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U.S. Nuclear Regulatory Commission
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Subject: McGuire Nuclear Station, Unit 1
Docket No. 50-369
Licensee Event Report 369/2005-05, Revision 0
Problem Investigation Process (PIP) M-05-04437

Pursuant to 10 CFR 50.73, Sections (a)(1) and (d), attached is Licensee Event Report (LER) 369/2005-05, Revision 0.

On September 21, 2005, while McGuire Nuclear Station Unit 1 was in Mode 6, all source range neutron flux monitors became inoperable when the annunciator alarm circuitry failed. In addition, core alterations commenced on September 22, 2005 while the source range neutron flux monitors were inoperable. The inability of the required source range monitors to generate an audible high flux at shutdown alarm was not discovered until September 23, 2005. All other Control room source range neutron flux indications were functioning properly during this period. This report is being submitted in accordance with 10 CFR 50.73 (a)(2)(i)(B) as a condition prohibited by Technical Specifications (TS).

This event was determined to be of no significance to the health and safety of the public. There are no regulatory commitments contained in the LER.

JP Hamell /for

G. R. Peterson

Attachment

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NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 06-30-2007

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LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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4. TITLE
Inoperable source range neutron flux monitors during mode 6 and core alterations.

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
09	21	2005	2005	- 005 -	00	11	21	2005	FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE	6
10. POWER LEVEL	000

	20.2201(b)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(B)		50.73(a)(2)(ix)(A)
	20.2201(d)		20.2203(a)(4)		50.73(a)(2)(iii)		50.73(a)(2)(x)
	20.2203(a)(1)		50.36(c)(1)(i)(A)		50.73(a)(2)(iv)(A)		73.71(a)(4)
	20.2203(a)(2)(i)		50.36(c)(1)(ii)(A)		50.73(a)(2)(v)(A)		73.71(a)(5)
	20.2203(a)(2)(ii)		50.36(c)(2)		50.73(a)(2)(v)(B)		OTHER Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iii)		50.46(a)(3)(ii)		50.73(a)(2)(v)(C)		
	20.2203(a)(2)(iv)		50.73(a)(2)(i)(A)		50.73(a)(2)(v)(D)		
	20.2203(a)(2)(v)	x	50.73(a)(2)(i)(B)		50.73(a)(2)(vii)		
	20.2203(a)(2)(vi)		50.73(a)(2)(i)(C)		50.73(a)(2)(viii)(A)		
	20.2203(a)(3)(i)		50.73(a)(2)(ii)(A)		50.73(a)(2)(viii)(B)		

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
Reza Djali, Regulatory Compliance	704-875-4228

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
D	IB	ANN	B230	YES	B	IB	ANN	B230	YES

14. SUPPLEMENTAL REPORT EXPECTED			15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
YES (If yes, complete 15.EXPECTED SUBMISSION DATE).	X	NO				

16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

Unit Status: At the start of the event, Unit 1 was in Mode 6 (Refueling) at 0% power, and Unit 2 in Mode 1 (Power Operation) at 100% power.

Event Description: On September 21, 2005, while Unit 1 was in Mode 6 all source range neutron monitors became inoperable when annunciator alarm circuitry failed. Subsequently, on September 22, 2005 core alteration activities commenced with these monitors inoperable. The inability of the required source range monitors to generate an audible high flux at shutdown alarm was not discovered until September 23, 2005. All other Control room source range neutron flux indications were functioning properly during this period. This event, which constitutes conditions prohibited by Technical Specifications, was determined to be of no significance to the health and safety of the public.

Event Cause: The causes of this event are attributed to an inadequate Operator Aid Computer (OAC) alarm response procedure, and the common alarm circuitry of the high flux at shutdown.

Corrective Action: Further core alterations were suspended while repairs were made to the annunciator system. Procedural enhancements will be made to ensure a more prescriptive OAC alarm response. Redundant and diverse alarms will be provided for the high flux at shutdown circuitry via the Operator Aid Computer. The source range neutron flux monitor procedures will be enhanced to clarify required features for operability of the components, and Operations training will be strengthened to emphasize the importance of annunciators on operability of components.

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17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

BACKGROUND

Applicable Energy Industry Identification (EIIS) system and component codes are enclosed within brackets. McGuire unique system and component identifiers are contained within parentheses.

Nuclear Instrumentation System [IG] (ENB):

The source range neutron flux monitors are used during refueling operations to monitor the core reactivity condition. The installed source range neutron flux monitors are part of the Nuclear Instrumentation System [IG] (ENB); NIS, and the Wide Range Neutron Flux Monitoring System; Gamma-Metrics. Source range indication is provided via the source range channels and Gamma-Metrics shutdown monitors using detectors located external to the reactor vessel. These detectors monitor neutrons leaking from the core. The NIS source range channels are BF3 detectors while Gamma-Metrics are fission chambers. These instruments provide continuous visible count rate indication in the control room and an audible high flux alarm in the control room to alert operators to a possible dilution accident.

