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March 24, 2003

U.S. Nuclear Regulatory Commission  
Document Control Desk  
Washington, D.C. 20555

Subject: McGuire Nuclear Station, Unit 1  
Docket No. 50-369  
Licensee Event Report 369/03-01, Revision 0

Pursuant to 10 CFR 50.73, Sections (a)(1) and (d), attached is Licensee Event Report (LER) 369/03-01, Revision 0.

On January 24, 2003, with Unit 1 at 100 percent power, McGuire experienced a failure of the Unit 1 Refueling Water Storage Tank (FWST) level instrumentation designed to initiate automatic swapover of the Emergency Core Cooling System (ECCS) suction from the FWST to the Containment Sump. During an event requiring ECCS operation, this condition could have prevented fulfillment of this ECCS safety function.

Probabilistic risk assessment has determined this event to be of no significance to the health and safety of the public. This LER is being submitted as per the requirements of 10 CFR 50.73 (a)(2)(v)(B), 10 CFR 50.73 (a)(2)(v)(D), 10 CFR 50.73 (a)(2)(vii), and 10 CFR 50.73 (a)(2)(i)(B). There are no regulatory commitments contained in this LER.

D. M. Jamil

Attachment

JE22

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cc: Mr. L. A. Reyes  
U.S. Nuclear Regulatory Commission  
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Atlanta Federal Center  
61 Forsyth St., SW, Suite 23T85  
Atlanta, GA 30323

INPO Records Center  
700 Galleria Parkway  
Atlanta, GA 30339

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U.S. Nuclear Regulatory Commission  
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<b>1. FACILITY NAME</b> McGuire Nuclear Station, Unit 1	<b>2. DOCKET NUMBER</b> 05000 369	<b>3. PAGE</b> 1 OF 9
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**4. TITLE**  
 Failure of Refueling Water Storage Tank level instrumentation during cold weather due to sensing line heat trace and insulation deficiencies.

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
01	24	03	2003	- 001 -	00	03	24	2003	FACILITY NAME	DOCKET NUMBER

<b>9. OPERATING MODE</b>	1	<b>11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)</b>								
<b>10. POWER LEVEL</b>	100%	<input type="checkbox"/> 20 2201(b)	<input type="checkbox"/> 20 2203(a)(3)(ii)	<input type="checkbox"/> 50 73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)					
		<input type="checkbox"/> 20 2201(d)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50 73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(x)					
		<input type="checkbox"/> 20 2203(a)(1)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50 73(a)(2)(iv)(A)	<input type="checkbox"/> 73.71(a)(4)					
		<input type="checkbox"/> 20 2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50 73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(5)					
		<input type="checkbox"/> 20 2203(a)(2)(ii)	<input type="checkbox"/> 50.36(c)(2)	<input checked="" type="checkbox"/> 50 73(a)(2)(v)(B)	<input type="checkbox"/> OTHER Specify in Abstract below or in NRC Form 366A					
		<input type="checkbox"/> 20 2203(a)(2)(iii)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(C)						
		<input type="checkbox"/> 20 2203(a)(2)(iv)	<input type="checkbox"/> 50 73(a)(2)(i)(A)	<input checked="" type="checkbox"/> 50 73(a)(2)(v)(D)						
		<input type="checkbox"/> 20.2203(a)(2)(v)	<input checked="" type="checkbox"/> 50 73(a)(2)(i)(B)	<input checked="" type="checkbox"/> 50.73(a)(2)(vii)						
<input type="checkbox"/> 20.2203(a)(2)(vi)	<input type="checkbox"/> 50 73(a)(2)(i)(C)	<input type="checkbox"/> 50 73(a)(2)(viii)(A)								
<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50 73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)								

**12. LICENSEE CONTACT FOR THIS LER**

<b>NAME</b> Julius W Bryant, Regulatory Compliance	<b>TELEPHONE NUMBER (Include Area Code)</b> 704-875-4162
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**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
B6a	DA	LIC	R369	YES					

<b>14. SUPPLEMENTAL REPORT EXPECTED</b>	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO	<b>15. EXPECTED SUBMISSION DATE</b>	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).						

