Duke Energy®

REGIS T. REPKO
Vice President
McGuire Nuclear Station

Duke Energy
MG01VP / 12700 Hagers Ferry Rd.
Huntersville, NC 28078

980-875-4111
980-875-4809 fax
regis.repko@duke-energy.com

March 21, 2011

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

Subject: Duke Energy Carolinas, LLC
McGuire Nuclear Station, Units 1 and 2
Docket No. 50-369, 50-370
Licensee Event Report 369/2011-01, Revision 0
Problem Investigation Process Number M-11-00329

Pursuant to 10 CFR 50.73 Sections (a) (1) and (d), attached is Licensee Event Report (LER) 369/2011-01, Revision 0, regarding the shutdown of both McGuire operating Units due to entry into Technical Specification Limiting Condition for Operation 3.0.3, caused by the inoperability of all four trains of the Nuclear Service Water (RN) System as a result of RN strainer macro-fouling.

This report is being submitted in accordance with 10 CFR 50.73 (a) (2) (i) (B), an operation prohibited by Technical Specifications and 10 CFR 50.73 (a) (2) (v) (B), any event or condition that could have prevented fulfillment of the safety function.

The completion of the Unit 1 and Unit 2 nuclear plant shutdowns and the resultant Unit 1 Reactor Protection System actuation is being reported separately under McGuire LER 369/2011-02.

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, contact Lee A. Hentz at 980-875-4187.

Sincerely,

Regis T. Repko

Attachment

IE22
NRR

cc: V. M. McCree, Regional Administrator
U.S. Nuclear Regulatory Commission, Region II
Marquis One Tower
245 Peachtree Center Ave., NE, Suite 1200
Atlanta, Georgia 30303-1257

Jon H. Thompson (Addressee Only)
Senior Project Manager (McGuire)
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville , MD 20852-2738

J. B. Brady
Senior Resident Inspector
U.S. Nuclear Regulatory Commission
McGuire Nuclear Station

W. L. Cox III, Section Chief
North Carolina Department of Environment and Natural Resources
Division of Environmental Health
Radiation Protection Section
1645 Mail Service Center
Raleigh, NC 27699-1645

NRC FORM 366 (10-2010) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

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

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 08/31/2013
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 Section (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects 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.

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4. TITLE
Shutdown of two Units due to entry into LCO 3.0.3 caused by the inoperability of all four trains of the Nuclear Service Water System due to strainer macro-fouling.

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
									McGuire Unit 2	05000 370
01	20	2011	2011	– 001	– 0	03	21	2011	FACILITY NAME: None	DOCKET NUMBER

9. OPERATING MODE: 1

10. POWER LEVEL: 100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

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

12. LICENSEE CONTACT FOR THIS LER

	TELEPHONE NUMBER (Include Area Code)
Lee A. Hentz, Regulatory Compliance	980-875-4187

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

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

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

Unit Status: At the time of the event, Units 1 and 2 were in Mode 1 at 100% power.

Event Description: On January 18, 2011, during testing of the 1B Nuclear Service Water (RN) pump while aligned to the Standby Nuclear Service Water Pond (SNSWP), its associated strainer became fouled with small, bluegill fish. After further investigation and testing, it was determined that both RN trains on each Unit were potentially inoperable due to macro-fouling from the SNSWP. Both Units entered TS LCO 3.0.3 and initiated shutdowns. McGuire requested and received a Notification of Enforcement Discretion (NOED) for both Units to remain in Mode 3 until the macro-fouling source was eliminated.

Event Cause: The causes of this event were lack of an effective macro fouling barrier in the SNSWP, deferral of the fish eradication treatment of the SNSWP in 2010, and lack of risk recognition.

Corrective Actions: The SNSWP was chemically treated to eliminate the macro-fouling source and the RN intake lines were flushed. A periodic chemical treatment was established and a macro-fouling barrier modification is planned.

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

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.

The principal safety related function of the Nuclear Service Water System [BI](RN) is the removal of decay heat from the reactor. The RN system provides assured cooling water for various Auxiliary Building and Reactor Building heat exchangers during all phases of station operation. Each unit has two redundant essential, safety related headers serving two trains of equipment necessary for safe station shutdown, and a non-essential header serving equipment not required for safe shutdown.

