Duke Power®
A Duke Energy Company

D.M. JAMIL
Vice President

Duke Power
Catawba Nuclear Station
4800 Concord Rd. / CN01VP
York, SC 29745-9635

803 831 4251
803 831 3221 fax

July 10, 2003

U. S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, DC 20555-0001

SUBJECT: Duke Energy Corporation
Catawba Nuclear Station Unit 1
Docket Nos. 50-413
Licensee Event Report 413/03-004 Revision 0
1A Containment Spray System Inoperable for Longer than Technical Specifications Allow Due to Heat Exchanger Fouling

Attached please find Licensee Event Report 413/03-004 Revision 0, entitled "1A Containment Spray System Inoperable for Longer than Technical Specifications Allow Due to Heat Exchanger Fouling"

During this event, Catawba submitted a request for Notice of Enforcement Discretion (NOED) via letter dated May 10, 2003. Recently it has been discovered that some of the information provided in that request was not correct. The answer to question 3 in the "Other Considerations" section included a statement that Catawba has replaced all of the reactor coolant pump seals with a newer model with the high temperature o-ring material. It has been discovered that some of the o-rings for the 1D reactor coolant pump have not been replaced with the new high temperature material. Duke has reviewed the PRA calculations which supported the NOED request and have determined that the results have not changed based on this new information. Catawba has entered this issue into the corrective action program for resolution.

IE22

This Licensee Event Report does not contain any regulatory commitments. This event is considered to be of no significance with respect to the health and safety of the public. Questions regarding this Licensee Event Report should be directed to R. D. Hart at (803) 831-3622.

Sincerely,

D. M. Jamil

Attachment

xc:

L. A. Reyes
U. S. Nuclear Regulatory Commission
Regional Administrator, Region II
Atlanta Federal Center
61 Forsyth St., SW, Suite 23T85
Atlanta, GA 30303

R. E. Martin (addressee only)
NRC Senior Project Manager (MNS/CNS)
U. S. Nuclear Regulatory Commission
Mail Stop O8-G9
Washington, DC 20555-0001

E. F. Guthrie
Senior Resident Inspector (CNS)
U. S. Nuclear Regulatory Commission
Catawba Nuclear Site

INPO Records Center
700 Galleria Place
Atlanta, GA 30339-5957

NRC FORM 366 (7-2001)	U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB NO. 3150-0104	EXPIRES 7-31-2004

LICENSEE EVENT REPORT (LER)

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

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
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4. TITLE
1A Containment Spray System Inoperable for Longer than Technical Specifications Allow Due to Heat Exchanger Fouling

5. EVENT DATE MO	DAY	YEAR	6. LER NUMBER YEAR	SEQUENTIAL NUMBER	REV NO	7. REPORT DATE MO	DAY	YEAR	8. OTHER FACILITIES INVOLVED FACILITY NAME	DOCKET NUMBER
05	11	2003	2003	- 004 -	00	07	10	2003	None	
									FACILITY NAME	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)(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)	X	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)
R. D. Hart, Regulatory Compliance	803-831-3622

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
X	BE	HX	YUBA	Y					

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)

The 1A containment spray system (CSS) was declared inoperable on May 8, 2003 at 0918 hours for testing evolutions. During the testing of the 1A CSS heat exchanger the acceptance criterion of procedure PT/1/A/4400/009, "Cooling Water Flow Monitoring for Asiatic Clams and Mussels Quarterly Test" was not met. This procedure is used to monitor flow resistance in the CSS heat exchanger and essential nuclear service water system (NSWS) piping. Engineering, Operations, and Maintenance investigated the cause of the failed test for the 1A CSS heat exchanger. Necessary inspection, chemical cleaning and subsequent testing activities could not be completed by May 11, 2003 at 0918 hours. Duke Energy requested a Notice of Enforcement Discretion from the NRC so that the Completion Time for the Required Actions of the Technical Specifications for the CSS would be extended from the current 72 hours by an additional 168 hours, for a total of 240 hours, so that this work could be completed. The NRC granted the request on May 10, 2003. The CSS 1A heat exchanger was chemically cleaned, tested and declared operable on May 17, 2003 at 0454.

