Duke Power Company
McGuire Nuclear Station
P.O. Box 488
Cornelius, N.C. 28031-0488

(704) 875-4000

DUKE POWER

December 3, 1990

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

Subject: McGuire Nuclear Station Unit 1 and 2
Docket No. 50-369
Licensee Event Report 369/90-28

Gentlemen:

Pursuant to 10CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report 369/90-28 concerning Ice basket U-bolts that were found damaged or missing because of a material deficiency. This report is being submitted in accordance with 10CFR 50.73(a)(2)(i), and (a)(2)(v). This event is considered to be of no significance with respect to the health and safety of the public. This report was Part 21 reportable.

Very truly yours,

Tony L. McConnell

T.L. McConnell

ARS/bcb

Attachment

xc: Mr. S.D. Ebneter
Administrator, Region II
U.S. Nuclear Regulatory Commission
101 Marietta St., NW, Suite 2900
Atlanta, GA 30323

INPO Records Center
Suite 1500
1100 Circle 75 Parkway
Atlanta, GA 30339

M&M Nuclear Consultants
1221 Avenue of the Americas
New York, NY 10020

Mr. Tim Reed
U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D.C. 20555

Mr. P.K. Van Doorn
NRC Resident Inspector
McGuire Nuclear Station

IE28
/1

NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES 8-31-88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
McGuire Nuclear Station, Unit 1	0 5 0 0 0 3 6 9	1 OF 8

TITLE (4) Ice Basket U-Bolts Were Found Damaged Or Missing Because Of A Material Deficiency

EVENT DATE (5) MONTH	DAY	YEAR	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	REPORT DATE (7) MONTH	DAY	YEAR	OTHER FACILITIES INVOLVED (8) FACILITY NAMES	DOCKET NUMBER(S)
1 0	2 3	9 0	9 0	— 0 2 8 —	0 0	1 1	2 8	9 0	McGuire, Unit 2	0 5 0 0 0 3 7 0
										0 5 0 0 0

OPERATING MODE (9): 5

POWER LEVEL (10): 0 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)

20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
20.405(a)(1)(i)	50.36(c)(1)	X 50.73(a)(2)(v)	73.71(c)
20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	X OTHER (Specify in Abstract below and in Text, NRC Form 366A)
20.405(a)(1)(iii)	X 50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	Part 21
20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER AREA CODE	
Alan Sipe, Chairman, McGuire Safety Review Group	7 0 4	8 7 5 - 4 1 8 3

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
B	B C	X X X X	W 1 2 0	Y					

SUPPLEMENTAL REPORT EXPECTED (14)

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

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

During a surveillance inspection of the Unit 2 Ice Condenser ice baskets while in the end of cycle (EOC) 6 refueling outage, Maintenance (MNT) personnel discovered several missing and broken U-bolts. Subsequently, Maintenance Engineering Services (MES) personnel initiated a Problem Investigation Report (PIR) to investigate the problem with the U-bolts. Design Engineering (DE) personnel performed an Operability Evaluation on Unit 1 and Unit 2 Ice Condensers and subsequently declared the Ice Condensers inoperable. MES and DE personnel immediately began evaluating a definitive course of action to demonstrate the integrity of the remaining U-bolts. MES and DE personnel devised a method of proof loading the bolts by torquing which proved they would withstand a worst case accident loading. With the results of the torquing test, DE personnel declared Unit 1 Ice Condenser conditionally operable. Torque testing is currently in progress on Unit 2. At the time of the discovery of this event, Unit 1 was in Mode 5 (Cold Shutdown), and Unit 2 was in Mode 6 (Refueling). This event has been assigned a root cause of Material Deficiency because of the U-bolt manufacturing process. To prevent recurrence of this event, MES and DE personnel will evaluate several options to resolve the problem. This event is Nuclear Plant Reliability Data System reportable.

NRC Form 366 (9-83)

EVALUATION:

Background

The primary function of the Ice Condenser [EIIS:BC] (NF) system is the absorption of thermal energy released abruptly in the event of a Loss-Of-Coolant Accident (LOCA) for the purpose of limiting the initial peak pressure in Containment. A secondary function of the NF system is the further absorption of energy after the initial incident causing the Containment pressure to be reduced to and held at a lower level for a period of time.

