Duke Energy

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March 22, 2001

U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

ATTENTION: Document Control Desk

Re: Duke Energy Corporation

Application for License Amendments
Pursuant to 10 CFR 50.4, 10 CFR 50.90, 10 CFR 50.91,
10 CFR 50.92, 10 CFR 51.22

Catawba Nuclear Station Unit 1, 2
USNRC License NPF No. 35 and NPF No. 52
USNRC Docket No. 50-413 and 50-414

McGuire Nuclear Station Unit 1, 2
USNRC License NPF No. 9 and NPF No. 17
USNRC Docket No. 50-369 and 50-370

Amendment to Technical Specification 3.6.12 - Ice Bed
Revise Chemical Sampling & Analysis, and
Flow Area Verification Surveillance Requirements

Duke Energy Corporation (Duke) herein submits this Application for License Amendment pertaining to Catawba Nuclear Station Units 1 and 2, and McGuire Nuclear Station Units 1 and 2. This Application is submitted pursuant to the requirements of 10 CFR 50.4, 10 CFR 50.90, 10 CFR 50.91, 10 CFR 50.92, and 10 CFR 51.22. The proposed amendment consists of changes to the facility Technical Specifications (TSs) that are incorporated into each Facility Operating License (FOL) as Appendix A.

The proposed amendment revises the TS associated with the ice bed portion of the ice condensers. These changes are initiated as part of an industry effort to enhance TSs related to ice condensers. This Application includes changes to two TS surveillance requirements (SRs). The first is a revision of the ice bed chemical analysis and sampling SR. The second is a revision to the ice bed flow area verification SR. There is existing precedent for these proposed changes in previous NRC approved FOL Amendments.[1] These changes are consistent with recently approved Westinghouse Owners Group (WOG) improved Standardized Technical Specification (NUREG 1431) changes.[2]

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[1]Letter, NRC to Tennessee Valley Authority (TVA), dated March 21, 2000, Watts Bar Nuclear Plant, Issuance of Amendment regarding Ice Condenser Ice Sampling SR; and
Letter, NRC to TVA, dated July 17, 2000, Watts Bar Nuclear Plant, Issuance of Amendment regarding Ice Condenser Flow Channel Inspection Requirements.

[2]TSTF-336, Revision 1, WOG, Ice Bed Flow Channel Blockage SR, NRC Approval date: July 28, 2000; TSTF-356, Revision 1, WOG, Revise Ice Condenser Ice Sampling and Analysis Requirements, NRC Approval Date: March 7, 2000.

A001

Duke currently performs extensive testing beyond the existing surveillances in an effort to monitor overall health of the ice bed. Duke has incorporated this testing experience in the proposed inspection requirements. Approval of these changes will reduce burden by implementing the more effective inspection requirements and eliminating those requirements replaced by the proposed SRs. Duke also requests that the amended license provide for implementation prior to the next scheduled refueling outage. The next Duke Ice Condenser plant refueling outage is scheduled for Catawba Unit 2 (End Of Cycle 11). Therefore, Duke request that this Application be approved with issuance of amendments by August 1, 2001.

This Application contains several enclosures for use by NRC staff in reviewing this request. Enclosure 1 and 3 contain the proposed changes to the TS pages of the FOLs for Catawba and McGuire Nuclear Stations, respectively. Enclosure 2 and 4 provide pages from the current TSs indicating changes as marked. Enclosures 5 and 7 provide copies of revised TS BASES pages that Duke plans to implement associated with the proposed amendment. These BASES changes have been evaluated pursuant to 10 CFR 50.59 and do not require NRC staff approval. Enclosures 6 and 8 provide the current TS BASES pages indicating changes as marked. Enclosure 9 contains the Duke Amendment Evaluation Report, which describes the changes and justification for the proposed license amendment. Enclosure 9 also contains the basis for determination that the changes do not involve a Significant Safety Hazard in accordance with the criteria contained in 10 CFR 50.92. Enclosure 9 also provides a basis for determining that the changes are subject to categorical exclusion from Environmental Review in accordance with the criteria in 10 CFR 51.22.

Duke has identified the following as commitments associated with this Application. Duke procedures for inspection of ice condenser flow passages will require that the individual performing the procedure be properly trained, and qualified. Duke procedures will also provide for inspection of the flow areas by looking down from the top of the ice bed, and where view is achievable up from the bottom of the ice bed. Lighting requirements will include lighting and back lighting with the appropriate intensity to achieve full view of the flow area and minimize glare. Any flow areas that can not be verified to be open will be conservatively evaluated as 100% blocked. Duke procedures will require a 100 percent inspection and evaluation for any gross ice buildup on the excluded structures, and the removal of significant ice accumulations. Flow area blockage determination uncertainty due to inspection methods will be accounted for by procedural controls that establish acceptance criteria less than the proposed TS required limit of 15%. The Catawba and McGuire Nuclear Station UFSARs will be revised as appropriate, per the requirements of 10 CFR 50.71 (e).

In accordance with Duke internal procedures and the Quality Assurance Program Topical Report, the proposed amendment has been previously reviewed and approved by each station's Plant Operations Review Committee and the Duke Corporate Nuclear Safety Review Board.

Pursuant to 10CFR50.91, a copy of this LAR is being forwarded to the appropriate North Carolina and South Carolina State Officials.

Please direct questions regarding this Application to M. R. Wilder at 704 875-5362.

Very truly yours,

H B Barron

H. B. Barron

Enclosures:

1. Catawba Nuclear Station, Proposed Amended FOL NPF 35 & 52, TS Pages
2. Catawba Nuclear Station, Marked Changes to Current TS Pages
3. McGuire Nuclear Station, Proposed Amended FOL NPF 9 & 17, TS Pages
4. McGuire Nuclear Station, Marked Changes to Current TS Pages
5. Catawba Nuclear Station, Revised TS BASES Pages associated with Proposed Amendment
6. Catawba Nuclear Station, Marked Changes to Current TS BASES Pages
7. McGuire Nuclear Station, Revised TS BASES Pages associated with Proposed Amendment
8. McGuire Nuclear Station, Marked Changes to Current TS BASES Pages
9. Duke Amendment Evaluation including No Significant Hazards Determination

xc w/enclosures:

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AFFIDAVIT

H. B. Barron, states that he is Vice President of McGuire Nuclear Station, Duke Energy Corporation; that he is authorized on the part of said corporation to sign and file with the Nuclear Regulatory Commission this amendment to the Catawba Nuclear Station Facility Operating Licenses Nos. NPF-35 and NPF-52 and the McGuire Nuclear Station Facility Operating Licenses Nos. NPF-9 and NPF-17 and Technical Specifications; and that all statements and matters set forth herein are true and correct to the best of his knowledge.

H B Barron,

H. B. Barron, Vice President
McGuire Nuclear Station
Duke Energy Corporation

Subscribed and sworn to me: 3/19/01
Date

Deborah G. Thrap, Notary Public
Deborah G. Thrap

My Commission Expires: 4/6/02
Date

SEAL

bxc: (w/enclosure)

B.L. Peele Jr. (MG01VP)
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B.W. Fulbright (MG05SE)
J.F. McKeown (CN03SE)
R.S. Lytton (EC09O)
T.K Pasour (Document Control Copy CN-801.01) (CN01EP)
T.K. Pasour (RGC Data File Copy) (CN01EP)
MNS Master File: 1.3.2.9
ELL (EC05O)
NSRB Support Staff (EC05N)
NCMPA-1
NCEMC
PMPA
SREC

Enclosure 1

Catawba Nuclear Station
Units 1 & 2
Proposed Amended FOL NPF-35, NPF-52
Technical Specification 3.6.12

Approval of this proposed change will affect the following Appendix "A" Technical Specification pages as described.

Remove	Insert
3.6.12-2	3.6.12-2
3.6.12-3	3.6.12-3

The following pages were provided for information only.

For Information Only
3.6.12-1

3.6 CONTAINMENT SYSTEMS

3.6.12 Ice Bed

LCO 3.6.12 The ice bed shall be OPERABLE.

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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Ice bed inoperable.	A.1 Restore ice bed to OPERABLE status.	48 hours
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3. <u>AND</u> B.2 Be in MODE 5.	6 hours 36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.6.12.1 Verify maximum ice bed temperature is $\leq$ 27°F.	12 hours

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.12.2	-----NOTE----- The chemical analysis may be performed on either the liquid solution or on the resulting ice. ----- Verify, by chemical analysis, that ice added to the ice condenser meets the boron concentration and pH requirements of SR 3.6.12.7.	Each ice addition
SR 3.6.12.3	Verify, by visual inspection, accumulation of ice on structural members comprising flow channels through the ice bed is ≤ 15 percent blockage of the total flow area for each safety analysis section.	18 months
SR 3.6.12.4	Verify total weight of stored ice is ≥ 2,330,856 lb by: a. Weighing a representative sample of ≥ 144 ice baskets and verifying each basket contains ≥ 1199 lb of ice; and b. Calculating total weight of stored ice, at a 95% confidence level, using all ice basket weights determined in SR 3.6.12.4.a.	18 months
SR 3.6.12.5	Verify azimuthal distribution of ice at a 95% confidence level by subdividing weights, as determined by SR 3.6.12.4.a, into the following groups: a. Group 1—bays 1 through 8; b. Group 2—bays 9 through 16; and c. Group 3—bays 17 through 24. The average ice weight of the sample baskets in each group from radial rows 1, 2, 4, 6, 8, and 9 shall be ≥ 1199 lb.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.12.6	Visually inspect, for detrimental structural wear, cracks, corrosion, or other damage, two ice baskets from each azimuthal group of bays. See SR 3.6.12.5.	40 months
SR 3.6.12.7	------------------------------ NOTE ------------------------------ The requirements of this SR are satisfied if the boron concentration and pH values obtained from averaging the individual sample results are within the limits specified below. -- Verify, by chemical analysis of the stored ice in at least one randomly selected ice basket from each ice condenser bay, that ice bed: a. Boron concentration is ≥ 1800 ppm and ≤ 2330 ppm; and b. pH is ≥ 9.0 and ≤ 9.5.	54 months

Enclosure 2

Catawba Nuclear Station
Units 1 & 2
Proposed Amended FOL NPF-35, NPF-52
Marked Changes
Technical Specification 3.6.12

Approval of this proposed change will affect the following Appendix "A" Technical Specification pages as described.