The RN system is normally supplied from a non-seismic source, Lake Norman [BS]. An additional supply of water to the RN system is the Standby Nuclear Service Water Pond [BS](SNSWP). The SNSWP, which is qualified for a Safe Shutdown Earthquake, serves as the heat sink/cooling water reservoir for the RN system in the event Lake Norman is lost. All RN supply and discharge piping for the SNSWP is seismically qualified.

Upon receipt of a safety injection signal from either unit, the B RN train is automatically aligned to the SNSWP and the A RN train is automatically aligned to Lake Norman. Operating procedures manually align the A RN train to the SNSWP during a seismic event (loss of Lake Norman).

Debris strainers [STR] are installed immediately upstream of each of the four RN pumps [P]. The function of the RN strainers is to reduce the impact of macro-fouling on downstream components. Each RN strainer has the capacity to be backwashed (cleaned) automatically or manually. The RN strainers are currently in a degraded/non-conforming condition due to the discovery of reverse flow in the backwash discharge line and the subsequent isolation of this backwash discharge flow path. Credit is currently being taken only for the backwash supply flow to the strainers, the grinding action of the strainers, and manual backwash to the Auxiliary Building ground water drainage sump. Modifications to correct the RN strainer backwash system operation are scheduled for implementation.

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Technical Specification (TS) 3.7.7 specifies that two RN trains shall be OPERABLE in Modes 1, 2, 3, and 4. TS 3.7.7 Condition A states that one RN train may be inoperable for up to 72 hours. TS 3.7.7 does not have a Condition for two inoperable RN trains. In this case, TS Limiting Condition for Operation (LCO) 3.0.3 applies. TS LCO 3.0.3 requires that action be initiated within 1 hour to place the affected unit(s) in Mode 3 within 7 hours, Mode 4 within 13 hours, and Mode 5 within 37 hours.

EVENT DESCRIPTION

The following historical information was selected from the timeline prepared during the root cause investigation of this event. The information is provided as a lead-in to the event being reported.

In July 2007, the 1B and 2B RN strainers experienced an unanticipated high number of automatic backwashes due to a seasonal influx of alewife fish from Lake Norman. During the review of this event, it was realized that the RN strainer backwash function during a loss of Instrument Air system (VI) event was not available because failed closed air operated valves would isolate the backwash function. Compensatory actions were put in place to allow manual operation of the air operated RN strainer backwash valves by a dedicated operator. This event was reported in McGuire Nuclear Station (McGuire) LER 369/2007-04.

Following this event, the RN backwash valves were modified so they could be mechanically opened without reliance on the VI system. Although the RN strainers were challenged during the 2007 event, they always were capable of clearing the high differential pressure (D/P) conditions. Furthermore, McGuire realized it was now susceptible to a new macro-fouling source from Lake Norman (Alewife fish).

In June 2008, McGuire discovered an additional design deficiency associated with the RN strainers. Testing of the 1B and 2B RN strainers indicated that the backwash return flow was not in the normal direction to the Condenser Circulating Water (RC) system but in the reverse direction. In other words, there was not enough pressure on the discharge of the backwash to overcome RC system head. At this point the RN strainers were thought to act as a backwash supply flow assisted "grinder" versus a debris removal "strainer". This degraded/non-conforming condition is documented in McGuire's corrective action program.

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To address this RN strainer degraded condition related to reverse return backwash flow, McGuire decided to manage the macro-fouling sources that would impact RN system operation. In addition, backwash return flow would be modified to manually route flow to the Auxiliary Building groundwater drainage system.

The direction to eliminate and manage the macro-fouling sources was accomplished in two ways. Based on the previously observed behavior of alewife, a specially designed screen was installed to prevent alewife from entering the RN system from Lake Norman. The plan to manage possible fouling sources in the SNSWP was to perform fish eradications through chemical treatments. Furthermore, hydroacoustics and other surveying techniques would be utilized to monitor fish activity in the SNSWP.

