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U.S. Nuclear Regulatory Commission
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Subject: Duke Energy Carolinas, LLC

McGuire Nuclear Station, Units 1 and 2
Docket Nos. 50-369 and 50-370

Catawba Nuclear Station, Units 1 and 2
Docket Nos. 50-413 and 50-414

Amendment to Technical Specification 3.6.13, "Ice Condenser Doors," Revised Surveillance Requirements

In accordance with the provisions of Section 50.90 of Title 10 of the Code of Federal Regulations (10CFR), Duke Energy Carolinas, LLC (Duke) is submitting a license amendment request (LAR) for the Renewed Facility Operating Licenses (FOL) and Technical Specifications (TS) for McGuire Nuclear Station Units 1 and 2, and Catawba Nuclear Station, Units 1 and 2.

The proposed LAR includes the following changes:

- Revision of station TS 3.6.13, Condition A with the adoption of NUREG-1431 wording concerning the application of the one (1) hour action statement (reference NUREG-1431, TS 3.6.16, Condition A), thus making the application of the action statement applicable only to ice condenser Lower Inlet Doors.

- Revision of station TS 3.6.13 adding a note to state that entry into Condition B is not required due to personnel standing on or opening an Intermediate or Top Deck Door for short durations to perform minor maintenance, surveillance or routine tasks. Associated TS Bases changes are also made consistent with this change.

- Revision of the surveillance requirement 3.6.13.5 wording for ice condenser Lower Inlet Door Initial Opening Torque.

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- Deletion of the surveillance requirement 3.6.13.6 for ice condenser Lower Inlet Door Torque Testing.

The proposed changes reduce licensee and regulatory burden by clarifying the intent of the ice condenser door technical specification surveillance requirements and aligning ice condenser door operability more closely with the safety analysis.

Attachment 1 provides Duke's evaluation of the LAR which contains a description of the proposed TS and associated Bases changes, the technical analysis, the determination that this LAR contains No Significant Hazards Considerations, the basis for the categorical exclusion from performing an Environmental Assessment/Impact Statement, and references.

Attachment 2a provides existing TS and associated Bases pages for McGuire Units 1 and 2, marked-up to show the proposed changes.

Attachment 2b provides existing TS and associated Bases pages for Catawba Units 1 and 2, marked-up to show the proposed changes.

Attachment 3a provides existing Updated Final Safety Analysis Report (UFSAR) pages for McGuire Units 1 and 2, marked-up to show the proposed changes. Attachment 3b provides existing UFSAR pages for Catawba Units 1 and 2, marked-up to show the proposed changes. The proposed changes to the McGuire and Catawba UFSARs are included as an aid in understanding the design and function of the Lower Inlet Doors.

The evaluations and discussions contained herein reflect the current McGuire and Catawba licensing and design basis. Sensitivity analyses (also discussed herein) conclude that this LAR will not affect any of the bounding conditions of the McGuire and Catawba ECCS Water Management Project, a potential future state. The conclusions of the Design Basis Accident pipe break size propagation evaluation are unaffected by the September 17, 2008 McGuire Unit 1 License Amendment Request to update the Leak-Before-Break (LBB) Evaluation and a proposed similar Catawba amendment request (potential future state conditions).

Duke requests that NRC review and approval of this LAR be completed by October 2, 2009. Duke has determined that a 60-day implementation grace period will be sufficient to implement this LAR.

Reprinted McGuire and Catawba Technical Specification and Bases pages will be provided to the NRC upon issuance of the approved amendments.

Revisions to the McGuire and Catawba UFSARs, necessary to reflect approval of this submittal, will be made in accordance with 10CFR50.71(e).

In accordance with Duke internal procedures and the Quality Assurance Topical Report, the proposed amendment has been reviewed and approved by the McGuire and Catawba Plant Operations Review Committee and the Duke Corporate Nuclear Safety Review Board.

Pursuant to 10CFR50.91, a copy of this LAR has been forwarded to the appropriate North and South Carolina state officials.

Please direct any questions you may have in this matter to K. L. Ashe at (704) 875-4535.

Very truly yours,

Bruce Hamilton

B. H. Hamilton

xc w/ Attachments:

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Bruce H. Hamilton affirms that he is the person who subscribed his name to the foregoing statement, and that all the matters and facts set forth herein are true and correct to the best of his knowledge.

Bruce Hamilton

Bruce H. Hamilton, Vice President, McGuire Nuclear Station

Subscribed and sworn to me: October 2, 2008
Date

Lori C. Bibby, Notary Public

My commission expires: July 1, 2012
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ATTACHMENT 1

EVALUATION OF PROPOSED AMENDMENT

1.0 SUMMARY DESCRIPTION

Pursuant to 10CFR50.90, Duke Energy Carolinas, LLC (Duke) is submitting a license amendment request (LAR) for the McGuire Nuclear Station Units 1 and 2, and Catawba Nuclear Station Units 1 and 2 Facility Operating Licenses (FOL) and Technical Specifications (TS). The proposed license amendment revises the McGuire Nuclear Station (MNS) Unit 1 and Unit 2, and the Catawba Nuclear Station (CNS), Unit 1 and Unit 2 Technical Specifications (TS) associated with the verification of ice condenser door operability. The proposed amendment affects the current MNS and CNS TS surveillance requirements (SR) 3.6.13.5 and 3.6.13.6, and associated TS Bases.

The changes included in this amendment request are as follows:

- <u>Adoption of NUREG-1431 Wording</u>

  Adoption of the NUREG-1431, "Standard Technical Specifications, Westinghouse Plants," Revision 3 TS 3.6.16 wording revises MNS TS 3.6.13 Condition A and CNS TS 3.6.13 Condition A to apply to the Lower Inlet Doors only, eliminating the one-hour action statement for any condition discovered involving the Intermediate Deck Doors or the Top Deck Doors. Associated TS Bases changes are also made consistent with this revision. It should be noted that the terms "Inlet Doors," as used in NUREG-1431, and "Lower Inlet Doors," as used in this submittal, are synonymous terms at McGuire and Catawba Nuclear Stations referring to the same doors. The use of the term "Lower Inlet Doors" is preferred so as to be consistent with the terminology used in the UFSARs.

  In addition, adoption of the NUREG-1431, Revision 3 TS 3.6.16 Bases wording revises the MNS TS 3.6.13 Actions and the CNS TS 3.6.13 Actions to provide a Note indicating entry into Condition B for the Intermediate Deck or Top Deck Doors is not required due to personnel standing on or opening doors for short durations to perform required surveillances, minor maintenance, or routine tasks. Associated TS Bases changes are also made consistent with this revision. The inclusion of the Note in MNS and CNS TS 3.6.13 is intended as an aid to the Control Room Operators.

- <u>Revision of the Lower Inlet Door Initial Opening Torque SR 3.6.13.5</u>

  The Lower Inlet Door Initial Opening Torque SR is revised in MNS SR 3.6.13.5 and CNS SR 3.6.13.5 to include verification of free door movement during the test. Associated TS Bases changes are also made consistent with this revision.

This LAR is not revising the Initial Opening Torque surveillance test acceptance criterion, a limit which assures that the inlet doors will break away from their seals at or below the analyzed lower compartment pressure of 1 pound per square foot.

- Elimination of Lower Inlet Door Torque Test SR 3.6.13.6

  The MNS SR 3.6.13.6 and CNS SR 3.6.13.6 surveillance test assessing the modulating capability of the Lower Inlet Doors while at the 40° open position is proposed to be eliminated. Associated TS SR reference and Bases changes are also made consistent with this revision.

The proposed changes reduce licensee and regulatory burden by clarifying the intent of the ice condenser door technical specification surveillance requirements, and align ice condenser door operability more closely with the safety analysis and licensing basis for McGuire and Catawba Nuclear Stations.

2.0 BACKGROUND

2.1 Ice Condenser System Description

The McGuire and Catawba Ice Condenser Systems prevent high pressure in the Containment and thus reduce the potential for the escape of fission products from the Containment. This low temperature heat sink, located on the inside of the steel Containment, consists of a suitable quantity of borated ice in a cold storage compartment.

The ice condenser is an annular compartment enclosing approximately 300° of the perimeter of the upper Containment compartment, but penetrating the operating deck so that a portion extends into the lower Containment compartment.

The ice condenser doors consist of the Lower Inlet Doors, the Intermediate Deck Doors, and the Top Deck Doors. The functions of the doors are to:

a. Seal the ice condenser from air leakage and provide thermal/humidity barriers during the lifetime of the unit; and

b. Open in the event of a Design Basis Accident (DBA) to direct the hot steam-air mixture from the DBA into the ice bed where the ice would absorb energy and limit Containment peak pressure and temperature during the accident transient. For the purposes of this Amendment Request, "DBA" refers to both Loss-of-Coolant Accidents (LOCA) and High Energy Line Breaks (HELB) inside Containment.

Limiting the pressure and temperature following a DBA reduces the release of fission product radioactivity from Containment to the environment.

The Lower Inlet Doors separate the atmosphere of the lower compartment from the ice bed inside the ice condenser. The Top Deck Doors are above the ice bed and exposed to the atmosphere of the upper compartment. The Intermediate Deck Doors, located below the Top Deck Doors, form the floor of a plenum at the upper part of the ice condenser. This upper plenum area is used to facilitate surveillance and maintenance of the ice bed and contains the air handling units that remove heat from the ice bed. Equalization vents located at the periphery of the intermediate and top decks are provided to balance small pressure differentials occurring across the decks during normal operation.

The ice baskets held in the ice bed within the ice condenser are arranged to promote heat transfer from steam to ice. This arrangement enhances the ice condenser's primary function of condensing steam and absorbing heat energy released to the Containment during a DBA.

The ice, together with the Containment Spray, serves as a Containment heat removal system and is adequate to absorb the initial blowdown of steam and water from a DBA as well as the additional heat loads that would enter Containment during the several hours following the initial blowdown. The additional heat loads would come from the residual heat in the reactor core, the hot piping and components, and the secondary system, including the steam generators. During the post blowdown period, the Air Return System (ARS) returns upper compartment air through the divider barrier to the lower compartment. This serves to equalize pressures in Containment and to continue circulating heated air and steam from the lower compartment through the ice condenser, where the heat is removed by the remaining ice.

The water from the melted ice drains into the lower compartment where it serves as a source of borated water (via the Containment sump) for the Emergency Core Cooling System (ECCS) and the Containment Spray System heat removal functions in the recirculation mode. The ice and the recirculated ice melt (via the

Containment Spray System) also serve to clean up the containment atmosphere.

In the event of a large break DBA, the ice condenser Lower Inlet Doors (located below the operating deck) open quickly due to the pressure rise in the lower compartment. This allows air and steam to flow from the lower compartment into the ice condenser. The resulting pressure increase within the ice condenser causes the Intermediate Deck Doors and the Top Deck Doors to open, which allows the air to flow out of the ice condenser into the upper compartment. Steam condensation within the ice condensers limits the pressure and temperature buildup in Containment. A divider barrier separates the upper and lower compartments and ensures that the steam is directed into the ice condenser.

In a small-break DBA scenario, the 48 Lower Inlet Doors are designed to open when the pressure differential between the lower compartment and the upper compartment is sufficiently high (approximately equal to the ice condenser cold head pressure of one pound per square foot). Once this breakaway pressure is reached and the lower inlet doors are slowly pushed away from their seals (the ajar position), the higher temperature steam/non-condensable gases from the lower compartment will enter the ice condenser and the heavier, more dense cold air inside will escape through the slightly open doors, dissipating the resisting cold head pressure. The doors will then open further or return toward the closed position under the influence of lower compartment small break pressure and the door spring closure mechanisms.

2.2 Propagation of DBA Break Size

The generic ice condenser design basis, generated by the original equipment manufacturer (OEM) in the 1967-1973 timeframe while ANSI Standard N18.2 (Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants) was being revised, assumed that a release in the lower compartment that initiated a small break DBA scenario could then propagate to a bigger release and a subsequent large break DBA. Per the standard in force at the time, this could occur either by a small leak growing larger (i.e., a change in the break geometry), or a small pipe break dynamically interacting with a larger high energy line in close proximity to it.

Consequently, the generic ice condenser system design was required to mitigate both the small break DBA and a subsequent large break DBA immediately following it. This was identified by the OEM as the "double break" scenario (or "double break test"), and the flow proportioning function of the lower inlet doors provided assurance that an asymmetric void would not be created in the ice bed during the small break phase, allowing bypass flow (i.e., uncondensed steam) to pass from the lower compartment to the upper compartment during a subsequent large break blowdown (Ref. 1h).

This scenario was determined by Duke to be beyond the design basis of the McGuire station and removed from the UFSAR via 10CFR50.59, invoking revised ANSI N18.2 safety criteria identified in 1973. The Catawba UFSAR does not identify the double break scenario as a design basis event. The double break scenario is discussed in more detail in Section 3.3.1.

2.3 Relevant Historical Information

Between 1967 and 1974, the Advisory Committee on Reactor Safeguards (ACRS), the NRC, and Westinghouse met numerous times to discuss the ice condenser design basis and evaluate the OEM's progress on certain aspects of the ice condenser Containment design. Unit 1 of the Donald C. Cook Nuclear Plant was started up in 1975, and after the first cycle of operation (ending in 1976) the ACRS, NRC, Westinghouse and American Electric Power Company personnel reconvened to review the ice condenser's actual performance. The meeting transcripts from this period are detailed in Ref. 1.

These meetings examined many topics, but there were two primary issues on which the committee focused that relate to the proposed amendment request:

1) The effect of Lower Inlet Door port failures (i.e., paired inlet doors that do not break away from their seals at all during a postulated transient, creating unusable relief ports around the ice bed periphery), and

2) The effect of steam bypass past the ice bed during a postulated transient, as compared to that analytically assumed to pass through the known openings in the Divider Deck.

Westinghouse conducted sensitivity analyses in response to these issues, the results of which were reported to the ACRS during this series of meetings.

The committee's inlet door discussions centered on the effect total port failures would have on the Containment shell pressure peak during the large break transient, as well as design characteristics to prevent these failures. In the context of these discussions, inlet door failures are paired inlet doors that fail to break away from their seals during a large break transient, preventing the venting of the energy release through that port.

Inlet door failure to break away during a small release was not specifically evaluated by Westinghouse. As the main concern with a small break event was even distribution of the release around the ice bed in order to properly accommodate a subsequent large break release ("double break"), sensitivity runs focused more on the effects of maldistribution and how to prevent it than on the initial opening of the doors. The basis was that there was more than sufficient capacity in the Containment Spray system to handle breaks too small to engage the ice condenser via the inlet doors, and significant effort had been put into ensuring they would open at the prescribed pressure differential.

The ACRS discussions involving unintentional steam bypass past the ice bed were more extensive and included small break scenarios as well as large break scenarios. In the context of the threat of steam bypass, there were basically two scenarios examined:

- Maldistribution of the release (i.e., via break flow asymmetry in the lower compartment or asymmetric inlet door behavior)

- Maldistribution of the ice bed inventory (ice in the ice baskets)

Maldistribution of the release was considered a threat since an asymmetric void (a "channel") could be created in the ice bed under such conditions, providing a bypass path for the remaining release. The context of the discussions was the small break scenario, since the large break release would be evenly distributed to the ice bed via the inlet door portal geometry alone (i.e., the inlet doors would be pushed out of the way in any large event).

Maldistribution of the ice bed inventory was considered a threat since a section of ice baskets loaded with less total ice than the others ("light" baskets) would melt first during a DBA release, even if the release was evenly distributed. The concern was that a channel in the ice bed could be created, requiring Containment Spray to mitigate the bypassing steam.

Sensitivity analyses were performed by Westinghouse to evaluate the effects of maldistribution, ultimately resulting in an analytical maldistribution limit for any one section of the ice bed, and technical specification surveillance requirements assuring evenly distributed small break release flow and appropriate ice mass distribution.

2.4 Recent NRC Inlet Door Inspection Report Activity

In the spring of 2006, the NRC Resident Inspectors at McGuire Nuclear Station noted a concern with TS SR 3.6.13.6 (Lower Inlet Door 40 Degree Torque Test series), in that the computation of the frictional torque component had produced negative values, a result that appeared to contradict the intuitively expected result. In addition, the NRC Residents noted that the test acceptance criteria for the frictional torque component had no documented lower bound, inferring that negative values in excess of the official (positive) maximum limit could be accepted as verification of an operable inlet door (Ref. 5,6).

Obtaining a negative value for the frictional torque component of the surveillance test requires that the measured opening torque of an inlet door held at the 40 degree open position be less than the torque required to statically hold the door open at the 40 degree position. Since the issue was relevant to both Duke plants, McGuire and Catawba were involved in its resolution.

Duke had interpreted the test acceptance limit to be an absolute value, allowing a positive or negative bound since the inlet doors were intended to modulate in both the open and close directions. While the test result value could be negative, no negative value in excess of the official TS surveillance limit was acceptable. The Ice Condenser Utility Group (ICUG) documented this interpretation in 2002 after discussing it at that year's ICUG Technical Conference. The interpreted position was not docketed, however, and in May of 2006 the McGuire NRC residents requested the formal design basis for the Lower Inlet Door (LID) 40-degree Torque Test series acceptance criteria per the requirements outlined in 10CFR50, Appendix B, Criterion III, Design Control; and Criterion XI, Test Control.

A clarified design basis for the Lower Inlet Doors was obtained by Duke directly from Westinghouse via contractual arrangement, since the design basis for the ice condenser is considered proprietary information by the OEM. The Westinghouse information confirmed the original test acceptance criteria (including a positive or negative bound), but required a significant amount of time to collect (final documentation was received in December, 2006), and as a result McGuire and Catawba received Green Non-Cited

Violations for failure to have readily retrievable design documentation to support the ice condenser lower inlet door surveillance procedure test acceptance limits.

In the process of documenting the basis for the acceptance limits, Westinghouse acknowledged that these criteria were not directly tied to the bounding Transient Mass Distribution (TMD) safety analysis, but were formulated from field tests on the first LIDs installed in Unit 1 of the Donald C. Cook plant in 1975. The limits were intended to be representative of inlet doors that behaved in the flow proportioning range with a specific characteristic curve, and were also intended to gauge inlet door hinge/spring mechanism material condition (Ref. 12).