Remove	Insert
3.6.12-2	3.6.12-2
3.6.12-3	3.6.12-3

The following pages were provided for information only.

For Information Only
3.6.12-1

3.6 CONTAINMENT SYSTEMS

3.6.12 Ice Bed

LCO 3.6.12 The ice bed shall be OPERABLE.

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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Ice bed inoperable.	A.1 Restore ice bed to OPERABLE status.	48 hours
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3.	6 hours
	AND	
	B.2 Be in MODE 5.	36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.6.12.1 Verify maximum ice bed temperature is $\leq$ 27°F.	12 hours

(continued)

SEE INSERT B FOR NEW SR 3.6.12.2

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
~~SR 3.6.12.2 Verify, by visual inspection, accumulation of ice or frost on structural members comprising flow channels through the ice condenser is ≤ 0.38 inch thick.~~ SR 3.6.12.3 Verify, by visual inspection, accumulation of ice on structural members comprising flow channels through the ice bed is ≤ 15 percent blockage of the total flow area for each safety analysis section.	~~9 months for structural members other than the lower inlet plenum support structures and turning vanes~~ 18 months ~~AND~~ ~~18 months for the lower inlet plenum support structures and turning vanes~~
~~SR 3.6.12.3 Verify by chemical analyses of at least nine representative samples of stored ice:~~ SEE INSERT A ~~a. Boron concentration is ≥ 1800 ppm; and~~ ~~b. pH is ≥ 9.0 and ≤ 9.5.~~	~~18~~ months 54
SR 3.6.12.4 Verify total weight of stored ice is ≥ 2,330,856 lb by: a. Weighing a representative sample of ≥ 144 ice baskets and verifying each basket contains ≥ 1199 lb of ice; and b. Calculating total weight of stored ice, at a 95% confidence level, using all ice basket weights determined in SR 3.6.12.4.a.	18 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.12.5	Verify azimuthal distribution of ice at a 95% confidence level by subdividing weights, as determined by SR 3.6.12.4.a, into the following groups: a. Group 1—bays 1 through 8; b. Group 2—bays 9 through 16; and c. Group 3—bays 17 through 24. The average ice weight of the sample baskets in each group from radial rows 1, 2, 4, 6, 8, and 9 shall be ≥ 1199 lb.	18 months
SR 3.6.12.6	Visually inspect, for detrimental structural wear, cracks, corrosion, or other damage, two ice baskets from each azimuthal group of bays. See SR 3.6.12.5.	40 months

INSERT A

-- NOTE --
The requirements of this SR are satisfied if the boron concentration and pH values obtained from averaging the individual sample results are within the limits specified below.

SR 3.6.12.7 Verify, by chemical analysis of the stored ice in at least one randomly selected ice basket from each ice condenser bay, that ice bed:

a. Boron concentration is ≥ 1800 ppm and ≤ 2330 ppm; and

b. pH is ≥ 9.0 and ≤ 9.5.

INSERT B

SR 3.6.12.2	-----------------------------------NOTE------------------------------ The chemical analysis may be performed on either the liquid solution or on the resulting ice. -- Verify, by chemical analysis, that ice added to the ice condenser meets the boron concentration and pH requirements of SR 3.6.12.7.	Each ice Addition

Enclosure 3

McGuire Nuclear Station
Units 1 & 2
Proposed Amended FOL NPF-9, NPF-17
Technical Specification 3.6.12

Approval of this proposed change will affect the following Appendix "A" Technical Specification pages as described.

Remove	Insert
3.6.12-2	3.6.12-2
3.6.12-3	3.6.12-3

The following pages were provided for information only.

For Information Only

3.6.12-1

3.6 CONTAINMENT SYSTEMS

3.6.12 Ice Bed

LCO 3.6.12 The ice bed shall be OPERABLE.

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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Ice bed inoperable.	A.1 Restore ice bed to OPERABLE status.	48 hours
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3. AND B.2 Be in MODE 5.	6 hours 36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.6.12.1 Verify maximum ice bed temperature is ≤ 27°F.	12 hours

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.12.2	Verify total weight of stored ice is ≥ 2,099,790 lb by: a. Weighing a representative sample of ≥ 144 ice baskets and verifying each basket contains ≥ 1081 lb of ice; and b. Calculating total weight of stored ice, at a 95% confidence level, using all ice basket weights determined in SR 3.6.12.2.a.	9 months
SR 3.6.12.3	Verify azimuthal distribution of ice at a 95% confidence level by subdividing weights, as determined by SR 3.6.12.2.a, into the following groups: a. Group 1 — bays 1 through 8; b. Group 2 — bays 9 through 16; and c. Group 3 — bays 17 through 24. The average ice weight of the sample baskets in each group from radial rows 1, 2, 4, 6, 8, and 9 shall be ≥ 1081 lb.	9 months
SR 3.6.12.4	------------------------------NOTE------------------------------ The chemical analysis may be performed on either the liquid solution or on the resulting ice. -- Verify, by chemical analysis, that ice added to the ice condenser meets the boron concentration and pH requirements of SR 3.6.12.7.	Each ice addition

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.12.5	Verify, by visual inspection, accumulation of ice on structural members comprising flow channels through the ice bed is ≤ 15 percent blockage of the total flow area for each safety analysis section.	18 months
SR 3.6.12.6	Visually inspect, for detrimental structural wear, cracks, corrosion, or other damage, two ice baskets from each azimuthal group of bays. See SR 3.6.12.3.	40 months
SR 3.6.12.7	------------------------------ NOTE ------------------------------ The requirements of this SR are satisfied if the boron concentration and pH values obtained from averaging the individual sample results are within the limits specified below. -- Verify, by chemical analysis of the stored ice in at least one randomly selected ice basket from each ice condenser bay, that ice bed: a. Boron concentration is ≥ 1800 ppm and ≤ 2330 ppm; and b. pH is ≥ 9.0 and ≤ 9.5.	54 months

Enclosure 4

McGuire Nuclear Station
Units 1 & 2
Proposed Amended FOL NPF-9, NPF-17
Marked Changes
Technical Specification 3.6.12

Approval of this proposed change will affect the following Appendix "A" Technical Specification pages as described.

Remove	Insert
3.6.12-2	3.6.12-2
3.6.12-3	3.6.12-3

The following pages were provided for information only.

For Information Only
3.6.12-1

3.6 CONTAINMENT SYSTEMS

3.6.12 Ice Bed

LCO 3.6.12 The ice bed shall be OPERABLE.

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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Ice bed inoperable.	A.1 Restore ice bed to OPERABLE status.	48 hours
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3. AND B.2 Be in MODE 5.	6 hours 36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.6.12.1 Verify maximum ice bed temperature is $\leq 27°F$.	12 hours

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.12.2	Verify total weight of stored ice is ≥ 2,099,790 lb by: a. Weighing a representative sample of ≥ 144 ice baskets and verifying each basket contains ≥ 1081 lb of ice; and b. Calculating total weight of stored ice, at a 95% confidence level, using all ice basket weights determined in SR 3.6.12.2.a.	9 months
SR 3.6.12.3	Verify azimuthal distribution of ice at a 95% confidence level by subdividing weights, as determined by SR 3.6.12.2.a, into the following groups: a. Group 1 — bays 1 through 8; b. Group 2 — bays 9 through 16; and c. Group 3 — bays 17 through 24. The average ice weight of the sample baskets in each group from radial rows 1, 2, 4, 6, 8, and 9 shall be ≥ 1081 lb.	9 months

(continued)

SEE INSERT B FOR
NEW SR 3.6.12.4

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
~~SR 3.6.12.4~~	---NOTE--- ~~This SR is not applicable to the lower inlet plenum support structures and turning vanes until after a unit outage of sufficient duration to perform the SR subsequent to August 12, 1998.~~ ------ ~~Verify, by visual inspection, accumulation of ice or frost on structural members comprising flow channels through the ice condenser is ≤ 0.38 inch thick.~~	18 months ~~9 months for structural members other than the lower inlet plenum support structures and turning vanes~~ ~~AND~~ ~~18 months for the lower inlet plenum support structures and turning vanes~~
SR 3.6.12.5	Verify, by visual inspection, accumulation of ice on structural members comprising flow channels through the ice bed is ≤ 15 percent blockage of the total flow area for each safety analysis section.	
~~SR 3.6.12.5~~ SEE INSERT A	~~Verify by chemical analyses of at least nine representative samples of stored ice:~~ ~~a. Boron concentration is ≥ 1800 ppm; and~~ ~~b. pH is ≥ 9.0 and ≤ 9.5.~~	~~18~~ 54 months
SR 3.6.12.6	Visually inspect, for detrimental structural wear, cracks, corrosion, or other damage, two ice baskets from each azimuthal group of bays. See SR 3.6.12.3.	40 months

INSERT A

--- NOTE ---

The requirements of this SR are satisfied if the boron concentration and pH values obtained from averaging the individual sample results are within the limits specified below.