In April 2009, the 2A RN strainer fouled during high velocity flow testing while aligned to the SNSWP. The source of the fouling was determined to be corrosion products which were separated from the RN piping due to the high velocity flow. The source of the fouling was unanticipated, and challenged the current assumptions regarding macro-fouling and RN strainer operability. This event was reported in LER 369/2009-01.

The accumulation of these events led to a series of proposed plant modifications that are being implemented in three phases. Phase 1 would install an assured air supply to the RN backwash valves to operate during loss of VI events (completed). Phase 2 would provide a means to reroute the strainer backwash return to the Auxiliary Building groundwater drainage system. Finally, Phase 3 would provide a safety related "booster" pump and piping to take suction on the backwash return and flush it to the RC system. Phase 3 will establish the originally intended design function of the RN strainer macro-fouling removal system. In the interim, macro-fouling sources to the RN system would continue to be managed.

In July 2009, the first SNSWP chemical treatment (fish eradication) was performed. The chemical Rotenone was dispensed in a spiraling pattern starting over the SNSWP intake. Once the chemical was applied, fish immediately began to surface, where they were netted, and then taken to the shore to be sorted, weighed, and disposed. Approximately 3000 pounds of fish were collected. A variety of fish species were collected; however, the majority by numbers was shad (threadfin and alewife) and sunfish. Based on previous fish surveys, alewife where thought to not exist in the SNSWP.

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As a result of the initial chemical treatment, and discovery of alewife in the SNSWP, it was decided to chemically treat the SNSWP on an annual frequency. In support of these treatments, and for general data, hydro-acoustic surveys prior to the Rotenone treatments would also be performed. The hydroacoustic surveys would identify targets (fish) in open water and provide insights on what to expect during the fish eradication.

In June 2010, a hydroacoustic survey was performed in support of the upcoming chemical treatment planned for July 2010. At this time, approximately 8,100 targets were observed, and were noted to be much smaller in size than the pre-Rotenone survey from the initial fish eradication.

The following week, the Duke Energy Fisheries Department began preparations for the upcoming treatment. During the survey of the SNSWP, it was discovered that a thermocline no longer existed. An established thermocline was considered a prerequisite for Rotenone treatments. The logic being the thermocline serves as a false bottom, where there is no dissolved oxygen, and the fish tend to reside above this level. This was considered important for two reasons: there would be less area to treat, and the fish are above the SNSWP intake preventing the risk of neutrally buoyant fish becoming a fouling source. The Fisheries Department contacted Engineering of this discovery. Engineering determined that mixing of the SNSWP from RN pump operations associated with maintenance activities had disrupted the thermocline. Since a thermocline did not exist, McGuire Engineering concluded that the SNSWP chemical treatment should be deferred.

Later in the summer of 2010, another opportunity to chemically treat the SNSWP became available when the thermocline had reestablished. Again, another unfavorable condition existed. Due to an unusually hot summer, the RC system low level intake (LLI) pumps were being operated. This was considered unfavorable because it was during fouling season, and alewife posed an elevated risk as a fouling source to the RN system supply from Lake Norman. As such, it was not an appropriate time to treat the SNSWP in the rare event that fish could migrate to the SNSWP intake such that both sources of water for the RN system could potentially become fouled. After assessing these risks, the decision was made to defer the chemical treatment again until the summer of 2011.

In September 2010, another hydroacoustic survey of the SNSWP was completed. This survey produced a fish population estimate of 25,869. Cast net surveys of open water fish identified bluegill, threadfin shad and mosquitofish.

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The data was presented to Engineering for review and Engineering determined this was not a threat. The concern for fouling had always been adult alewife due to their behavior patterns, and their role in the previous McGuire macro-fouling event in June 2007. The bluegill and mosquitofish were considered shoreline species that typically did not congregate, nor descend to the depth of the SNSWP intake. The behavioral patterns of bluegill and mosquitofish were not believed to be a risk at this time. The threadfin shad were also not considered a threat at this time. McGuire operated the RN system from the SNSWP frequently for various reasons throughout the rest of 2010 with no macro-fouling concerns or events.

On January 18, 2011, the 1B RN pump was started for performance testing while aligned to the SNSWP. Approximately fifteen minutes after the start of the test, the 1B RN Pump was secured due to low pump suction pressure associated with high RN strainer differential pressure.