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

**Unit Status:** At the time of the event, Unit 1 and Unit 2 were in Mode 1 (Power Operation) at 100 percent power.

**Event Description:** On January 24, 2003, Unit 1 experienced a failure of the Refueling Water Storage Tank (FWST) level instrumentation designed to initiate automatic swapover of the Emergency Core Cooling System (ECCS) suction from the FWST to the Containment Sump. While in this condition, automatic swapover of the ECCS suction from the FWST to the Containment Sump would not have occurred during an event requiring ECCS operation. This condition could have prevented fulfillment of this ECCS safety function. The level instrumentation failed due to frozen sensing lines. Annunciators immediately alerted operators who operated heat tracing in manual override such that continuous heat was applied to the sensing lines. These actions restored the Unit 1 FWST level instrumentation to operable status. This event was not significant with respect to the health and safety of the public.

**Event Cause:** Design deficiencies with the sensing lines heat trace system and configuration control deficiency with the sensing lines insulation.

**Corrective Action:** Redesign of the Unit 1 & 2 FWST level instrumentation heat trace systems. Revise heat trace system design documentation and ensure conformance. Insulate sensing lines in accordance with design documents. Revise FWST heat trace related configuration control documents.

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

**BACKGROUND**

The following information is provided to assist readers in understanding the event described in this LER. Applicable Energy Industry Identification (EIIS) system and component codes are enclosed within brackets. McGuire unique system and component identifiers are contained within parentheses.

McGuire Nuclear Station Unit 1 is a four loop Westinghouse Pressurized Water Reactor.

Refueling Water Storage Tank [DA-TK] (FWST):

The Unit 1 Refueling Water Storage Tank is a component of McGuire's Emergency Core Cooling System (ECCS). Its purpose is to supply borated water during the injection phase of a Loss of Coolant Accident (LOCA) to ensure the ECCS system can perform its safety function of mitigating the consequences of a LOCA. The FWST tank capacity shall meet the following criteria:

- Following a LOCA, the volume of borated refueling water is sufficient to assure no return to criticality with Unit 1 at cold shutdown and no control rods inserted into the core.
- The volume is sufficient to refill the Unit 1 reactor vessel above the reactor nozzles after a LOCA.
- The volume of borated water in the Unit 1 containment will be sufficient to permit the initiation of the recirculation phase following a LOCA.

FWST Level Instrument Loops [DA-LIC] (FWLP):

1FWLP5000, 1FWLP5010, and 1FWLP5020 are Unit 1 FWST level instrument loops which function in a 2 out of 3 logic to produce an FWST low level signal. In conjunction with a safety injection signal (SI), the low level signal (180 inches tank level decreasing) will initiate automatic swapover of the ECCS suction from the Unit 1 FWST to the Unit 1 Containment Sump. This provides protection against a loss of net positive suction head (NPSH) for the ECCS pumps and helps ensure the ECCS safety function can be performed. 1FWLP5000 and 1FWLP5010 each have a dedicated sensing line from the Unit 1 FWST. 1FWLP5020 shares a common sensing line with non-safety Unit 1 FWST level instrument loop 1FWLP5341.

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**EVENT DESCRIPTION**

At the time of the event on January 24, 2003, Unit 1 was in Mode 1 at 100 percent power. All Unit 1 emergency core cooling systems and Unit 1 emergency diesel generators were operable. Outside ambient air temperatures averaged less than 32 degrees Fahrenheit for the 14 days prior to the event. For several hours prior to the event, outside ambient air temperatures averaged less than 10 degrees Fahrenheit. Historically, these were much colder temperatures than normally experienced at the McGuire Station.