This event/inspection report finding is noteworthy in that the complexity of the Lower Inlet Door 40 degree Torque Test series described by TS SR 3.6.13.6 renders it not only cumbersome to perform, but the results subject to misinterpretation. This situation represents an unnecessary burden on the licensee and the regulatory staff.

3.0 DETAILED DESCRIPTION AND TECHNICAL EVALUATION

The proposed changes are initiated as a result of an industry review of all ice condenser-related technical specifications for potential enhancement conducted by the Ice Condenser Utility Group from 1999-2003, as well as the application of extensive operating experience. ICUG determined that, based on differences in plant designs and analysis capability, each station determining that revisions to the I/C Door Technical Specification were needed should submit such revisions independently.

Duke has evaluated the operating characteristics of the McGuire and Catawba ice condensers to ensure that the proposed changes preserve the analyzed functions of the ice condenser. The technical justification for each of the proposed changes follows:

3.1 Adoption of NUREG-1431 Wording

Adoption of the NUREG-1431, Revision 3, TS 3.6.16 wording revises MNS TS 3.6.13 Condition A and CNS TS 3.6.13 Condition A to apply to the Lower Inlet Doors only, eliminating the one-hour action statement for any condition discovered involving the Intermediate Deck Doors or the Top Deck Doors, which are addressed by the 14-day action statement of Condition B. Associated TS Bases changes are also made consistent with this revision. It should be noted that the terms "Inlet Doors," as used in

NUREG 1431, and "Lower Inlet Doors," as used in this submittal, are synonymous terms referring to the same doors. The use of the term "Lower Inlet Doors" is preferred so as to be consistent with the terminology used in the MNS and CNS UFSARs. This standard technical specification wording was not originally incorporated in the MNS/CNS Ice Condenser Doors technical specifications during conversion to the Improved Technical Specifications (ITS) in 1998, which has resulted in undesirable entries into Condition A.

The one-hour action statement defined in Condition A of the TS for the Ice Condenser Lower Inlet Doors reflects the need to have the ice condenser in a state of readiness consistent with the analyzed initial conditions for Containment during any Mode of Applicability for the doors (i.e., Mode 4 or above). As the Lower Inlet Doors admit steam and non-condensable gases into the ice bed during either a large or small break DBA scenario, thus mitigating the pressure and temperature rise inside Containment, the one-hour action is appropriate.

The 14-day action statement defined in Condition B of the TS for the Ice Condenser Doors is designed for situations and components that do not significantly challenge the functional capability of the ice condenser during a postulated DBA (e.g., operable but degraded condition). The Intermediate Deck and Top Deck Doors are primarily thermal/humidity barriers. The time-dependent behavior of these doors, which are located outside the ice bed, is neither quantified nor included in the design basis analysis (Ref. 17) and, as such, the 14-day action statement is appropriate. If any of these doors are discovered not closed, Condition B appropriately contains an action to verify ice bed temperature every four hours during this period until they are closed.

Additionally, adoption of the NUREG-1431, Revision 3, TS 3.6.16 Bases wording revises the MNS TS 3.6.13 Actions and the CNS TS 3.6.13 Actions to provide a Note indicating entry into Condition B for the Intermediate Deck or Top Deck Doors is not required due to personnel standing on or opening doors for short durations to perform required surveillances, minor maintenance, or routine tasks. Associated TS Bases changes are also made consistent with this TS Note addition. This clarification only applies to tasks necessary to ensure ice condenser operability, require only a minimum amount of time to perform (i.e., less than the identified four hour frequency of Condition B), and involve a small number of personnel. Condition B was provided for Intermediate and Top Deck Doors found to be physically restrained from opening, and for any door conditions that threaten ice melt or sublimation, such as a door being found open or incapable of full closure. Performance of Required Action B.1 and B.2 are not necessary when momentarily opening a door (1) to determine if it is physically restrained, (2) to conduct minor maintenance activities such as ice removal, or (3) to perform routine tasks such as system walkdowns (Ref. 18).

The proposed changes to the TS and the TS Bases are consistent with the Tennessee Valley Authority's Sequoyah Nuclear Plant (Amendments 161 and 151; SER dated August 10, 1992, and Amendments 267 and 258, dated March 22, 2001) and Watts Bar Nuclear Plant (initial license; SER dated November 9, 1995, and Amendment 25, dated July 17, 2000). These amendments adopted the wording in the Ice Condenser Door Technical Specification contained in NUREG-1431, Revisions 1 and 3, with the appropriate action statements (as described above) for the ice condenser doors at these two stations.

3.2 Revision of the Lower Inlet Door Opening Torque SR 3.6.13.5

The Lower Inlet Door Initial Opening Torque SR is revised in MNS SR 3.6.13.5 and CNS SR 3.6.13.5 to include verification of free door movement during the test.

The 10CFR50, Appendix A (GDC 40) "Testing of Containment Heat Removal System" requirement states: "The Containment heat removal system shall be designed to permit appropriate periodic pressure and functional testing to assure (1) the structural and leaktight integrity of its components, (2) the operability and performance of the active components of the system, and (3) the operability of the system as a whole, and under conditions as close to the design as practical the performance of the full operational sequence that brings the system into operation, including operation of applicable portions of the protection system, the transfer between normal and emergency power sources, and the operation of the associated cooling water system."

Pursuant to items (1) and (2) of this requirement, the Lower Inlet Door Initial Opening Torque surveillance (SR 3.6.13.5) can be enhanced by including an assessment of LID motion in addition to the existing assessment of the initial opening (breakaway) torque.

The Lower Inlet Door Initial Opening Torque test limiting value of 675 in-lb is based on the design cold head pressure differential on the closed lower inlet doors of approximately 1 pound per square foot (psf). This value is established in the Westinghouse LID performance evaluation (Ref. 9a) and relates directly to the Containment response analyses. In accordance with 10CFR50.36, verifying the inlet doors initially break away at this pressure or less assures proper introduction of a large or small break release to the ice bed and maintains consistency with the initial conditions of the bounding safety analysis.

In order to perform the initial opening torque test, appropriate test conditions are procedurally established in Containment and the door is pulled (or pushed) slightly off of its seal from the closed position to verify the door face has not become frozen to it, and the force required to break the seal measured and converted to torque. As the cold head in the ice condenser provides the pressure required to compress the doors against their seals, loss of available cold head is minimized during the test to optimize the conditions for the remaining doors.

The proposed surveillance enhances this initial opening torque test by adding a further assessment that verifies free movement of the door through its available swing arc.

While inlet door movement characteristics (after initially breaking away) are not tied directly to the Containment response analysis (Ref. 12), this assessment will monitor the performance of the inlet door components (i.e., hinges and spring closure mechanisms) and verify they are being properly maintained. Early visual detection of changes to inlet door movement through the swing arc will facilitate prediction of potential challenges to the Initial Opening Torque surveillance limit that may occur due to component aging or degradation. To perform this freedom of movement assessment, each Lower Inlet Door will be manually pulled (or pushed) open to the shock absorber and released, allowing the door to return toward the closed position under the influence of the spring closure mechanisms. The test will typically be performed after the Initial Opening Torque (breakaway) tests are completed for all 48 inlet doors, since cold head for the movement assessment is not required. The motion of the Lower Inlet Door during the proposed assessment carries it through approximately 40 degrees of swing arc, which is sufficient movement to ensure the hinges and spring closure mechanisms are not degraded and that spring engagement will move the door back toward the closed position.

The proposed two-part surveillance, therefore, ensures Lower Inlet Door operability by verifying each door is capable of (1) introducing the release to the ice bed, and relieving the pressure in the lower compartment at the appropriate differential (less than or equal to 1 psf) to maintain consistency with the safety analysis, and (2) verifying that each door moves freely through its available range of motion to ensure LID component integrity (hinges, spring closure mechanisms) is being maintained. For the latter test, the opening angle of the Lower Inlet Doors is limited by the position of the shock absorbers such that the 40 degree position (approximately) is the maximum angle achievable.

The freedom of movement assessment is currently performed during the application of SR 3.6.13.6, the Lower Inlet Door Torque Test series, and is accomplished through a complex series of static force measurements / torque conversions carried out with the Lower Inlet Door held at the 40-degree open position. There is little to no inlet door movement required for the existing test series; the functional capability of the LID through its range of motion is considered assured if the SR test acceptance limits are met at the 40 degree position.

As described following, the Lower Inlet Door Torque Test series (SR 3.6.13.6) is proposed to be eliminated.

3.3 Elimination of the Lower Inlet Door Torque Test SR

The MNS SR 3.6.13.6 and CNS SR 3.6.13.6 surveillance test assessing the flow proportioning capability of the Lower Inlet Doors while at the 40° open position is proposed to be eliminated.

SR 3.6.13.6 was originally designed to verify that the Lower Inlet Doors will proportion steam flow into the ice bed during small break events, and after the blowdown phase of a large break event (i.e., the long-term phase). Employing this function, lower energy steam flow into the ice condenser would be evenly distributed to prevent a maldistribution into any one section of the ice bed.

Controlling the distribution of the energy inflow during a postulated small break DBA was intended to prevent an asymmetric ice melt and keep Containment pressure limits from being exceeded during a subsequent postulated large break DBA event (Ref. 1g and 3, also discussed later in this Section). The doors would control this potential maldistribution by behaving in accordance with a specific flow proportioning design requirement at low differential pressures (i.e., less than 1 psfd). The verification of this capability consists of a complex series of force measurements / torque conversions performed on each Lower Inlet Door in order to evaluate the equivalent torques at the Lower Inlet Door hinge centerline:

a. Quantify the closing torque supplied by the Lower Inlet Door spring tension mechanism at the 40° open position,

b. Quantify the torque required to further open the Lower Inlet Door from the 40° open position, and

c. Calculate a "hinge friction" torque component based on the results of the first two tests.

These surveillance tests and the associated acceptance criteria are described in the current McGuire and Catawba TS Bases for SR 3.6.13.6.

The Lower Inlet Doors are designed to remain closed until sufficient pressure is achieved in the lower compartment of Containment to break them away from their seals.

Once the Lower Inlet Doors are initially opened, the cold head inside the ice condenser dissipates through the openings between paired doors, and the loss of this resisting cold head allows the Lower Inlet Doors to open further under the influence of the elevated lower compartment pressure, venting energy into the ice condenser.

3.3.1 Discussion of DBA Break Size Propagation

Unit 1 of the D.C. Cook Nuclear Plant was the first ice condenser Containment licensed by the NRC (1975). A review of the D.C. Cook UFSAR therefore provides some historical insights relating to the original ice condenser Containment system design features prior to the licensing of MNS and CNS.

The current D.C. Cook UFSAR (Ref. 3), states the following:

"For small pipe breaks, which generate less than the pressure drop required to fully open the spring-hinged, ice condenser inlet doors and result in the door performance being in the flow proportioning range, a larger than normal fraction of the break flow will pass through the deck by way of the divider deck bypass area and into the upper compartment.

Another case has been examined where it is postulated that a small break loss-of-coolant accident precedes a larger break accident which occurs before all of the coolant energy is released by the small break, (i.e., a double accident). During the small break blowdown, some quantity of steam and air will bypass the ice condenser and enter the upper compartment via leakage in the divider deck. The important design requirement for the case of a double accident is that the amount of steam leakage into the upper compartment must be limited during the first part (small break) of the accident so that only a small increase in final peak pressure results for the second part (double-ended break) of the postulated accident. The steam which reaches the upper compartment will then add to the peak pressure for the second part of the accident. Therefore, the Containment spray system is used to limit the partial pressure of steam in the upper compartment due to deck bypass. The key elements which determine the double accident performance are the ice condenser lower doors, which open at a low differential pressure to admit steam to the ice condenser and limit the bypass flow of steam and thus the partial pressure of steam in the upper compartment, and the sprays which condense this bypass flow of steam and limit the partial pressure of steam in the upper compartment to a low value, less than 2 psia."

This language is part of the original design performance criteria from the 1972 edition of the D.C. Cook FSAR, which was the Westinghouse "proof of concept" for the ice condenser design (Ref. 1h).

Due to the age of the Cook Nuclear Plant, it was not designed to ANSI N18.2-1973, Section 2.1.3.3, which requires a design that prevents propagation of a small break LOCA to a large break LOCA. Considering that McGuire and Catawba are designed to ANSI N18.2-1973, Section 2.1.3.3, it is apparent that the consideration of the "double accident" scenario should not have been included as a consideration in establishing the design bases when these plants were licensed.

McGuire/Catawba UFSARs Section 15.0, "Accident Analysis" addresses the representative initiating events as they apply to these facilities. In accordance with ANSI N18.2-1973, "Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants", initiating events are defined as one of the following four categories:

Condition I Normal Operation and Operational Transients

Condition II Faults of Moderate Frequency

Condition III Infrequent Faults

Condition IV Limiting Faults

Small break and large break LOCAs are considered to be Condition III and Condition IV Events, respectively. According to ANSI N18.2-1973, Section 2.1.3.3: "A Condition III incident [infrequent faults] shall not, by itself, generate a Condition IV fault or result in a consequential loss of function of the Reactor Coolant System or Containment barriers." Therefore, the propagation of a small break LOCA into a large break LOCA is considered to be beyond the McGuire and Catawba design bases[1]. The reactor coolant system is properly designed to prevent the dynamic effects of a small pipe break from damaging other numerous small piping branches to cause a large break LOCA.

Section 3.6 of the McGuire and Catawba UFSARs also describes criteria for performing the evaluation of dynamic effects. The criterion described by UFSAR Section 3.6.2.2 further defines the limitations of the mechanism of propagation. This mechanism is limited such that only weaker nearby piping is subject to propagation of the break due to dynamic effects. Although not directly stated in the UFSARs, the greatest dynamic effects would result at the initiation of the postulated break and would decrease over time, so it is reasonable to conclude by engineering judgment that such propagation would occur immediately at the initial onset of the postulated break. This conclusion is consistent with and supported by the analysis criteria outlined in UFSAR Section 3.6.2.2 that the propagation of circumferential and longitudinal breaks will reach full size within one (1) millisecond.

In addition, a review of Chapters 3, 6 and 15 of the McGuire/Catawba UFSARs was performed to determine the break sizes and types used in the safety analyses. Section

[1] Duke obtained permission to use Leak-Before-Break (LBB) methodology as relief from the requirements of GDC-4 as they apply to the dynamic effects of a LOCA from a break of the Reactor Coolant main loop (Ref. 16, 21). However, it does not apply to smaller diameter branch piping.

6.2.1.3.2 discusses reactor coolant system pipe breaks that include double ended guillotine breaks in the hot leg, cold leg pump suction, and the cold leg pump discharge piping. Section 6.2.1.4 discusses various main steam line breaks sized 0.4, 0.6, 0.86, 1.1, 1.4, and 2.4 square feet. Section 15.6.5.1 discusses a double ended guillotine break in the reactor coolant system cold leg nozzle, and Section 15.6.5.2 discusses small break LOCAs in piping sized 1.5, 2, 3, and 4 inches in diameter.

3.3.2 Large Break DBA Analysis Approach

10CFR50.46 (Ref. 2) criteria requires that range of break sizes be analyzed and documented in the McGuire/Catawba UFSARs that addresses core damage mitigation as it relates to Emergency Core Cooling System performance capabilities. Small break scenarios are included in this range, up to and including the double-ended rupture of the reactor coolant system piping. The range of break sizes evaluated was discussed previously.

Pressure transients in Containment are analyzed separately and, as reported in the McGuire/Catawba UFSARs, the bounding analysis for this group of transients represents the double-ended rupture of the Recirculating Steam Generator (RSG) Cold Leg Pump Discharge piping. The NRC has approved the use of the GOTHIC code in modeling the long-term phase of the large break LOCA Containment response for Duke (the short term response is still modeled by the original TMD analysis). Adherence to MNS and CNS TS SR 3.6.12.4 (total ice mass) and SR 3.6.12.5 (ice mass per basket) prevents ice bed burn-through during the blowdown phase. The effects of early ice bed burn-through are recognized as a long-term concern. The approved Containment analysis methodology (GOTHIC) was therefore used to evaluate the effect of ice bed cross-flow and a postulated ice bed bypass on Containment response via a series of sensitivity analyses.

The original Westinghouse ice condenser TMD model (the original McGuire and Catawba safety analysis of record) did not include the effect of lateral ice bed cross-flow between TMD sections. The ice condenser sections are modeled as independent nodes, which ultimately results in the need to have all inlet doors opening proportionally to prevent any one of these sections from being depleted too early in a postulated small break transient. While Westinghouse did perform cross-flow sensitivity analyses that showed significant pressure reductions on the Containment shell during these transients due to this effect, the OEM elected to leave the bounding TMD analysis without cross-flow for conservatism. As noted previously, the conservative approach used in the original ice condenser design relates to the restrictive requirement that it be capable of handling a small break transient immediately followed by a large break transient (Ref. 1g, 1h, 1j).

The GOTHIC sensitivity analyses reaffirm the significant effect of steam cross-flow within the ice condenser bays; these analyses were performed in response to questions asked by the NRC regarding a submittal made by the Ice Condenser Utility Group [NRC approved Technical Specification Task Force (TSTF) 429-A, "Ice Mass Determination Surveillance Requirements," Revision 3]. The GOTHIC Containment models and analysis methodology used for these responses are described in the Duke Topical Report DPC-NE-3004, "Mass and Energy Release and Containment Response Methodology," Revision 1, approved by the NRC's February 29, 2000 Safety Evaluation Report (Ref. 11). The responses and description of the GOTHIC sensitivity runs are contained in industry topical report ICUG-001, "Application of the Active Ice Mass Management Concept to the Ice Condenser Ice Mass Technical Specification," Revision 2, approved by the NRC's September 11, 2003 Safety Evaluation Report (Ref. 10).