McGuire Technical Specification (TS) 3.9.3 Nuclear Instrumentation:

TS 3.9.3 specifies that two source range neutron flux monitors shall be operable in Mode 6. The two required source range neutron flux monitors may consist of a combination of NIS source range monitors.
As per TS 3.9.3 Condition A, with one required source range neutron flux monitor inoperable, core alterations shall be suspended, and any operation that would cause an introduction of coolant into the Reactor Coolant System (RCS) with boron concentration less than required to meet the boron concentration of the RCS, the refueling canal, and the refueling cavity as stated in Core Operating Limit Report (COLR) be suspended immediately. When two required source range neutron flux monitors become inoperable, TS 3.9.3, condition B states to initiate action to restore one source neutron flux monitor to operable status and perform SR 3.9.1.1 to ensure boron concentration in RCS, the refueling canal, and the refueling cavity is within the limits specified in COLR every 12 hours.

TS Surveillance Requirement (SR) 3.9.3.2 requires a channel calibration to be performed every 18 months. The channel calibration ensures the channel will respond within the required range and accuracy to a known change in neutron population. The channel calibration shall encompass the entire channel, including the required sensor, alarm, interlock, display, and trip functions.

Thus a source range channel will be rendered inoperable when its alarm function is disabled.

The Channel Operational Test (COT) is performed every 92 days per Reactor Trip System (RTS) instrumentation SR 3.3.1.8. Although TS 3.3.1 is not applicable in mode 6, the COT is performed at the prescribed frequency. This test injects a simulated signal into the channel as close to the sensor as practical in order to verify the operability of required alarm, interlock, and trip functions and ensures they are within required range and accuracy.

Main Control Board Annunciator System [ANN] (EMB)

The main control board annunciator system [ANN](EMB) provides alarm indication for plant parameters. The alarm condition is typically indicated by a flashing window and an audible sound (horn) to draw the operator's attention. This system is strictly for plant monitoring and provides no automatic action. With the exception of the annunciator panel 1AD-14 and 1AD-15, all other annunciators are non safety. The high flux at shutdown annunciator is located on the annunciator panel 1AD-2.

Operator Aid Computer [None] (IKE)

The Operator Aid Computer [None](IKE) provides indications and alarms for plant parameters. The alarm condition is indicated by an audible sound (horn) along with a new entry into the alarm log screen on the computer display to draw the operator's attention. The alarming parameter can be interrogated to identify alarm limits, list of responses to be taken to return parameter to normal status, setpoints, description, and references. This system is non-safety and is strictly for monitoring and provides no automatic action.

EVENT DESCRIPTION

Note: All events are shown in the approximate sequence in which they occurred. All times are approximate.

- At 06:24 on September 20, 2005, prior to entry into Mode 6, Operations issued removal addendum to Removal and Restoration (R&R) 05-1909 for procedure OP/1/A/6100/SD-21; "Mode 6 checklist". Operation tagged and

locked closed the reactor makeup water isolation to the chemical and volume control system (NV).

- At 03:20 on September 21, 2005 Unit 1 entered Mode 6 (Refueling).
- Minimum boron concentration of the reactor coolant system, the refueling canal, and the refueling cavity is given as 2675 parts per million (ppm) in the COLR.
- At 04:00 on September 21, 2005 the reactor coolant boron concentration was 2794 ppm.
- Around 21:08 on September 21, 2005 while performing pre-modification installation activities, Maintenance was tracing wiring in the back of the annunciator cabinet. In doing so, cables and wiring were being moved around.
- At 21:08 on September 21, 2005 Operator Aid Computer (OAC) alarm "U-1 ANNUNCIATOR POWER SUPPLY TROUBLE" was received along with several other main control board annunciators on panel 1AD-1 and 1AD-2. The annunciator alarm responses were followed. The annunciator panel 1AD-1 did not light when tested as opposed to the annunciator panel 1AD-2 which did light when tested. A work request was generated to repair the deficiency on annunciator panel 1AD-1. Since the high flux at shutdown annunciator is located on 1AD-2 panel, Operations had no reason to question the high flux at shutdown alarm's operability.

  Note that the OAC alarm response did not have any reference to the operability of equipment represented on the main control board annunciator panels.
- At 04:00 on September 22, 2005 the refueling canal boron concentration was 2718 ppm.
- At 18:00 on September 22, 2005 the COT was completed on NIS source range 1N-31. While performing this COT, the high flux at shutdown annunciator did not function. The inability of the alarm to function was attributed to outstanding work against the annunciator panel trouble stated above. The operability of NIS source range neutron flux monitor due to inability to generate audible high flux at shutdown alarm was not realized at this time.

  Note that the COT was on its routine scheduled time. Its acceptance criteria were not prescriptive enough and allowed for deviation based on existing plant conditions. The failure of the annunciator alarm was not communicated to the control room staff, therefore Operations had no reason to question the high flux at shutdown alarm's operability at

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this time. This was a missed opportunity to find the high flux at shutdown alarm malfunction.

