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Serial No: MNS-14-087

November 24, 2014

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

10 CFR 50.73

Subject: Duke Energy Carolinas, LLC  
McGuire Nuclear Station (MNS), Unit 1  
Docket No. 50-369, Renewed License No. NPF-9  
Licensee Event Report 369/2014-02, Revision 0  
Problem Investigation Process Number M-14-09052

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report (LER) 369/2014-02, Revision 0, regarding American Society of Mechanical Engineers (ASME) rejectable flaws discovered on the MNS Unit 1 Safety Injection piping.

This report is being submitted in accordance with 10 CFR 50.73(a)(2)(ii)(A). This event is considered to be of no significance with respect to the health and safety of the public.

There are no regulatory commitments contained in this LER.

If questions arise regarding this LER, please contact Brian Richards of Regulatory Affairs at 980-875-5171.

Sincerely,

Steven D. Capps

Attachment

IE22  
NRR

U.S. Nuclear Regulatory Commission  
November 24, 2014  
Page 2

cc: V. M. McCree  
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U.S. Nuclear Regulatory Commission  
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**LICENSEE EVENT REPORT (LER)**

(See page 2 for required number of digits/characters for each block)

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollections.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

**1. FACILITY NAME**

McGuire Nuclear Station, Unit 1

**2. DOCKET NUMBER**

05000- 369

**3. PAGE**

1 OF 6

**4. TITLE**

Degraded Condition due to Rejectable Flaws on 1B and 1C Safety Injection Lines

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
09	27	2014	2014	02	0	11	24	2014	None	
9. OPERATING MODE			11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)							
No Mode			<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> 50.73(a)(2)(vii)				
			<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input checked="" type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)				
			<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)				
			<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)				
			<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)				
			<input type="checkbox"/> 20.2203(a)(2)(iii)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(4)				
			<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(5)				
			<input type="checkbox"/> 20.2203(a)(2)(v)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> OTHER				
			<input type="checkbox"/> 20.2203(a)(2)(vi)	<input type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(v)(D)	<input type="checkbox"/> Specify in Abstract below or in NRC Form 366A				
10. POWER LEVEL										
000										

**12. LICENSEE CONTACT FOR THIS LER**

LICENSEE CONTACT

Brian H. Richards, Senior Nuclear Engineer

TELEPHONE NUMBER (Include Area Code)

980-875-5171

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
X	BQ	PSP	X000	Y					

**14. SUPPLEMENTAL REPORT EXPECTED**

YES (If yes, complete EXPECTED SUBMISSION DATE)  NO

**15. EXPECTED SUBMISSION DATE**

MONTH DAY YEAR

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

While Unit 1 was in a refueling outage on September 26, 2014, manual ultrasonic (UT) examinations identified indications on Safety Injection (SI) system piping. On September 27, phased-array UT techniques confirmed two indications as rejectable flaws. Because the flaws were rejectable under American Society of Mechanical Engineers (ASME) Code requirements, this event is reportable as a degraded condition in accordance with 10CFR50.73(a)(2)(ii)(A). Stress analysis showed that the cracks would not have prevented the piping from performing its safety function, so this event did not impact public health and safety.

The cause of both flaws is a legacy issue of previous leakage past valve 1NI-3 (Unit 1 Cold Leg Injection Isolation) creating a high frequency thermal cycle condition. When combined with original construction deficiencies in the affected lines, this condition initiated the fatigue cracks identified during the UT examinations.

Actions were taken to repair the SI piping on Unit 1 and to inspect other susceptible lines before the unit restarted from its refueling outage. As part of planned corrective actions, valves with the potential to cause cold water in-leakage to these lines will be monitored for leakage.

Reference previous McGuire Unit 2 LER 370/2014-01, Revision 1, dated July 24, 2014.



**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

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1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE	
McGuire Nuclear Station, Unit 1	05000369	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	2	OF 6
		2014	- 02	- 00		

**17. NARRATIVE**

**BACKGROUND:**

Applicable Energy Industry Identification [EII] system and component codes are enclosed within brackets. McGuire-specific system and component identifiers are contained within parentheses.

**Safety Injection System [BQ](NI):**

The NI system is designed to provide Emergency Core Cooling for the Reactor Coolant System [AB](NC) in order to prevent fuel clad melting to assure that the core remains in place and substantially intact in case of an accident. Each unit's NI system contains an "A" and "B" train pump that both actuate automatically upon a safety injection signal following low pressurizer pressure or high containment pressure.