The Ice Condenser is subdivided into 24 bays which contain a total of 1944 ice baskets [EIIS:BSKT] that are 12 inches in diameter and 48 feet long. Each bay consists of 9 columns and 9 rows of ice baskets. The ice columns are composed of four basket sections approximately 12 feet long each, filled with borated flake ice.

The baskets are formed from a 14 gage (.075 inches) perforated sheet metal. The perforations are 1.0 inch x 1.0 inch holes spaced on a 1.25 inch center. The radius at the junction of the perforation is 0.0625 inches. The ice basket material is made from ASTM-569 commercial quality, low carbon steel. The basket component parts are corrosion protected by a hot dip galvanized process. The perforated basket assembly has an open area of approximately 64 percent to provide the necessary surface area for heat transfer between the steam/air mixture and the ice to limit the Containment pressure within design limits. Interconnection couplings and stiffening rings are located at the bottom and at 6 foot levels of each basket section respectively. The bottom coupling and stiffening ring are cylindrical in shape and approximately 3 inches high with a rolled internal lip. The lip provides stiffening to the basket.

Two U-bolt assemblies, located at the bottom of each ice basket column, affix the basket, by means of a clevis, to its lower support structure. These assemblies serve to provide assurance that the ice basket does not lift-off under the loading condition represented by a Design Basis Accident (DBA) Large Break (LB) LOCA in combination with a Safe Shutdown Earthquake (SSE). The U-bolts are Cadmium plated, 3/8 of an inch in diameter, SAE J 429 Grade 8 material. (Reference page 8 of 8.)

Technical Specification (TS) 3/4.6.5.1 specifies that the ice bed shall be operable with:

a. The stored ice having a boron concentration of at least 1800 ppm boron as sodium tetraborate and pH of 9.0 to 9.5,

b. Flow channels [EIIS:CHA] through the Ice Condenser,

c. A maximum ice bed temperature of less than or equal to 27°F,

d. A total ice weight of at least 2,466,420 pounds (lbs.) at a 95 percent level of confidence, and

e. 1944 ice baskets.

The surveillance requirement states, in part, that the Ice Condenser shall be determined operable at least once per 9 months by weighing a representative sample of at least 144 ice baskets and verifying that each basket contains at least 1269 lbs. of ice.

These conditions are applicable in Mode 1 (Power Operation), Mode 2 (Startup), Mode 3 (Hot Standby), and Mode 4 (Hot Shutdown). The TS action statement states that with the ice bed inoperable, restore the ice bed to operable status within 48 hours or be in at least Hot Standby within the next 6 hours and in Cold Shutdown within the following 30 hours.

Description of Event

While performing a surveillance inspection during the EOC6 refueling outage, under work request (WR) 503971, Maintenance (MNT) personnel discovered several missing and broken U-bolts on the Unit 2 Ice Condenser ice baskets. The results of the inspection were reported to Maintenance Engineering Services (MES) personnel. On October 22, 1990, WR 504146 was generated to visually inspect all Unit 2 ice basket bottoms and note any discrepancies. On October 23, 1990, Problem Investigation Report (PIR) 2-M90-0289 was written to address the U-bolt problem. It was later determined by MES personnel that the Unit 1 Ice Condenser had the potential for the same problem. Subsequently, Unit 1 was added to the PIR changing it to 0-M90-0289, and WR 504183 was written to inspect all Unit 1 ice basket bottoms for missing or broken U-bolts. The results of the two WRs revealed 8 missing and 5 broken U-bolts on Unit 2 to date; and a total of 2 missing and 4 broken U-bolts on Unit 1.

The preliminary findings of a metallurgical analysis performed by Duke Power personnel on the broken U-bolts from Unit 2 indicated the probable failure mechanism could be attributed to the manufacturing process (quench cracking or hydrogen induced cracking), followed by crack propagation during maintenance of the ice baskets.

Design Engineering (DE) personnel were called upon to evaluate the Operability of the Ice Condensers on both Units. Since the extent of the problem was unknown, and the potential existed for unanalyzed situations within the Ice Condensers, DE personnel determined the Ice Condensers on Unit 1 and Unit 2 to be inoperable on November 1, 1990. At the time of the determination, Unit 1 was in Mode 5 (Cold Shutdown), due to a main turbine [EIIS:TRB] intercept valve [EIIS:V] problem; and Unit 2 was in Mode 6 (Refueling), EOC 6 outage.