BACKGROUND

Catawba Nuclear Station Unit 1 is a Westinghouse Pressurized Water Reactor [EIIS: RCT].

The Containment Spray System (CSS) [EIIS: BE] provides containment atmosphere cooling to limit post accident pressure and temperature in containment to less than the design values. Reduction of containment pressure and the iodine removal capability of the spray reduce the release of fission product radioactivity from containment to the environment, in the event of a Design Basis Accident (DBA).

The CSS consists of two separate trains of equal capacity, each capable of meeting the system design basis spray coverage. Each train includes a containment spray pump [EIIS: P], one containment spray heat exchanger [EIIS: HX], spray headers, nozzles [EIIS: NZL], valves [EIIS: V], and piping. Each train is powered from a separate Engineered Safety Feature (ESF) bus [EIIS: BU]. The refueling water storage tank (RWST) [EIIS: DA] supplies borated water to the CSS during the injection phase of operation. In the recirculation mode of operation, containment spray pump suction is transferred from the RWST to the containment recirculation sump(s). When the CSS suction is from the containment recirculation sump, its associated heat exchanger receives nuclear service water system (NSWS) flow for cooling. The NSWS is served by two bodies of water, Lake Wylie and the Standby Nuclear Service Water Pond (SNSWP). Lake Wylie serves as the non-safety class, non-seismic, normal source of nuclear service water. The SNSWP is a Category 1 seismically designed structure with sufficient water to bring the station to cold shutdown following a Loss of Coolant Accident on one unit and a normal cooldown on the other unit.

Since the spring/summer of 2002, a significant negative trend was observed in the Lake Wylie water quality due to a prolonged drought in the southeast, followed by heavy rain the past 6 months. Lake Wylie water quality was at low levels in the April and early May, 2003 time frame. Normal lake "turbidity" (a measure of total suspended solids) runs at less than 5 Nephelometric Turbidity Unit (NTU). On March 26, 2003, lake turbidity peaked at 92.1 NTU, the highest in the past five years.

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

The CSS heat exchangers are vertical shell and U-tube design. Borated water from the RWST or containment recirculation sump circulates through the tubes, while NSWS circulates through the shell. During normal operation, the NSWS side of the CSS heat exchangers is maintained in wet lay-up condition with the NSWS side isolated and treated NSWS water recirculated through the heat exchanger. Historically, the wet lay-up systems for the CSS heat exchangers are in service approximately 50% of the time. The 1A CSS heat exchanger had no hand-holes or manways for inspection and/or cleaning access. The basic materials of construction for the CSS heat exchangers are carbon steel; including the shell, divider plate, tie-rods, and baffle plates. The tubes and impingement plate are stainless steel. The tube sheet is stainless steel clad carbon steel.

Technical Specification (TS) 3.6.6 requires in part that two CSS trains be operable. Condition A for TS 3.6.6 states that with one CSS train inoperable, the CSS train must be restored to operable status within 72 hours. Condition B states that with the Required Action and associated Completion Time of Condition A not met, the unit must be in Mode 3 within 6 hours and in Mode 5 within 84 hours.

This event is being reported under 10 CFR 50.73(a)(2)(i)(B) (any operation or condition prohibited by the plant's Technical Specifications (TS)), and 10CFR50.36(c)(2)(i) (Limiting Condition for Operation (LCO) not met). No structures, systems, or components were out of service at the time of this event that contributed to the event. At the time these conditions were identified, Unit 1 was operating in Mode 1, Power Operation.

