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US Nuclear Regulatory Commission  
Washington, DC 20555-0001

1 January 2019

**Subject: Reportable Occurrence on December 22, 2018 at the Kansas State University  
TRIGA Mark II Nuclear Reactor Facility**

To Whom It May Concern:

On December 23, 2018, I notified the NRC of a reportable occurrence involving discovery of a limiting conditions for operations (LCO) violation on December 22, 2018. The relevant LCO is Technical Specifications (TS) 3.4, Safety Channel and Control Rod Operability. Specifically, TS 3.4.3 Specifications requires a CONTROL ROD (STANDARD) position interlock be operable during PULSE MODE operations. Per TS 3.4.4 A., the condition of any required SAFETY SYSTEM CHANNEL or interlock function not OPERABLE requires IMMEDIATE restoration of channel or interlock to operation or IMMEDIATE reactor SHUTDOWN. The CONTROL ROD (STANDARD) position interlock has a SEMIANNUAL functional test surveillance requirement as specified in TS 4.4.2. Per TS, surveillance requirements must be met for all equipment/components/conditions to be considered operable. Failure to perform a surveillance within the required time interval or failure of a surveillance test shall result in the component/condition being inoperable. Recent implementation of a procedure review during component retest revealed an inadequacy in the procedure used to perform the required surveillance of the CONTROL ROD (STANDARD) position interlock.

This letter documents the reportable occurrence in accordance with reporting requirements.

Background

Multiple interlocks are implemented in the reactor control system to ensure proper reactor operation. Hard-wired components in the control rod drive circuitry are used to implement these interlocks. As required by TS, the CONTROL ROD (STANDARD) position interlock functions to prevent withdrawing control rods other than the pulse rod when the reactor is in PULSE MODE. This ensures the reactivity added during a pulse is limited to the reactivity added by the pulse rod. The position interlock does not prevent the ability to scram any control rod.

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As described in the Safety Analysis Report (SAR), the Pulse Mode Interlock prevents withdrawing standard control rods when the Mode switch is in Hi Pulse. Additionally, standard control rod withdrawal interlock function is provided by manually actuating the Pulse Interlock pushbutton switch on the NLW-1000 wide range power channel after the reactor mode switch is placed in the PULSE MODE. The Pulse Interlock on the NLW-1000 disables the channel to prevent over-ranging and period scram trip during a pulse and activates the Source Interlock on the control console. The Source Interlock prevents withdrawal of the standard control rods when indicated neutron flux is  $< 2$  cps. Therefore, by removing the power signal from the NLW-1000 channel, standard control rod withdrawal is prevented. The Pulse Interlock pushbutton has the capability to be actuated in STEADY STATE MODE and PULSE MODE during testing. Another interlock associated with the NLW-1000 power channel is the Pulse Power Interlock which prevents pulsing at reactor powers above 10 kW (normally set at 1 kW). However, the Pulse Power Interlock is not required by TS, but is configured as a good operating practice.

For the TS required CONTROL ROD (STANDARD) position interlock in PULSE MODE, a semi-annual functional test is required by TS 4.4.2. This surveillance requirement assures the interlock will function as required. In accordance with TS 6.9, an interlock is considered operable if surveillance requirements are being met. If a surveillance is not performed within the required time interval, the component is considered inoperable. To meet the surveillance requirements for interlocks, Procedure No. 5 – Semi-Annual Check Minimum Interlock & SCRAM Checks is performed on a semi-annual basis and following any maintenance activities that could potentially affect operability and function of the required systems. Per TS 6.3(a)4, written procedures, reviewed and approved by the RSC, shall be followed for periodic testing of reactor instrumentation. Procedure No. 5 was approved by the Reactor Safeguards Committee on February 7, 2012.

