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To Whom It May Concern,

The following 14-day follow-up report documents corrective actions taken following a reportable occurrence at the Kansas State University TRIGA Mark II nuclear reactor, License R-88. The Event Notification number pertaining to this occurrence is 49117. This report begins with a description of the reportable event, background information about the cause of the event, a timeline of events, and the contributing causes as identified by the Facility. The report concludes with the corrective actions taken by the facility to preclude a similar occurrence from happening in the future.

Description of Event

During operations at full power (500 kWth), the Senior Reactor Operator (SRO) on duty noticed that the fuel temperature thermocouple reader indicated a temperature of 202°C, approximately 60 – 70°C below the expected value. The SRO recognized that the problem was likely caused by a fuel thermocouple wire grounding to its conduit. A trainee was instructed to move the wires to avoid grounding. Following this action, the thermocouple reader indicated the proper value. Upon review of the log book, the SRO noticed that the faulty fuel temperature reading had been logged for several days without corrective action. The facility Technical Specifications (TS) require at least one fuel temperature indication to be operable during operation, and define a system as “operable” when it is capable of performing its intended function in a normal manner. Therefore the fuel temperature indication was not operable as defined in the TS. Since the reactor was not immediately secured nor was the indication immediately fixed, the event constitutes a Reportable Occurrence per facility TS 6.9.2.

Background

For the four days of reactor operations during which the problem with the thermocouple existed, the reactor was operated for short amounts of time (~10 – 15 minutes) at various power levels in order to characterize a new beam port configuration and test an experimental apparatus. The total time above 100 kWth was 2 hours and 51 minutes. The reactor was typically staffed by a trainee at the panel, supervised by a licensed reactor operator (RO).

The indicated temperature is the average reading of three thermocouples. One thermocouple is at the fuel midplane, one is 2” above the midplane, and one is 2” below the midplane. The fuel temperature indication, when partially grounded, is approximately correct below the point of adding head (approximately 10 kWth). It differs from the expected value by approximately 15°C at 100 kWth, and by approximately 65°C at 500 kWth. The fuel temperature readout at the control panel is used to provide an automatic scram at 400°C. This setpoint is set well below the Safety Limit of 750°C fuel temperature during steady state reactor operations. The fuel temperature scram is NOT required by TS. Normal operations at the reactor do not approach this scram setpoint or the Safety Limit.

The logbooks are reviewed daily as part of the pre-operation reactor checkout procedure. The staff is trained to review logs back to the most recent time they were on duty, to check for changes to the reactor, problems with instruments, etc. The staff is not trained to audit the previous days' logs for anomalous readings.

Timeline

The following timeline of operations is taken from the reactor logbook. Only operations at or above 100 kWth are listed, because the difference between measured and expected temperature is small at lower power levels. All times are local (Central Daylight Time).

Date	Time	Power	T (Measured, °C)	T (Expected, °C)
6/7/2013	0946 – 1001	500 kW	200	265
6/7/2013	1037 - 1050	500 kW	202	265
6/7/2013	1441 – 1446	500 kW	202	265
6/10/2013	0937 – 0950	100 kW	83	100
6/10/2013	1005 – 1015	100 kW	87	100
6/10/2013	1029 – 1041	100 kW	84	100
6/12/2013	0906 – 0919	100 kW	84	100
6/12/2013	0934 - 0959	530 kW	217	270
6/12/2013	1611 – 1633	100 kW	74*	100
6/13/2013	1103 – 1143	500 kW	201	265
6/13/2013	1352 – 1406	530 kW	209	270

**Temperature was logged while it was still rising toward an equilibrium value.*

6/13/2013 – 1559 – Problem observed and corrected by repositioning thermocouple wires.

6/14/2013 – 1020 – Reportable occurrence reported to NRC Headquarters Operations Center.

Causes

The facility identified the following as contributing causes to the event.

1. Licensed operators were not sufficiently attentive when supervising trainees at the control panel. The licensed operators were focused on reactor power indications and did not pay sufficient attention to other TS-related indications.
2. The log book review required prior to daily operations was not conducted with sufficient rigor to detect the improper thermocouple readings logged the previous day. The review was instead focused on noting changes to the reactor facility and problems with instrumentation since the operators' previous duty at the panel.
3. Only one functioning instrumented fuel element was used to provide the required fuel temperature indication channel. Therefore no redundant readout was available to check against the indicated fuel temperature.
4. The sharp edge on the instrumented fuel element conduit can cut through the insulation on the thermocouple wires, causing grounding.

Corrective Actions

The facility has performed the following corrective actions:

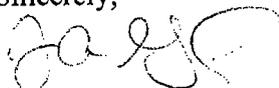
1. The instrumented element that caused the problem was raised from the reactor core. One of the three sets of K-type thermocouple wire for that element was completely stripped where it leaves the conduit, such that the thermocouple wire pair could either ground or touch at room temperature. Electrical tape was used to re-insulate the thermocouple and to dull the sharp conduit edge that had stripped the wires.
2. The second installed instrumented fuel element was raised from the core, but no stripped wires were identified. Electrical tape was used to wrap the thermocouple wires and to dull the conduit edge.
3. A third, fresh, instrumented element was installed. The sharp conduit edge was dulled with electrical tape prior to installation to prevent stripping of the thermocouple wire.
4. The reactor staff who are present for the summer semester were briefed and trained on the event. The remaining staff members were informed via email and will be briefed and trained prior to resuming operation.

The following additional corrective actions are planned for the future:

1. The reactor staff will be trained on a continuing basis to be vigilant for anomalous values in the prior days' log entries during the daily reactor checkout.
2. The reactor staff will be trained on a continuing basis on the importance of vigilance when supervising trainees and the importance of attentiveness to all channels of information at the control console, as opposed to focusing on a few specific indicators, such as reactor power channels.
3. The Reactor Safeguards Committee will be presented with a revision to Procedure 15 – Reactor Startup. This revision will include a chart or list of expected instrument readings for select power levels. The revised procedure will go into effect upon approval by the RSC.

The reactor resumed operation on June 19, 2013. A copy of this report will be provided to the Kansas State University Reactor Safeguards Committee for review.

Sincerely,



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