U.S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket Nos. License Nos.	50-369 and 50-370 NPF-9 and NPF-17
Report No:	50-369/97-16 and 50-370/97-16
Licensee:	Duke Energy Company
Facility:	McGuire Nuclear Station, Units 1 and 2
Location:	12700 Hagers Ferry Rd. Huntersville, NC 28078
Dates:	July 12 - August 27, 1997
Inspectors:	M. Sykes, Acting Senior Resident Inspector M. Franovich, Resident Inspector
Approved:	C. Ogle, Chief, Project Branch 1 Division of Reactor Projects

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Enclosure

EXECUTIVE SUMMARY
McGuire Nuclear Station
NRC Inspection Report 50-369/97-16 and 50-370/97-16

This special inspection reviewed aspects of a problem involving inoperable Unit 2 ice condenser lower inlet doors.

Engineering

- The immediate corrective actions regarding the inoperable Unit 2 lower ice condenser doors were adequate. However, long-term corrective actions for both Unit 1 and Unit 2 were not established.

- An apparent violation was identified concerning the failure to comply with Technical Specification requirements for the operability of the ice condenser inlet doors on Unit 2 for an unknown period of time during operation in Modes 1, 2, 3, and 4.

- An apparent violation was identified concerning the failure to perform adequate corrective actions in accordance with 10 CFR Part 50 Appendix B Criterion XVI, in light of relevant industry operating experience at another ice condenser facility and operational events at the McGuire facility. A preliminary review of industry experience and site-specific operational events indicated that prior opportunities may have existed to implement corrective actions to prevent the occurrence of the event at the McGuire facility.

Report Details

Summary of Plant Status

Unit 1 began the period at 100 percent rated thermal power. On July 12, power was reduced to approximately 95 percent to realign the number 3 turbine stop valve to its normal position. Unit 1 operated at 100 percent for the remainder of the reporting period.

Unit 2 began the period in Mode 5 (cold shutdown) for a forced outage to repair a failed 2D reactor coolant pump motor. While shutdown, the licensee determined that 10 of 48 ice condenser lower inlet doors were inoperable because of upward ice condenser floor movement. The licensee repaired the failed reactor coolant pump motor and the lower ice condenser inlet doors and returned Unit 2 to power operations on July 22. On August 4, power was reduced to approximately 95 percent to complete moderator temperature coefficient measurements. The unit was returned to 100 percent power on August 5, where it continued to operate for the remainder of the reporting period.

Review of Updated Final Safety Analysis Report (UFSAR) Commitments

While performing inspections discussed in this report, the inspectors reviewed the applicable portions of the UFSAR that were related to the areas inspected. The inspectors verified that the UFSAR wording was consistent with the observed plant practices, procedures, and/or parameters.

III. ENGINEERING

E1 Conduct of Engineering

E1.1 Inoperable Unit 2 Ice Condenser Lower Inlet Doors

a. Inspection Scope (37551)

The inspectors reviewed the facts and circumstances related to a failure to comply with Technical Specification requirements for the operability of the Unit 2 ice condenser inlet doors. On July 17, 1997, with the unit in Mode 5 (cold shutdown) for a forced outage, the licensee discovered that 10 of 48 lower inlet doors were inoperable for an unknown period of time since the previous Unit 2 refueling outage. The affected doors were mechanically bound because the concrete floor raised to the point where metal flashing interfered with the doors. Prior to restart of Unit 2, the inspectors reviewed the immediate corrective actions, initial root cause evaluations, and applicability of the problem to Unit 1. The inspectors also reviewed station documents, reviewed the UFSAR and design basis documents, and interviewed plant personnel. On August 15, the licensee submitted licensee event report (LER) 50-370/97-03 to address this event in accordance with the requirements of 10 CFR 50.73.

b. Observations and Findings

Ice Condenser System Design

The ice condenser is a passive accident mitigation system that contains approximately 2.5 million pounds of borated ice. Because the McGuire containment has a low design pressure capability of approximately 15.0 psig, the ice condenser system condenses steam and suppresses pressure to ensure containment integrity during an accident. The system, which consists of ice contained within an array of approximately 1,940 baskets, has lower inlet, intermediate deck, and top deck doors that allow passage of steam released from an accident.