SR 3.6.12.7 Verify, by chemical analysis of the stored ice in at least one randomly selected ice basket from each ice condenser bay, that ice bed:

a. Boron concentration is ≥ 1800 ppm and ≤ 2330 ppm; and

b. pH is ≥ 9.0 and ≤ 9.5.

INSERT B

SR 3.6.12.4	------------------------------------NOTE------------------------------ The chemical analysis may be performed on either the liquid solution or on the resulting ice. -- Verify, by chemical analysis, that ice added to the ice condenser meets the boron concentration and pH requirements of SR 3.6.12.7.	Each ice addition

Enclosure 5

Catawba Nuclear Station
Units 1 & 2
Revised Technical Specification 3.6.12 BASES
Associated with Proposed Amendment
(For Information Only)

pages: B 3.6.12-1
B 3.6.12-2
B 3.6.12-3
B 3.6.12-4
B 3.6.12-5
B 3.6.12-6
B 3.6.12-7
B 3.6.12-8
B 3.6.12-9
B 3.6.12-10

B 3.6 CONTAINMENT SYSTEMS

B 3.6.12 Ice Bed

BASES

BACKGROUND

The ice bed consists of over 2,330,856 lb of ice stored in 1944 baskets within the ice condenser. Its primary purpose is to provide a large heat sink in the event of a release of energy from a Design Basis Accident (DBA) in containment. The ice would absorb energy and limit containment peak pressure and temperature during the accident transient. Limiting the pressure and temperature reduces the release of fission product radioactivity from containment to the environment in the event of a DBA.

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 portion has a series of hinged doors exposed to the atmosphere of the lower containment compartment, which, for normal unit operation, are designed to remain closed. At the top of the ice condenser is another set of doors exposed to the atmosphere of the upper compartment, which also remain closed during normal unit operation. Intermediate deck doors, located below the top deck doors, form the floor of a plenum at the upper part of the ice condenser. These doors also remain closed during normal unit operation. The upper plenum area is used to facilitate surveillance and maintenance of the ice bed.

The ice baskets contain the ice within the ice condenser. The ice bed is considered to consist of the total volume from the bottom elevation of the ice baskets to the top elevation of the ice baskets. The ice baskets position the ice within the ice bed in an arrangement 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 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 condenser limits the

BACKGROUND (continued)

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, is adequate to absorb the initial blowdown of steam and water from a DBA and the additional heat loads that would enter containment during 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.

As ice melts, the water passes through the ice condenser floor drains into the lower compartment. Thus, a second function of the ice bed is to be a large source of borated water (via the containment sump) for long term Emergency Core Cooling System (ECCS) and Containment Spray System heat removal functions in the recirculation mode.

A third function of the ice bed and melted ice is to remove fission product iodine that may be released from the core during a DBA. Iodine removal occurs during the ice melt phase of the accident and continues as the melted ice is sprayed into the containment atmosphere by the Containment Spray System. The ice is adjusted to an alkaline pH that facilitates removal of radioactive iodine from the containment atmosphere. The alkaline pH also minimizes the occurrence of the chloride and caustic stress corrosion on mechanical systems and components exposed to ECCS and Containment Spray System fluids in the recirculation mode of operation.

It is important for the ice to be uniformly distributed around the 24 ice condenser bays and for open flow paths to exist around ice baskets. This is especially important during the initial blowdown so that the steam and water mixture entering the lower compartment do not pass through only part of the ice condenser, depleting the ice there while bypassing the ice in other bays.

BASES

BACKGROUND (continued)

Two phenomena that can degrade the ice bed during the long service period are:

a. Loss of ice by melting or sublimation; and

b. Obstruction of flow passages through the ice bed due to buildup of ice.

Both of these degrading phenomena are reduced by minimizing air leakage into and out of the ice condenser.

The ice bed limits the temperature and pressure that could be expected following a DBA, thus limiting leakage of fission product radioactivity from containment to the environment.

APPLICABLE SAFETY ANALYSES

The limiting DBAs considered relative to containment temperature and pressure 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 not assumed 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, RHR Spray System, and the ARS also function to assist the ice bed in limiting pressures and temperatures. Therefore, the postulated DBAs are analyzed in regards to containment 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, RHR Spray System, and ARS being 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 the 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

BASES

APPLICABLE SAFETY ANALYSES (continued)

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."

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

The ice bed satisfies Criterion 3 of 10 CFR 50.36 (Ref. 3).

LCO

The ice bed LCO requires the existence of the required quantity of stored ice, appropriate distribution of the ice and the ice bed, open flow paths through the ice bed, and appropriate chemical content and pH of the stored ice. The stored ice functions to absorb heat during a DBA, thereby limiting containment air temperature and pressure. The chemical content and pH of the ice provide core SDM (boron content) and remove radioactive iodine from the containment atmosphere when the melted ice is recirculated through the ECCS and the Containment Spray System, respectively. The limits on boron concentration and pH of the ice are associated with containment sump pH ranging between 7.5 and 9.3 inclusive following the design basis LOCA.

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 bed. Therefore, the LCO is applicable in MODES 1, 2, 3, and 4.

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

BASES

ACTIONS

A.1

If the ice bed is inoperable, it must be restored to OPERABLE status within 48 hours. The Completion Time was developed based on operating experience, which confirms that due to the very large mass of stored ice, the parameters comprising OPERABILITY do not change appreciably in this time period. Because of this fact, the Surveillance Frequencies are long (months), except for the ice bed temperature, which is checked every 12 hours. If a degraded condition is identified, even for temperature, with such a large mass of ice it is not possible for the degraded condition to significantly degrade further in a 48 hour period. Therefore, 48 hours is a reasonable amount of time to correct a degraded condition before initiating a shutdown.

B.1 and B.2

If the ice bed 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 3.6.12.1

Verifying that the maximum temperature of the ice bed is ≤ 27°F ensures that the ice is kept well below the melting point. The 12 hour Frequency was based on operating experience, which confirmed that, due to the large mass of stored ice, it is not possible for the ice bed temperature to degrade significantly within a 12 hour period and was also based on assessing the proximity of the LCO limit to the melting temperature.

Furthermore, the 12 hour Frequency is considered adequate in view of indications in the control room, including the alarm, to alert the operator to an abnormal ice bed temperature condition. This SR may be satisfied by use of the Ice Bed Temperature Monitoring System.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.6.12.2

This SR ensures that initial ice fill and any subsequent ice additions meet the boron concentration and pH requirements of SR 3.6.12.7. The SR is modified by a NOTE that allows the chemical analysis to be performed on either the liquid or resulting ice of each sodium tetraborate solution prepared. If ice is obtained from offsite sources, then chemical analysis data must be obtained for the ice supplied.

SR 3.6.12.3

This SR ensures that the air/steam flow channels through the ice bed have not accumulated ice blockage that exceeds 15 percent of the total flow area through the ice bed region. The allowable 15 percent buildup of ice is based on the analysis of the sub-compartment response to a design basis LOCA with partial blockage of the ice condenser flow channels. The analysis did not perform detailed flow area modeling, but rather lumped the ice condenser bays into six sections ranging from 2.75 bays to 6.5 bays. Individual bays are acceptable with greater than 15 percent blockage, as long as 15 percent blockage is not exceeded for any analysis section.

To provide a 95 percent confidence that flow blockage does not exceed the allowed 15 percent, the visual inspection must be made for at least 54 (33 percent) of the 162 flow channels per ice condenser bay. The visual inspection of the ice bed flow channels is to inspect the flow area, by looking down from the top of the ice bed, and where view is achievable up from the bottom of the ice bed. Flow channels to be inspected are determined by random sample. As the most restrictive ice bed flow passage is found at a lattice frame elevation, the 15 percent blockage criteria only applies to "flow channels" that comprise the area:

a. between ice baskets, and
b. past lattice frames and wall panels.

Due to a significantly larger flow area in the regions of the upper deck grating and the lower inlet plenum support structures and turning vanes, it would require a gross buildup of ice on these structures to obtain a degradation in air/steam flow. Therefore, these structures are excluded as part of a flow channel for application of the 15 percent blockage criteria. Plant and industry experience have shown that removal of ice from the excluded structures during the refueling outage is sufficient to ensure they remain operable throughout the operating cycle. Thus, removal of any gross ice buildup on the excluded structures is performed following outage maintenance activities.