**APPROXIMATE TIMELINE:**

- 1/23/2003 at 2339 Unit 1 FWST Hi Level Annunciator received. FWST Level indication associated with 1FWLP5020 and 1FWLP5341 observed to be failed high. Unit 1 was in the TS 3.3.2 Condition associated with one inoperable FWST level instrument loop (1FWLP5020). Consequently, the inoperable channel was placed in trip as required by TS 3.3.2. Work requests were written to investigate the cause and initiate actions to restore 1FWLP5020 to operable status.
- 1/24/2003 at 0045 FWST Level indication associated with 1FWLP5010 observed to be failed high. Unit 1 was in TS 3.0.3 due to more than one inoperable FWST level instrument loop (1FWLP5020 and 1FWLP5010). Investigation of event continued.
- 1/24/2003 at 0102 FWST Level indication associated with 1FWLP5000 observed to be failed high. Investigation of event continued.
- 1/24/2003 at 0200 Heat trace controller for 1FWLP5000, 1FWLP5010, 1FWLP5020, and 1FWLP5341 placed in manual override to apply continuous heat to the sensing lines for the Unit 1 FWST level instrument loops.
- 1/24/2003 at 0236 Operators observed that Unit 1 FWST level indications began to return to expected values.

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1/24/2003 at 0342 1FWLP5000 and 1FWLP5010 were returned to operable status. Exited TS 3.0.3 prior to any Unit 1 power reduction.

1/24/2003 at 1152 1FWLP5020 was returned to operable status. Exited TS 3.3.2. 1FWLP5341 returned to service.

Upon reaching the Unit 1 FWST low level setpoint during a LOCA coincident with a SI signal, 1FWLP5000, 1FWLP5010, and 1FWLP5020 initiate automatic swapper of ECCS suction from the Unit 1 FWST to the Unit 1 Containment Sump. This provides protection against a loss of NPSH for the ECCS pumps which helps ensure the ECCS safety function can be performed. As shown in the above timeline, at least two of these level instrument loops were simultaneously in a failed high condition on January 24, 2003 from 0045 until 0342 hours. With two FWST level instrument loops failed high, Unit 1 was not capable of achieving the 2 out of 3 logic needed to generate an FWST low level signal. This condition could have prevented fulfillment of the ECCS safety function which is reportable under the requirements of 10 CFR 50.73(a)(2)(v)(B) and 10 CFR 50.73(a)(2)(v)(D). This event also represented a common-cause inoperability of independent channels reportable as per 10 CFR 50.73(a)(2)(vii). Finally, during this event, more than one of the safety related Unit 1 FWST level instrument loops were inoperable at the same time. Since TS 3.3.2 provides no associated required action for this condition, Unit 1 was in a condition prohibited by TS's for which the provisions of TS 3.0.3 were applicable for greater than one hour. This is reportable under the requirements of 10 CFR 50.73(a)(2)(i)(B).

**CAUSAL FACTORS**

Inspection of sensing lines and heat trace system components associated with 1FWLP5000, 1FWLP5010, 1FWLP5020, and 1FWLP5341 identified the design and configuration control deficiencies listed below:

**Design Deficiencies:**

- Some thermocouples were mounted in close proximity to the respective heat trace cables. Thus, when energized, the heat trace cables unduly influenced the thermocouple indication. Therefore, the temperature measured by the thermocouples was higher than the actual temperature of the associated sensing line. This caused the heat trace controller to

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prematurely de-energize the associated heat trace cables, resulting in reduced heat input to the sensing line. This degraded the ability of the heat trace system to control sensing line temperature.

- Design documentation does not specify a method to ensure the heat trace cables maintained adequate contact along the entire length of the FWST level instrument sensing lines. Consequently, some portions of the heat trace cable were not adequately contacting the respective sensing line. This degraded the ability of the heat trace system to control sensing line temperature.

**Configuration Control Deficiency:**

- The Unit 1 FWST level instrument loop sensing lines were not insulated in accordance with applicable design documents.

The above deficiencies, in conjunction with below freezing outside ambient temperatures on January 24, 2003, resulted in freezing of the sensing lines for 1FWLP5000, 1FWLP5010, 1FWLP5020, and 1FWLP5341. A frozen sensing line manifests itself as a failed high FWST level signal.

**CORRECTIVE ACTIONS**

**Immediate:** The normal and emergency heat trace controllers for 1FWLP5000, 1FWLP5010, 1FWLP5020, and 1FWLP5341 were placed in manual override, providing continuous heating to both heat trace cables for each level instrument loop sensing line. Subsequent to these actions, Unit 1 FWST level instrumentation was restored to operable status.