Forty-eight (48) lower inlet doors, which are contained in 24 bays (two doors per bay), are located in the lower compartment. The inlet doors will passively open when a differential pressure of approximately one pound per square foot (PSF) exists between the lower containment and the ice bed. The design function of the lower inlet doors is to uniformly open during a loss of coolant accident (LOCA) or steam line break in containment so that the thermal energy released into the containment is evenly absorbed by the borated ice. These doors are adjacent to the ice condenser floor structure. In each bay, a thin layer of metal flashing surrounds the bottom of the doors' frame and protects small bags of insulation.

The ice condenser floor consists of a four inch wear slab layer of concrete imbedded with glycol cooling coils. The floor is cooled by one of two floor cooling pumps that circulate glycol through the cooling coils. A protective layer of ice is normally on the floor. Beneath the wear slab is an insulation layer of foam-concrete. Combined, the floor structure and the cooling system minimize heat entering the ice condenser from the lower crane wall and equipment room; thereby minimizing ice sublimation rates.

Sequence of Events

During a forced outage on July 12, several Unit 2 ice condenser inlet doors actuated due to depressurization of upper containment when personnel entered the containment through the upper airlock. Through visual inspection, Operations personnel discovered that one inlet door was 12 inches open and another door was off its seat. No ice melted from the event; however, Operations declared the ice condenser inoperable and a work order was developed to determine if a test of the doors would be required prior to entry to Mode 4. This condition was reported to the NRC on July 12, 1997, in accordance with the reporting requirements of 10 CFR 50.72.

On July 15, the licensee retracted the notification based on their interpretation that a valid engineered safety feature actuation of the lower inlet doors had not occurred since a substantial number of the doors did not open. On July 16, a retest of the doors was required when maintenance personnel noticed abnormal conditions (i.e., door bulging) in the ice condenser.

On July 17, with Unit 2 still in Mode 5, the licensee determined that 10 of 48 lower ice condenser inlet doors in eight of the 24 bays (two doors per bay) were incapable of opening at a torque less than or equal to that specified in Technical Specifications. In Modes 1, 2, 3, and 4, Technical Specification section 3/4.6.5.3.1 requires that the torque to initially open each door be less than or equal to 675 inch-pounds. The inlet doors were tested per Station Procedure PT/0/A/4200/32, Periodic Inspection of Ice Condenser Lower Inlet Doors, and were found to require more than the 15.5 lbs opening force limit (which correlates to the Technical Specification limit due to the testing method). Three of the doors required at least 80 lbs of force to open. Inlet doors in bays 2, 5, 6, 8, and 19 through 22 were affected. On July 18, 1997, the licensee reported this condition to the NRC in accordance with the requirements of 10 CFR 50.72.

The licensee's investigation revealed that the affected doors were dragging on flashing between the floor and the bottom of the doors. The licensee attributed the door binding to upward movement of the floor where the floor (wear slab) appeared to be raised by approximately 0.75 inches above its normal height. The licensee also discovered that ice normally on the floor had disappeared and the floor cooling system was degraded.

Immediate Corrective Actions

Before restart of Unit 2 on July 21, 1997, immediate corrective actions included a modification to remove a portion of the flashing that interfered with the doors. This left a minimum clearance of at least 2.25 inches in every bay between the floor and the remaining flashing. Based on operational data from Sequoyah (where a similar problem occurred), this modification should provide a sufficient gap under a worst case floor movement for the remainder of the operating cycle. The licensee also performed baseline measurements of the floor to monitor future floor growth. A small amount of the bagged insulation that the flashing was protecting was also removed. Removal of the insulation increases ice sublimation rates; however, the licensee determined that sufficient ice mass existed in the ice condenser for the remaining two months in the fuel cycle. The inspectors concluded that the 10 CFR 50.59 evaluation for the minor modification was adequate.