BASES

SURVEILLANCE REQUIREMENTS (continued)

Operating experience has demonstrated that the ice bed is the region that is the most flow restrictive, due to the normal presence of ice accumulation on lattice frames and wall panels. The flow area through the ice basket support platform is not a more restrictive flow area because it is easily accessible from the lower plenum and is maintained clear of ice accumulation. There is not a mechanistically credible method for ice to accumulate on the ice basket support platform during plant operation.

Plant and industry experience has shown that the vertical flow area through the ice basket support platform remains clear of ice accumulation that could produce blockage. Normally only a glaze may develop or exist on the ice basket support platform which is not significant to blockage of flow area. Additionally, outage maintenance practices provide measures to clear the ice basket support platform following maintenance activities of any accumulation of ice that could block flow areas.

Activities that have a potential for significant degradation of flow channels should be limited to outage periods. Performance of this SR following completion of these activities assures the ice bed is in an acceptable condition for the duration of the operating cycle.

Frost buildup or loose ice is not to be considered as flow channel blockage, whereas attached ice is considered blockage of a flow channel. Frost is the solid form of water that is loosely adherent, and can be brushed off with the open hand.

SR 3.6.12.4

The weighing program is designed to obtain a representative sample of the ice baskets. The representative sample shall include 6 baskets from each of the 24 ice condenser bays and shall consist of one basket from radial rows 1, 2, 4, 6, 8, and 9. If no basket from a designated row can be obtained for weighing, a basket from the same row of an adjacent bay shall be weighed.

The rows chosen include the rows nearest the inside and outside walls of the ice condenser (rows 1 and 2, and 8 and 9, respectively), where heat transfer into the ice condenser is most likely to influence melting or sublimation. Verifying the total weight of ice ensures that there is adequate ice to absorb the required amount of energy to mitigate the DBAs.

BASES

SURVEILLANCE REQUIREMENTS (continued)

If a basket is found to contain < 1199 lb of ice, a representative sample of 20 additional baskets from the same bay shall be weighed. The average weight of ice in these 21 baskets (the discrepant basket and the 20 additional baskets) shall be ≥ 1199 lb at a 95% confidence level.

Weighing 20 additional baskets from the same bay in the event a Surveillance reveals that a single basket contains < 1199 lb ensures that no local zone exists that is grossly deficient in ice. Such a zone could experience early melt out during a DBA transient, creating a path for steam to pass through the ice bed without being condensed. The Frequency of 18 months was based on ice storage tests and the allowance built into the required ice mass over and above the mass assumed in the safety analyses. Operating experience has verified that, with the 18 month Frequency, the weight requirements are maintained with no significant degradation between surveillances.

SR 3.6.12.5

This SR ensures that the azimuthal distribution of ice is reasonably uniform, by verifying that the average ice weight in each of three azimuthal groups of ice condenser bays is within the limit. The Frequency of 18 months was based on ice storage tests and the allowance built into the required ice mass over and above the mass assumed in the safety analyses. Operating experience has verified that, with the 18 month Frequency, the weight requirements are maintained with no significant degradation between surveillances.

SR 3.6.12.6

This SR ensures that a representative sampling of accessible portions of ice baskets, which are relatively thin walled, perforated cylinders, have not been degraded by wear, cracks, corrosion, or other damage. Each ice basket must be raised at least 12 feet for this inspection. The Frequency of 40 months for a visual inspection of the structural soundness of the ice baskets is based on engineering judgment and considers such factors as the thickness of the basket walls relative to corrosion rates expected in their service environment and the results of the long term ice storage testing.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.6.12.7

Verifying the chemical composition of the stored ice ensures that the stored ice has a boron concentration ≥ 1800 ppm and ≤ 2330 ppm as sodium tetraborate and a high pH, ≥ 9.0 and ≤ 9.5 at 25°C, in order to meet the requirement for borated water when the melted ice is used in the ECCS recirculation mode of operation. Additionally, the minimum boron concentration setpoint is used to assure reactor subcriticality in a post LOCA environment, while the maximum boron concentration is used as the bounding value in the hot leg switchover timing calculation (Ref. 4). This is accomplished by obtaining at least 24 ice samples. Each sample is taken approximately one foot from the top of the ice of each randomly selected ice basket in each ice condenser bay. The SR is modified by a NOTE that allows the boron concentration and pH value obtained from averaging the individual samples' analysis results to satisfy the requirements of the SR. If either the average boron concentration or average pH value is outside their prescribed limit, then entry into ACTION Condition A is required. Sodium tetraborate has been proven effective in maintaining the boron content for long storage periods, and it also enhances the ability of the solution to remove and retain fission product iodine. The high pH is required to enhance the effectiveness of the ice and the melted ice in removing iodine from the containment atmosphere. This pH range also minimizes the occurrence of chloride and caustic stress corrosion on mechanical systems and components exposed to ECCS and Containment Spray System fluids in the recirculation mode of operation. The Frequency of 54 months is intended to be consistent with the expected length of three fuel cycles, and was developed considering these facts:

a. Long term ice storage tests have determined that the chemical composition of the stored ice is extremely stable;

b. There are no normal operating mechanisms that significantly change the boron concentration of the stored ice, and pH remains within a 9.0 – 9.5 range when boron concentrations are above approximately 1200 ppm; and

c. Operating experience has demonstrated that meeting the boron concentration and pH requirements has not been a problem.

BASES

REFERENCES

1. UFSAR, Section 6.2.
2. 10 CFR 50, Appendix K.
3. 10 CFR 50.36, Technical Specifications, (c)(2)(ii).
4. UFSAR, Section 6.3.3.

Enclosure 6

Catawba Nuclear Station
Units 1 & 2
Marked Changes
Technical Specification 3.6.12 BASES
(For Information Only)

pages:	B 3.6.12-1
	B 3.6.12-2
	B 3.6.12-3
	B 3.6.12-4
	B 3.6.12-5
	B 3.6.12-6
	B 3.6.12-7
	B 3.6.12-8
	B 3.6.12-9

B 3.6 CONTAINMENT SYSTEMS

B 3.6.12 Ice Bed

BASES

BACKGROUND

The ice bed consists of over 2,330,856 lb of ice stored in 1944 baskets within the ice condenser. Its primary purpose is to provide a large heat sink in the event of a release of energy from a Design Basis Accident (DBA) in containment. The ice would absorb energy and limit containment peak pressure and temperature during the accident transient. Limiting the pressure and temperature reduces the release of fission product radioactivity from containment to the environment in the event of a DBA.

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 portion has a series of hinged doors exposed to the atmosphere of the lower containment compartment, which, for normal unit operation, are designed to remain closed. At the top of the ice condenser is another set of doors exposed to the atmosphere of the upper compartment, which also remain closed during normal unit operation. Intermediate deck doors, located below the top deck doors, form the floor of a plenum at the upper part of the ice condenser. These doors also remain closed during normal unit operation. The 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 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 condenser limits the

BASES

BACKGROUND (continued)

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, is adequate to absorb the initial blowdown of steam and water from a DBA and the additional heat loads that would enter containment during 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.

As ice melts, the water passes through the ice condenser floor drains into the lower compartment. Thus, a second function of the ice bed is to be a large source of borated water (via the containment sump) for long term Emergency Core Cooling System (ECCS) and Containment Spray System heat removal functions in the recirculation mode.

A third function of the ice bed and melted ice is to remove fission product iodine that may be released from the core during a DBA. Iodine removal occurs during the ice melt phase of the accident and continues as the melted ice is sprayed into the containment atmosphere by the Containment Spray System. The ice is adjusted to an alkaline pH that facilitates removal of radioactive iodine from the containment atmosphere. The alkaline pH also minimizes the occurrence of the chloride and caustic stress corrosion on mechanical systems and components exposed to ECCS and Containment Spray System fluids in the recirculation mode of operation.

It is important for the ice to be uniformly distributed around the 24 ice condenser bays and for open flow paths to exist around ice baskets. This is especially important during the initial blowdown so that the steam and water mixture entering the lower compartment do not pass through only part of the ice condenser, depleting the ice there while bypassing the ice in other bays.

BASES

BACKGROUND (continued)

Two phenomena that can degrade the ice bed during the long service period are:

a. Loss of ice by melting or sublimation; and

b. Obstruction of flow passages through the ice bed due to buildup of ~~frost or ice~~. Both of these degrading phenomena are reduced by minimizing air leakage into and out of the ice condenser.

Start new paragraph

The ice bed limits the temperature and pressure that could be expected following a DBA, thus limiting leakage of fission product radioactivity from containment to the environment.

APPLICABLE SAFETY ANALYSES

The limiting DBAs considered relative to containment temperature and pressure 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 not assumed 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, RHR Spray System, and the ARS also function to assist the ice bed in limiting pressures and temperatures. Therefore, the postulated DBAs are analyzed in regards to containment 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, RHR Spray System, and ARS being 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 the 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

BASES

APPLICABLE SAFETY ANALYSES (continued)

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."

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

The ice bed satisfies Criterion 3 of 10 CFR 50.36 (Ref. 3).

LCO

The ice bed LCO requires the existence of the required quantity of stored ice, appropriate distribution of the ice and the ice bed, open flow paths through the ice bed, and appropriate chemical content and pH of the stored ice. The stored ice functions to absorb heat during a DBA, thereby limiting containment air temperature and pressure. The chemical content and pH of the ice provide core SDM (boron content) and remove radioactive iodine from the containment atmosphere when the melted ice is recirculated through the ECCS and the Containment Spray System, respectively. The limits on boron concentration and pH of the ice are associated with containment sump pH ranging between 7.5 and 9.3 inclusive following the design basis LOCA.