Using this model, the Peak Containment Pressure Transient (large break DBA) was re-analyzed assuming an extreme asymmetric initial ice distribution, with lighter weight baskets located directly above the assumed break location. The analysis (Ref.10) showed that even if a localized region of extremely light ice baskets is assumed to be initially present in the ice condenser, the steam entering the ice condenser at that section will not melt this ice and then completely bypass the remaining ice in the bed. The entire ice bed will still be melted during the event, since there is no isolated pathway for the steam to bypass the ice condenser.

In a small break DBA event, bypass is even less likely since the motive force for the steam in the lower compartment in this case will be created by the low pressure areas of condensing steam in the ice bed as opposed to a forceful blowdown of the reactor coolant system. In effect, the steam will have an affinity for the ice, a scenario also consistent with the Westinghouse sensitivity analysis (Ref. 1j). Therefore, as confirmed by the more refined three-dimensional analytical capabilities of the GOTHIC methodology, the original flow proportioning design requirement for the Lower Inlet Doors is not necessary as long as the doors open at the appropriate initial breakaway pressure differential to admit the steam flow. The peak Containment pressure is not challenged for the small break DBA scenario, and the large-break DBA remains bounding. The ice condenser will still meet its design function for all Containment pressurization scenarios.

3.3.3 Sensitivity of Containment to Bypass Flow

The original Westinghouse TMD analysis and the associated sensitivity runs addressed the ability of the ice condenser Containment to handle bypass flow (i.e., steam flow from the break that is not directed to the ice bed but bypasses it via structural openings in the Divider Deck). While the designed bypass area between the upper and lower compartments of the ice condenser Containment is less than 5 square feet, the OEM's sensitivity analysis results show that a bypass area of up to 50 square feet is possible before the Containment shell pressure would be challenged (Ref. 1i, 9b). The results of these analyses are described and presented in McGuire/Catawba UFSAR Section 6.2.1.1.3; this license amendment does not affect this work.

These sensitivity analyses have been designated as being historical in nature due to minor changes in plant operating parameters not reflected by the original work. The sensitivity analyses are not used to establish any acceptance criteria within the design basis; rather, they demonstrate the extreme amount of margin between the deck leakage design basis value and a leakage value which would challenge the containment pressure design limit.

3.3.4 Additional Considerations

- Manual Start of Containment Air Return Fan Amendment Requests

  It is noted that the large break LOCA Containment analysis methodology contained in NRC approved Topical Report DPC-NE-3004, Rev 1, has been recently used by Duke with minor modifications to simulate the response to a SBLOCA transient in support of the "Amendment to Allow an Additional Operator Action to Manually Start One Containment Air Return Fan in Response to NRC Bulletin 2003-01", which the NRC approved for both McGuire and Catawba (Ref. 7 and 8). However, the small break models employed in that submittal are case-specific and are not invoked in this amendment request.

  The proposed elimination of TS 3.6.13.6 does not affect any initial conditions or assumptions made in the earlier submittal.

- Containment Transients

  Lower Inlet Door flow-proportioning behavior also has no impact on the Peak Containment Temperature Transient described in Section 6.2.1.1.3 of the McGuire/Catawba UFSARs. This transient utilizes a steam line break in lieu of an RCS break. The pressure differentials across the Lower Inlet Doors following a large steam line break will cause all of the doors to open completely. After the blowdown phase and for smaller steam line breaks, door behavior emulates that exhibited during a small break DBA. Therefore, there is no flow-proportioning requirement for the Lower Inlet Doors in the Peak Containment Temperature transient response.

  Other transients described in Section 6.2 of the McGuire/Catawba UFSARs (Peak Reverse Differential Pressure, Minimum Containment Backpressure) utilize the mass and energy release from a large break LOCA. The ice condenser still meets its design function during all of these scenarios; there is no flow-proportioning requirement for any of these transients.

- ECCS Sump Amendment Requests

  Recent Duke LARs "License Amendment Request Revising McGuire Units 1 and 2 Updated Final Safety Analysis Report Commitments to USNRC Regulatory Guide 1.82, Revision 0, 'Sumps For Emergency Core Cooling and Containment Spray Systems' and Revising McGuire Units 1 and 2 Technical Specification Surveillance Requirement (SR) 3.5.2.8 and Associated Bases," (Ref. 13) and "License Amendment Request Revising Catawba, Units 1 and 2 Commitments to USNRC Regulatory Guide 1.82, Revision 0, 'Sumps For Emergency Core Cooling and Containment Spray Systems' and Revising Technical Specification Surveillance Requirement (SR) 3.5.2.8 and Associated Bases," (Ref. 19) were also reviewed for potential impact. The proposed Ice Condenser Door TS LAR does not change the ice condenser accident response during any large break or small break event.

- ECCS Water Management (potential future state)

  The Duke ECCS Water Management Project, initiated in response to GSI-191 and NRC Bulletin 2003-01, was also reviewed for possible interactions (Ref. 15). This internal project primarily involves the potential implementation of a delay in the actuation of the Containment Spray pumps in order to optimize the use of ECCS inventory. Since the GOTHIC sensitivity analyses referenced in support of the proposed change include the use of Containment Spray early in the LBLOCA event (i.e., automatic initiation), the effect of delaying spray was evaluated further using this methodology and a model representative of both the McGuire and Catawba containments. The long-term containment response analytically matched the results of the original sensitivity analyses, confirming that the use of spray early in the bounding LBLOCA event has little effect on long-term containment response, even if an early ice bed burn-through is assumed to occur. The proposed Ice Condenser Door TS license amendment request does not affect any of the bounding conditions for the ECCS Water Management Project; as stated previously, the contribution to the ECCS sump from the ice condenser is not changed.

- Amendment Request to Update the Leak-Before-Break Evaluation (potential future state)

  The September 17, 2008 McGuire Unit 1 License Amendment Request to update the Leak-Before-Break (LBB) Evaluation (Ref. 22), submitted as a contingency related to the required inspection of the reactor vessel hot leg nozzle-to-safe-end welds, was reviewed for potential impact. A similar request will be prepared for Catawba. The conclusions of the DBA break size propagation (i.e., double accident) discussion contained in Section 3.3.1 of this Ice Condenser Door LAR are unaffected by the proposed change.

Duke has concluded that the original requirement that the Lower Inlet Doors modulate low pressure steam flow during a small break DBA should not be considered as part of the design or licensing basis of the ice condenser, and the existing surveillance test (MNS/CNS SR 3.6.13.6), designed to verify this Lower Inlet Door behavior, is therefore unnecessary and overly restrictive. The maintenance program procedurally monitors Lower Inlet Door condition at each refueling outage, and the Lower Inlet Door Initial Opening Torque surveillance test (SR 3.6.13.5), as revised by this LAR, verifies the capability of the doors to properly vent energy to the ice bed in response to either a large-break or a small-break DBA and provides an appropriate visual assessment of inlet door condition through the available swing arc.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria:

This LAR does not alter or revise the current bounding safety analyses of record in any way. This LAR is supported by sensitivity analyses using approved methodology that show the McGuire and Catawba Containment acceptance criteria will continue to be met with no loss of safety margin following implementation of the proposed changes. Consequently, McGuire and Catawba will remain in compliance with the applicable regulations and requirements. These are: 10CFR50, Appendix A, General Design Criterion (GDC) 16, "Containment Design," which requires that the reactor Containment and associated systems provide an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment; GDC 38, "Containment Heat Removal," which requires that a system be provided to remove heat from the reactor Containment; GDC 40, "Testing of Containment Heat Removal

System," which requires appropriate periodic testing to assure system operability, and GDC 50, "Containment Design Basis," which requires that the reactor Containment structure be designed with conservatism to accommodate applicable design parameters (pressure, temperature, leakage rate). TS 3.6.13 for the Ice Condenser Doors satisfy Criterion 3 of 10 CFR 50.36 which is the NRC regulation that addresses the content of nuclear plant TS. This LAR is being submitted in accordance with 10 CFR 50.90.

4.2 Precedent

The Tennessee Valley Authority's Sequoyah Nuclear Plant (Amendments 161 and 151; SER dated August 10, 1992, and Amendments 267 and 258, SER dated March 22, 2001) and Watts Bar Nuclear Plant (initial license; SER dated November 9, 1995 and Amendment 25, SER dated July 17, 2000) adopted the wording in their Ice Condenser Door Technical Specifications contained in NUREG-1431, Revision 1 and Revision 3.

The original GOTHIC sensitivity runs referenced in this submittal are contained in industry topical report ICUG-001, "Application of the Active Ice Mass Management Concept to the Ice Condenser Ice Mass Technical Specification," Revision 2, approved by the NRC's September 11, 2003 SER (Ref. 10).

4.3 Significant Hazards Consideration:

Duke Energy Carolinas, LLC (Duke) has concluded that operation of Catawba Nuclear Station (CNS) Units 1 & 2, and McGuire Nuclear Station (MNS) Units 1 & 2, in accordance with the proposed changes to the Technical Specifications (TS) does not involve a significant hazards consideration. Duke's conclusion is based on its evaluation, in accordance with 10 CFR 50.91(a)(l), of the three standards set forth in 10 CFR 50.92(c).

A. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

The only analyzed accidents of possible consideration in regards to changes potentially affecting the ice condenser are a loss of coolant accident (LOCA) and a high energy line break (HELB) inside Containment. However, the ice condenser is not postulated as being the initiator of any LOCA or HELB. This is because it is designed to remain functional following a design basis earthquake, and the ice condenser does not interconnect or interact with any systems that interconnect or interact with the Reactor Coolant or Main Steam Systems. Since these proposed changes do not result in, or require, any physical change to the ice condenser that could introduce an interaction with the Reactor Coolant or Main Steam Systems, then there can be no change in the probability of an accident previously evaluated. Regarding consequences of analyzed accidents, the ice condenser is an engineered safety feature designed, in part, to limit the Containment sub-compartment and Containment vessel pressure immediately following the initiation of a LOCA or HELB. Conservative sub-compartment and Containment pressure analysis shows these criteria will be met if the total ice mass within the ice bed is maintained in accordance with the DBA analysis; therefore, the proposed TS SR changes of these requirements will not increase the consequences of any accident previously evaluated.

Thus, based on the above, the proposed changes do not involve a significant increase in the probability or consequences of an accident previously evaluated.

B. Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

As previously described, the ice condenser is not postulated as being the initiator of any design basis accident. The proposed changes do not impact any plant system, structure or component that is an accident initiator. The proposed TSs and TS Bases changes do not involve any hardware changes to the ice condenser or other change that could create any new accident mechanisms. Therefore, there can be no new or different accidents created from those already identified and evaluated.

C. Does the proposed amendment involve a significant reduction in the margin of safety?

Response: No.

Margin of safety is related to the confidence in the ability of the fission product barriers to perform their design functions during and following an accident situation. These barriers include the fuel cladding, the reactor coolant system, and the Containment system. The performance of the fuel cladding and the reactor coolant system will not be impacted by the proposed changes. The

Application provides a description of additional sub-compartment and Containment pressure response analysis that has been performed. This analysis demonstrates that Containment will remain fully capable of performing its design function with implementation of the proposed changes. Therefore, no safety margin will be significantly impacted.

The changes proposed in this LAR do not make any physical alteration to the ice condenser doors, nor does it affect the required functional capability of the doors in any way. The intent of the proposed changes to the ice condenser door surveillance requirements is to eliminate an unnecessary and overly restrictive Lower Inlet Door torque surveillance test. There will be no degradation in the operable status of the ice condenser doors and the ability to confirm operability for the ice condenser doors will be maintained, such that the doors will continue to fully perform their safety function as assumed in the plant's safety analyses.

Thus, it can be concluded that the proposed TS and TS Bases changes do not involve a significant reduction in the margin of safety.

4.4 Conclusions

Duke is requesting changes to McGuire and Catawba Nuclear Station Technical Specification (TS) 3.6.13, Ice Condenser Doors, and the associated TS Bases.

The proposed changes reduce licensee and regulatory burden by clarifying the ice condenser door Limiting Conditions of Operation (LCO), clarifying the intent of the ice condenser inlet door technical specification surveillance requirements, and aligning ice condenser door operability more closely with the safety analysis and the licensing basis.

The proposed change to the LCO provides clarification to the one hour (Condition A) Action Statement, which should only apply to the Lower Inlet doors and not to the Intermediate Deck and Top Deck doors. This clarification will maintain consistency with the current revision (Revision 3) of the NUREG-1431 Standard Technical Specifications (TS 3.6.16).

The proposed change to the LCO also provides a needed enhancement to the Action Statements addressing the presence of personnel in the Ice Condenser Upper Plenum performing routine maintenance and surveillance-related tasks while in a Mode of

Applicability (i.e., Modes 1, 2, 3 and 4). This enhancement will also maintain consistency with the current revision (Revision 3) of the NUREG-1431 Standard Technical Specifications Bases (TSB 3.6.16).

The proposed changes to the Lower Inlet Door surveillance requirements eliminate an unnecessary and overly restrictive quantification of inlet door freedom of movement torques, and replace it with a verification that each Lower Inlet Door initially breaks away within the current required torque limit and then is also free to move through its available range of motion once off its seal. This assessment aligns Lower Inlet Door operability more closely with the safety analysis of record and the licensing basis for McGuire and Catawba Nuclear Stations.

5.0 ENVIRONMENTAL CONSIDERATION

The proposed changes do not involve a significant hazards consideration, a significant change in the types of or significant increase in the amounts of any effluents that may be released offsite, or a significant increase in individual or cumulative occupational radiation exposure. Therefore, the proposed changes meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), an environmental assessment of the proposed changes is not required.

6.0 REFERENCES

The following NRC guidance documents, inspection reports, letters, ACRS meeting transcripts, and related Amendments were consulted, as well as the listed OEM design documentation:

1) Advisory Committee on Reactor Safeguards Meeting Transcripts
   a) December 22, 1976, ACRS Subcommittee Meeting on D.C. Cook Unit 1
   b) December 14, 1976, Report to the ACRS by the Office of Nuclear Reactor Regulation, Docket 50-315
   c) February 5, 1976, 190th General Meeting ACRS
   d) February 4, 1976, ACRS Subcommittee Meeting on D.C. Cook Nuclear Plant, Unit 1
   e) January 21, 1976, Donald C. Cook Unit 1 Safety Evaluation Report, Supplement 5
   f) April 25, 1974, NRC Staff Evaluation of Tests Conducted to Demonstrate the Functional Adequacy of the Ice Condenser Design
   g) October 12, 1973, ACRS Meeting Transcript

h) October 11, 1973, ACRS Meeting Transcript
i) October 5, 1973, ACRS Meeting Transcript
j) September 12, 1973, ACRS Meeting Transcript

2) 10CFR50.46, Acceptance Criteria for Emergency Core Cooling Systems for Light Water Nuclear Power Reactors.
3) Donald C. Cook UFSAR, Section 14.3.4.5.4, "Ice Condenser Performance Criteria".
4) Donald C. Cook UFSAR, Appendix M, Amendment 20 (March, 1972), Amendment 40 (April, 1973) and Amendment 45 (July, 1973).
5) McGuire Nuclear Station - NRC Integrated Inspection Report 05000369/2006005, 05000370/2006005, and 072000038/2006005 and Exercise of Enforcement Discretion, dated January 30, 2007.
6) Catawba Nuclear Station - NRC Integrated Inspection Report 05000413/2006005 and 05000414/2006005, dated January 30, 2007.
7) McGuire Nuclear Station License Amendments 234 (Unit 1) and 216 (Unit 2): “Amendment to Allow an Additional Operator Action to Manually Start One Containment Air Return Fan in Response to NRC Bulletin 2003-01”, SER dated September 25, 2006.
8) Catawba Nuclear Station License Amendments 231 (Unit 1) and 227 (Unit 2): “Amendment to Allow an Additional Operator Action to Manually Start One Containment Air Return Fan in Response to NRC Bulletin 2003-01”, SER dated September 25, 2006.
9) Westinghouse Electric Corporation Design Reports
   a) WCAP-7689, "Design and Performance Evaluation of Ice Condenser Inlet Doors," (Unrestricted Version) dated March, 1971
   b) WCAP 7611-L, "Design and Performance Evaluation of Ice Condenser Inlet Doors," (Proprietary Version) dated March, 1971
   c) WCAP-8077, “Ice Condenser Containment Pressure Transient Analysis Method,” (Proprietary) and WCAP-8078 (Non-Proprietary), dated March, 1973
   d) WCAP-8110, Supplement 1, "Test Plans and Results for the Ice Condenser System," dated April 30, 1973
   e) WCAP-8264, "Westinghouse Mass and Energy Release Data for Containment Design," dated March, 1974
10) Duke Power Company, “Application of the Active Ice Mass Management Concept to the Ice Condenser Ice Mass Technical Specification,” ICUG-001, Ice Condenser Utility Group, Revision 2, June, 2003, SER dated September 11, 2003.