EVENT DESCRIPTION
(Dates and times are approximate)

Date/Time	Event Description
5/01/03	Enclosure 13.2 of PT/1/A/4400/009, "Cooling Water Flow Monitoring for Asiatic Clams and Mussels Quarterly Test," was performed to determine 1B CSS heat exchanger resistance factor. The 1B CSS heat exchanger resistance factor met the acceptance criterion. This PT is used to determine a flow coefficient, or

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	conversely, a flow resistance factor, for the CSS heat exchanger, which is then used as a monitoring point of flow impediment for the NSWS through the shell-side of the heat exchanger.
5/08/03~0918	Operations declared the 1A train of CSS inoperable for routine testing evolutions.
5/08/03~1100	Operations commenced enclosure 13.5 of PT/1/A/4400/009 for the 1A CSS heat exchanger. NSWS flow was established and the expected shell side flow was observed for approximately 30 minutes. The shell side flow then decreased significantly with no other system changes. A resistance factor of 506 was calculated, which did not meet the acceptance criterion of greater than or equal to 650.
5/08/03	Engineering, Operations, and Maintenance investigated the cause of the lower than normal resistance factor for the 1A CSS heat exchanger. An additional test was run on day shift which yielded a resistance factor of 566.
5/08/03	Troubleshooting activities included venting the 1A CSS heat exchanger, visual inspection of NSWS valves associated with the heat exchanger, samples from the heat exchanger, and blowdown of the instrument lines.
5/08-09/03	During the ensuing investigation, PT/1/A/4400/009 was performed several times to aid troubleshooting. NSWS flow through the 1A CSS heat exchanger during each test appeared to decrease continually and never stabilized.
5/09/03	The 2A and 2B CSS heat exchangers were tested per PT/2/A/4400/009. The resistance factors for each heat exchanger passed the procedure acceptance criterion.
5/09/03~1723	After further troubleshooting, testing and

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	evaluation, the decision was made to isolate the 1A CSS heat exchanger to gain access to the shell-side internals and determine the cause of fouling.
5/10/03~0141	The 1A CSS heat exchanger was drained. Maintenance cut and removed a 2 inch drain line to allow for inspection. The inspection revealed some evidence of clam fouling.
5/10/03~0800	The 18 inch NSWS line was cut and a section removed. Inspections revealed some clam and corrosion product fouling. Engineering began to determine the most effective cleaning method.
5/10/03~1200	Engineering determined that chemical cleaning of the 1A CSS heat exchanger was required. Engineering began implementing the chemical cleaning plan.
5/10/03~1600	A conference call was held between Catawba and the NRC to discuss a request for Notice of Enforcement Discretion (NOED). The NOED request was for an additional 7 days (168 hours) to support inspection, chemical cleaning, and testing activities necessary to restore the 1A CSS heat exchanger to operable status.
5/10/03~1730	NRC granted Catawba's NOED request. The TS 3.6.6 Required Action time was extended by 168 hours to expire at 0918 on May 18, 2003. The NRC requested performance of a resistance factor test on the 1B CSS heat exchanger.
5/10/03	The 1B CSS heat exchanger was tested and the resistance factor met the acceptance criterion.
5/10-14/03	Activities progressed to prepare the 1A CSS heat exchanger for chemical cleaning.

5/14/03~2305 The chemical cleaning of the 1A CSS heat exchanger was started.

5/16/03 Chemical cleaning was completed.

5/16/03~1703 Operations completed 1A CSS heat exchanger resistance factor testing and the results determined a resistance factor of 960 which is greater than the acceptance criterion of 650.

5/17/03~0123 Operations completed PT/1/A/4400/006A, CSS Heat Exchanger 1A Heat Capacity Test. The test acceptance criterion was met.

5/17/03~0454 The NSWS A train flow balance test was successfully completed and the 1A CSS train was declared operable. Catawba exited from the NOED.

Based on the above sequence of events the 1A CSS train was inoperable from May 8, 2003 at 0918 until May 17, 2003 at 0454. This resulted in the 1A CSS train being inoperable for approximately 8 days and 19 hours. This time frame exceeded the required action time of TS 3.6.6 (72 hours plus 6 hours to be in hot standby).

CAUSAL FACTORS

The root cause of this event is a less than adequate CSS heat exchanger monitoring and cleaning program. This allowed the failure scenario described below to occur.