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 bed. Therefore, the LCO is applicable in MODES 1, 2, 3, and 4.

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

BASES

ACTIONS

A.1

If the ice bed is inoperable, it must be restored to OPERABLE status within 48 hours. The Completion Time was developed based on operating experience, which confirms that due to the very large mass of stored ice, the parameters comprising OPERABILITY do not change appreciably in this time period. Because of this fact, the Surveillance Frequencies are long (months), except for the ice bed temperature, which is checked every 12 hours. If a degraded condition is identified, even for temperature, with such a large mass of ice it is not possible for the degraded condition to significantly degrade further in a 48 hour period. Therefore, 48 hours is a reasonable amount of time to correct a degraded condition before initiating a shutdown.

B.1 and B.2

If the ice bed 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 3.6.12.1

Verifying that the maximum temperature of the ice bed is ≤ 27°F ensures that the ice is kept well below the melting point. The 12 hour Frequency was based on operating experience, which confirmed that, due to the large mass of stored ice, it is not possible for the ice bed temperature to degrade significantly within a 12 hour period and was also based on assessing the proximity of the LCO limit to the melting temperature.

Furthermore, the 12 hour Frequency is considered adequate in view of indications in the control room, including the alarm, to alert the operator to an abnormal ice bed temperature condition. This SR may be satisfied by use of the Ice Bed Temperature Monitoring System.

INSERT G FOR NEW SR 3.6.12.2

BASES

SURVEILLANCE REQUIREMENTS (continued)

INSERT B

~~SR 3.6.12.2~~

~~This SR ensures that the flow channels through the ice condenser have not accumulated an excessive amount of ice or frost blockage. The visual inspection must be made for two or more flow channels per ice condenser bay and must include the following specific locations along the flow channel:~~

~~a. Past the lower inlet plenum support structures and turning vanes;~~

~~b. Between ice baskets;~~

~~c. Past lattice frames;~~

~~d. Through the intermediate floor grating; and~~

~~e. Through the top deck floor grating.~~

~~The allowable 0.38 inch thick buildup of frost or ice is based on the analysis of containment response to a DBA with partial blockage of the ice condenser flow passages. If a flow channel in a given bay is found to have an accumulation of frost or ice > 0.38 inch thick, a representative sample of 20 additional flow channels from the same bay must be visually inspected.~~

~~If these additional flow channels are all found to be acceptable, the discrepant flow channel may be considered single, unique, and acceptable deficiency. More than one discrepant flow channel in a bay is evidence of abnormal degradation of the ice condenser. These requirements are based on the sensitivity of the partial blockage analysis to additional blockage. The Frequency of 9 months for structural members other than the lower inlet plenum support structures and turning vanes was based on ice storage tests and the allowance built into the required ice mass over and above the mass assumed in the safety analyses. The 18 month Frequency for the lower inlet plenum support structures and turning vanes is based on the need to perform this Surveillance during the conditions that exist during a plant outage. These areas are access restricted due to ALARA considerations during plant operation.~~

BASES

SURVEILLANCE REQUIREMENTS (continued)

~~SR 3.6.12.3~~ SR 3.6.12.7

INSERT C

INSERT D

Verifying the chemical composition of the stored ice ensures that the stored ice has a boron concentration ~~of at least 1800 ppm~~ as sodium tetraborate and a high pH, ≥ 9.0 and ≤ 9.5 at 25°C, in order to meet the requirement for borated water when the melted ice is used in the ECCS recirculation mode of operation. Sodium tetraborate has been proven effective in maintaining the boron content for long storage periods, and it also enhances the ability of the solution to remove and retain fission product iodine. The high pH is required to enhance the effectiveness of the ice and the melted ice in removing iodine from the containment atmosphere. This pH range also minimizes the occurrence of chloride and caustic stress corrosion on mechanical systems and components exposed to ECCS and Containment Spray System fluids in the recirculation mode of operation. The Frequency of ~~18 months~~ was developed considering these facts:

INSERT E

INSERT F

a. Long term ice storage tests have determined that the chemical composition of the stored ice is extremely stable;

~~b.~~ c. Operating experience has demonstrated that meeting the boron concentration and pH requirements has ~~never~~ not been a problem~~; and~~

~~c. Someone would have to enter the containment to take the sample, and, if the unit is at power, that person would receive a radiation dose.~~

SR 3.6.12.4

The weighing program is designed to obtain a representative sample of the ice baskets. The representative sample shall include 6 baskets from each of the 24 ice condenser bays and shall consist of one basket from radial rows 1, 2, 4, 6, 8, and 9. If no basket from a designated row can be obtained for weighing, a basket from the same row of an adjacent bay shall be weighed.

The rows chosen include the rows nearest the inside and outside walls of the ice condenser (rows 1 and 2, and 8 and 9, respectively), where heat transfer into the ice condenser is most likely to influence melting or sublimation. Verifying the total weight of ice ensures that there is adequate ice to absorb the required amount of energy to mitigate the DBAs.

BASES

SURVEILLANCE REQUIREMENTS (continued)

If a basket is found to contain < 1199 lb of ice, a representative sample of 20 additional baskets from the same bay shall be weighed. The average weight of ice in these 21 baskets (the discrepant basket and the 20 additional baskets) shall be ≥ 1199 lb at a 95% confidence level.

Weighing 20 additional baskets from the same bay in the event a Surveillance reveals that a single basket contains < 1199 lb ensures that no local zone exists that is grossly deficient in ice. Such a zone could experience early melt out during a DBA transient, creating a path for steam to pass through the ice bed without being condensed. The Frequency of 18 months was based on ice storage tests and the allowance built into the required ice mass over and above the mass assumed in the safety analyses. Operating experience has verified that, with the 18 month Frequency, the weight requirements are maintained with no significant degradation between surveillances.

SR 3.6.12.5

This SR ensures that the azimuthal distribution of ice is reasonably uniform, by verifying that the average ice weight in each of three azimuthal groups of ice condenser bays is within the limit. The Frequency of 18 months was based on ice storage tests and the allowance built into the required ice mass over and above the mass assumed in the safety analyses. Operating experience has verified that, with the 18 month Frequency, the weight requirements are maintained with no significant degradation between surveillances.

SR 3.6.12.6

This SR ensures that a representative sampling of accessible portions of ice baskets, which are relatively thin walled, perforated cylinders, have not been degraded by wear, cracks, corrosion, or other damage. Each ice basket must be raised at least 12 feet for this inspection. The Frequency of 40 months for a visual inspection of the structural soundness of the ice baskets is based on engineering judgment and considers such factors as the thickness of the basket walls relative to corrosion rates expected in their service environment and the results of the long term ice storage testing.

BASES

REFERENCES

1. UFSAR, Section 6.2.
2. 10 CFR 50, Appendix K.
5. 10 CFR 50.36, Technical Specifications, (c)(2)(ii).
6. UFSAR, Section 6.3.3.

Insert A

The ice baskets contain the ice within the ice condenser. The ice bed is considered to consist of the total volume from the bottom elevation of the ice baskets to the top elevation of the ice baskets. The ice baskets position the ice within the ice bed in an arrangement to promote heat transfer from steam to ice.

Insert B

SR 3.6.12.3

This SR ensures that the air/steam flow channels through the ice bed have not accumulated ice blockage that exceeds 15 percent of the total flow area through the ice bed region. The allowable 15 percent buildup of ice is based on the analysis of the sub-compartment response to a design basis LOCA with partial blockage of the ice condenser flow channels. The analysis did not perform detailed flow area modeling, but rather lumped the ice condenser bays into six sections ranging from 2.75 bays to 6.5 bays. Individual bays are acceptable with greater than 15 percent blockage, as long as 15 percent blockage is not exceeded for any analysis section.

To provide a 95 percent confidence that flow blockage does not exceed the allowed 15 percent, the visual inspection must be made for at least 54 (33 percent) of the 162 flow channels per ice condenser bay. The visual inspection of the ice bed flow channels is to inspect the flow area, by looking down from the top of the ice bed, and where view is achievable up from the bottom of the ice bed. Flow channels to be inspected are determined by random sample. As the most restrictive ice bed flow passage is found at a lattice frame elevation, the 15 percent blockage criteria only applies to "flow channels" that comprise the area:

a. between ice baskets, and
b. past lattice frames and wall panels.

Due to a significantly larger flow area in the regions of the upper deck grating and the lower inlet plenum support structures and turning vanes, it would require a gross buildup of ice on these structures to obtain a degradation in air/steam flow. Therefore, these structures are excluded as part of a flow channel for application of the 15 percent blockage criteria. Plant and industry experience have shown that removal of ice from the excluded structures during the refueling outage is sufficient to ensure they remain operable throughout the operating cycle. Thus, removal of any gross ice buildup on the excluded structures is performed following outage maintenance activities.