After additional evaluation and testing, it was concluded that the RN strainer high differential pressure was due to macro-fouling as the result of a large number of small, bluegill fish drawn in from the SNSWP. Subsequent to the discovery of the fouling condition with the 1B RN Train, TS 3.7.7 Condition A had been entered (one RN train inoperable).

On January 20, 2011, when the 2B RN pump was started for testing, its strainer also rapidly fouled and required the pump to be secured. In addition, since the potential also existed to align the 1A and 2A RN trains to the SNSWP for certain accident scenarios, this common mode failure (strainer macro-fouling from the SNSWP) could also make the RN A trains potentially inoperable.

On January 20, 2011, when the 1A and 2A RN trains were also determined to be potentially inoperable, TS LCO 3.0.3 was entered on both Units. After power reductions, the Unit 1 reactor was manually tripped after a loss of Feedwater flow and the Unit 2 reactor was manually tripped per procedure. A Notification of Enforcement Discretion (NOED) was processed by McGuire and verbally approved by the NRC to allow both Units to remain in Mode 3 while the RN system and the SNSWP were returned to operable status. Remaining in Mode 3 versus transitioning both Units to Mode 5 was justified by Probabilistic Risk Assessment (PRA) to be less of a nuclear safety risk.

On January 23, 2011, all four trains of the RN system were returned to operable status after the SNSWP was chemically treated with Rotenone to

eliminate the fish and the SNSWP intake piping was back flushed to ensure no macro-fouling sources remained in the intake piping.

Reportability Determination

Given that both McGuire Units were in LCO TS 3.0.3 for greater than 1 hour and Operators initiated actions (power reductions) to shutdown both Units, this event is reportable as an "Operation or Condition Prohibited by Technical Specifications" in accordance with 10 CFR 10.73(a)(2)(i)(B).

In addition, with both RN trains on each Unit determined to be potentially inoperable due to macro-fouling from the SNSWP, this event is also reportable as an "Event or Condition That Could Have Prevented Fulfillment of a Safety Function" in accordance with 10 CFR 50.73(a)(2)(v)(B).

The completion of the Unit 1 and 2 nuclear plant shutdowns and the resultant Unit 1 Reactor Protection System actuation due to loss of Feedwater flow is being reported separately under McGuire LER 369/2011-02.

CAUSAL FACTORS

Three causes were identified for this event.

Cause 1

An effective macro-fouling screen covering the SNSWP intake ports for the RN suction piping was not in place as a barrier to prevent this event.

Discussion

The lack of an effective macro-fouling barrier protecting the SNSWP intake structure is considered a key causal factor to this event. An effective fish barrier capable of filtering small fish would have prevented this event, even in the presence of large numbers of bluegill gathered around the intake structure. McGuire has installed a fish barrier on the RN system supply from Lake Norman to protect against the alewife species. Schooling or congregating fish populations have caused numerous industry fouling events for raw water intake structures, and it appears that McGuire

personnel had discounted all fish related threats except for those associated with alewife species. Had the threat associated with different species in deep sections of the SNSWP been recognized, a need for a macro-fouling barrier may have been recognized and installed prior to this event.

Cause 2

Deferral of the Rotenone fish eradication chemical treatment of the SNSWP in 2010 led to the RN strainer macro-fouling event.

Discussion

The Rotenone treatment of the SNSWP was scheduled for July 2010. Days before the treatment, Duke Energy Fisheries notified Engineering that a prerequisite of having a thermocline present in the SNSWP did not exist. At that time, McGuire Engineering considered the presence of a thermocline a key prerequisite requirement for Rotenone treatment to preclude the potential for RN strainer fouling from the dead or dying fish population. The thermocline was lost due to operation of the 2B RN train from the SNSWP from July 6 through 8 of 2010. A thoroughly mixed pond eliminates the stratified temperature gradient which in turn eliminates the thermocline. Based on this, McGuire Engineering concluded that the treatment should be deferred.