The most probable failure scenario is that an indeterminate quantity of clams, corrosion products and Lake Wylie mud/silt/sediment of uncertain composition were deposited in the 1A CSS heat exchanger at an accelerated rate following an NSWS flow rate set-point increase implemented in August 2002. This was done to increase the NSWS flow through the component cooling water (CCW) system [EIIS: CC] heat exchangers to reduce the settlement of mud/silt/sediment in the system. As an unintended consequence, the set-point change increased NSWS flow rates in the 1A/2A and 1B/2B NSWS supply headers, increasing the likelihood of transporting clams, corrosion products, silt and sediment down the 1A/1B supply

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headers toward the CSS heat exchangers. These NSWS system contaminants were more than what could reasonably be passed through the 1A CSS heat exchanger, given normal in-service times and typical NSWS flow rates. The contributing factors that ultimately combined to produce the contaminant build-up condition in the 1A CSS heat exchanger are as follows:

1. The NSWS flow is on the shell-side of the CSS heat exchangers (design vulnerability).
2. The NSWS supply piping for the 1A and 1B CSS heat exchangers takes off from the lower side of the 1A and 1B NSWS supply headers at approximate 45 degree down angles (design vulnerability). Operating experience indicates that such an orientation can create a gravity-influenced NSWS flow path for solids.
3. Fresh corrosion buildup on pipe surfaces left exposed following the NSWS Pipe Cleaning Project (October 2000) which was susceptible to flaking off.
4. The 42 inch buried NSWS system piping between the 2A and 2B NSWS 30 inch supply header branch connections and the 1A and 1B NSWS supply header 42 inch to 30 inch reduction (design vulnerability). NSWS header flow is significantly reduced after the 2A and 2B 30 inch branch connections, resulting in low flow velocity regions before the 1A and 1B 42 inch headers before they reduce to 30 inches. Operating experience indicates that NSWS low-velocity regions are susceptible to settling and accumulation of clams, corrosion products, silt and sediment.
5. The high turbidity levels and poor water quality in Lake Wylie.

An additional missed opportunity for this event is attributed to an inadequate transportability review for a previous root-cause report (which evaluated the 2002 CCW system heat exchanger tube-side fouling and tube-sheet blockage events as a combined investigation), and the corresponding corrective actions to prevent recurrence, which were focused entirely on early problem detection with respect to the CCW heat exchanger. The root-cause investigation placed primary emphasis on monitoring and predicting the unusually rapid fouling of the CCW heat exchangers, and had the root-cause transportability review been more rigorous, additional corrective actions might have been taken to circumvent or delay the combined effect of the contributing factors.

CORRECTIVE ACTIONS

Immediate:

1. The 2A, 2B, and 1B CSS heat exchangers were tested per PT/1(2)/A/4400/009 and successfully passed the test.

Subsequent:

1. A team was formed to investigate the cause of the fouling of the 1A CSS heat exchanger. The team investigated several potential root causes and corrective actions.

2. The 1A CSS heat exchanger was chemically cleaned. The heat exchanger was then retested, passed the acceptance criteria and was declared operable.

3. The heat capacity tests were completed for both the 1A and 1B CSS heat exchangers. Both heat exchangers met the acceptance criteria.

4. Temporary modifications were installed for flushing the Unit 1 NSWS to CSS supply lines.

5. The A and B NSWS supply lines to both the 1A and 1B CSS heat exchangers were flushed to assist in removing any debris from the lines.

6. Permanent modifications were installed for flushing the A and B NSWS supply headers.

7. The A and B NSWS supply headers were flushed to assist in removing debris from the lines.

8. The scheduled surveillance monitoring frequency for the CSS heat exchangers for Unit 1 and Unit 2 has been increased. This includes flow resistance and heat transfer testing.

Planned:

1. The CSS heat exchanger monitoring program will be enhanced. This will include but not limited to the following:

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a. The NSWS A and B supply headers will be flushed periodically to assist in eliminating NSWS contaminants in the headers.
b. PT/1(2)/A/4400/009 will be reviewed and revised as necessary to enhance the consistency and accuracy of data collected and enhance the test acceptance criteria.
c. Inspections and/or cleanings will be completed on both the 1A and 1B CSS heat exchangers during the next Unit 1 refueling outage.
d. The results of these actions will be used to determine if additional corrective actions are needed.