Within the Discussion section of Procedure 5, the CONTROL ROD (STANDARD) position interlock functional test is listed as a TS required item. The Pulse Power Interlock is not included in the Discussion section of the procedure but step 5 within the procedure directs the operator to TEST the Pulse Power Interlock. Subsequent sub-steps instruct the operator to manually engage the Pulse Interlock pushbutton, ensure the SOURCE interlock light is energized, attempt to withdraw the standard control rods, and VERIFY none of the rods withdraw. The procedure does not instruct the operator to enter PULSE MODE at any time and it does not instruct the operator to achieve a power level above 1 kW.

Recently the facility has implemented new documentation methods for recording and reviewing results of procedures. A results checklist for Procedure No. 5 revealed an issue in the interlock test procedure during retest following transient rod drive maintenance.

#### Reportable Occurrence Description

Following maintenance and inspection of the transient rod drive system the Reactor Supervisor supported by the Reactor Manager conducted two surveillance checks per TS 4.9 Maintenance Retest Requirements the evening of December 21, 2018. At approximately 6:55 PM CDT,

Procedure No. 4 – Control Rod Drop Time Measurement for the transient rod was performed satisfactorily. Procedure 16 – Pulsed Operation II. Functional Performance Check of Transient Rod was performed satisfactorily at approximately 7:05 PM CDT. The remaining relevant retest items in Procedure No. 5: multiple rod interlock, pulse rod interlock, pulse power interlock, and standard control rod position interlock were tested satisfactorily at 8:05 PM CDT by the Reactor Supervisor without the support of the Reactor Manager. At approximately 9:35 PM CDT, the Reactor Supervisor sent an email to the Reactor Manager describing an inadequacy with Procedure No. 5 to test the CONTROL ROD (STANDARD) position interlock. The Reactor Supervisor also communicated in the email the CONTROL ROD (STANDARD) position interlock was subsequently tested to be operable in that it functioned properly during the test.

On December 22, 2018, the Reactor Supervisor and Reactor Manager met to discuss the finding and review the procedure. Based on the review of the documentation, it was determined Procedure No. 5 did not test the interlock required by TS 3.4 Safety Channel and Control Rod Operability in the correct mode. The Reactor Manager declared an LCO violation at 5:03 PM CDT on December 22, 2018 because of failure to perform required surveillance resulting in an inoperable interlock during previous PULSE MODE operations.

#### Immediate Corrective Action and Efficacy

Upon declaration of the LCO violation, operations were administratively suspended immediately at approximately 5:03 PM CDT on December 22, 2018. At the time of declaration, the reportable occurrence was communicated to the Reactor Supervisor who was the only staff member reporting to the facility due to a holiday break. Other members of the reactor staff and RSC were notified by email on December 24, 2018 at approximately 10:53 AM CDT. The suspension of operations was effective in preventing further LCO violations.

#### Summary of Findings

The main cause of this reportable occurrence was an inadequate procedure to test a TS required SAFETY SYSTEM CHANNEL in the appropriate mode. The insufficient procedure was likely due to confusion and lack of understanding the multiple interlocks associated with PULSE MODE operations and distinguishing interlocks currently required by TS. A test of the CONTROL ROD (STANDARD) position interlock by the Reactor Supervisor showed it to be operable and no operational history would suggest it was non-functioning otherwise.

#### Additional Corrective Actions

The following actions will be taken:

1. Reactor staff review of the reportable occurrence at a staff meeting. Estimated Completion Date: 01/31/2019
2. Reactor staff retraining and debrief on reactor control system. Estimated Completion Date: 01/31/2019

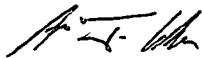
3. RSC review of the reportable occurrence. Estimated Completion Date: 01/11/2019
4. RSC review and approval of revised interlock testing procedure. Estimated Completion Date: 01/11/2019
5. Retest of interlocks implementing revised testing procedure. Following procedure approval by RSC

Resumption of operations will only occur following RSC approval.

Please contact me if additional information is required.

I swear under penalty of perjury that the foregoing is true and correct.

Regards,



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