Another opportunity to treat the SNSWP occurred in the August to September 2010 timeframe when a thermocline had re-established. Discussions with Engineering revealed that the decision was made to not treat the pond based on concerns with seasonal, potential alewife fouling from Lake Norman. The intent was not to induce any additional challenges to the RN system with the alewife fouling potential that occurs during this time of year.

Cause 3

There was a distinct lack of risk recognition associated with the presence of significant macro-fouling sources (small fish) in the SNSWP. Similarly, the organization did not realize there were insufficient barriers or defense in depth in place for RN operation from the SNSWP.

Discussion

From a defense in depth perspective, proper operation (without macro-fouling) of the RN system from the SNSWP was solely dependent on McGuire's ability to predict the behavior of large numbers of small, open water fish populations. Just after the July 2009 Rotenone treatment, there was an estimated fish population of 83. In June 2010, the estimated number rose to 8,082, and September 2010 the estimated number rose to 25,869. The cast netting surveys performed during this time frame identified the predominate species as small mosquitofish, bluegill and threadfin shad. There were no alewives identified. The prevalent mindset in the organization was that these species of fish did not pose a credible risk to the RN strainers.

Of the three potential barriers that could have prevented this event (adequate RN strainer backwash, fish barrier on the SNSWP intake, and elimination of SNSWP macro-fouling source), none were effectively in place. In effect, the only basis for assuring successful RN system operation from the SNSWP was a reliance on McGuire's ability to predict atypical behavior of the altered fish assemblage present in the SNSWP.

CORRECTIVE ACTIONS

Immediate:

1. The SNSWP was chemically treated to eliminate the macro-fouling mechanism and a post treatment survey was performed to verify the effectiveness.

2. All four trains of the RN system were flushed from the strainers back to the SNSWP intake to remove any latent macro-fouling sources.

Subsequent:

1. The frequency of the chemical treatment of the SNSWP to prevent fish population development was revised to at least a semi-annual frequency.

2. Monthly hydroacoustic surveys of the SNSWP were established to validate the effectiveness of the chemical treatment.

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3. Periodic underwater inspections (divers) were established to inspect the SNSWP intake structure, the dam, and rip-rap (shoreline) for fish activity.

Planned:

1. Install a macro-fouling barrier for the SNSWP intake pipes.

2. Engineering to use this event for training or as a case study on lessons learned from the event.

3. The Leadership Training Review Committee shall use this event as a case study relative to decision making.

SAFETY ANALYSIS

Duke Energy used a risk-informed approach to determine the risk significance associated with the Technical Specification violation of the Unit 1 and 2 Nuclear Service Water System (RN) due to strainer macro-fouling caused by small fish drawn in from the Standby Nuclear Service Water Pond (SNSWP).

The Incremental Conditional Core Damage Probability (ICCDP) and the Incremental Conditional Large Early Release Probability (ICLERP) of this event were evaluated by considering the following:

- The duration of the period of vulnerability of macro-fouling
- The use of the average maintenance PRA model to represent plant configuration, equipment unavailability, and maintenance activities during this violation. Consideration was given to the availability of key equipment during the period of vulnerability to macro-fouling.
- The impact of internal and external initiating events.
- The availability of the RN system A trains during seismic events and subsequent alignment to the SNSWP.

The ICCDP associated with this event was determined to be less than 1.0E-06 with the use of the internal events model (including fire and tornado risk). The ICLERP associated with this event was determined to be less than 1.0E-07. The total ICCDP including seismic contribution to core damage is less than 1.0E-06.

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Therefore, this event is considered to have a small risk impact and is of no significance with respect to the health and safety of the public.

ADDITIONAL INFORMATION

The 2011 RN strainer macro-fouling event is not considered recurring. Although there have been previous macro-fouling challenges to the RN strainers, notably the July 2007 and April 2009 events, these events did not overwhelm the strainers (with backwash in service) rendering the RN system inoperable.

To determine if a recurring or similar event exists, a search of the McGuire Problem Identification Process (PIP) database was conducted for a time period covering 5 years prior to the date of this event. Based on Duke Energy's definition of a recurring event, similar significant event with the similar event and cause codes; no recurring events were identified associated with macro-fouling of important raw water systems at McGuire.