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March 1, 2022

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC

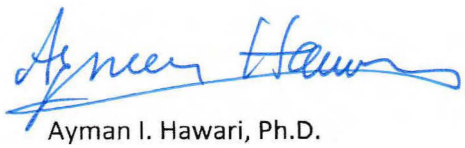
SUBJECT **Report for Event Number 55747 "Technical Specification Violation"**
License No. R-120
Docket No. 50-297

As required by Technical Specification (TS) 6.7.1, attached is a written report of Event Report Number 55747 regarding a Technical Specification violation that occurred at the North Carolina State University (NCSU) PULSTAR research reactor on February 17, 2022.

If you have any questions regarding this report or require additional information, please contact Scott Lassell, the Manager of Engineering and Operations, at (919) 515-3347 or salassel@ncsu.edu.

I declare under penalty of perjury that the forgoing is true and correct. Executed on 1 March 2022.

Sincerely,



Ayman I. Hawari, Ph.D.
Director, Nuclear Reactor Program
North Carolina State University

Enclosures: Written response to Event Report Number 55747

Report of Event Report Number 55747 regarding a Technical Specification Violation

Event Description

- At 13:30 on 2/17/2022, the reactor operator took operations logs, scanned the console indications, and had noted that the N-16 Power Monitoring Channel percent reactor power meter indication was reading at 95% power consistent with the other power channel indications.
- At 13:45, the reactor was operating at 950kW as indicated by the Linear, Safety and Log-N Channels. The reactor operator observed that the N-16 Power Monitoring Channel percent reactor power meter was indicating a power level of 20%. Following the requirements of operating procedure OP105 Immediate Operator Actions, Section 4.2 Abnormal Channel Behavior, the operator shutdown the reactor by ganged insert at 13:46.
- Upon initiating reactor shutdown by actuation of the gang rod insert switch, the operator observed that the N-16 Power Monitoring Channel percent reactor power meter indication step increased back up to 95% momentarily, consistent with the other power level channels, before then decreasing on a shutdown period.
- The reactor operator completed the shutdown, secured the reactor, and informed the Designated Senior Reactor Operator (DSRO).
- The reactor power recorder data was subsequently reviewed and it showed that the indications from the Linear, Safety and Log-N power channels were all stable at a nominal power of 950kW in the period leading up to the shutdown at 13:46. The N-16 Channel output is not recorded.
- The operability of the N-16 Power Measuring Channel is required under Limiting Conditions for Operation (LCO) per Technical Specification (TS) 3.4(a) for power levels above 500 kW. The percent reactor power meter is part of the channel and was observed to be indicating incorrectly for a brief period with reactor power at 950kW, so per TS 1.2.14 the channel was not operable. This was a violation of TS 3.4(a).
- The NRP Director was informed following the event. The NRC Project Manager, Duane Hardesty, was called at 16:10 and informed. Per TS 1.2.24(d), a notification of a Reportable Event / TS Violation was made by the MEO to the NRC Headquarters Operations Officer at 16:37, and was logged by the NRC Operations Center as event #55747.

Discussion

Procedures were followed during reactor operation, shutdown, and the subsequent investigation. No SCRAM occurred as the N-16 Channel is not part of the reactor safety system and does not have an automatic shutdown function associated with it. The operator responded correctly to the event and completed the Immediate Operator Actions required by procedure OP105. Notifications were made as required. There was no reactor or radiological safety issue associated with this event.

Immediately following securing the reactor, the DSRO performed channel tests on the N-16 channel electrometer, using a calibrated current source to introduce currents representing 25%, 50%, 75%, and 100% of full power levels, and repeated these tests several times. The N-16 electrometer and percent reactor power meter indicated correctly for all iterations of these channel tests. Per surveillance procedure PS-1-08-4, N-16 Semi-Annual Calibration, the DSRO then inserted a Cobalt-60 check source in the test thimble located next to the N-16 Channel Xenon filled ionization chamber. Per the procedure, the decay-corrected source activity was calculated to have yielded a channel current of 0.052nA; the actual reading ranged from 0.049nA to 0.051nA which was within acceptable tolerances. The false low power indication on the N-16 Power Monitoring Channel percent reactor power meter was not reproduced in any of these tests.

Corrective Actions

Reactor staff performed diagnostic tests and evaluation of the N-16 Power Monitoring Channel components. Maintenance Log #878 was opened to document repairs made to the N-16 Channel. In support of power channel diagnostics, the NRP Director authorized the staff to restart the reactor on 2/21/2022 with power limited to levels up to 400 kW in compliance with TS 3.4(a).

In the period from 2/17/2022 through 2/28/2022, the staff performed multiple inspections, surveillances, and evaluations on the N16 Channel components. Linearity testing has been performed for the entire channel chain up to 400kW, and a calibrated current source has been utilized to verify channel response up to 100% power. Extensive monitoring of the channel outputs during operations and over shutdown periods with the current source applied have been performed with the electrometer output recorded. No deficiencies have been found in these tests and the false low power indication on the N-16 Power Monitoring Channel percent reactor power meter has not been reproduced. External support is being solicited from instrumentation vendors to assist with channel component diagnostics, repair and/or replacement.

Corrective actions identified to prevent recurrence from this event are as follows:

- Assure that all N-16 Power Monitoring Channel components have been evaluated, repaired or replaced as necessary, and are operable per TS requirements. To assure operability following evaluation and servicing by an instrumentation support vendor, N-16 Power Monitoring Channel surveillance testing shall be completed and channel response with no deficiencies shall be observed for 5 days of reactor operation at a power level of < 500kW.
- The N-16 Power Monitoring Channel electrometer output has been connected to a digital data recorder and is recorded along with the other power monitoring channels allowing review and comparison.
- As resources permit, add a redundant N-16 Power Monitoring Channel to provide additional assurance that the operability specification is met.
- In consultation with and approval from NRC, and consistent with the guidance given in ANSI 15.1-2007, update the definition of 'Reportable Occurrence' in TS Section 1 and add provisions to TS Section 3 'Limiting Condition for Operation', that would allow credit for operator action in responding to and correcting abnormal channel behavior.