The planned corrective actions as well as any future corrective actions will be addressed via the Catawba Corrective Action Program. There are no NRC commitments contained in this LER.

SAFETY ANALYSIS

During the time period that the 1A CSS heat exchanger was inoperable, the 1B CSS train was operable and no equipment was taken out of service that would have rendered this train inoperable.

Duke Energy evaluated the effect of remaining at power for an additional 168 hours (actual time was approximately 139 hours) with the 1A CSS heat exchanger out of service using an Internal and External Events probabilistic risk assessment with average unavailabilities. The Containment Spray System has no impact on the calculated core damage frequency (CDF). The CSS is not included in the Level One PRA model. The CSS also has no significant impact on the calculated large early release frequency (LERF). At Catawba, LERF is dominated by sequences involving inter-system loss-of-coolant-accidents (ISLOCAs) or pressure spikes due to hydrogen burns. It is unlikely that the CSS could mitigate the pressure spikes due to a hydrogen burn.

At Catawba, the residual heat removal (RHR) system has been designed to include a provision for diversion of a portion of the RHR pump flow from the low head injection path to auxiliary spray headers in the upper containment volume. For this mode, the RHR pumps continue to supply recirculation flow from the containment sump to the core via the safety injection and centrifugal charging pumps. The diversion of the RHR flow from the low head injection

path to the auxiliary spray headers occurs only after the switchover to the recirculation mode and no earlier than 50 minutes after initiation of the LOCA.

A qualitative assessment of the risks that were not considered in the quantitative analysis resulted in the development of several compensatory measures. These were implemented during the period of non-compliance with the Technical Specifications. The core damage frequency (CDF) at Catawba is dominated by the risk from the turbine building flood initiator. This risk was mitigated by controlling the work performed on associated systems and by increased turbine building rounds on Unit 1 and Unit 2 by Operations while the 1A CSS heat exchanger was out of service which reduced the likelihood of this initiator below the random occurrence rate. This included no discretionary maintenance performed on the Unit 1 or Unit 2 Condenser Circulating Water System and Cooling Towers that would have increased the probability of a turbine building flood. This action resulted in a reduction of risk. CNS limited the performance of maintenance or testing on the offsite power system and maintained the offsite circuits operable which reduced the likelihood of losing off site power and represented a reduction in risk.

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

ADDITIONAL INFORMATION

A review of LERs from the last three (3) years found no LERs written for components serviced by the NSWS being inoperable for longer than required by TS due to fouling.

Catawba performed a search of an industry data base. The results of the search date back to the early 1980's and establish a longstanding history in the industry of raw water-related problems. In general, these problems cluster around instances of heat exchangers, piping and instrumentation becoming clogged by a combination of mud, silt, corrosion products and biological contaminants, e.g., Asiatic clams and mussels, and instances of corrosion-induced pressure boundary failure, e.g., failures such as pinhole leaks and heat exchanger shell and channel erosion-corrosion or tube pitting related to microbiologically induced

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corrosion (MIC). SOER 84-1, Cooling Water System Degradation Due to Aquatic Life, relates three major categories of biofouling control methods:

- Mechanical, e.g., intake screens, debris filters, automatic online and manual cleaning systems
- Chemical, e.g., chlorine, ozone, chlorine dioxide, bromine chloride
- Thermal, e.g., backwash and local steam injection.

The first two methods have been utilized extensively at Catawba with mixed results, which is similar to the experience of the industry as well. The third approach is generally impractical or unfeasible due to cost or design limitations of the component or piping. Energy Industry Identification System (EIIS) codes are identified in the text as [EIIS: XX]. This event did involve an equipment failure and is reportable to the Equipment Performance and Information Exchange (EPIX) program. This event did not include a Safety System Functional Failure. There were no releases of radioactive materials, radiation exposures or personnel injuries associated with this event.