11) Duke Power Company, "Mass & Energy Release and Containment Response Methodology," DPC-NE-3004-PA, Rev. 1, SER dated February 29, 2000.
12) Westinghouse Electric Co., "McGuire and Catawba Nuclear Plants, Responses to Questions 3 and 8 on Ice Condenser Design Basis and Safety Function," Letter DPC-06-081, Rev. 1, dated November 28, 2006.
13) Duke Energy Corporation, "License Amendment Request Revising McGuire Units 1 and 2 Updated Final Safety Analysis Report Commitments to USNRC Regulatory Guide 1.82, Revision 0, 'Sumps For Emergency Core Cooling and Containment Spray Systems' and Revising McGuire Units 1 and 2 Technical Specification Surveillance Requirement (SR) 3.5.2.8 and Associated Bases," SER dated May 4, 2007.
14) NRC Document, "Staff Evaluation of Tests Conducted to Demonstrate the Functional Adequacy of the Ice Condenser Design," dated April 25, 1974.
15) Duke Energy Corporation, "ECCS Water Management Initiative," letter to NRC dated September 13, 2006, Docket Nos. 50-413 and 50-414.
16) Letter, B. J. Youngblood, NRC Division of PWR Licensing, to H. B. Tucker, Duke Power, dated May 8, 1986, Subject: "McGuire Nuclear Station - Elimination of Large Primary Loop Pipe Ruptures."
17) Westinghouse Letter EDRE-EMT-284, "Catawba Ice Condenser Intermediate Deck Door Questions," dated November 1, 1997.
18) Industry/TSTF Standard Technical Specification Change Traveler, TSTF-336, Revision 1, approval letter dated October 31, 2000.
19) Duke Energy Corporation, "License Amendment Request Revising Catawba, Units 1 and 2 Commitments to USNRC Regulatory Guide 1.82, Revision 0, 'Sumps For Emergency Core Cooling and Containment Spray Systems' and Revising Technical Specification Surveillance Requirement (SR) 3.5.2.8 and Associated Bases," SER dated November 8, 2007.
20) NUREG-1431, "Standard Technical Specifications, Westinghouse Plants," Revision 3
21) Letter, K. N. Jabbour, NRC Division of PWR Licensing, to H. B. Tucker, Duke Power, dated April 7, 1987, Subject: "Catawba Nuclear Station - Elimination of Large Primary Loop Pipe Ruptures."
22) Duke Energy Corporation, McGuire Unit 1 License Amendment Request Updating Leak-Before-Break Evaluation, dated September 17, 2008

ATTACHMENT 2a

MARKED PAGES OF AFFECTED McGUIRE TECHNICAL SPECIFICATIONS
AND ASSOCIATED BASES

3.6 CONTAINMENT SYSTEMS

3.6.13 Ice Condenser Doors

LCO 3.6.13 The ice condenser lower inlet doors, intermediate deck doors, and top deck doors shall be OPERABLE and closed.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

-----NOTES-----

1. Separate Condition entry is allowed for each ice condenser door.
2. Entry into Condition B is not required due to personnel standing on or opening an intermediate deck or top deck door for short durations to perform required surveillances, minor maintenance such as ice removal or routine tasks such as system walkdowns.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more ice condenser lower inlet doors inoperable due to being physically restrained from opening.	A.1 Restore lower inlet door to OPERABLE status.	1 hour
B. One or more ice condenser doors inoperable for reasons other than Condition A or not closed.	B.1 Verify maximum ice bed temperature is ≤ 27°F.	Once per 4 hours
	<u>AND</u>	
	B.2 Restore ice condenser door to OPERABLE status and closed positions.	14 days

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Required Action and associated Completion Time of Condition B not met.	C.1 Restore ice condenser door to OPERABLE status and closed position.	48 hours
D. Required Action and associated Completion Time of Condition A or C not met.	D.1 Be in MODE 3. AND D.2 Be in MODE 5.	6 hours 36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.6.13.1	Verify all lower inlet doors indicate closed by the Inlet Door Position Monitoring System.	12 hours
SR 3.6.13.2	Verify, by visual inspection, each intermediate deck door is closed and not impaired by ice, frost, or debris.	7 days
SR 3.6.13.3	Verify, by visual inspection, each top deck door: a. Is in place; and b. Has no condensation, frost, or ice formed on the door that would restrict its opening.	92 days

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.13.4	Verify, by visual inspection, each lower inlet door is not impaired by ice, frost, or debris.	18 months
SR 3.6.13.5	Verify torque required to cause each lower inlet door to begin to open is ≤ 675 in-lb and verify free movement of the door.	18 months
SR 3.6.13.6	~~Perform a torque test on each inlet door~~ (deleted)	~~18 months~~
SR 3.6.13.7	Verify for each intermediate deck door: a. No visual evidence of structural deterioration; b. Free movement of the vent assemblies; and c. Free movement of the door.	18 months

B 3.6 CONTAINMENT SYSTEMS

B 3.6.13 Ice Condenser Doors

BASES

BACKGROUND

The ice condenser doors consist of the lower inlet doors, the intermediate deck doors, and the top deck doors. The functions of the doors are to:

a. Seal the ice condenser from air leakage and provide thermal/humidity barriers during the lifetime of the unit; and

b. Open in the event of a Design Basis Accident (DBA) to direct the hot steam-air mixture from the DBA into the ice bed, where the ice would absorb energy and limit containment peak pressure and temperature during the accident transient.

Limiting the pressure and temperature following a DBA reduces the release of fission product radioactivity from containment to the environment.

The ice condenser is an annular compartment enclosing approximately 300° of the perimeter of the upper containment compartment, but penetrating the operating deck so that a portion extends into the lower containment compartment. The lower inlet doors separate the atmosphere of the lower compartment from the ice bed inside the ice condenser. The top deck doors are above the ice bed and exposed to the atmosphere of the upper compartment. The intermediate deck doors, located below the top deck doors, form the floor of a plenum at the upper part of the ice condenser. This upper plenum area is used to facilitate surveillance and maintenance of the ice bed. INSERT A

The ice baskets held in the ice bed within the ice condenser are arranged to promote heat transfer from steam to ice. This arrangement enhances the ice condenser's primary function of condensing steam and absorbing heat energy released to the containment during a DBA.

In the event of a DBA, the ice condenser lower inlet doors (located below the operating deck) open due to the pressure rise in the lower compartment. This allows air and steam to flow from the lower compartment into the ice condenser. The resulting pressure increase within the ice condenser causes the intermediate deck doors and the top deck doors to open, which allows the air to flow out of the ice condenser into the upper compartment. Steam condensation within the ice condensers limits the pressure and temperature buildup in containment. A divider barrier separates the upper and lower compartments and ensures that the steam is directed into the ice condenser.

BASES

BACKGROUND (continued)

The ice, together with the containment spray, serves as a containment heat removal system and is adequate to absorb the initial blowdown of steam and water from a DBA as well as the additional heat loads that would enter containment during the several hours following the initial blowdown. The additional heat loads would come from the residual heat in the reactor core, the hot piping and components, and the secondary system, including the steam generators. During the post blowdown period, the Air Return System (ARS) returns upper compartment air through the divider barrier to the lower compartment. This serves to equalize pressures in containment and to continue circulating heated air and steam from the lower compartment through the ice condenser, where the heat is removed by the remaining ice.

The water from the melted ice drains into the lower compartment where it serves as a source of borated water (via the containment sump) for the Emergency Core Cooling System (ECCS) and the Containment Spray System heat removal functions in the recirculation mode. The ice ~~(via the Containment Spray System)~~ and the recirculated ice melt (via the Containment Spray System) also serve to clean up the containment atmosphere.

The ice condenser doors ensure that the ice stored in the ice bed is preserved during normal operation (doors closed) and that the ice condenser functions as designed if called upon to act as a passive heat sink following a DBA.

APPLICABLE SAFETY ANALYSES

The limiting DBAs considered relative to containment pressure and temperature are the loss of coolant accident (LOCA) and the steam line break (SLB). The LOCA and SLB are analyzed using computer codes designed to predict the resultant containment pressure and temperature transients. DBAs are assumed not to occur simultaneously or consecutively.

Although the ice condenser is a passive system that requires no electrical power to perform its function, the Containment Spray System and ARS also function to assist the ice bed in limiting pressures and temperatures. Therefore, the postulated DBAs are analyzed with respect to Engineered Safety Feature (ESF) systems, assuming the loss of one ESF bus, which is the worst case single active failure and results in one train each of the Containment Spray System and the ARS being rendered inoperable.

The limiting DBA analyses (Ref. 1) show that the maximum peak containment pressure results from the LOCA analysis and is calculated to

BASES

APPLICABLE SAFETY ANALYSES (continued)

be less than the containment design pressure. For certain aspects of transient accident analyses, maximizing the calculated containment pressure is not conservative. In particular, the cooling effectiveness of the ECCS during the core reflood phase of a LOCA analysis increases with increasing containment backpressure. For these calculations, the containment backpressure is calculated in a manner designed to conservatively minimize, rather than maximize, the calculated transient containment pressures, in accordance with 10 CFR 50, Appendix K (Ref. 2).

The maximum peak containment atmosphere temperature results from the SLB analysis and is discussed in the Bases for LCO 3.6.5, "Containment Air Temperature."

INSERT B

~~An additional design requirement was imposed on the ice condenser door design for a small break accident in which the flow of heated air and steam is not sufficient to fully open the doors.~~

~~For this situation, the doors are designed so that all of the doors would partially open by approximately the same amount. Thus, the partially opened doors would modulate the flow so that each ice bay would receive an approximately equal fraction of the total flow.~~

~~This design feature ensures that the heated air and steam will not flow preferentially to some ice bays and deplete the ice there without utilizing the ice in the other bays.~~

In addition to calculating the overall peak containment pressures, the DBA analyses include the calculation of the transient differential pressures that would occur across subcompartment walls during the initial blowdown phase of the accident transient. The internal containment walls and structures are designed to withstand the local transient pressure differentials for the limiting DBAs.

The ice condenser doors satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii) (Ref. 3).

LCO

This LCO establishes the minimum equipment requirements to assure that the ice condenser doors perform their safety function. The ice condenser lower inlet doors, intermediate deck doors, and top deck doors must be closed to minimize air leakage into and out of the ice condenser, with its attendant leakage of heat into the ice condenser and loss of ice through melting and sublimation. ~~The~~ All lower inlet doors, intermediate deck doors, and top deck doors must be OPERABLE to

BASES

LCO (continued)

ensure the proper ~~opening~~ functioning of the ice condenser in the event of a DBA. ~~OPERABILITY includes being free of any obstructions that would limit their opening, and for the inlet doors, being adjusted such that the opening and closing torques are within limits. The ice condenser doors function with the ice condenser to limit the pressure and temperature that could be expected following a DBA.~~ INSERT C

APPLICABILITY

In MODES 1, 2, 3, and 4, a DBA could cause an increase in containment pressure and temperature requiring the operation of the ice condenser doors. Therefore, the LCO is applicable in MODES 1, 2, 3, and 4.

The probability and consequences of these events in MODES 5 and 6 are reduced due to the pressure and temperature limitations of these MODES. Therefore, the ice condenser doors are not required to be OPERABLE in these MODES.

ACTIONS

~~A Note~~ Note 1 provides clarification that, for this LCO, separate Condition entry is allowed for each ice condenser door.

Note 2 provides clarification that entry into the Conditions and Required Actions is not required for short duration (< 4 hours) routine activities during Modes of Applicability for the Intermediate Deck and Top Deck Doors.

A.1

If one or more ice condenser lower inlet doors are inoperable due to being physically restrained from opening, the lower inlet door(s) must be restored to OPERABLE status within 1 hour. The Required Action is necessary to return operation to within the bounds of the containment analysis. The 1 hour Completion Time is consistent with the ACTIONS of LCO 3.6.1, "Containment," which requires containment to be restored to OPERABLE status within 1 hour.

B.1 and B.2

If one or more ice condenser doors are determined to be partially open or otherwise inoperable for reasons other than Condition A or if a door is found that is not closed, it is acceptable to continue unit operation for up to 14 days, provided the ice bed temperature instrumentation is monitored once per 4 hours to ensure that the open or inoperable door is not allowing enough air leakage to cause the maximum ice bed temperature

BASES

ACTIONS (continued)

to approach the melting point. The Frequency of 4 hours is based on the fact that temperature changes cannot occur rapidly in the ice bed because of the large mass of ice involved. The 14 day Completion Time is based on long term ice storage tests that indicate that if the temperature is maintained below 27°F, there would not be a significant loss of ice from sublimation. If the maximum ice bed temperature is > 27°F at any time or if the doors are not closed and restored to OPERABLE status within 14 days, the situation reverts to Condition C and a Completion Time of 48 hours is allowed to restore the inoperable door to OPERABLE status or enter into Required Actions D.1 and D.2. Ice bed temperature must be verified within ~~the specified~~ Frequency as augmented by the provisions of SR 3.0.2. INSERT D

C.1

If Required Actions B.1 or B.2 are not met, the doors must be restored to OPERABLE status and closed positions within 48 hours. The 48 hour Completion Time is based on the fact that, with the very large mass of ice involved, it would not be possible for the temperature to increase to the melting point and a significant amount of ice to melt in a 48 hour period.

D.1 and D.2

If the ice condenser doors cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.6.13.1

Verifying, by means of the Inlet Door Position Monitoring System, that the lower inlet doors are in their closed positions makes the operator aware of an inadvertent opening of one or more lower inlet doors. The Frequency of 12 hours ensures that operators on each shift are aware of the status of the doors.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.6.13.2

Verifying, by visual inspection, that each intermediate deck door is closed and not impaired by ice, frost, or debris provides assurance that the intermediate deck doors (which form the floor of the upper plenum where frequent maintenance on the ice bed is performed) have not been left open or obstructed. In determining if a door is impaired by ice, the frost accumulation on the doors, joints, and hinges are to be considered in conjunction with the lifting force limits of SR 3.6.13.7. The Frequency of 7 days is based on engineering judgment and takes into consideration such factors as the frequency of entry into the intermediate ice condenser deck, the time required for significant frost buildup, and the probability that a DBA will occur.

SR 3.6.13.3

Verifying, by visual inspection, that the top deck doors are in place and not obstructed provides assurance that the doors are performing their function of keeping warm air out of the ice condenser during normal operation, and would not be obstructed if called upon to open in response to a DBA. The Frequency of 92 days is based on engineering judgment, which considered such factors as the following:

a. The relative inaccessibility and lack of traffic in the vicinity of the doors make it unlikely that a door would be inadvertently left open;

b. Excessive air leakage would be detected by temperature monitoring in the ice condenser; and

c. The light construction of the doors would ensure that, in the event of a DBA, air and gases passing through the ice condenser would find a flow path, even if a door were obstructed.

SR 3.6.13.4

Verifying, by visual inspection, that the ice condenser lower inlet doors are not impaired by ice, frost, or debris provides assurance that the doors are free to open in the event of a DBA. For this unit, the Frequency of 18 months is based on door design, which does not allow water condensation to freeze, and operating experience which indicates a low propensity for ice build-up on or behind the doors while the Unit is at power ~~which indicates that the inlet doors very rarely fail to meet their SR acceptance criteria~~. Because of high radiation in the vicinity of the lower

BASES

SURVEILLANCE REQUIREMENTS (continued)

inlet doors during power operation, this Surveillance is normally performed during a shutdown.

SR 3.6.13.5

Verifying the initial opening torque of the lower inlet doors provides assurance that no doors have become stuck in the closed position and maintains consistency with the safety analysis initial conditions. Verifying the doors are free to move provides assurance that the hinges and spring closure mechanisms are functioning properly and not degrading. ~~The value of 675 in-lb is based on the design opening pressure on the doors of 1.0 lb/ft². For this unit, the Frequency of 18 months is based on the passive nature of the closing mechanism (i.e., once adjusted, there are no known factors that would change the setting, except possibly a buildup of ice; ice buildup is not likely, however, because of the door design, which does not allow water condensation to freeze). Operating experience indicates that the lower inlet doors usually meet their SR acceptance criteria. Because of high radiation in the vicinity of the lower inlet doors during power operation, this Surveillance is normally performed during a shutdown.~~ INSERT E

SR 3.6.13.6 (deleted)

~~The torque test Surveillance ensures that the inlet doors have not developed excessive friction and that the return springs are producing a door return torque within limits. The torque test consists of the following:~~

1. ~~Verify that the torque, T(OPEN), required to cause opening motion at the 40° open position is ≤ 195 in-lb;~~

2. ~~Verify that the torque, T(CLOSE), required to hold the door stationary (i.e., keep it from closing) at the 40° open position is ≥ 78 in-lb but ≤ 250.6 in-lb; and~~

3. ~~Calculate the frictional torque, T(FRICT) = 0.5 {T(OPEN) - T(CLOSE)}, and verify that the T(FRICT) is ≥ - 40 in-lb but ≤ + 40 in-lb.~~

~~The purpose of the friction and return torque Specifications is to ensure that, in the event of a small break LOCA or SLB, all of the 24 door pairs open uniformly. This assures that, during the initial blowdown phase, the steam and water mixture entering the lower compartment does not pass through part of the ice condenser, depleting the ice there, while bypassing the ice in other bays. The Frequency of 18 months is based on the~~

BASES

SURVEILLANCE REQUIREMENTS (continued)

~~passive nature of the closing mechanism (i.e., once adjusted, there are no known factors that would change the setting, except possibly a buildup of ice; ice buildup is not likely, however, because of the door design, which does not allow water condensation to freeze). Operating experience indicates that the inlet doors very rarely fail to meet their SR acceptance criteria. Because of high radiation in the vicinity of the inlet doors during power operation, this Surveillance is normally performed during a shutdown.~~

SR 3.6.13.7

Verifying the OPERABILITY of the intermediate deck doors provides assurance that the intermediate deck doors are free to open in the event of a DBA. The verification consists of visually inspecting the intermediate doors for structural deterioration, verifying free movement of the vent assemblies, and ascertaining free movement of each door when lifted with the applicable force shown below:

	Door	Lifting Force
a.	Adjacent to crane wall	< 37.4 lb
b.	Paired with door adjacent to crane wall	≤ 33.8 lb
c.	Adjacent to containment wall	≤ 31.8 lb
d.	Paired with door adjacent to containment wall	≤ 31.0 lb

The 18 month Frequency is based on the passive design of the intermediate deck doors, the frequency of personnel entry into the intermediate deck, and the fact that SR 3.6.13.2 confirms on a 7 day Frequency that the doors are not impaired by ice, frost, or debris, which are ways a door would fail the opening force test (i.e., by sticking or from increased door weight).

REFERENCES

1. UFSAR, Chapter 6.

2. 10 CFR 50, Appendix K.

3. 10 CFR 50.36, Technical Specifications, (c)(2)(ii).

~~4. DPC-1201.17-00-0006 "Design and Licensing Basis for Ice Condenser Lower Inlet Doors Technical Specification Surveillance Requirements, 40° Opening, Closing and Frictional Torques".~~

INSERT A

and contains the air handling units that remove heat from the ice bed. Equalization vents located at the periphery of the intermediate and top decks are provided to balance small pressure differentials occurring across the decks during normal operation.