MES and DE personnel began evaluating a definitive course of action to demonstrate the integrity of the remaining U-bolts. A decision was made by

Management personnel to focus on the Unit 1 Ice Condenser U-bolts, since Unit 2 was in a refueling outage.

DE personnel, looking at the limiting load case for the uplift of an ice basket (dead weight + SSE + DBA) came up with a proof load of 1948 lbs., and added a 25 percent margin for conservatism, to arrive at a load of 2450 lbs, per leg, which would be necessary to establish the integrity of the U-bolts. To demonstrate the ability of the U-bolts to carry this load, a torquing test was devised. To determine the torque necessary to correlate to the required load, a series of tests were conducted under the environmental conditions the bolts are subjected to. The test results determined it would be necessary to apply 19 foot (ft) - lbs. to each bolt to simulate the required load. MNT personnel performed the proof load testing on 70 percent (1368) of the ice baskets. Every basket (576) that had the potential of being ejected from the support lattice in the event of a worst case accident loading was tested. The baskets that were inaccessible were located below intermediate deck door frame steel beams and movement of any of these baskets out of the Ice Condenser during a worst case accident loading would be prevented. A small percentage (approximately 0.3 percent) of the U-bolts broke while being tested. These U-bolts were replaced. While performing the proof load testing, MNT personnel also replaced or repaired as necessary any failed hardware, such as lockwashers, and grid bars. Three grid bars could not be repaired due to their inaccessibility and were accounted for in the DE Operability Evaluation. The results of the proof load testing were evaluated by DE personnel and on November 12, 1990, DE personnel issued an Operability Evaluation, revision 1, which stated the Unit 1 Ice Condensers would be conditionally operable. The condition of Operability states:

> Ice basket weighing and replenishment are not to be performed in the future without prior approval of Design Engineering. Any revisions to the procedure for ice basket weighing are to be submitted to Design Engineering for approval.

Operations Control Room [EIIS:NA] personnel returned Unit 1 to Mode 1 on November 14, 1990.

The Unit 2 Ice Condenser basket U-bolts are currently being torque tested by MNT personnel. This testing will be completed prior to Mode 4. DE personnel will be issuing an Operability Evaluation based on the results of this testing process.

Conclusion

This event has been assigned a root cause of Material Deficiency because of the U-bolt manufacturing process. A discussion of the preliminary metallurgical finding states, in part, that the fractures found in the U-bolts started in one of two locations - between the two bends or in a radius of a bend. The fracture origins were determined to be intergranular in structure. The two most probable modes of intergranular crack formation in a steel of this grade (grade 8 - medium carbon alloy steel, oil quenched and tempered at a minimum of 800 degrees Fahrenheit) are quench cracking and hydrogen induced cracking. The intergranular cracks appeared to have been introduced by the manufacturing process as a result of either quenching or the pickup of hydrogen during Cadmium plating. This discussion focused on the U-bolts taken from the Unit 2 Ice Condenser; however, the metallurgical analysis performed on U-bolts found fractured during the torque testing on Unit 1, indicated that the crack initiation and propagation modes were similar to that found on the Unit 2 U-bolts.

It has been determined by MES personnel that the maintenance techniques used by MNT personnel on the ice baskets are the likely sources of stress which caused the U-bolts to fail. There are two loads placed on the ice baskets when they are weighed. These loads are rotating and weighing. When MNT personnel perform the TS required weighing of the ice baskets, a controlled load of 3000 lbs. is applied vertically upward on each ice basket. Simultaneously, the basket is being rotated approximately 20 degrees to dislodge any ice that has accumulated between the basket and the lattice structure or wall panels [EIIS:PL]. This process is repeated 5 times, weighing and rotating. These loading conditions are not typical of the design basis loading conditions in magnitude or geometry. The results of the metallurgical analysis indicated that the techniques used by MNT personnel to weigh the ice baskets may have propagated the cracks that originated in the U-bolts because of the manufacturing process. These MNT techniques, however, would not have resulted in damage to the U-bolts had they been properly manufactured.