- At 20:40 on September 22, 2005 core alterations commenced when Maintenance began unlatching control rods.
- At 05:15 on September 23, the upper internals were removed, ending the first phase of core alterations. The next core alteration activity would be core offload which was scheduled on the following day.
- At 10:48 On September 23, 2005 during preparation for fuel offload, the operability of Gamma-Metrics 1N-51 and 1N-52 was questioned by Operations due to outstanding alarms on 1AD-2. When the COT on 1N-51 was performed to demonstrate operability of 1N-51, Maintenance noted that the high flux at shutdown annunciator did not alarm.
- At 11:20 on September 23, 2005 Engineering concluded that all source range neutron flux monitors were inoperable because, by design, they all feed a single annunciator alarm window which was not functioning at this time. Furthermore, their investigation identified channel calibration procedures for source range neutron flux monitors were deficient in that they did not ensure the high flux at shutdown alarm would function.
- At 11:53 on September 23, 2005 Operations declared all four source ranges inoperable and entered Required Actions A, and B of TS 3.9.3.
- At 11:55 on September 23, 2005 refueling canal boron concentration was 2753 ppm.
- At 14:30 on September 23, 2005 NC system boron concentration was 2749 ppm.
- By 15:22 on September 23, 2005 Maintenance had identified a blown fuse as the cause of the annunciator panel failure and had repaired this deficiency. Subsequently, the COT was performed successfully on NIS source range 1N-32, and Gamma-Metrics 1N-51 for post maintenance testing to ensure proper alarm function. Consequently, Operations declared 1N-32 and 1N-51 operable.
- At 15:41 on September 23, 2005 core alterations; core offload, resumed.

On September 21, 2005 at 21:08 when the annunciator panel failed, all source range neutron flux monitors became inoperable due to the inability of the required source range monitors to generate an audible high flux at shutdown alarm. The required source range neutron monitors remained inoperable until 15:22 on September 23, 2005. At 20:40 on September 22, 2005 core alterations

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commenced when Maintenance started unlatching the control rods. Given that the applicable Required Actions A and B of TS 3.9.3 and their respective Completion Times were not satisfied during this period, this represented a condition prohibited by plant Technical Specifications reportable as per the requirements of 10 CFR 50.73 (a)(2)(i)(B).

CAUSAL FACTORS

A cause evaluation has concluded the inability to discover the failed audible high flux at shutdown alarm was due to an inadequate OAC alarm response procedure. Another cause leading to this event is the common alarm circuitry for the high flux at shutdown alarm.

CORRECTIVE ACTIONS

Immediate:

- Required Actions A, and B of TS 3.9.3 were entered upon discovery of the inoperable source range neutron flux monitors.

Subsequent:

- Investigation into the cause of the annunciator power supply failure was initiated, and repaired. The required number of source range neutron flux monitors were returned to operable status.
- The channel calibration procedure for the NIS source range neutron flux monitors was revised to ensure high flux at shutdown alarm will be checked.

Planned:

- The OAC alarm response for annunciator power supply failure will be enhanced to ensure operability of components represented on the annunciator panel is considered.
- Redundant and diverse alarms will be provided for the high flux at shutdown circuitry via the OAC. Appropriate station procedures will be updated to ensure the alarms are functioning prior to the mode of applicability.
- The Gamma-Metrics neutron flux monitor procedure will be enhanced to ensure all required functions for operability of the monitors including the alarms are properly verified.

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- The COT procedure for the NIS source range neutron monitors will be enhanced to ensure acceptance criteria clearly states required functions for operability of the source range neutron flux channels.
- The Operations training program will be strengthened to emphasize the importance of annunciators on operability of components.

SAFETY ANALYSIS

UFSAR Chapter 15.4.6, "Chemical and Volume Control System Malfunction that Results in a Decrease in Boron Concentration in the Reactor Coolant", provides an analysis of a boron dilution event for the McGuire Nuclear Station while in Mode 6. The result of the analysis assumes that unborated water is delivered to the Reactor Coolant System and manual action terminates the event after receipt of a high flux at shutdown alarm.

The boron concentration in the Reactor Coolant System was verified to be within the COLR limits before and after the high flux at shutdown annunciator failure event. During this period the Reactor Makeup water to NV isolation valve was procedurally locked closed. Any other unborated water addition sources were under strict procedural control to ensure the required boron concentration stated in the COLR would not be violated.

The UFSAR analysis for dilution during refueling results in Table 15-19 show that a dilution in Mode 6 would progress over a time period of more than an hour. The OAC was available during the event and would have provided the operator with multiple indications and diverse alarms. Aside from high flux at shutdown annunciator, all other source range neutron flux monitoring indicators and alarms such as high flux at shutdown bistable, containment evacuation alarm, audible source range counts in the control room, and Gamma-Metrics high flux at shutdown LED were functioning properly. Thus, considering the progression of a dilution over a time period of more than an hour, the operators would have had sufficient time to mitigate the dilution event.

In conclusion, the overall safety significance of this event was determined to be minimal and there was no impact on the health and safety to the public.

ADDITIONAL INFORMATION

A three year search of the McGuire corrective action database (PIP) and LER database revealed no other failure of the audible high flux at shutdown annunciator alarm circuitry; therefore, this event is not recurring.