Verified Unit 2 FWST level indication was indicating properly. Observed that the heat trace control panel readings and displays for the Unit 2 FWST level instrument loops were indicating properly. Surveillance frequency of the Unit 1 and Unit 2 FWST level instrument loops heat trace systems was increased.

**Subsequent:** Guidance to operators was put in place to monitor temperatures and to operate the normal and emergency heat trace controllers for 1FWLP5000, 1FWLP5010, 1FWLP5020, and 1FWLP5341 to prevent freezing of the Unit 1 and Unit 2 FWST level instrument loop sensing lines.



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Restored the insulation and heat trace system for the Unit 1 FWST level instrument loop sensing lines to as-designed conditions.

Using thermography, a non-intrusive inspection was performed on the Unit 2 FWST level instrument loop sensing lines. When compared to thermography readings for the Unit 1 sensing lines, the Unit 2 thermography results provided assurance that the insulation and heat trace system for the Unit 2 sensing lines was adequate.

Evaluated instrumentation associated with other Unit 1 or Unit 2 systems for design or configuration control deficiencies. No deficiencies were identified that might render the sensing lines for other instrumentation susceptible to freezing.

**Planned:**

The heat trace systems for the Unit 1 and Unit 2 FWST level instrument loops will be redesigned as needed to ensure the heat trace systems control sensing line temperatures such that adequate margin above freezing is maintained.

Design documentation associated with the heat trace systems for the Unit 1 and Unit 2 FWST level instrument loops will be revised as needed to ensure the heat trace cables maintain adequate contact along the entire length of the level instrument sensing lines. The heat trace systems will be made to conform to this revised design documentation.

Configuration control documents associated with Unit 1 and Unit 2 FWST activities will be revised as needed to ensure the FWST level instrument loops sensing lines remain insulated in accordance with applicable design documents.

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**SAFETY ANALYSIS**

A probabilistic risk assessment concerning the period of time that the Unit 1 FWST level instrument loops were inoperable was performed. During this time, automatic swapover of the ECCS suction from the Unit 1 FWST to the Unit 1 Containment Sump would not have occurred during an event requiring ECCS operation. If an event had occurred, operators would have had to monitor Unit 1 Containment Sump level and ECCS parameters and manually swap ECCS suction from the FWST to the Containment Sump.

Due to the lower likelihood of a large LOCA initiating event, the risk during this condition was found to be dominated by the possibility of a small or medium LOCA during the period that the Unit 1 FWST level instrument loops were inoperable. A quantitative analysis was performed which credited the ability of the operators to recognize that the level instruments are not responsive, monitor Containment Sump level and ECCS parameters, and then manually align the ECCS to the Unit 1 Containment Sump. This analysis determined that the conditional core damage frequency (CCDF) for this event is below the threshold value which would represent a significant increase in conditional core damage probability (CCDP).

LOCAs are not significant contributors to the large early release frequency. The estimated conditional large early release probability associated with this event is not significant enough to represent a risk to the public.

Based upon the above, the risk attributable to the short period of time that the Unit 1 FWST level instrument loops were inoperable is not significant with respect to the health and safety of the public.

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**ADDITIONAL INFORMATION**

A review of the McGuire corrective action database identified the following previous similar occurrences since 1990:

- In 1996, Unit 2 FWST level instrumentation was rendered inoperable during cold weather. In that case, the FWST level transmitters failed when strip heaters and thermostats in the panels housing the transmitters did not function properly. The cause was determined to be lack of a formal program to monitor proper operation of the FWST level transmitter panel strip heaters and thermostats. Although similar instrumentation failed during that event, the circumstances, cause, and corrective actions differed from the event described in this report.
  
- In 2000, one of the Unit 1 FWST level instrument loops failed due to a frozen sensing line. The cause was determined to be separation of insulation from a small portion of the sensing line. That event was not attributed to a design deficiency or a failure to insulate in accordance with applicable design documents. Consequently, the cause and corrective actions differed from the event described in this report.