To prevent recurrence of this event MES personnel will evaluate the current MNT techniques used on Unit 1 and Unit 2 ice baskets and will either replace and/or upgrade the bolting, redesign the mounting bracket assembly, or if unable to replace the bolting, MNT personnel will test a sample of the remaining bolts.

A review of the Operating Experience Program (OEP) data base for the past twenty-four months prior to this event revealed no events involving Material Deficiency because of the Manufacturing Process; therefore, this event is not considered to be recurring.

This event is Nuclear Plant Reliability Data System (NPRDS) reportable.

There were no personnel injuries, radiation overexposures, or uncontrolled releases of radioactive material as a result of this event.

CORRECTIVE ACTIONS:

Immediate: None

Subsequent: 1) WRs 504183 and 504146 were issued by MES personnel to inspect all U-bolts and ice basket bottoms on Units 1 and 2.

2) MES personnel devised torquing requirements to determine the integrity of the Unit 1 U-bolts.

3) DE personnel performed an Operability Evaluation and subsequently determined Unit 1 and 2 Ice Condensers to be inoperable on November 1, 1990.

4) MNT personnel performed a torquing test on 1368 ice baskets on Unit 1.

5) DE personnel determined the Unit 1 Ice Condenser was conditionally operable.

Planned:

1) MES personnel will evaluate and modify as appropriate the MNT techniques used when weighing the ice baskets.

2) MES personnel will either replace and/or upgrade the bolting, redesign the mounting bracket assembly, or, if unable to replace the bolting, MNT personnel will test a sample of the remaining bolts.

SAFETY ANALYSIS:

The safety evaluation of the McGuire Ice Condensers is based on having a required number of ice baskets operable with a sufficient quantity of ice. The effect of having fractured or missing U-bolts in the bottom coupling of the ice baskets, which is an unanalyzed activity, was that during a postulated DBA plus SSE, a loaded ice basket or baskets could possibly have moved out of the Ice Condenser matrix. The movement could change the flow of fluid through the Ice Condenser, or prevent the ice in the subject basket or adjacent baskets from contributing to the condensing and cooling of the fluid released during a DBA. Additionally, movement of a loaded ice basket out of the lattice structure would represent a missile with possible unanalyzed safety questions due to possible impact on safety-related equipment. However, while this condition would be unanalyzed, the probability of an ejectable basket, with 2 broken U-bolts unobstructed by Ice Condenser air handling units (AHUs) [EIIS:AHU], drain lines, Ice Condenser bridge crane [EIIS:CRN] rail structure, and Ice Condenser top deck support structure, is unlikely. Also, in the event of a DBA, the steam flow going into the bottom of the Ice Condenser would not all be directed vertically upward. Some of the flow would be going at some upward angle and this would tend to slant the basket in the matrix, thereby blocking it in place. Additionally, the Design Basis for containment and containment heat removal systems, assumes an instantaneous guillotine break of the largest pipe in the Reactor Coolant (NC) system [EIIS:AB]. Analysis performed by Westinghouse demonstrated that the probability of NC and connected system piping greater than 6 inches in diameter is extremely low, in accordance with General Design Criteria (GDC) - 4, Appendix A, 10 CFR Part 5. Therefore, the probability of a pipe break releasing sufficient mass and energy to lift an ice basket is extremely low. Potential damage to other safety-related structures should be minimal as determined by Westinghouse.

The other support members of the Ice Condenser were intact (i.e. lattice frame [EIIS:FRM], intermediate deck and deck doors [EIIS:DR], wall panels) during the time period of the event and would have served to prevent any significant movement of the ice baskets in question. At no time during this period was the Ice Condenser system challenged. No seismic events occurred and no movement of the subject baskets occurred. Also, during this time period, the Containment Spray (NS) system [EIIS:BE], the Safety Injection (NI) system [EIIS:BQ], and other safeguard systems were available to mitigate possible problems during a DBA to control Containment pressure.

This event did not affect the health and safety of the public.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
McGuire Nuclear Station, Unit 1	0 5 0 0 0 3 6 9	9 0	0 2 8	0 0	8 OF 8

TEXT (If more space is required, use additional NRC Form 366A's) (17)

BOTTOM ICE BASKET ASSEMBLY