**Chemical and Volume Control System [CB](NV):**

The NV system is designed to maintain required water inventory in the NC system; maintain seal-water injection flow to the reactor coolant pumps; control water chemistry conditions; and provide emergency core cooling (part of the system shares piping with the NI system).

The two flaws discovered in the Unit 1 NI piping were reported per 10 CFR 50.72 (b)(3)(ii)(A), "Any event or condition that results in the condition of the nuclear power plant, including its principle safety barriers, being seriously degraded." An Emergency Notification System report was made to the Nuclear Regulatory Commission (NRC) on September 27, 2014, at 2009 hours. A 10 CFR 50.73 (a)(2)(ii)(A) licensee event report is also required due to this degraded condition.

These flaws were detected during extent of condition examinations performed as a result of a flaw previously discovered on McGuire Unit 2 and documented in LER 370/2014-01, Revision 1. The previous Unit 2 flaw was found during normal inspections required by the Non-Destructive Examination (NDE) Augmented Examination program, which was driven by MRP-146, "Thermal Fatigue in Normally Stagnant Non-Isolable Reactor Coolant System Branch Lines." MRP-146 is an Electric Power Research Institute (EPRI) document that provides guidance on the mechanisms causing the initiation and growth of thermal fatigue cracks. Non-isolable branch lines connected to the NC system are susceptible to high cycle thermal fatigue if exposed to specific operational conditions and configurations.

One flaw was found on the 1.5 inch nominal diameter NI line near where it is connected to the 27.5 inch inside diameter 1B NC cold leg piping. The second flaw was found on the 1.5 inch nominal diameter NI line near where it is connected to the 27.5 inch inside diameter 1C NC cold leg piping. Neither of these NI lines was scoped into the MRP-146 program due to size and piping orientation; rather, the lines were included in the extent of condition examinations due to the similarities in application to the Unit 2 piping previously found to be flawed.

1NI-3 (Unit 1 Cold Leg Injection Isolation), 1NI-9A (Unit 1 NV Pumps to NC Cold Legs Containment Outside Isolation), and 1NI-10B (Unit 1 NV Pumps to NC Cold Legs Containment Outside Isolation) are valves in parallel flowpaths upstream of the flaw locations. Turbulent swirl in the NI connections to the NC cold leg piping, in concert with cold water leakage (from the NV system) past any of these valves, can lead



**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

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1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE	
McGuire Nuclear Station, Unit 1	05000369	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	3	OF 6
		2014	- 02	- 00		

**17. NARRATIVE**

to thermal fatigue cracking. Due to the valve design, leakage past 1NI-9A and 1NI-10B is not expected. Based on hydrostatic testing, no leakage past 1NI-9A or 1NI-10B existed when the flaws were discovered. 1NI-9A and 1NI-10B have no leak-by history associated with their operation.

1NI-3, however, has had a history of leakage, and the valve was last replaced in 1995. As part of an extent of condition review following the McGuire Unit 2 event in spring 2014 (reference LER 370/2014-01, Revision 1), acoustic monitoring identified leakage past 1NI-3. An operability determination analyzed the quantity of leakage and found it to be below the critical flow rate for lines susceptible to MRP-146 phenomena. Crack initiation due to thermal stress is not expected below this critical flow rate. Additionally, the 1B and 1C NI nozzles had been previously inspected with no reported indications, and the nozzle configurations were not considered susceptible to MRP-146 per EPRI guidelines.

No significant structures, systems, or components were out of service at the time of discovery such that they contributed to the event.

**EVENT DESCRIPTION:**

On September 26, 2014, while Unit 1 was in a refueling outage (no mode), manual ultrasonic (UT) examination of branch lines connected to the NC system cold leg piping detected flaw-like indications.

Use of phased-array UT techniques on September 27, 2014, confirmed that a circumferential indication on the 1.5 inch nominal diameter NI line connected to the 1B NC cold leg was a rejectable flaw under American Society of Mechanical Engineers (ASME) rules. This flaw was identified as a crack approximately 1.25 inches long and located on the nozzle side of the pipe-to-nozzle weld NCIF-1493. Examinations showed that the flaw was surface-connected to the inner diameter of the piping and that it extended slightly greater than 50% of the piping wall thickness.

Similarly, the phased-array UT techniques confirmed that an axial indication on the 1.5 inch nominal diameter NI line connected to the 1C NC cold leg was a rejectable flaw under ASME rules. This flaw was identified as a crack approximately 1.125 inches long on the piping side of the pipe-to-nozzle weld. It extended into weld NCIF-1615 and through to the 1C NC nozzle. Examinations showed that the flaw was surface-connected to the inner diameter of the piping and that it extended slightly greater than 50% of the piping wall thickness. Two additional axial indications were detected within one inch of the originally reported flaw but were not considered rejectable under ASME rules.