Several of the Unit 1 lower ice condenser doors were examined by use of a video camera that was lowered through the intermediate deck doors down to the wear slab. Video surveillance did not reveal deformation of flashing or concrete heave. The inspector reviewed videos of both Unit 1 and Unit 2 to verify the licensee's surveillance results. Floor ice and beam cooler frost were significantly present in the Unit 1 ice condenser. The licensee also reviewed historical ice basket data, determining that Unit 1 did not have significant ice melt events comparable to the Unit 2 events discussed below. On August 19, the system engineer informed the inspector that removal of the door frame flashing on Unit 1 was placed on the Unit 1 forced outage list to be performed at the next opportunity as testing warrants.

Apparent Cause, Review of Industry Experience, and Operating Experience

Water intrusion, freezing, and expansion in the floor concrete coupled with subsequent freeze and thaw cycles are the likely phenomena causing the concrete to heave upward. The licensee identified several Unit 2 operational events and design attributes that may have contributed to the problem. Two events in 1993 resulted in some of the ice melting. The first event involved feedwater valve 2CF-130, where a maintenance error caused high temperature and pressure feedwater to be released into containment. The second event involved a loss of offsite power event where reactor coolant was released into containment when the pressurizer relief tank rupture disk ruptured. In 1994, the licensee intentionally performed an aggressive wall panel defrost in Unit 2 ice condenser bays 18 through 24 that may have also introduced water into the concrete flooring. Additionally, the licensee postulated that the design of the floor cooling system did not account for localized heat loads from the steam generators.

On July 20, 1997, the licensee discovered that the performance of the floor cooling system was degraded for some period of time following the last Unit 2 refueling outage. Video surveillance of Unit 2 revealed that no ice was present on the concrete wear slab, and virtually no frost was present on the beam cooler lines that remove residual heat. Normally, a protective coat of at least 0.25 inches of ice is on the floor and heavy frost is accumulated on the beam coolers. The lack of ice and frost on these components was a self-revealing condition indicative of degraded floor cooling system performance. Together, these events may explain the concrete heave in the bays that were affected.

On July 29, the inspectors interviewed the ice condenser system engineer. The inspectors questioned the system engineer on past corrective actions at McGuire to address a similar event that occurred at the Sequoyah facility in 1992. Apparently, McGuire personnel in 1992 did not perceive that the floor problems at Sequoyah applied to McGuire because: (1) the concrete floor at Sequoyah was severely cracked and the floor moved in multiple planes; and (2) water intrusion at Sequoyah was the result of intentional floor defrosting and floor cleaning practices that were not performed at the McGuire facility.

The inspectors also asked if any baseline measurements of floor dimensions or special efforts to monitor floor growth were established in view of both the Sequoyah event and the ice melt events that had occurred at McGuire since then. No floor measurements had been taken, nor was additional monitoring established beyond the regular Technical Specification required door surveillances that are performed once every eighteen months. In 1992, the licensee did examine the condition of the wear slab and concluded that the cracking experienced at Sequoyah was not evident at McGuire. The licensee also stated that, unlike what was experienced at Sequoyah, the current condition of the Unit 2 floor indicates movement in a single plane. The inspectors noted that the licensee did not determine if the Sequoyah floor cracking had exhibited movement in a single plane before the severe cracking of the concrete occurred.

During the July 29 interview, the system engineer informed the inspectors that the setpoint for the temperature controlled glycol/floor cooling flow valve had drifted from 12°F to 19°F. The licensee believes that this degradation aggravated the condition of the floor; however, the licensee maintained that the ice on the floor did not melt.