INSERT B

For very small break events occurring in the lower compartment that do not by themselves produce sufficient breakaway pressure to open the lower inlet doors, slowly released steam will migrate through the Divider Barrier into the upper compartment. In this situation, the Containment ARS will actuate at its defined pressure setpoint (including a defined time delay) and open the lower inlet doors, returning the steam/air mixture to the lower compartment and displacing it into the ice condenser where the steam portion of the flow will be condensed (Ref. 1). The Containment ARS can also be actuated manually.

INSERT C

Ice condenser door OPERABILITY includes the absence of any obstructions that would physically restrain the doors from opening (i.e., prevent initial breakaway under any circumstances), and for the lower inlet doors, being adjusted such that the initial opening torques are within prescribed limits. The ice condenser doors function with the ice condenser to limit the pressure and temperature that could be expected following a DBA.

INSERT D

Entry into Condition B is not required due to personnel standing on or opening an intermediate deck or top deck door for short durations (< 4 hours) to perform required surveillances, minor maintenance such as ice removal, or routine tasks such as system walkdowns.

INSERT E

The verifications consist of:

a) Ascertaining the opening torque (torque required to just begin to move the door off of its seal) of each door when pulled (or pushed) open and ensuring this torque is ≤ 675 in-lb, as resolved to the vertical hinge pin centerline, and

b) Opening each door manually to the full extent of its available swing arc (i.e., up to slight contact with the shock absorber) and releasing the door, verifying that the spring closure mechanisms are capable of returning the door toward the closed position.

The opening torque test a) should be performed first to minimize the loss of cold head in the ice condenser and prevent any preconditioning of the seal area. During the freedom of movement test b) the cold head is not required, and once the effect of cold head is reduced through outflow, the door may not completely return to its seal from the open position.

The opening torque test limiting value of 675 in-lb is based on the design cold head pressure on the closed lower inlet doors of approximately 1 pound per square foot. The Frequency of 18 months is based on the passive nature of the spring closure mechanism and operating experience, which indicates a low propensity for ice build-up on or behind the doors while the Unit is at power. Because of high radiation in the vicinity of the lower inlet doors during power operation, this Surveillance is normally performed during a shutdown.

ATTACHMENT 2b

MARKED PAGES OF AFFECTED CATAWBA TECHNICAL SPECIFICATIONS AND ASSOCIATED BASES

3.6 CONTAINMENT SYSTEMS

3.6.13 Ice Condenser Doors

LCO 3.6.13 The ice condenser lower inlet doors, intermediate deck doors, and top deck doors shall be OPERABLE and closed.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

---NOTES---

1. Separate Condition entry is allowed for each ice condenser door.
2. Entry into Condition B is not required due to personnel standing on or opening an intermediate deck or top deck door for short durations to perform required surveillances, minor maintenance such as ice removal or routine tasks such as system walkdowns.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more ice condenser lower inlet doors inoperable due to being physically restrained from opening.	A.1 Restore lower inlet door to OPERABLE status.	1 hour
B. One or more ice condenser doors inoperable for reasons other than Condition A or not closed.	B.1 Verify maximum ice bed temperature is ≤ 27°F.	Once per 4 hours
	<u>AND</u>	
	B.2 Restore ice condenser door to OPERABLE status and closed position.	14 days

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Required Action and associated Completion Time of Condition B not met.	C.1 Restore ice condenser door to OPERABLE status and closed positions.	48 hours
D. Required Action and associated Completion Time of Condition A or C not met.	D.1 Be in MODE 3. AND D.2 Be in MODE 5.	6 hours 36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.6.13.1	Verify all lower inlet doors indicate closed by the Inlet Door Position Monitoring System.	12 hours
SR 3.6.13.2	Verify, by visual inspection, each intermediate deck door is closed and not impaired by ice, frost, or debris.	7 days
SR 3.6.13.3	Verify, by visual inspection, each top deck door: a. Is in place; and b. Has no condensation, frost, or ice formed on the door that would restrict its opening.	92 days

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.13.4	Verify, by visual inspection, each lower inlet door is not impaired by ice, frost, or debris.	18 months
SR 3.6.13.5	Verify torque required to cause ~~each~~ lower inlet door to begin to open is ≤ 675 in-lb and verify free movement of the door.	18 months
SR 3.6.13.6	~~Perform a torque test on each inlet door~~. (deleted)	~~18 months~~
SR 3.6.13.7	Verify for each intermediate deck door: a. No visual evidence of structural deterioration; b. Free movement of the vent assemblies; and c. Free movement of the door.	18 months

B 3.6 CONTAINMENT SYSTEMS

B 3.6.13 Ice Condenser Doors

BASES

BACKGROUND

The ice condenser doors consist of the lower inlet doors, the intermediate deck doors, and the top deck doors. The functions of the doors are to:

a. Seal the ice condenser from air leakage and provide thermal/humidity barriers during the lifetime of the unit; and

b. Open in the event of a Design Basis Accident (DBA) to direct the hot steam air mixture from the DBA into the ice bed, where the ice would absorb energy and limit containment peak pressure and temperature during the accident transient.

Limiting the pressure and temperature following a DBA reduces the release of fission product radioactivity from containment to the environment.

The ice condenser is an annular compartment enclosing approximately 300° of the perimeter of the upper containment compartment, but penetrating the operating deck so that a portion extends into the lower containment compartment. The lower inlet doors separate the atmosphere of the lower compartment from the ice bed inside the ice condenser. The top deck doors are above the ice bed and exposed to the atmosphere of the upper compartment. The intermediate deck doors, located below the top deck doors, form the floor of a plenum at the upper part of the ice condenser. This upper plenum area is used to facilitate surveillance and maintenance of the ice bed INSERT A

The ice baskets held in the ice bed within the ice condenser are arranged to promote heat transfer from steam to ice. This arrangement enhances the ice condenser's primary function of condensing steam and absorbing heat energy released to the containment during a DBA.

In the event of a DBA, the ice condenser lower inlet doors (located below the operating deck) open due to the pressure rise in the lower compartment. This allows air and steam to flow from the lower compartment into the ice condenser. The resulting pressure increase within the ice condenser causes the intermediate deck doors and the top deck doors to open,

BASES

BACKGROUND (continued)

which allows the air to flow out of the ice condenser into the upper compartment. Steam condensation within the ice condensers limits the pressure and temperature buildup in containment. A divider barrier separates the upper and lower compartments and ensures that the steam is directed into the ice condenser.

The ice, together with the containment spray, serves as a containment heat removal system and is adequate to absorb the initial blowdown of steam and water from a DBA as well as the additional heat loads that would enter containment during the several hours following the initial blowdown. The additional heat loads would come from the residual heat in the reactor core, the hot piping and components, and the secondary system, including the steam generators. During the post blowdown period, the Air Return System (ARS) returns upper compartment air through the divider barrier to the lower compartment. This serves to equalize pressures in containment and to continue circulating heated air and steam from the lower compartment through the ice condenser, where the heat is removed by the remaining ice.

The water from the melted ice drains into the lower compartment where it serves as a source of borated water (via the containment sump) for the Emergency Core Cooling System (ECCS) and the Containment Spray System heat removal functions in the recirculation mode. The ice ~~(via the Containment Spray System)~~ and the recirculated ice melt (via the Containment Spray System) also serve to clean up the containment atmosphere.

The ice condenser doors ensure that the ice stored in the ice bed is preserved during normal operation (doors closed) and that the ice condenser functions as designed if called upon to act as a passive heat sink following a DBA.

APPLICABLE SAFETY ANALYSES

The limiting DBAs considered relative to containment pressure and temperature are the loss of coolant accident (LOCA) and the steam line break (SLB). The LOCA and SLB are analyzed using computer codes designed to predict the resultant containment pressure and temperature transients. DBAs are assumed not to occur simultaneously or consecutively.

BASES

APPLICABLE SAFETY ANALYSES (continued)

Although the ice condenser is a passive system that requires no electrical power to perform its function, the Containment Spray System and ARS also function to assist the ice bed in limiting pressures and temperatures. Therefore, the postulated DBAs are analyzed with respect to Engineered Safety Feature (ESF) systems, assuming the loss of one ESF bus, which is the worst case single active failure and results in one train each of the Containment Spray System and the ARS being rendered inoperable.

The limiting DBA analyses (Ref. 1) show that the maximum peak containment pressure results from the LOCA analysis and is calculated to be less than the containment design pressure. For certain aspects of transient accident analyses, maximizing the calculated containment pressure is not conservative. In particular, the cooling effectiveness of the ECCS during the core reflood phase of a LOCA analysis increases with increasing containment backpressure. For these calculations, the containment backpressure is calculated in a manner designed to conservatively minimize, rather than maximize, the calculated transient containment pressures, in accordance with 10 CFR 50, Appendix K (Ref. 2).

The maximum peak containment atmosphere temperature results from the SLB analysis and is discussed in the Bases for LCO 3.6.5, "Containment Air Temperature."

INSERT B

~~An additional design requirement was imposed on the ice condenser door design for a small break accident in which the flow of heated air and steam is not sufficient to fully open the doors.~~

~~For this situation, the doors are designed so that all of the doors would partially open by approximately the same amount. Thus, the partially opened doors would modulate the flow so that each ice bay would receive an approximately equal fraction of the total flow.~~

~~This design feature ensures that the heated air and steam will not flow preferentially to some ice bays and deplete the ice there without utilizing the ice in the other bays.~~

In addition to calculating the overall peak containment pressures, the DBA analyses include the calculation of the transient differential pressures that would occur across subcompartment walls during

BASES

APPLICABLE SAFETY ANALYSES (continued)

the initial blowdown phase of the accident transient. The internal containment walls and structures are designed to withstand the local transient pressure differentials for the limiting DBAs.

The ice condenser doors satisfy Criterion 3 of 10 CFR 50.3~~6~~(c)(2)(ii) (Ref. 3).

LCO

This LCO establishes the minimum equipment requirements to assure that the ice condenser doors perform their safety function. The ice condenser lower inlet doors, intermediate deck doors, and top deck doors must be closed to minimize air leakage into and out of the ice condenser, with its attendant leakage of heat into the ice condenser and loss of ice through melting and sublimation. ~~The~~ All lower inlet doors, intermediate deck doors, and top deck doors must be OPERABLE to ensure the proper ~~opening~~ functioning of the ice condenser in the event of a DBA. ~~OPERABILITY includes being free of any obstructions that would limit their opening, and for the inlet doors, being adjusted such that the opening and closing torques are within limits. The ice condenser doors function with the ice condenser to limit the pressure and temperature that could be expected following a DBA.~~ INSERT C

APPLICABILITY

In MODES 1, 2, 3, and 4, a DBA could cause an increase in containment pressure and temperature requiring the operation of the ice condenser doors. Therefore, the LCO is applicable in MODES 1, 2, 3, and 4.

The probability and consequences of these events in MODES 5 and 6 are reduced due to the pressure and temperature limitations of these MODES. Therefore, the ice condenser doors are not required to be OPERABLE in these MODES.

ACTIONS

~~A Note~~ Note 1 provides clarification that, for this LCO, separate Condition entry is allowed for each ice condenser door.

Note 2 provides clarification that entry into the Conditions and Required Actions is not required for short duration (< 4 hours) routine activities during Modes of Applicability for the Intermediate Deck and Top Deck Doors.

A.1

If one or more ice condenser lower inlet doors are inoperable due to being physically restrained from opening, the lower inlet door(s) must be

BASES

ACTIONS (continued)

restored to OPERABLE status within 1 hour. The Required Action is necessary to return operation to within the bounds of the containment analysis. The 1 hour Completion Time is consistent with the ACTIONS of LCO 3.6.1, "Containment," which requires containment to be restored to OPERABLE status within 1 hour.

B.1 and B.2

If one or more ice condenser doors are determined to be partially open or otherwise inoperable for reasons other than Condition A or if a door is found that is not closed, it is acceptable to continue unit operation for up to 14 days, provided the ice bed temperature instrumentation is monitored once per 4 hours to ensure that the open or inoperable door is not allowing enough air leakage to cause the maximum ice bed temperature to approach the melting point. The Frequency of 4 hours is based on the fact that temperature changes cannot occur rapidly in the ice bed because of the large mass of ice involved. The 14 day Completion Time is based on long term ice storage tests that indicate that if the temperature is maintained below 27°F, there would not be a significant loss of ice from sublimation. If the maximum ice bed temperature is > 27°F at any time or if the doors are not closed and restored to OPERABLE status within 14 days, the situation reverts to Condition C and a Completion Time of 48 hours is allowed to restore the inoperable door to OPERABLE status or enter into Required Actions D.1 and D.2. Ice bed temperature must be verified to be within ~~the specified~~ Frequency as augmented by the provisions of SR 3.0.2. INSERT D

C.1

If Required Actions B.1 or B.2 are not met, the doors must be restored to OPERABLE status and closed positions within 48 hours. The 48 hour Completion Time is based on the fact that, with the very large mass of ice involved, it would not be possible for the temperature to increase to the melting point and a significant amount of ice to melt in a 48 hour period.

D.1 and D.2

If the ice condenser doors cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within

ACTIONS (continued)

36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.6.13.1

Verifying, by means of the Inlet Door Position Monitoring System, that the lower inlet doors are in their closed positions makes the operator aware of an inadvertent opening of one or more lower inlet doors. The Frequency of 12 hours ensures that operators on each shift are aware of the status of the doors.

SR 3.6.13.2

Verifying, by visual inspection, that each intermediate deck door is closed and not impaired by ice, frost, or debris provides assurance that the intermediate deck doors (which form the floor of the upper plenum where frequent maintenance on the ice bed is performed) have not been left open or obstructed. In determining if a door is impaired by ice, the frost accumulation on the doors, joints, and hinges are to be considered in conjunction with the lifting force limits of SR 3.6.13.7. The Frequency of 7 days is based on engineering judgment and takes into consideration such factors as the frequency of entry into the intermediate ice condenser deck, the time required for significant frost buildup, and the probability that a DBA will occur.

SR 3.6.13.3

Verifying, by visual inspection, that the top deck doors are in place and not obstructed provides assurance that the doors are performing their function of keeping warm air out of the ice condenser during normal operation, and would not be obstructed if called upon to open in response to a DBA. The Frequency of 92 days is based on engineering judgment, which considered such factors as the following:

a. The relative inaccessibility and lack of traffic in the vicinity of the doors make it unlikely that a door would be inadvertently left open;

b. Excessive air leakage would be detected by temperature monitoring in the ice condenser; and

BASES

SURVEILLANCE REQUIREMENTS (continued)

c. The light construction of the doors would ensure that, in the event of a DBA, air and gases passing through the ice condenser would find a flow path, even if a door were obstructed.

SR 3.6.13.4

Verifying, by visual inspection, that the ice condenser lower inlet doors are not impaired by ice, frost, or debris provides assurance that the doors are free to open in the event of a DBA. For this unit, the Frequency of 18 months is based on door design, which does not allow water condensation to freeze, and operating experience, which indicates a low propensity for ice build-up on or behind the doors while the Unit is at power ~~which indicates that the inlet doors very rarely fail to meet their SR acceptance criteria.~~ Because of high radiation in the vicinity of the lower inlet doors during power operation, this Surveillance is normally performed during a shutdown.

SR 3.6.13.5

Verifying the initial opening torque of the lower inlet doors provides assurance that no doors have become stuck in the closed position and maintains consistency with the safety analysis input parameters. Verifying the doors are free to move provides assurance that the hinges and spring closure mechanisms are functioning properly and not degrading. ~~The value of 675 in-lb is based on the design opening pressure on the doors of 1.0 lb/ft². For this unit, the Frequency of 18 months is based on the passive nature of the closing mechanism (i.e., once adjusted, there are no known factors that would change the setting, except possibly a buildup of ice; ice buildup is not likely, however, because of the door design, which does not allow water condensation to freeze). Operating experience indicates that the lower inlet doors usually meet their SR acceptance criteria. Because of high radiation in the vicinity of the lower inlet doors during power operation, this Surveillance is normally performed during a shutdown.~~ INSERT E

SR 3.6.13.6 (deleted)

~~The torque test Surveillance ensures that the inlet doors have not developed excessive friction and that the return springs are producing a door return torque within limits. The torque test consists of the following:~~

SURVEILLANCE REQUIREMENTS (continued)

1. ~~Verify that the torque, T(OPEN), required to cause opening motion at the 40° open position is ≤ 195 in-lb;~~

2. ~~Verify that the torque, T(CLOSE), required to hold the door stationary (i.e., keep it from closing) at the 40° open position is ≥ 78 in-lb but ≤ 250.6 in-lb; and~~

3. ~~Calculate the frictional torque, T(FRICT) = 0.5 {T(OPEN) - T(CLOSE)}, and verify that the T(FRICT) is ≥ - 40 in-lb but ≤ + 40 in-lb.~~

~~The purpose of the friction and return torque Specifications is to ensure that, in the event of a small break LOCA or SLB, all of the 24 door pairs open uniformly. This assures that, during the initial blowdown phase, the steam and water mixture entering the lower compartment does not pass through part of the ice condenser, depleting the ice there, while bypassing the ice in other bays. The Frequency of 18 months is based on the passive nature of the closing mechanism (i.e., once adjusted, there are no known factors that would change the setting, except possibly a buildup of ice; ice buildup is not likely, however, because of the door design, which does not allow water condensation to freeze). Operating experience indicates that the inlet doors very rarely fail to meet their SR acceptance criteria. Because of high radiation in the vicinity of the inlet doors during power operation, this Surveillance is normally performed during a shutdown.~~

SR 3.6.13.7

Verifying the OPERABILITY of the intermediate deck doors provides assurance that the intermediate deck doors are free to open in the event of a DBA. The verification consists of visually inspecting the intermediate doors for structural deterioration, verifying free movement of the vent assemblies, and ascertaining free movement of each door when lifted with the applicable force shown below:

	Door	Lifting Force
a.	Adjacent to crane wall	≤ 37.4 lb
b.	Paired with door adjacent to crane wall	≤ 33.8 lb
c.	Adjacent to containment wall	≤ 31.8 lb
d.	Paired with door adjacent to containment wall	≤ 31.0 lb

BASES

SURVEILLANCE REQUIREMENTS (continued)

The 18 month Frequency is based on the passive design of the intermediate deck doors, the frequency of personnel entry into the intermediate deck, and the fact that SR 3.6.13.2 confirms on a 7 day Frequency that the doors are not impaired by ice, frost, or debris, which are ways a door would fail the opening force test (i.e., by sticking or from increased door weight).