Operating experience has demonstrated that the ice bed is the region that is the most flow restrictive, due to the normal presence of ice accumulation on lattice frames and wall panels. The flow area through the ice basket support platform is not a more restrictive flow area because it is easily accessible from the lower plenum and is maintained clear of ice accumulation. There is not a mechanistically credible method for ice to accumulate on the ice basket support platform during plant operation. Plant and industry experience has shown that the vertical flow area through the ice basket support platform remains clear of ice accumulation that could produce blockage. Normally only a glaze may develop or exist on the ice basket support platform which is not significant to blockage of flow area. Additionally, outage maintenance practices provide measures to

clear the ice basket support platform following maintenance activities of any accumulation of ice that could block flow areas.

Activities that have a potential for significant degradation of flow channels should be limited to outage periods. Performance of this SR following completion of these activities assures the ice bed is in an acceptable condition for the duration of the operating cycle.

Frost buildup or loose ice is not to be considered as flow channel blockage, whereas attached ice is considered blockage of a flow channel. Frost is the solid form of water that is loosely adherent, and can be brushed off with the open hand.

Insert C

... $\geq$ 1800 ppm and $\leq$ 2330 ppm ...

Insert D

Additionally, the minimum boron concentration setpoint is used to assure reactor subcriticality in a post LOCA environment, while the maximum boron concentration is used as the bounding value in the hot leg switchover timing calculation (Ref. 4). This is accomplished by obtaining at least 24 ice samples. Each sample is taken approximately one foot from the top of the ice of each randomly selected ice basket in each ice condenser bay. The SR is modified by a NOTE that allows the boron concentration and pH value obtained from averaging the individual samples' analysis results to satisfy the requirements of the SR. If either the average boron concentration or average pH value is outside their prescribed limit, then entry into ACTION Condition A is required.

Insert E

... 54 months is intended to be consistent with the expected length of three fuel cycles, and ...

Insert F

b. There are no normal operating mechanisms that significantly change the boron concentration of the stored ice, and pH remains within a 9.0 – 9.5 range when boron concentrations are above approximately 1200 ppm: and

Insert G

<u>SR 3.6.12.2</u>

This SR ensures that initial ice fill and any subsequent ice additions meet the boron concentration and pH requirements of SR 3.6.12.7. The SR is modified by a NOTE that allows the chemical analysis to be performed on either the liquid or resulting ice of each sodium tetraborate solution prepared. If ice is obtained from offsite sources, then chemical analysis data must be obtained for the ice supplied.

Enclosure 7

McGuire Nuclear Station
Units 1 & 2
Revised Technical Specification 3.6.12 BASES
Associated with Proposed Amendment
(For Information Only)

B 3.6 CONTAINMENT SYSTEMS

B 3.6.12 Ice Bed

BASES

BACKGROUND

The ice bed consists of over 2,099,790 lb of ice stored in 1944 baskets within the ice condenser. Its primary purpose is to provide a large heat sink in the event of a release of energy from a Design Basis Accident (DBA) in containment. The ice would absorb energy and limit containment peak pressure and temperature during the accident transient. Limiting the pressure and temperature reduces the release of fission product radioactivity from containment to the environment in the event of a DBA.

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 portion has a series of hinged doors exposed to the atmosphere of the lower containment compartment, which, for normal unit operation, are designed to remain closed. At the top of the ice condenser is another set of doors exposed to the atmosphere of the upper compartment, which also remain closed during normal unit operation. Intermediate deck doors, located below the top deck doors, form the floor of a plenum at the upper part of the ice condenser. These doors also remain closed during normal unit operation. The upper plenum area is used to facilitate surveillance and maintenance of the ice bed.

The ice baskets contain the ice within the ice condenser. The ice bed is considered to consist of the total volume from the bottom elevation of the ice baskets to the top elevation of the ice baskets. The ice baskets position the ice within the ice bed in an arrangement 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 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 condenser 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.

BACKGROUND (continued)

The ice, together with the containment spray, is adequate to absorb the initial blowdown of steam and water from a DBA and the additional heat loads that would enter containment during 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.

As ice melts, the water passes through the ice condenser floor drains into the lower compartment. Thus, a second function of the ice bed is to be a large source of borated water (via the containment sump) for long term Emergency Core Cooling System (ECCS) and Containment Spray System heat removal functions in the recirculation mode.

A third function of the ice bed and melted ice is to remove fission product iodine that may be released from the core during a DBA. Iodine removal occurs during the ice melt phase of the accident and continues as the melted ice is sprayed into the containment atmosphere by the Containment Spray System. The ice is adjusted to an alkaline pH that facilitates removal of radioactive iodine from the containment atmosphere. The alkaline pH also minimizes the occurrence of the chloride and caustic stress corrosion on mechanical systems and components exposed to ECCS and Containment Spray System fluids in the recirculation mode of operation.

It is important for the ice to be uniformly distributed around the 24 ice condenser bays and for open flow paths to exist around ice baskets. This is especially important during the initial blowdown so that the steam and water mixture entering the lower compartment do not pass through only part of the ice condenser, depleting the ice there while bypassing the ice in other bays.

Two phenomena that can degrade the ice bed during the long service period are:

a. Loss of ice by melting or sublimation; and

b. Obstruction of flow passages through the ice bed due to buildup of ice.

Both of these degrading phenomena are reduced by minimizing air leakage into and out of the ice condenser.

BACKGROUND (continued)

The ice bed limits the temperature and pressure that could be expected following a DBA, thus limiting leakage of fission product radioactivity from containment to the environment.

APPLICABLE SAFETY ANALYSES

The limiting DBAs considered relative to containment temperature and pressure 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 not assumed 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, RHR Spray System, and the ARS also function to assist the ice bed in limiting pressures and temperatures. Therefore, the postulated DBAs are analyzed in regards to containment 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, RHR Spray System, and ARS being 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 the 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."

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

The ice bed satisfies Criterion 3 of 10 CFR 50.36 (Ref. 3).

BASES

LCO

The ice bed LCO requires the existence of the required quantity of stored ice, appropriate distribution of the ice and the ice bed, open flow paths through the ice bed, and appropriate chemical content and pH of the stored ice. The stored ice functions to absorb heat during a DBA, thereby limiting containment air temperature and pressure. The chemical content and pH of the ice provide core SDM (boron content) and remove radioactive iodine from the containment atmosphere when the melted ice is recirculated through the ECCS and the Containment Spray System, respectively.

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 bed. Therefore, the LCO is applicable in MODES 1, 2, 3, and 4.

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

ACTIONS

A.1

If the ice bed is inoperable, it must be restored to OPERABLE status within 48 hours. The Completion Time was developed based on operating experience, which confirms that due to the very large mass of stored ice, the parameters comprising OPERABILITY do not change appreciably in this time period. Because of this fact, the Surveillance Frequencies are long (months), except for the ice bed temperature, which is checked every 12 hours. If a degraded condition is identified, even for temperature, with such a large mass of ice it is not possible for the degraded condition to significantly degrade further in a 48 hour period. Therefore, 48 hours is a reasonable amount of time to correct a degraded condition before initiating a shutdown.

B.1 and B.2

If the ice bed 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 3.6.12.1

Verifying that the maximum temperature of the ice bed is ≤ 27°F ensures that the ice is kept well below the melting point. The 12 hour Frequency was based on operating experience, which confirmed that, due to the large mass of stored ice, it is not possible for the ice bed temperature to degrade significantly within a 12 hour period and was also based on assessing the proximity of the LCO limit to the melting temperature.

Furthermore, the 12 hour Frequency is considered adequate in view of indications in the control room, including the alarm, to alert the operator to an abnormal ice bed temperature condition. This SR may be satisfied by use of the Ice Bed Temperature Monitoring System.

SR 3.6.12.2

The weighing program is designed to obtain a representative sample of the ice baskets. The representative sample shall include 6 baskets from each of the 24 ice condenser bays and shall consist of one basket from radial rows 1, 2, 4, 6, 8, and 9. If no basket from a designated row can be obtained for weighing, a basket from the same row of an adjacent bay shall be weighed.

The rows chosen include the rows nearest the inside and outside walls of the ice condenser (rows 1 and 2, and 8 and 9, respectively), where heat transfer into the ice condenser is most likely to influence melting or sublimation. Verifying the total weight of ice ensures that there is adequate ice to absorb the required amount of energy to mitigate the DBAs.

If a basket is found to contain < 1081 lb of ice, a representative sample of 20 additional baskets from the same bay shall be weighed. The average weight of ice in these 21 baskets (the discrepant basket and the 20 additional baskets) shall be ≥ 1081 lb at a 95% confidence level.

Weighing 20 additional baskets from the same bay in the event a Surveillance reveals that a single basket contains < 1081 lb ensures that no local zone exists that is grossly deficient in ice. Such a zone could experience early melt out during a DBA transient, creating a path for steam to pass through the ice bed without being condensed. The Frequency of 9 months was based on ice storage tests and the allowance built into the required ice mass over and above the mass assumed in the safety analyses. Operating experience has verified that, with the 9 month Frequency, the weight requirements are maintained with no significant degradation between surveillances.

SURVEILLANCE REQUIREMENTS (continued)

SR 3.6.12.3

This SR ensures that the azimuthal distribution of ice is reasonably uniform, by verifying that the average ice weight in each of three azimuthal groups of ice condenser bays is within the limit. The Frequency of 9 months was based on ice storage tests and the allowance built into the required ice mass over and above the mass assumed in the safety analyses. Operating experience has verified that, with the 9 month Frequency, the weight requirements are maintained with no significant degradation between surveillances.