The inspectors interviewed the instrumentation and controls (I&C) engineer and ice condenser system engineer on the procedure used to calibrate the glycol bleed controller for floor cooling. The inspector expressed concern that inadequate performance of the floor cooling system may create a source of water (from ice normally on the floor) that could be absorbed by the concrete. The I&C engineer informed the inspector that the system had never been calibrated and is run-to-failure. The licensee also postulated that the floor ice had sublimated away and did not melt, as evidenced by boron residue on the floor. However, the inspectors' examination of the video also revealed boron residue streams near the floor drains, which may indicate that an ice melt had occurred.

The inspectors also questioned if a mispositioned valve may have inadvertently isolated glycol to the floor cooling coils during maintenance and train swaps. Some plant drawings indicate that the idle pump had its associated discharge valve normally closed. Operations responded that the train swap practice for the floor cooling system did not require valve closure and the valves were not referenced in the procedure for train swaps.

On August 19, the inspector identified information in the UFSAR regarding the consequences of water on the floor of the ice condenser. UFSAR section 6.2.2.1.3 states that "..the effects of water on the floor and insulation [are] negligible." The licensee initiated PIP-0M-97-3070 to incorporate into the UFSAR industry and site-specific experience regarding water intrusion and temperature swing effects.

Preliminary Review of Safety Significance

To evaluate the short-term containment response, the licensee performed special scoping loss of coolant accident (LOCA) analyses using the GOTHIC computer code to demonstrate that the ice condenser would have performed its safety function during design basis accidents. Up to 16 blocked doors were assumed for a range of pipe break sizes. The results demonstrated that peak containment steam pressures would not exceed the design pressure. The inspector performed a preliminary review of LER 50-370/97-03 and noted to the licensee that an evaluation of post-accident hydrogen (e.g., degraded core, radiolysis of core and sump water, corrosion of aluminum and zinc, etc.) had not been performed. According to UFSAR section 6.2.7, 12 igniters are located in the ice condenser. The inspectors were concerned that blockage of the lower inlet doors may impact the distribution of hydrogen in containment and reduce the hydrogen mitigation system's effectiveness in preventing a detonable concentration during an accident. The licensee acknowledged the inspector's concern.

c. Conclusions

The inspectors concluded that the licensee's immediate corrective actions regarding the inoperable Unit 2 lower ice condenser doors were adequate. At the end of the inspection period, long-term corrective actions for both Unit 1 and Unit 2 were not established.

As a result of the degraded condition, two apparent violations were identified. The first apparent violation is related to a failure to comply with Technical Specification requirements for the operability of the ice condenser inlet doors on Unit 2 for an unknown period of time during operation in Modes 1, 2, 3, and 4. This is identified as apparent violation (EEI) 50-370/97-16-01, Failure to Comply With Technical Specification Requirements for Ice Condenser Lower Inlet Doors.

The second apparent violation is related to a failure to perform adequate corrective actions in accordance with 10 CFR Part 50 Appendix B Criterion XVI, in light of relevant industry operating experience at another ice condenser facility and operational events at the McGuire facility. A preliminary review of industry experience and site-specific operational events indicates that prior opportunities may have existed to implement corrective actions to prevent the occurrence of the event at the McGuire facility. This is identified as EEI 50-370/97-16-02, Failure to Implement Effective Corrective Actions to Prevent Ice Condenser Lower Inlet Door Binding.

V. Management Meetings

X1 Exit Meeting Summary

The inspectors presented the inspection results to members of licensee management at the conclusion of the inspection on August 7, 1997. The licensee acknowledged the findings presented.

The inspectors asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified. On August 27, a phone exit was held between the acting branch chief and the site vice-president to inform the licensee of the two apparent violations.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

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INSPECTION PROCEDURES USED

IP 37551: Onsite Engineering

ITEMS OPENED, CLOSED, AND DISCUSSED

OPENED

50-370/97-16-01	EEI	Failure to Comply With Technical Specification Requirements for Ice Condenser Lower Inlet Doors.
50-370/97-16-02	EEI	Failure to Implement Effective Corrective Actions to Prevent Ice Condenser Lower Inlet Door Binding.