REFERENCES

1. UFSAR, Chapter 6.

2. 10 CFR 50, Appendix K.

3. 10 CFR 50.36, Technical Specifications, (c)(2)(ii).

~~4. DPC-1201.17-00-0006, "Design and Licensing Basis for Ice Condenser Lower Inlet Doors Technical Specification Surveillance Requirements, 40° Opening, Closing and Frictional Torques."~~

INSERT A

and contains the air handling units that remove heat from the ice bed. Equalization vents located at the periphery of the intermediate and top decks are provided to balance small pressure differentials occurring across the decks during normal operation.

INSERT B

For very small break events occurring in the lower compartment that do not by themselves produce sufficient breakaway pressure to open the lower inlet doors, slowly released steam will migrate through the Divider Barrier into the upper compartment. In this situation, the Containment ARS will actuate at its defined pressure setpoint (including a defined time delay) and open the lower inlet doors, returning the steam/air mixture to the lower compartment and displacing it into the ice condenser where the steam portion of the flow will be condensed (Ref. 1). The Containment ARS can also be actuated manually.

INSERT C

Ice condenser door OPERABILITY includes the absence of any obstructions that would physically restrain the doors from opening (i.e., prevent initial breakaway under any circumstances), and for the lower inlet doors, being adjusted such that the initial opening torques are within prescribed limits. The ice condenser doors function with the ice condenser to limit the pressure and temperature that could be expected following a DBA.

INSERT D

Entry into Condition B is not required due to personnel standing on or opening an intermediate deck or top deck door for short durations (< 4 hours) to perform required surveillances, minor maintenance such as ice removal, or routine tasks such as system walkdowns.

INSERT E

The verifications consist of:

a) Ascertaining the opening torque (torque required to just begin to move the door off of its seal) of each door when pulled (or pushed) open and ensuring this torque is ≤ 675 in-lb, as resolved to the vertical hinge pin centerline, and

b) Opening each door manually to the full extent of its available swing arc (i.e., up to slight contact with the shock absorber) and releasing the door, verifying that the spring closure mechanisms are capable of returning the door toward the closed position.

The opening torque test a) should be performed first to minimize the loss of cold head in the ice condenser and prevent any preconditioning of the seal area. During the freedom of movement test b) the cold head is not required, and once the effect of cold head is reduced through outflow, the door may not completely return to its seal from the open position.

The opening torque test limiting value of 675 in-lb is based on the design cold head pressure on the closed lower inlet doors of approximately 1 pound per square foot. The Frequency of 18 months is based on the passive nature of the spring closure mechanism and operating experience, which indicates a low propensity for ice build-up on or behind the doors while the Unit is at power. Because of high radiation in the vicinity of the lower inlet doors during power operation, this Surveillance is normally performed during a shutdown.

ATTACHMENT 3a

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6.2.2.7.3 Design Evaluation

The pressure drop through the ducts and manifolds was estimated by using loss coefficients determined by using a standard reference (Reference 49) as a guide. The pressure drop through the air handlers was determined by test. The overall system flow rate was established by superimposing the system flow versus ΔP curve over the fan flow versus ΔP curve.

With the flow rate established the capacity of the air handlers was determined. First the air handler capacity was theoretically determined for a set of design conditions approximating operating conditions. Next the air handler units were tested by the manufacturer to the set of specified design conditions. It was determined that the theoretical relationships adequately predicted air handler performance and these techniques were then used to adjust the test values to those of actual operation. The gross operating capacity of one air handler is just under 30,000 Btu/hr by test and calculation.

The nominal heat load of 432,000 Btu/hr is adjusted by a factor of 10/7 to insure adequate capacity under operating conditions for fouling, defrosting or isolated instances of one or several unit failures. Maintenance and inspection insures reliable mechanical operation and cooling performance.

An estimate of the number of air handlers required is made to initiate the calculation, the flow pressure and rates drops are then calculated and the fan motor heat and heat transfer rates of the air handler unit predicted. The predicted performance is compared with the required capability and the calculation is reiterated varying the number of AH units until the predicted performance just exceeds the required capability.

The final number of required air handlers was determined to be 30.

A modal frequency analysis was performed for the air handling unit housings and support structure. The results indicate that the design frequency is approximately 20 Hz, so that the fundamental mode is well out of the frequency range of peak amplification on the response spectra. In the process of designing the structure on the basis of stiffness, strength of members subjected various combinations exceeds specified limits by generous margins.

6.2.2.8 Lower Inlet Doors

6.2.2.8.1 Design Basis

Function

The ice condenser inlet doors form the barrier to air flow through the inlet ports of the ice condenser for normal unit operation. They also provide the continuation of thermal insulation around the lower section of the crane wall to minimize heat input that would promote sublimation and mass transfer of ice in the ice condenser compartment. In the event of a loss-of-coolant accident, LOCA, causing a pressure increase in the lower compartment, the doors open, venting air and steam ~~relatively evenly~~ into ~~all sections~~ of the ice condenser.

The door panels are provided with tension spring mechanisms that produce a small closing torque on the door panels as they open. ~~The magnitude of the closing torque is equivalent to providing approximately a one-pound-per-square-foot pressure drop through the inlet ports with the door panels open to a position equivalent to the full port flow area~~. The zero load position of the spring mechanisms is set such that, with zero differential pressure across the door panels, the gasket holds the door slightly open. ~~This setting provides assurance that all doors will be open slightly, upon removal of cold air head, therefore eliminating significant inlet maldistribution for very small incidents~~. INSERT 1

For larger incidents, the doors open fully and flow distribution is controlled by the flow area and pressure drops of inlet ports. The doors are provided with shock absorber assemblies to dissipate the larger door kinetic energies generated during large break incidents. /

a. All doors open to allow venting of energy to the ice condenser for any leak rate which results in a divider deck differential pressure in excess of the ice condenser cold head.

The force required to open the doors of the ice condenser is sufficiently low such that the energy from an leakage of steam through the divider barrier can be readily absorbed by the Containment Spray System without exceeding Containment design pressure.

~~b. Doors and door ports limit maldistribution to 150 percent maximum, peak-to-average mass input for the accident transient, for any Reactor Coolant System release of sufficient magnitude to cause the doors to open.~~

B ~~c~~. The basic performance requirement for lower inlet doors for design basis accident conditions is to open rapidly and fully, to insure proper venting of released energy into the ice condenser. The opening rate of the inlet doors is important to insure minimizing the pressure buildup in the lower compartment due to the rapid release of energy to that compartment. The rate of pressure rise and the magnitude of the peak pressure in any lower compartment region is related to the confinement of that compartment. The time period to reach peak lower compartment pressure due to the design basis accident is approximately 0.05 seconds.

C ~~d~~. Doors are of simple mechanical design to minimize the possibility of malfunction.

D ~~e~~. The inertia of the doors is low, consistent with producing a minimal effect on initial pressure.

5. Design Criteria - Normal Operation

a. The doors restrict the leakage of air into and out of the ice condenser to the minimum practicable limit. The inlet door leakage has been confirmed by test to be within the 50 cfm total used for the ice condenser design.

b. The doors restrict local heat input in the ice condenser to the minimum practicable limit. Heat leakage through the doors to the ice bed is a total of 20,000 Btu/hr or less (for 24 pairs of doors).

c. The doors are instrumented to provide indication of their closed position. Under zero differential pressure conditions all doors remain 3/8 inch open.

d. Provision made for adequate means of inspecting the doors during reactor shutdown.

e. The doors are designed to withstand earthquake loadings without damage so as not to affect subsequent ice condenser operation for normal and accident conditions. These loads are derived from the seismic analysis of the Containment.

~~f. The Door System provide a flow proportioning capability for small break conditions in accordance with Figure 6-128.~~

6. Interface Requirements

a. Crane wall attachment of the door frame is via studs with a compressible seal. Attachment to the crane wall is critical for the safety function of the doors.

b. Sufficient clearance is required for THE doors to open into the ice condenser. Items to be considered in this interface are floor clearance, lower support structure clearance and floor drain operation and sufficient clearance (approximately six inches) to accommodate ice fallout in the event of a seismic disturbance occurring coincident with a loss-of-coolant accident. * INSERT

c. Door opening and stopping forces are transmitted to the crane wall and lower support structure, respectively.

Design Loads

* INSERT:

Original ice basket qualification testing (Topical Report WCAP-8110, Supplement 9-A), has shown freshly loaded ice is considered fused after five weeks. In the event of an earthquake (OBE or greater) which occurs within five weeks following the completion of ice basket replenishment, plant procedures require a visual inspection of applicable areas of the ice condenser within 24 hours to confirm that opening of the ice condenser lower inlet doors is not impeded by any ice fallout resulting from the seismic disturbance. This alternative method of compliance with the requirements of GDC 2 is credible based upon the reasonable assurance that the ice condenser doors will open following a seismic event during the 5 week period and the low probability of a seismic event occurring coincident with or subsequently followed by a Design Basis Accident.

APPROVED BY NRC SER DATED APRIL 2, 2008
AMENDMENTS 246/226

Pressure loading during LOCA is provided by the Transient Mass Distribution (TMD) code from an analysis of a double-ended hot leg break in the corner formed by the refueling canal, with 100 percent entrainment of water in the flow. For conservatism, TMD results were increased by 40 percent in performing the design analysis for the lower inlet doors.

The lower inlet door design parameters and loads are presented in Table 6-95.

6.2.2.8.2 System Design

Twenty-four pairs of inlet doors are located on the ice condenser side of ports in the crane wall at an elevation immediately above the ice condenser floor. General details of these doors are shown in Figure 6-129 through Figure 6-133. Each door panel is 92.5 in. high, 42 in. wide and 7.5 in. thick. Each pair is hinged vertically on a common frame.

Each door consists of a 0.5 in. thick Fiber Reinforced Polyester (FRP) plate stiffened by six steel ribs, bolted to the plate. The FRP plate is designed to take vertical bending moments resulting from pressures generated from a LOCA and from subsequent stopping forces on the door. The ribs are designed to take horizontal bending moments and reactions, as well as tensile loads resulting from the door angular velocity, and transmit them to the crane wall via the hinges and door frame.

Seven inches of urethane foam are bonded to the back of the FRP plate to provide thermal insulation. The front and back surfaces of the door are protected with 26 gauge stainless steel covers which provide a complete vapor barrier around the insulation. The urethane foam and stainless steel covers do not carry overall door moments and shearing forces.

Three hinge assemblies are provided for each door panel; each assembly is connected to two of the door ribs. Loads from each of the two ribs are transmitted to a single 1.572 inch diameter hinge shaft through brass bushings. These bushings have a spherical outer surface which prevents binding which might otherwise be caused by door rib and hinge bar flexure during accident loading conditions. The hinge shaft is supported by two self-aligning, spherical roller bearings in a cast steel housing. Vertical positioning of the door panel and shaft with respect to the bearing housing are provided by steel caps bolted to the ends of the shaft and brass spacer rings between the door ribs and bearings. Shims are provided between the shaft and caps to obtain final alignment. Each bearing housing is bolted to the door frame by four bolts, threaded into tapped holes in the housing. Again, shims are provided between the housings and door frame to maintain hinge alignment. Hinges are designed and fabricated to prevent galling and self welding.

The door frame is fabricated mainly from steel angle sections; 6 in. x 6 in. on the sides and 6 in. x 4 in. on the top and bottom. A 4 in. central I beam divides the frame into sections for each door. At each hinge bracket, extensions and gusset plates, fabricated from steel plate, are welded to the frame to carry loads to the crane wall.

The door panel is sealed to the frame by compliant bulb-type rubber seals which fit into channels welded to the door frame. During normal unit operations these seals are compressed by the cold air head of the ice bed acting on the door panels. As the seals operate at a much warmer temperature than the ice bed, frosting of the seal region is extremely unlikely.

RETURN

Each door is provided with four ~~proportioning~~ springs. One end of each spring is attached to the door panel and the other to a spring housing mounted on the door frame. ~~These springs provide a door return torque proportional to the door opening angle and thus satisfy the requirement for flow proportioning. In addition, they assure that the doors close in the event they are inadvertently opened during normal unit operations.~~ The springs are adjusted during assembly such that, with no load on the doors, the doors are slightly open. ~~For small door openings, the required 3/8 inch effective door opening is controlled by a 3/8 inch gap between panels and is, thus, independent of the door position as measured in degrees.~~

DOOR RETURN

Stresses in the ~~flow proportioning~~ springs are calculated considering dynamic effects as well as static ones. Welded and bolted connections are analyzed as part of the overall door, frame and hinge analysis.

All portions of the door and frame show factors of safety greater than one. The general acceptance criterion is that stresses be within the allowable limits of the AISC-69 Structural Code. This provides an additional margin of conservatism over the general ice condenser design criteria for D + DBA which permit stresses up to 1.33 times the AISC limits. For materials and components not covered by the Code, i.e., bearings, non-metallic materials, etc., conservative acceptance criteria are established on the basis of manufacturer's recommendations and/or engineering evaluations.

~~Flow proportioning characteristics of the door are evaluated by determining the door opening as a function of applied pressure. Assuming a triangular pressure distribution across the door, the flow area vs pressure at full door opening, is determined to be consistent with the curve shown on Figure 6-128. In addition the~~ THE effects of door closure were evaluated assuming the pressure is suddenly released from a fully opened door and the door allowed to shut under the effect of the door ~~proportioning~~ RETURN springs. Stress levels in the door, gasket, and frame are found to be acceptable for this condition. In addition to the above analysis, full scale simulated blowdown tests have been performed on prototype door and shock absorber assemblies. These tests confirm the adequacy of these components at test levels up to 140 percent of maximum loading conditions predicted by the TMD Code.

Analysis of Seismic Loading

Seismic analysis of the doors indicates that stresses are insignificant in comparison with those occurring during a LOCA. Under a SSE the doors could open several inches (actually, the crane wall will move away from the doors). At the termination of the earthquake, the doors immediately close and reseal under the effects of ~~proportioning~~ RETURN spring tension and the ice bed cold air head. Thus, any loss of cold air during a 1/2 SSE or SSE is small and limited to a short period of time.

The dynamic testing of the air box shock absorber is discussed in Reference 54.

Surveillance Testing

To verify that the Lower Inlet Doors (LIDs) will function as intended, periodic testing is performed. Section 3.6.13 of Technical Specifications specifies tests and inspections performed to verify the functional capability of the LIDs. Bases for the surveillance tests and inspections are provided in the Bases for Section 3.6.13 of Technical Specifications.

Visual inspections of the LIDs are performed to verify that the doors are not impaired by ice, frost or debris. This provides assurance that the doors are free to open in the event of a Design Basis Accident (DBA). To provide assurance that the doors are not stuck in the closed position, a physical test is also performed on the closed LIDs to determine the torque required to pull the doors off of their seals.

IN ADDITION, A VISUAL ASSESSMENT OF THE DOOR'S MOTION THROUGH ITS SWING ARC (I.E., APPROXIMATELY 40° OR UP TO SLIGHT CONTACT WITH THE SHOCK ABSORBER) IS PERFORMED TO ENSURE THE INLET DOOR MOVES FREELY AND RETURNS THE DOOR BACK TOWARD THE CLOSED POSITION, AND ALSO TO MONITOR THE PERFORMANCE OF THE HINGES AND SPRING CLOSURE MECHANISMS TO ENSURE THEY ARE BEING PROPERLY MAINTAINED.

~~A torque test series is also performed with the LIDs open to evaluate active LID components (i.e., hinges, clevises, and springs) for degradation, to verify that the LIDs will open uniformly, and verify that the return springs are producing a door return torque within limits. This test consists of determining the torque required to cause opening motion at the 40° open position, and also determining the torque required to hold the door stationary, keepingit from closing, at the 40° open position. Using the results from these tests, the resisting frictional torque in the active components is calculated per the following equation:~~

$$\cancel{T_{(F)} = [T_{(O)} - T_{(C)}] \div 2}$$

~~Where: $T_{(F)}$ = calculated frictional torque~~

~~$T_{(O)}$ = measured opening torque~~

~~$T_{(C)}$ = measured closing torque~~

~~There are two primary types of friction associated with the operation of the LID's. These are friction associated with the hinges and with the spring mechanisms, with the latter being more significant. While, the hinge friction is generally uniform in both directions of door motion, impacts from friction in the spring mechanisms can vary. Static and dynamic friction in the four spring end rod clevis pins can result in variations in spring force between the opening and closing directions. This variation has been seen to create increased closing torques with the springs in a significantly elongated configuration (approaching 40 degrees open). While this can lead to measured closing torques greater than the measured opening torques, it is not a concern as it results from the springs' mechanical behavior in an elongated configuration affecting the door over a limited range as it approaches the open position. The calculated fricitional torque value is indicative of both the total door friction and the resultant frictional impacts on spring force, thus providing good indication of the overall impacts of friction on door performan~~ce.

6.2.2.9 Lower Support Structure

6.2.2.9.1 Design Basis

Function

The lower support structure is designed to support and hold down the ice baskets in the required array, to provide an adequate flow area into the ice bed for the air and steam mixture in the event of a Design Basis Accident, to direct and distribute the flow of air and steam through the ice bed, and to protect the Containment structure opposite the ice condenser inlet doors from direct jet impingement forces.

The last two functions are accomplished by turning vanes that are designed to turn the flow of the air and steam mixture up through the ice bed in event of a Design Basis Accident. For such an event, the vanes would serve to reduce the drag forces on the lower support structural members, reduce the impingement forces on the Containment across from the lower inlet doors and to distribute the flow more uniformly over the ice bed. In addition to the turning vanes, the lower support structure has a continuous impingement plate around the outer circumference of the lower support structure, designed to reduce the jet impingement forces on the Containment structure across from the lower inlet doors in the event of a Design Basis Accident.

