected normal and accident conditions in an SMR, it is promising that both sensors performed well in a high-radiation environment similar to what may be found in an SMR containment.

NEXT STEPS: AMS will continue to work with the manufacturer and is open to evaluating further sensor designs that may be suitable for the SMR market.