Based on the oxidation to primary surfaces, these flaws may have existed in 2011 when the welds were last examined ultrasonically. However, the exact age of the flaws could not be conclusively established.



**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

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1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE	
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER		
McGuire Nuclear Station, Unit 1	05000369	2014	- 02	- 00	4	OF 6

**17. NARRATIVE**

The relevant sequence of events pertaining to the piping flaws is as follows:

- 9/26/2014 UT examinations identified flaw-like indications on branch lines connected to the NC system
- 9/27/2014 Phased-array UT confirmed reportable flaws on the 1.5 inch nominal diameter NI line to the 1B and 1C NC cold legs
- 10/12/2014 Flaw on 1B NI line was repaired
- 10/13/2014 Flaw on 1C NI line was repaired

**CAUSAL FACTORS:**

The cause evaluation concluded that the causal factors for this event are as follows:

1. A legacy issue with leakage through isolation valve 1NI-3 created the high frequency thermal cycle condition, which initiated the NI piping to the 1B and 1C NC cold leg nozzle fatigue cracks identified in the 2014 UT inspection.
2. Original construction deficiencies produced areas in the affected lines containing remnant stress risers that were susceptible to flaw initiation.

Additionally, based on metallurgical report details, McGuire conservatively assumed that the flaws may have been present at the time of the previous ultrasonic examinations in 2011. Programmatic deficiencies may have affected previous examinations.

**CORRECTIVE ACTIONS:**

Prior to the discovery of these piping flaws on McGuire Unit 1, industry and internal operating experience with previously undetected flaws led to changes to non-destructive examination (NDE) processes and procedures used at McGuire and at other Duke facilities. These changes resulted in greater attention to detail and oversight when performing inspections associated with the NDE program and are similar to recommendations that INPO recently made in IER L4-14-40, "Ultrasonic Examination Reliability Issues." McGuire will continue to pursue corrective actions in concert with Duke Energy fleet to improve the reliability of NDE examinations in response to industry, fleet, and McGuire operating experience.

**Immediate:**

1. Performed ASME Code repair of the 1B and 1C NI lines containing the flaws in accordance with ASME Section III NB Class I.
2. Performed UT examinations on all potentially susceptible piping as determined by the extent of condition review. No other rejectable indications were found.



**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

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1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE	
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER		
McGuire Nuclear Station, Unit 1	05000369	2014	- 02	- 00	5	OF 6

**17. NARRATIVE**

3. Reviewed exams conducted by the individual who conducted the 2011 NDE exams of the affected lines as part of a human performance extent of condition evaluation. Performed re-examination of one additional weld as a result of the review. No other indications were found.
4. Removed valve 1NI-3 and capped the piping, thus eliminating a potential leakage path.
5. Leak-tested valves 1NI-9A and 1NI-10B. No seat leakage was detected.
6. Verified that seismic snubbers were not binding the 1B and 1C NI lines.
7. Verified that vibration levels taken at the NI lines during NV flow testing were acceptable.
8. Notified EPRI of thermal fatigue cracks found in 1.5 inch up-horizontal (UH) lines, which were screened out of the MRP-146 program.

**Planned:**

1. Each Refueling Outage, pressure test unit-specific valves NI-9A and NI-10B to determine and ensure acceptable leakage rates are obtained for the valves. Alternate methods of verification can be used if they provide high confidence of acceptable in-leakage during plant operation.
2. NDE program owner to make program and procedure changes to reduce the risk of human errors in the field.

**SAFETY ANALYSIS:**

The NI piping flaws found on Unit 1 had no impact on public health and safety. A stress analysis concluded that despite the presence of the piping flaws, neither of the 1.5 inch nominal diameter NI piping nozzles would catastrophically fail when exposed to design basis loadings. The analysis further concluded that the piping would not leak under design basis loadings because the flaw would not have breached the wall.



**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
McGuire Nuclear Station, Unit 1	05000369	2014	- 02	- 00	6	OF	6

17. NARRATIVE

ADDITIONAL INFORMATION:

A review of the McGuire corrective action program (PIP) was conducted to determine whether this was a recurring event (i.e., similar event with the same cause code). The only other piping/welding flaw issue associated with thermal fatigue documented within the past five years was PIP M-14-03153. Since the flaws on the 1B and 1C NI lines were examined as part of the extent of condition review stemming from the McGuire Unit 2 piping flaw documented in this PIP, and since there were no failed corrective actions that could have prevented the event, the event documented in this LER is not considered recurring.