Analysis & Measurement Services Corp.
partnered with
Oak Ridge National Laboratory

NE-19-19013, Testing of I&C Sensors and Cables for Small Modular Reactors

YEAR AWARDED: 2019

TOTAL PROJECT VALUE: $500K (DOE funding, $400K; awardee cost share, $100K)

STATUS: In progress

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DESCRIPTION: Analysis & Measurement Services Corp. (AMS) requested a voucher in 2019 under the Gateway for Accelerated Innovation in Nuclear Program to use the thermal hydraulics laboratory and vacuum test chambers at Oak Ridge National Laboratory (ORNL) for response characterization of resistance temperature detectors and thermal aging of instrumentation and control (I&C) cables in vacuum. I&C sensors and cables installed within the containment of a small modular reactor (SMR) will be subjected to harsh environmental conditions, including high temperature, radiation, and vacuum during normal operation. If not adequately derated, these conditions, combined with ohmic heating within cables, can lead to accelerated aging and premature failure. In order to generate more useful data for I&C cable derating purposes, AMS needed access to specialized vacuum test chambers and high voltage-current power supplies, such as those available at ORNL.

BENEFIT: To safely obtain the high temperatures and low flow rates that characterize a natural circulation SMR, AMS needed access to a thermal-hydraulic facility capable of achieving these conditions. The ORNL thermal-hydraulic test facility was adapted to provide these SMR-like process conditions. The vacuum testing (to be completed) at ORNL will reliably and safely provide high current test data in a high-temperature vacuum environment that could not otherwise be obtained. Without these resources, completing this research would be difficult and prohibitively expensive.

IMPACT: As part of an ongoing research and development project on the I&C needs of SMRs, AMS is characterizing the dynamic performance of typical nuclear-grade thermowell-mounted resistance temperature detectors to verify that these sensors can meet SMR plant technical specifications at the conditions expected during startup and operation.

LESSONS LEARNED: Foundational data that gives AMS the capability to authoritatively advise on process measurement and reactor control protocol.

SIGNIFICANT CONCLUSIONS: The data collected from this access will help sensor and cable manufacturers design products with enhanced performance characteristics necessary for SMR and advanced reactor applications. Furthermore, the development of new in-situ I&C test technologies will improve both the safety and economic competitiveness of currently operating reactors as well as next-generation reactors through increased condition monitoring and reduced hands-on maintenance (which contributes to high operating costs for nuclear power plants).

NEXT STEPS: AMS will continue to work with SMR designers and manufacturers to evaluate further sensor and instrument designs that may be suitable for the market.