SR 3.6.12.4

This SR ensures that initial ice fill and any subsequent ice additions meet the boron concentration and pH requirements of SR 3.6.12.7. The SR is modified by a NOTE that allows the chemical analysis to be performed on either the liquid or resulting ice of each sodium tetraborate solution prepared. If ice is obtained from offsite sources, then chemical analysis data must be obtained for the ice supplied.

SR 3.6.12.5

This SR ensures that the air/steam flow channels through the ice bed have not accumulated ice blockage that exceeds 15 percent of the total flow area through the ice bed region. The allowable 15 percent buildup of ice is based on the analysis of the sub-compartment response to a design basis LOCA with partial blockage of the ice condenser flow channels. The analysis did not perform detailed flow area modeling, but rather lumped the ice condenser bays into six sections ranging from 2.75 bays to 6.5 bays. Individual bays are acceptable with greater than 15 percent blockage, as long as 15 percent blockage is not exceeded for any analysis section.

To provide a 95 percent confidence that flow blockage does not exceed the allowed 15 percent, the visual inspection must be made for at least 54 (33 percent) of the 162 flow channels per ice condenser bay. The visual inspection of the ice bed flow channels is to inspect the flow area, by looking down from the top of the ice bed, and where view is achievable up from the bottom of the ice bed. Flow channels to be inspected are determined by random sample. As the most restrictive ice bed flow passage is found at a lattice frame elevation, the 15 percent blockage criteria only applies to "flow channels" that comprise the area:

a. between ice baskets, and
b. past lattice frames and wall panels.

SURVEILLANCE REQUIREMENTS (continued)

Due to a significantly larger flow area in the regions of the upper deck grating and the lower inlet plenum support structures and turning vanes, it would require a gross buildup of ice on these structures to obtain a degradation in air/steam flow. Therefore, these structures are excluded as part of a flow channel for application of the 15 percent blockage criteria. Plant and industry experience have shown that removal of ice from the excluded structures during the refueling outage is sufficient to ensure they remain operable throughout the operating cycle. Thus, removal of any gross ice buildup on the excluded structures is performed following outage maintenance activities.

Operating experience has demonstrated that the ice bed is the region that is the most flow restrictive, due to the normal presence of ice accumulation on lattice frames and wall panels. The flow area through the ice basket support platform is not a more restrictive flow area because it is easily accessible from the lower plenum and is maintained clear of ice accumulation. There is not a mechanistically credible method for ice to accumulate on the ice basket support platform during plant operation. Plant and industry experience has shown that the vertical flow area through the ice basket support platform remains clear of ice accumulation that could produce blockage. Normally only a glaze may develop or exist on the ice basket support platform which is not significant to blockage of flow area. Additionally, outage maintenance practices provide measures to clear the ice basket support platform following maintenance activities of any accumulation of ice that could block flow areas.

Activities that have a potential for significant degradation of flow channels should be limited to outage periods. Performance of this SR following completion of these maintenance activities assures the ice bed is in an acceptable condition for the duration of the operating cycle.

Frost buildup or loose ice is not to be considered as flow channel blockage, whereas attached ice is considered blockage of a flow channel. Frost is the solid form of water that is loosely adherent, and can be brushed off with the open hand.

SR 3.6.12.6

This SR ensures that a representative sampling of accessible portions of ice baskets, which are relatively thin walled, perforated cylinders, have not been degraded by wear, cracks, corrosion, or other damage. Each ice basket must be raised at least 12 feet for this inspection. The Frequency of 40 months for a visual inspection of the structural soundness of the ice baskets is based on engineering judgment and

SURVEILLANCE REQUIREMENTS (continued)

considers such factors as the thickness of the basket walls relative to corrosion rates expected in their service environment and the results of the long term ice storage testing.

SR 3.6.12.7

Verifying the chemical composition of the stored ice ensures that the stored ice has a boron concentration ≥ 1800 ppm and ≤ 2330 ppm as sodium tetraborate and a high pH, ≥ 9.0 and ≤ 9.5 at 20°C, in order to meet the requirement for borated water when the melted ice is used in the ECCS recirculation mode of operation. Additionally, the minimum boron concentration setpoint is used to assure reactor subcriticality in a post LOCA environment, while the maximum boron concentration is used as the bounding value in the hot leg switchover timing calculation (Ref. 4). This is accomplished by obtaining at least 24 ice samples. Each sample is taken approximately one foot from the top of the ice of each randomly selected ice basket in each ice condenser bay. The SR is modified by a NOTE that allows the boron concentration and pH value obtained from averaging the individual samples' analysis results to satisfy the requirements of the SR. If either the average boron concentration or average pH value is outside their prescribed limit, then entry into ACTION Condition A is required. Sodium tetraborate has been proven effective in maintaining the boron content for long storage periods, and it also enhances the ability of the solution to remove and retain fission product iodine. The high pH is required to enhance the effectiveness of the ice and the melted ice in removing iodine from the containment atmosphere. This pH range also minimizes the occurrence of chloride and caustic stress corrosion on mechanical systems and components exposed to ECCS and Containment Spray System fluids in the recirculation mode of operation. The Frequency of 54 months is intended to be consistent with the expected length of three fuel cycles, and was developed considering these facts:

a. Long term ice storage tests have determined that the chemical composition of the stored ice is extremely stable;

b. There are no normal operating mechanisms that significantly change the boron concentration of the stored ice, and pH remains within a 9.0 – 9.5 range when boron concentrations are above approximately 1200 ppm; and

c. Operating experience has demonstrated that meeting the boron concentration and pH requirements has not been a problem.

REFERENCES

1. UFSAR, Section 6.2.
2. 10 CFR 50, Appendix K.
3. 10 CFR 50.36, Technical Specifications, (c)(2)(ii).
4. UFSAR, Section 6.3.3.10.

Enclosure 8

McGuire Nuclear Station
Units 1 & 2
Marked Changes
Technical Specification 3.6.12 BASES
(For Information Only)

B 3.6 CONTAINMENT SYSTEMS

B 3.6.12 Ice Bed

BASES

BACKGROUND

The ice bed consists of over 2,099,790 lb of ice stored in 1944 baskets within the ice condenser. Its primary purpose is to provide a large heat sink in the event of a release of energy from a Design Basis Accident (DBA) in containment. The ice would absorb energy and limit containment peak pressure and temperature during the accident transient. Limiting the pressure and temperature reduces the release of fission product radioactivity from containment to the environment in the event of a DBA.

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 portion has a series of hinged doors exposed to the atmosphere of the lower containment compartment, which, for normal unit operation, are designed to remain closed. At the top of the ice condenser is another set of doors exposed to the atmosphere of the upper compartment, which also remain closed during normal unit operation. Intermediate deck doors, located below the top deck doors, form the floor of a plenum at the upper part of the ice condenser. These doors also remain closed during normal unit operation. The 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 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 condenser 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, is adequate to absorb the initial blowdown of steam and water from a DBA and the additional heat loads that would enter containment during 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.

As ice melts, the water passes through the ice condenser floor drains into the lower compartment. Thus, a second function of the ice bed is to be a large source of borated water (via the containment sump) for long term Emergency Core Cooling System (ECCS) and Containment Spray System heat removal functions in the recirculation mode.

A third function of the ice bed and melted ice is to remove fission product iodine that may be released from the core during a DBA. Iodine removal occurs during the ice melt phase of the accident and continues as the melted ice is sprayed into the containment atmosphere by the Containment Spray System. The ice is adjusted to an alkaline pH that facilitates removal of radioactive iodine from the containment atmosphere. The alkaline pH also minimizes the occurrence of the chloride and caustic stress corrosion on mechanical systems and components exposed to ECCS and Containment Spray System fluids in the recirculation mode of operation.

It is important for the ice to be uniformly distributed around the 24 ice condenser bays and for open flow paths to exist around ice baskets. This is especially important during the initial blowdown so that the steam and water mixture entering the lower compartment do not pass through only part of the ice condenser, depleting the ice there while bypassing the ice in other bays.

Two phenomena that can degrade the ice bed during the long service period are:

a. Loss of ice by melting or sublimation; and

b. Obstruction of flow passages through the ice bed due to buildup of ~~frost or~~ ice. Both of these degrading phenomena are reduced by minimizing air leakage into and out of the ice condenser.

Start new paragraph

BASES

BACKGROUND (continued)

The ice bed limits the temperature and pressure that could be expected following a DBA, thus limiting leakage of fission product radioactivity from containment to the environment.

APPLICABLE SAFETY ANALYSES

The limiting DBAs considered relative to containment temperature and pressure 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 not assumed 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, RHR Spray System, and the ARS also function to assist the ice bed in limiting pressures and temperatures. Therefore, the postulated DBAs are analyzed in regards to containment 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, RHR Spray System, and ARS being 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 the 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."

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

The ice bed satisfies Criterion 3 of 10 CFR 50.36 (Ref. 3).

BASES

LCO

The ice bed LCO requires the existence of the required quantity of stored ice, appropriate distribution of the ice and the ice bed, open flow paths through the ice bed, and appropriate chemical content and pH of the stored ice. The stored ice functions to absorb heat during a DBA, thereby limiting containment air temperature and pressure. The chemical content and pH of the ice provide core SDM (boron content) and remove radioactive iodine from the containment atmosphere when the melted ice is recirculated through the ECCS and the Containment Spray System, respectively.