Design Criteria and Codes

The loading combinations, stress limits and material specifications used in the design of the lower support structure are given in Sections 6.2.2.16 and 6.2.2.18.

Design Conditions

The normal operating temperature range is 10°F to 25°F. The normal operational temperature change, including maintenance operations is 10°F to 70°F. The maximum temperature during a Design Basis Accident is 250°F.

The loads used for the design of the lower support structure are given in Table 6-96. The loads consist of dead weight (gravity), forces as a result of DBA, 1/2 SSE and SSE seismic loads and loads as a result of thermal changes.

The dead loads include the weight of the crane wall insulated duct panels, the weight of the intermediate deck doors and frames, the weight of the lattice frames and columns, and the weight of the turning vanes. The weight of the ice baskets filled with ice, the slotted jet impingement plate assemblies and the door shock absorber, also act on the lower support structure.

Forces and loadings that occur during LOCA were provided by the Transient Mass Distribution (TMD) Code from analysis of double-ended breaks in an end compartment near the refueling canal, with 100

75. Duke Power Company, An Analysis of Hydrogen Control Measures at McGuire Nuclear Station, February 17, 1981.

76. Parker, W. O., Duke, letter to H. R. Denton, NRC, "An Analysis of Hydrogen Control Measures at McGuire Nuclear Station," October 30, 1982; Revision 1, December 31, 1981; Revision 2, January 22, 1982; Revision 3, March 11, 1982; Revision 4, May 4, 1982; Revision 5, November 5, 1982; Revision 6, February 15, 1983; Revision 7, March 16, 1983; Revision 8, April 22, 1983.

77. U. S. Nuclear Regulatory Commission, "NRC Staff Analysis of Hydrogen Control Measures for McGuire Nuclear Station, Units 1 and 2," Docket No.s 50-369 and 50-370, February 17, 1981.

78. Deleted Per 1998 Update.

79. W Letter, DAP-92-034, DCP-92-026 to DPC, June 9, 1992.

80. Stress Evaluation for revised Ice Basket Lower Supports, McGuire Nuclear Station Units 1 and 2, Westinghouse Calculation No. MED-PCE-10522, June 1991, M.F. Hankinson.

81. Duke Power Company, McGuire and Catawba Mass and Energy Release and Containment Response Methodology, DPC-NE-3004-P, September 1994.

82. RELAP5/MOD3 Code Manual, Volumes 1 to 5, NUREG/CR-5535, EGG-2596 (Draft), June 1990.

83. GOTHIC Containment Analysis Package, Version 4.0, RP3048-1, Prepared for Electric Power Research Institute, Numerical Applications, Inc., September 1993.

84. ANSI/ANS-56.4 - 1983, "American National Standard Pressure and Temperature Transient Analysis for Light Water Reactor Containments", American Nuclear Society, December 23, 1983.

85. "RETRAN-02: A Program for Transient Thermal-Hydraulic Analysis of Complete Fluid Flow Systems," EPRI-NP-1850-CCM, Revision 4, EPRI, November 1988.

86. M.S. Tuckman (Duke) letter dated November 11, 1998 to Document Control Desk (NRC), "Response to Generic Letter 98-04: Potential Degradation of the Emergency Core Cooling System and the Containment Spray System After a Loss-of-Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment," McGuire Nuclear Station, Units 1 and 2, Docket Nos. 50-359, 370.

~~87. DPC-1201.17-00-0006, "Design and Licensing Basis for Ice Condenser Lower Inlet Doors Technical Specification Surveillance Requirements, 40º Opening, Closing and Frictional torques".~~

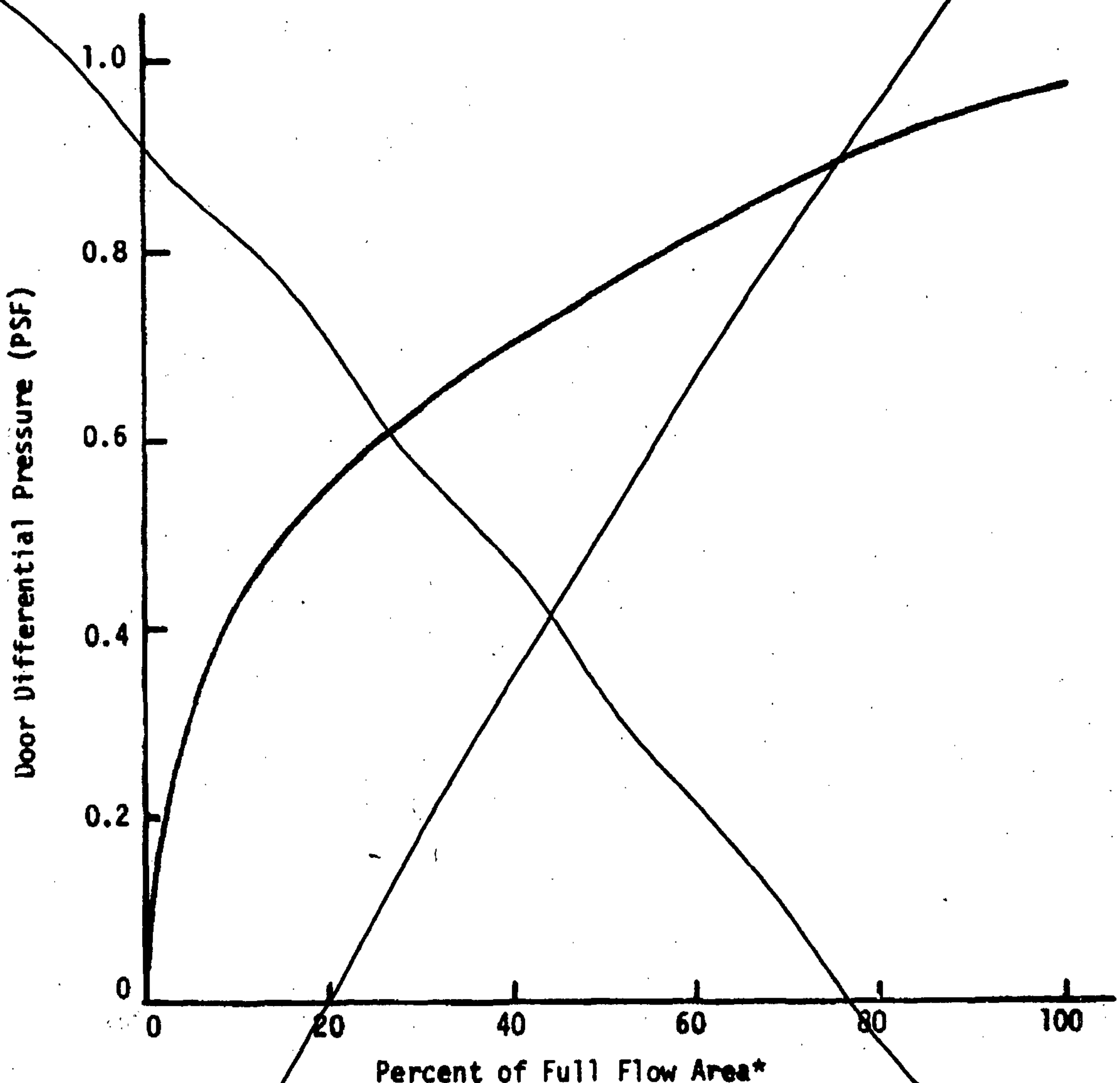
Table 6-20. Allowable Leakage Area For Various Reactor Coolant System Break Sizes

Break Size	5 ft^2 Deck Leak Air Compression Peak (psig)	Deck Leakage Area (ft^2)	Resultant Peak Containment Pressure (psig)
Double-ended	7.7	50	11.9
0.6 Double-ended	6.6	50	12.5
3 ft^2	6.25	50	12.2
0.5 ft^2	5.75	50	14.5
0.5 ft^2 [(1)]	5.75	50	11.8[1]
8 inch diameter	5.5	40	14.9
8 inch diameter[1]	5.5	50	12.0[1]
6 inch diameter	5.0	40	14.7
2 1/2 inch diameter	4.0	50	13.4
1/2 inch diameter	3.0	>50	3.0

Note:

1. This case assumes upper compartment structural heat sink steam condensation of 6 lb/sec and 30 percent of deck leakage is air.
2. Reference 87 describes Westinghouse review of design deck leakage sensitivity studies performed in the 1970s. These studies evaluated the sensitivity of allowable deck bypass leakage to changes in lower inlet door performance. Sensitivities for characteristic curves ranging from 0.4 psf to 1.2 psf at the 40 degree door position were reviewed. These show that the Deck Leakage Areas listed here would be reduced by no more than 10 square feet with uniform door characteristic curves at 1.2 psf (at 40 degrees). Substantial margin remains between these reduced values (30-40 square feet) and the design value of 5 square feet.

Figure 6-128. Flow Area Pressure Differential



*Full Flow Area is defined as the minimum door port area with doors fully open

DELETE

INSERT 1

The developed ice condenser cold head will then compress the gasket seals, and will also serve to re-close the doors should the panels briefly and inadvertently break away from the seal during normal operation.

For small incidents, initial inlet door opening (location and magnitude) is determined by local lower compartment pressure. As the developed ice condenser cold head is lost through open doors, the remainder of the doors will also tend to open, providing numerous pathways for steam to enter the ice condenser.

ATTACHMENT 3b

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The ice condenser inlet doors form the barrier to air flow through the inlet ports of the ice condenser for normal unit operation. They also provide the continuation of thermal insulation around the lower section of the crane wall to minimize heat input that would promote sublimation and mass transfer of ice in the ice condenser compartment. In the event of a loss-of-coolant accident, LOCA, causing a pressure increase in the lower compartment, the doors open, venting air and steam ~~relatively evenly~~ into ~~all sections of~~ the ice condenser.

The door panels are provided with tension spring mechanisms that produce a small closing torque on the door panels as they open. ~~The magnitude of the closing torque is equivalent to providing approximately a one pound per square foot pressure drop through the inlet ports with the door panels open to a position equivalent to the full port flow area.~~ The zero load position of the spring mechanisms is set such that, with zero differential pressure across the door panels, the gasket holds the door slightly open. ~~This setting provides assurance that all doors will be open slightly, upon removal of cold air head, therefore eliminating significant inlet maldistribution for very small incidents.~~ INSERT 1

For larger incidents, the doors open fully and flow distribution is controlled by the flow area and pressure drops of inlet ports. The doors are provided with shock absorber assemblies to dissipate the larger door kinetic energies generated during large break incidents.

Design Criteria

Radiation Exposure

Maximum radiation at inlet door is 5 rad/hr gamma during normal operations. No secondary radiation due to neutron exposure.

Structural Requirements

Refer to Section 6.7.16

Loading Modes

The door hinges and crane wall embedments, etc., must support the dead weight of the door assembly during all conditions of operation. Door hinges shall be designed and fabricated to preclude galling and self welding.

Seismic Loads tend to open the door.

During normal operations the outer surface of the door operates at a temperature approaching that of the lower compartment while the inner surface approaches that of the ice bed. During loss-of-coolant accidents, the outer surface is subjected to higher temperatures on a transient basis. Resultant thermal stresses are considered in the door design.

During large break accidents, the doors are accelerated by pressure gradients then stopped by the Shock Absorber System. During small break accidents, doors open in proportion to the applied pressure with restoring force provided by springs. Upon removal of pressure, door closure results as a result of spring action.

Design Criteria - Accident Conditions

All doors open to allow venting of energy to the ice condenser for any leak rate which results in a divider deck differential pressure in excess of the ice condenser cold head.

The force required to open the doors of the ice condenser is sufficiently low such that the energy from any leakage of steam through the divider barrier can be readily absorbed by the Containment Spray System without exceeding Containment design pressure.

~~Doors and door ports limit maldistribution to 150 percent maximum, peak to average mass input for the accident transient, for any Reactor Coolant System release of sufficient magnitude to cause the doors to open.~~

The basic performance requirement for lower inlet doors for design basis accident conditions is to open rapidly and fully, to insure proper venting of released energy into the ice condenser. The opening rate of the inlet doors is important to insure minimizing the pressure buildup in the lower compartment due to the rapid release of energy to that compartment. The rate of pressure rise and the magnitude of the peak pressure in any lower compartment region is related to the confinement of that compartment. The time period to reach peak lower compartment pressure due to the design basis accident is approximately 0.05 seconds.

Doors are of simple mechanical design to minimize the possibility of malfunction.

The inertia of the doors is low, consistent with producing a minimal effect on initial pressure.

Design Criteria - Normal Operation

The doors restrict the leakage of air into and out of the ice condenser to the minimum practicable limit. The inlet door leakage has been confirmed by test to be within the 50 cfm total used for the ice condenser design.

The doors restrict local heat input in the ice condenser to the minimum practicable limit. Heat leakage through the doors to the ice bed is a total of 20,000 Btu/hr or less (for 24 pairs of doors).

The doors are instrumented to provide indication of their closed position. Under zero differential pressure conditions all doors remain 3/8 inch open.

Provision for adequate means of inspecting the doors during reactor shutdown.

The doors are designed to withstand earthquake loadings without damage so as not to affect subsequent ice condenser operation for normal and accident conditions. These loads are derived from the seismic analysis of the Containment.

~~The Door System provides a flow proportioning capability for small break conditions in accordance with Figure 6-153.~~

Interface Requirements

Crane wall attachment of the door frame is via bolts into embedded anchor plates with a compressible seal. Attachment to the crane wall is critical for the safety function of the doors.

Sufficient clearance is required for the doors to open into the ice condenser. Items to be considered in this interface are floor clearance, lower support structure clearance and floor drain operation and sufficient clearance (approximately six inches) to accommodate ice fallout in the event of a seismic disturbance occurring coincident with a loss-of-coolant accident. * INSERT

Door opening and stopping forces are transmitted to the crane wall and lower support structure, respectively.

Design Loads

Pressure loading during LOCA is provided by the Transient Mass Distribution (TMD) code from an analysis of a double-ended hot leg break in the corner formed by the refueling canal, with 100 percent entrainment of water in the flow. For conservatism, TMD results were increased by 40 percent in performing the design analysis for the lower inlet doors.

The lower inlet door design parameters and loads are presented in Table 6-122.

* INSERT:

Original ice basket qualification testing (Topical Report WCAP-8110, Supplement 9-A), has shown freshly loaded ice is considered fused after five weeks. In the event of an earthquake (OBE or greater) which occurs within five weeks following the completion of ice basket replenishment, plant procedures require a visual inspection of applicable areas of the ice condenser within 24 hours to confirm that opening of the ice condenser lower inlet doors is not impeded by any ice fallout resulting from the seismic disturbance. This alternative method of compliance with the requirements of GDC 2 is credible based upon the reasonable assurance that the ice condenser doors will open following a seismic event during the 5 week period and the low probability of a seismic event occurring coincident with or subsequently followed by a Design Basis Accident.

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AMENDMENTS 241/236

6.7.8.2 System Design

Twenty-four pairs of inlet doors are located on the ice condenser side of ports in the crane wall at an elevation immediately above the ice condenser floor. General details of these doors are shown in Figure 6-154 through Figure 6-158. Each door panel is 92.5 in. high, 42 in. wide and 7.5 in thick. Each pair is hinged vertically on a common frame.

Each door consists of a 0.5 in. thick Fiber Reinforced Polyester (FRP) plate stiffened by six steel ribs, bolted to the plate. The FRP plate is designed to take vertical bending moments resulting from pressures generated from a LOCA and from subsequent stopping forces on the door. The ribs are designed to take horizontal bending moments and reactions, as well as tensile loads resulting from the door angular velocity, and transmit them to the crane wall via the hinges and door frame.

Seven inches of urethane foam are bonded to the back of the FRP plate to provide thermal insulation. The front and back surfaces of the door are protected with 26 gauge stainless steel covers which provide a complete vapor barrier around the insulation. The urethane foam and stainless steel covers do not carry overall door moments and shearing forces.

Three hinge assemblies are provided for each door panel; each assembly is connected to two of the door ribs. Loads from each of the two ribs are transmitted to a single 1.572 inch diameter hinge shaft through brass bushings. These bushings have a spherical outer surface which prevents binding which might otherwise be caused by door rib and hinge bar flexure during accident loading conditions. The hinge shaft is supported by two self-aligning, spherical roller bearings in a cast steel housing. Vertical positioning of the door panel and shaft with respect to the bearing housing are provided by steel caps bolted to the ends of the shaft and brass spacer rings between the door ribs and bearings. Shims are provided between the shaft and caps to obtain final alignment. Each bearing housing is bolted to the door frame by four bolts, threaded into tapped holes in the housing. Again, shims are provided between the housings and door frame to maintain hinge alignment. Hinges are designed and fabricated to prevent galling and self welding.

The door frame is fabricated mainly from steel angle sections; 6 in x 6 in. on the sides and 6 in. x 4 in. on the top and bottom. A 4 in. central I beam divides the frame into sections for each door. At each hinge bracket, extensions and gusset plates, fabricated from steel plate, are welded to the frame to carry loads to the crane wall.

The door panel is sealed to the frame by a compliant rubber seal which attaches to channels welded to the door frame. During normal unit operations these seals are compressed by the cold air head of the ice bed acting on the door panels. As the seals operate at a much warmer temperature than the ice bed, frosting of the seal region is extremely unlikely.

Each door is provided with four RETURN ~~flow proportioning~~ springs. One end of each spring is attached to the door panel and the other to a spring housing mounted on the door frame. ~~These springs provide a door return torque proportional to the door opening angle and thus satisfy the requirement for flow proportioning. In addition, they assure that the doors close in the event they are inadvertently opened during normal unit operations.~~ The springs are adjusted during assembly such that, with no load on the doors, the doors are slightly open. ~~For small door openings, the required 3/8 inch effective door opening is controlled by a 3/8 inch gap between panels and is, thus, independent of the door position as measured in degrees.~~

In order to dissipate the large kinetic energies resulting from pressures acting on the doors during a LOCA, each door is provided with a shock absorber assembly as shown in Figure 6-158. The shock absorber element is a sheet metal air box approximately 93 in. high, 46 in. wide, and 29.6 in. thick at its thickest section. The air box is attached to a back plate assembly which is bolted to the ice condenser lower support structure.

Two edges of the sheet metal box are fastened to the ends of back plate by clamping bars and bolts, making them air tight joints. The sheet metal is bent such that it has an impact face and a pre-folded side.

When the lower inlet doors open due to sudden pressure rise, they impact on the impact face of the air box. The impact face moves with the door. Because of a restraining rod within the box, the pre-folded side of the air box collapses inwards. The volume of the air trapped in the air box decreases as the impact face moves towards the back plate, thereby increasing air pressure. Part of the kinetic energy of the door is used up in compressing air. To prevent excessive pressure rise, the air is allowed to escape through the clearance gap between the sheet metal and end plates. A portion of the energy of the doors is also used in buckling of stiffeners.

Material

Door materials are consistent with the listing of acceptable materials as presented in Section 6.7.18. All exposed surfaces are made of stainless steel or coated with paint suitable for use inside the Containment. All insulation material is compatible with containment chemistry requirements for normal and accident conditions.

6.7.8.3 Design Evaluation

The lower inlet doors are dynamically analyzed to determine the loads and structural integrity of the door for the design basis load conditions.

Using TMD results as input, the door dynamic analysis is performed using the "D00R" Program. This computer program has been developed to predict door dynamic behavior under accident conditions. This program takes the door geometry and the pressures and calculates flow conditions in the door port. From the flow are derived the forces on the door due to static pressure, dynamic pressure and momentum. These forces, plus a door movement generated force, i.e., air friction, are used to find the moment on the door and from this the hinge loads. Output from the program includes door opening angle, velocity and acceleration as functions of time as well as both radial and tangential hinge reactions.

Analysis Due to LOCA

The net load distributions on the door for both opening and stopping are determined by considering the applied pressures acting on the door and then solving the rigid body equations of motion such that the net forces and moments at the hinge point are zero. In the process, this produces expressions for the inertial forces in the door and a hinge reaction as functions of the applied pressure.

The expressions for net load distribution are integrated to determine door shear and moment as functions of distance from the hinge point. The resultant load, shear and moment distribution curves and the total hinge loads, calculated by the "D00R" Program, provides the inputs for subsequent stress analysis.

Using this input, the door assembly is analyzed as a stiffened plate structure with vertical bending being taken by the FRP outer plate and horizontal bending plus radial tensile loads being resisted by the steel ribs. As inertial forces are directly accounted for in the analysis, no dynamic load factor was applied.

Hinge pin, hinge bracket, and frame stresses are analyzed under hinge reactions considering the effects of tension, shear bending, and torsion as appropriate. For these components, a dymamic load factor of 1.2 was calculated and applied.

DOOR RETURN

Stresses in the ~~flow proportioning~~ springs are calculated considering dynamic effects as well as static ones. Welded and bolted connections are analyzed as part of the overall door, frame and hinge analysis.

All portions of the door and frame show factors of safety greater than one. The general acceptance criterion is that stresses be within the allowable limits of the AISC-69 Structural Code. This provides an additional margin of conservatism over the general ice condenser design criteria for D + DBA which permit stresses up to 1.33 times the AISC limits. For materials and components not covered by the Code, i.e., bearings, non-metallic materials, etc., conservative acceptance criteria are established on the basis of manufacturer's recommendations and/or engineering evaluations.

~~Flow proportioning characteristics of the door are evaluated by determining the door opening as a function of applied pressure. Assuming a triangular pressure distribution across the door, the flow area vs. pressure at full door opening, is determined to be consistent with the curve shown on Figure 6-153. In addition,~~ The effects of door closure were evaluated assuming the pressure is suddenly released from a fully opened door and the door allowed to shut under the effect of the door ~~proportioning~~ RETURN springs. Stress levels in the door, gasket, and frame are found to be acceptable for this condition. In addition to the above analysis, full scale simulated blowdown tests have been performed on prototype door and shock absorber assemblies. These tests confirm the adequacy of these components at test levels up to 140 percent of maximum loading conditions predicted by the TMD Code.

Analysis of Seismic Loading

Seismic analysis of the doors indicates that stresses are insignificant in comparison with those occurring during a LOCA. Under a SSE the doors could open several inches (actually, the crane wall will move away from the doors). At the termination of the earthquake, the doors immediately close and reseal under the effects of ~~proportioning~~ RETURN spring tension and the ice bed cold air head. Thus, any loss of cold air during a OBE or SSE is small and limited to a short period of time.

The dynamic testing of the air box shock absorber is discussed in Reference 12.

Surveillance Testing

To verify that the Lower Inlet Doors (LIDs) will function as intended, periodic testing is performed. Section 3.6.13 of Technical Specifications specifies tests and inspections performed to verify the functional capability of the LIDs. Bases for the surveillance tests and inspections are provided in the Bases for Section 3.6.13 of Technical Specifications.

Visual inspections of the LIDs are performed to verify that the doors are not impaired by ice, frost or debris. This provides assurance that the doors are free to open in the event of a Design Basis Accident (DBA). To provide assurance that the doors are not stuck in the closed position, a physical test is performed on the closed LIDs to determine the torque required to pull the doors off of their seals.

~~A torque test series is also performed with the LIDs open to evaluate active LID components (i.e., hinges, clevises, and springs) for degradation, to verify that the LIDs will open uniformly, and verify that the return springs are producing a door return torque within limits. This test consists of determining the torque required to cause opening motion at the 40° open position, and also determining the torque required to hold the door stationary, keeping it from closing, at the 40° open position. Using the results from these tests, the resisting frictional torque in the active components is calculated per the following equation:~~

~~$T_{(F)} = [T_{(O)} - T_{(C)}] \div 2$~~

~~Where: $T_{(F)}$ = calculated frictional torque~~

~~$T_{(O)}$ = measured opening torque~~

~~$T_{(C)}$ = measured closing torque~~

IN ADDITION, A VISUAL ASSESSMENT OF THE DOOR'S MOTION THROUGH ITS AVAILABLE SWING ARC (I.E., APPROXIMATELY 40° OR UP TO SLIGHT CONTACT WITH THE SHOCK ABSORBER) IS PERFORMED TO ENSURE THE INLET DOOR MOVES FREELY AND RETURNS THE DOOR BACK TOWARD THE CLOSED POSITION, AND ALSO TO MONITOR THE PERFORMANCE OF THE HINGES AND SPRING MECHANISMS TO ENSURE THEY ARE PROPERLY MAINTAINED

~~There are two primary types of friction associated with the operation of the LID's. These are friction associated with the hinges and with the spring mechanisms, with the latter being more significant. While the hinge friction is generally uniform in both directions of door motion, impacts from friction in the spring mechanisms can vary. Static and dynamic friction in the four spring rod end clevis pins can result in variations in spring force between the opening and closing directions. This variation has been seen to~~

~~create increased closing torques with the springs in a significantly elongated configuration (approaching 40 degrees open). While this can lead to measured closing torques greater than the measured opening torques, it is not a concern as it results from the springs' mechanical behavior in an elongated configuration affecting the door over a limited range as it approaches the open position. The calculated frictional torque value is indicative of both the total door friction and the resultant frictional impacts on spring force, thus providing good indication of the overall impacts of friction on door performance.~~

6.7.9 Lower Support Structure

6.7.9.1 Design Bases

The lower support structure is designed to support and hold down the ice baskets in the required array, to provide an adequate flow area into the ice bed for the air and steam mixture in the event of a Design Basis Accident, to direct and distribute the flow of air and steam through the ice bed, and to protect the Containment structure opposite the ice condenser inlet doors from direct jet impingement forces.

The last two functions are accomplished by turning vanes that are designed to turn the flow of the air and steam mixture up through the ice bed in event of a Design Basis Accident. For such an event, the vanes would serve to reduce the drag forces on the lower support structural members, reduce the impingement forces on the Containment across from the lower inlet doors and to distribute the flow more uniformly over the ice bed. In addition to the turning vanes, the lower support structure has a continuous impingement plate around the outer circumference of the lower support structure, designed to reduce the jet impingement forces on the Containment structure across from the lower inlet doors in the event of a Design Basis Accident.

Design Criteria and Codes

The loading combinations, stress limits and material specifications used in the design of the lower support structure are given in Sections 6.7.16 and 6.7.18.

Design Conditions

The normal operating temperature range is 10°F to 25°F. The normal operational temperature change, including maintenance operations is 10°F to 70°F. The maximum temperature during a Design Basis Accident is 317°F (The Peak Containment Temperature Transient is discussed in Section 6.2.1.1.3.3.)

The loads used for the design of the lower support structure consist of dead weight (gravity), forces as a result of DBA, OBE and SSE seismic loads and loads as a result of thermal changes.

The dead loads include the weight of the crane wall insulated duct panels, the weight of the intermediate deck doors and frames, the weight of the lattice frames and columns, and the weight of the turning vanes. The weight of the ice baskets filled with ice, the slotted jet impingement plate assemblies and the door shock absorber, also act on the lower support structure.

Forces and loadings that occur during LOCA were provided by the Transient Mass Distribution (TMD) Code from analysis of double-ended breaks in an end compartment, with 100 percent entrainment of water in the flow. For conservatism, all forces and loads that are a result of TMD were increased by 40 percent in performing the detail design and analysis for the lower support structure.

The lower support structure seismic design loads were developed using dynamic seismic analysis and the defined seismic response curves for the Catawba Nuclear Station.

Thermal loading conditions, which result from two thermal excursions were specified for the lower support structure. One thermal excursion from 10°F to 70°F, is defined as a normal operating service load, and the other, defined as 70°F to 250°F, is the thermal excursion seen by the lower support structure following a LOCA.

13. Final Report-Ice Condenser Full-Scale Tests at the Waltz Mill Facility, *WCAP-8282*, February 1974 (Westinghouse NES Proprietary), and *WCAP-8110*, Supplement 6, May, 1974.

14. Final Report-Ice Condenser Full-Scale Tests at the Waltz Mill Facility, *WCAP-8282*, Addendum 1, May, 1974 (Westinghouse NES Proprietary), and *WCAP-8110*, Supplement 7, May, 1974.

15. Stress and Structural Analysis and Testing of Ice Baskets, *WCAP-8304*, (Westinghouse NES Proprietary), and *WCAP-8110*, Supplement 8, May, 1974.

16. Ice Fallout From Sesimic Testing of Fused Ice Basket, *WCAP-8110*, Supplement 9-A, May, 1974.

17. Static Testing of Production Ice Baskets, *WCAP-8110*, Supplement 10, September, 1974.

18. Sequoyah Nuclear Plant Final Safety Analysis Report, Tennessee Valley Authority, Docket Numbers 50-327 and 50-328.

19. Stress Evaluation for Revised Ice Basket Lower Supports, McGuire Nuclear Station Units 1 and 2, Westinghouse Calculation No. MED-PCE-10522, June 1991, revised June 1992, M.F. Hankinson; and letter from T.R. Puryear, Westinghouse Technical Services Manager, regarding applicability to CNS Units 1 and 2. CNM number CNM 1201.17-30 sh20.

20. Ice Condenser Cable Suspension System for Block Ice Technology - Design Qualification, WCAP-14624, April, 1996, Duke Number CNM 1201.17-30 sh30.

21. Application of the Active Ice Mass Management Concept to the Ice Condenser Ice Mass Technical Specification, *ICUG-001*, Ice Condenser Utility Group, Revision 2, June 2003.

22. "Mass & Energy Release and Containment Response Methodology," DPC-NE-3004-PA, Rev. 1, Duke Power Co., SER dated February 29, 2000.

~~23. DPC-1201.17-00-0006, Design Basis for Ice Condenser Lower Inlet Doors Tech. Specification Surveillance Requirements, 40° Opening, Closing and Frictional Torques~~

23 ~~24~~. ND Suction Pressure Control Setpoint Determination for 1(2)FW96 and 1(2)FW97, CNC-1223.21-00-0020.

24 ~~25~~. Documentation of Design Basis for 1(2)FW28 and 1(2)FW56 and Bypass Line, CNC-1223.21-00-0021.

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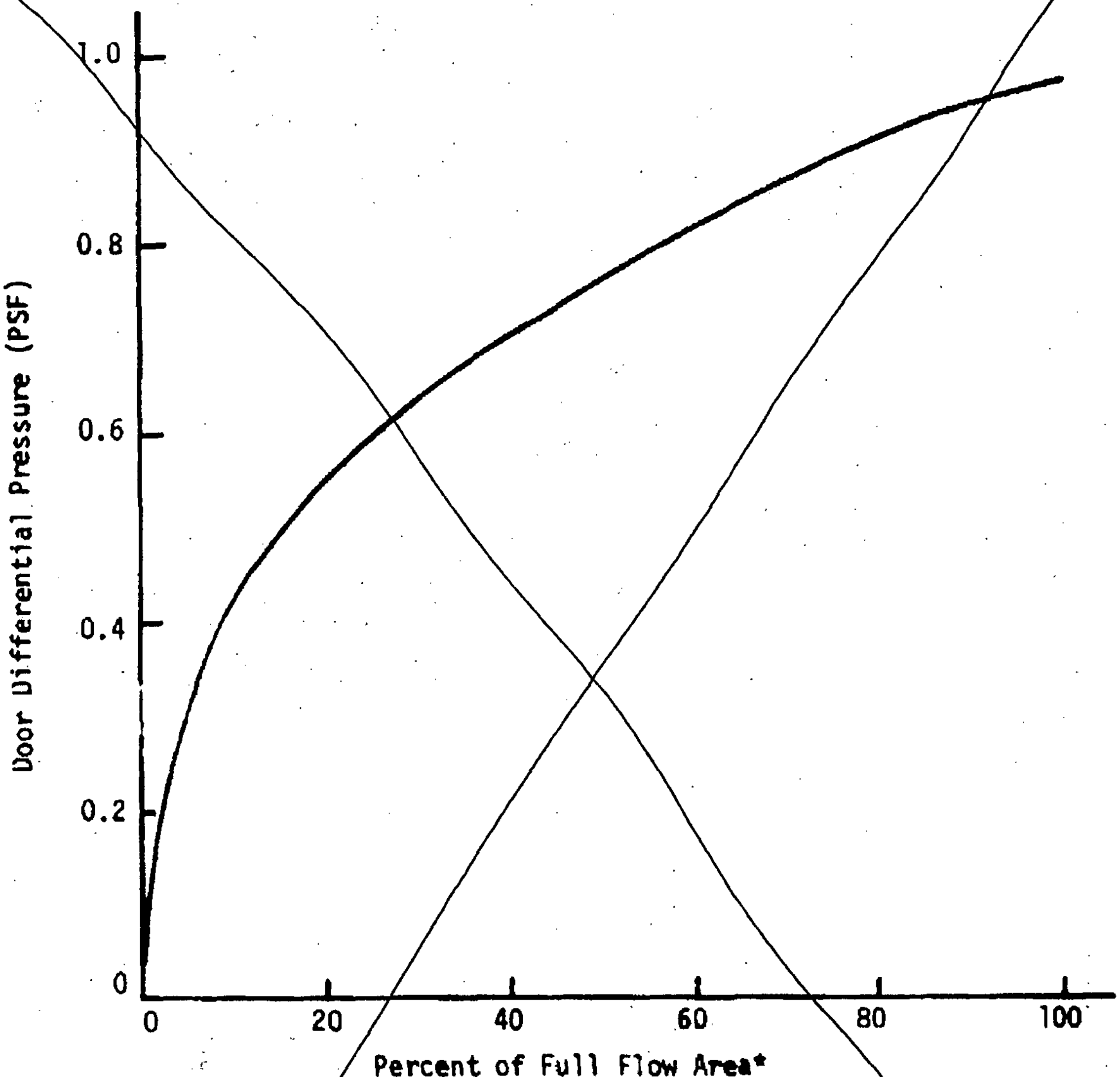
Table 6-12. Allowance Leakage Area for Various Reactor Coolant System Break Sizes

Break Size	5 ft^2 Deck Leak Air Compression Peak (psig)	Deck Leakage Area (ft^2)~~(2)~~	Resultant Peak Containment Pressure (psig)
Double-ended	7.7	50	11.9
0.6 Double-ended	6.6	50	12.5
3 ft^2	6.25	50	12.2
0.5 ft^2	5.75	50	14.5
0.5 ft^2 (1)	5.75	50	11.8 (1)
8 inch diameter	5.5	40	14.9
8 inch diameter (1)	5.5	50	12.0 (1)
6 inch diameter	5.0	40	14.7
2 ½ inch diameter	4.0	50	13.4
½ inch diameter	3.0	>50	3.0

Note:

1. This case assumes upper compartment structural heat sink steam condensation of 6 lb/sec and 30 percent of deck leakage is air.
2. ~~See Reference 23. This reference describes Westinghouse review of design deck leakage sensitivity studies performed in the 1970s. These studies evaluated the sensitivity of allowable deck bypass leakage to changes in lower inlet door flow proportioning opening characteristic variation limit curves (similar to Figure 6-153). Sensitivities for characteristic curves ranging from 0.4 psf to 1.2 psf at the 40 degree door position were reviewed. These show that the Deck Leakage Areas listed here would be reduced by no more than 10 square feet with uniform door characteristic curves at 1.2 psf (at 40 degrees). Substantial margin remains between these reduced values (30-40 square feet) and the design value of 5 square feet.~~

Figure 6-153. Flow Area - Pressure Differential



*Full Flow Area is defined as the minimum door port area with doors fully open

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The developed ice condenser cold head will then compress the gasket seals, and will also serve to re-close the doors should the panels briefly and inadvertently break away from the seal during normal operation.

For small incidents, initial inlet door opening (location and magnitude) is determined by local lower compartment pressure. As the developed ice condenser cold head is lost through open doors, the remainder of the doors will also tend to open, providing numerous pathways for steam to enter the ice condenser.