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 bed. Therefore, the LCO is applicable in MODES 1, 2, 3, and 4.

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

ACTIONS

A.1

If the ice bed is inoperable, it must be restored to OPERABLE status within 48 hours. The Completion Time was developed based on operating experience, which confirms that due to the very large mass of stored ice, the parameters comprising OPERABILITY do not change appreciably in this time period. Because of this fact, the Surveillance Frequencies are long (months), except for the ice bed temperature, which is checked every 12 hours. If a degraded condition is identified, even for temperature, with such a large mass of ice it is not possible for the degraded condition to significantly degrade further in a 48 hour period. Therefore, 48 hours is a reasonable amount of time to correct a degraded condition before initiating a shutdown.

B.1 and B.2

If the ice bed 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.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.6.12.1

Verifying that the maximum temperature of the ice bed is ≤ 27°F ensures that the ice is kept well below the melting point. The 12 hour Frequency was based on operating experience, which confirmed that, due to the large mass of stored ice, it is not possible for the ice bed temperature to degrade significantly within a 12 hour period and was also based on assessing the proximity of the LCO limit to the melting temperature.

Furthermore, the 12 hour Frequency is considered adequate in view of indications in the control room, including the alarm, to alert the operator to an abnormal ice bed temperature condition. This SR may be satisfied by use of the Ice Bed Temperature Monitoring System.

SR 3.6.12.2

The weighing program is designed to obtain a representative sample of the ice baskets. The representative sample shall include 6 baskets from each of the 24 ice condenser bays and shall consist of one basket from radial rows 1, 2, 4, 6, 8, and 9. If no basket from a designated row can be obtained for weighing, a basket from the same row of an adjacent bay shall be weighed.

The rows chosen include the rows nearest the inside and outside walls of the ice condenser (rows 1 and 2, and 8 and 9, respectively), where heat transfer into the ice condenser is most likely to influence melting or sublimation. Verifying the total weight of ice ensures that there is adequate ice to absorb the required amount of energy to mitigate the DBAs.

If a basket is found to contain < 1081 lb of ice, a representative sample of 20 additional baskets from the same bay shall be weighed. The average weight of ice in these 21 baskets (the discrepant basket and the 20 additional baskets) shall be ≥ 1081 lb at a 95% confidence level.

Weighing 20 additional baskets from the same bay in the event a Surveillance reveals that a single basket contains < 1081 lb ensures that no local zone exists that is grossly deficient in ice. Such a zone could experience early melt out during a DBA transient, creating a path for steam to pass through the ice bed without being condensed. The Frequency of 9 months was based on ice storage tests and the allowance built into the required ice mass over and above the mass assumed in the safety analyses. Operating experience has verified that, with the 9 month Frequency, the weight requirements are maintained with no significant degradation between surveillances.

INSERT G FOR NEW SR 3.6.12.4

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.6.12.3

This SR ensures that the azimuthal distribution of ice is reasonably uniform, by verifying that the average ice weight in each of three azimuthal groups of ice condenser bays is within the limit. The Frequency of 9 months was based on ice storage tests and the allowance built into the required ice mass over and above the mass assumed in the safety analyses. Operating experience has verified that, with the 9 month Frequency, the weight requirements are maintained with no significant degradation between surveillances.

INSERT B

~~SR 3.6.12.4~~

~~This SR ensures that the flow channels through the ice condenser have not accumulated an excessive amount of ice or frost blockage. The visual inspection must be made for two or more flow channels per ice condenser bay and must include the following specific locations along the flow channel:~~

~~a. Past the lower inlet plenum support structures and turning vanes;~~

~~b. Between ice baskets;~~

~~c. Past lattice frames;~~

~~d. Through the intermediate floor grating; and~~

~~e. Through the top deck floor grating.~~

~~The allowable 0.38 inch thick buildup of frost or ice is based on the analysis of containment response to a DBA with partial blockage of the ice condenser flow passages. If a flow channel in a given bay is found to have an accumulation of frost or ice > 0.38 inch thick, a representative sample of 20 additional flow channels from the same bay must be visually inspected.~~

~~If these additional flow channels are all found to be acceptable, the discrepant flow channel may be considered single, unique, and acceptable deficiency. More than one discrepant flow channel in a bay is not acceptable, however. These requirements are based on the sensitivity of the partial blockage analysis to additional blockage. The Frequency of 9 months for structural members other than the lower inlet~~

BASES

SURVEILLANCE REQUIREMENTS (continued)

~~plenum support structures and turning vanes was based on ice storage tests and the allowance built into the required ice mass over and above the mass assumed in the safety analyses. The 18 month Frequency for the lower inlet plenum support structures and turning vanes is based on the need to perform this Surveillance during the conditions that exist during a plant outage. These areas are access restricted due to ALARA considerations during plant operation.~~

~~The SR is modified by a Note that indicates the Surveillance for the lower inlet plenum support structures and turning vanes is not applicable until after a unit outage of sufficient duration to perform the Surveillance subsequent to August 12, 1998.~~

~~SR 3.6.12.5~~ SR 3.6.12.7

INSERT C

INSERT D

Verifying the chemical composition of the stored ice ensures that the stored ice has a boron concentration ~~of at least 1800 ppm~~ as sodium tetraborate and a high pH, ≥ 9.0 and ≤ 9.5 at 20°C, in order to meet the requirement for borated water when the melted ice is used in the ECCS recirculation mode of operation. Sodium tetraborate has been proven effective in maintaining the boron content for long storage periods, and it also enhances the ability of the solution to remove and retain fission product iodine. The high pH is required to enhance the effectiveness of the ice and the melted ice in removing iodine from the containment atmosphere. This pH range also minimizes the occurrence of chloride and caustic stress corrosion on mechanical systems and components exposed to ECCS and Containment Spray System fluids in the recirculation mode of operation. The Frequency of ~~18 months~~ was developed considering these facts:

INSERT E

a. Long term ice storage tests have determined that the chemical composition of the stored ice is extremely stable;

INSERT F

c ~~b.~~ Operating experience has demonstrated that meeting the boron concentration and pH requirements has ~~never~~ not been a problem~~; and~~

~~c. Someone would have to enter the containment to take the sample, and, if the unit is at power, that person would receive a radiation dose.~~

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.6.12.6

This SR ensures that a representative sampling of accessible portions of ice baskets, which are relatively thin walled, perforated cylinders, have not been degraded by wear, cracks, corrosion, or other damage. Each ice basket must be raised at least 12 feet for this inspection. The Frequency of 40 months for a visual inspection of the structural soundness of the ice baskets is based on engineering judgment and considers such factors as the thickness of the basket walls relative to corrosion rates expected in their service environment and the results of the long term ice storage testing.

REFERENCES

1. UFSAR, Section 6.2.
2. 10 CFR 50, Appendix K.
3. 10 CFR 50.36, Technical Specifications, (c)(2)(ii).
4. UFSAR, Section 6.3.3.10.

Insert A

The ice baskets contain the ice within the ice condenser. The ice bed is considered to consist of the total volume from the bottom elevation of the ice baskets to the top elevation of the ice baskets. The ice baskets position the ice within the ice bed in an arrangement to promote heat transfer from steam to ice.

Insert B

SR 3.6.12.5

This SR ensures that the air/steam flow channels through the ice bed have not accumulated ice blockage that exceeds 15 percent of the total flow area through the ice bed region. The allowable 15 percent buildup of ice is based on the analysis of the sub-compartment response to a design basis LOCA with partial blockage of the ice condenser flow channels. The analysis did not perform detailed flow area modeling, but rather lumped the ice condenser bays into six sections ranging from 2.75 bays to 6.5 bays. Individual bays are acceptable with greater than 15 percent blockage, as long as 15 percent blockage is not exceeded for any analysis section.

To provide a 95 percent confidence that flow blockage does not exceed the allowed 15 percent, the visual inspection must be made for at least 54 (33 percent) of the 162 flow channels per ice condenser bay. The visual inspection of the ice bed flow channels is to inspect the flow area, by looking down from the top of the ice bed, and where view is achievable up from the bottom of the ice bed. Flow channels to be inspected are determined by random sample. As the most restrictive ice bed flow passage is found at a lattice frame elevation, the 15 percent blockage criteria only applies to "flow channels" that comprise the area:

a. between ice baskets, and
b. past lattice frames and wall panels.

Due to a significantly larger flow area in the regions of the upper deck grating and the lower inlet plenum support structures and turning vanes, it would require a gross buildup of ice on these structures to obtain a degradation in air/steam flow. Therefore, these structures are excluded as part of a flow channel for application of the 15 percent blockage criteria. Plant and industry experience have shown that removal of ice from the excluded structures during the refueling outage is sufficient to ensure they remain operable throughout the operating cycle. Thus, removal of any gross ice buildup on the excluded structures is performed following outage maintenance activities.

Operating experience has demonstrated that the ice bed is the region that is the most flow restrictive, due to the normal presence of ice accumulation on lattice frames and wall panels. The flow area through the ice basket support platform is not a more restrictive flow area because it is easily accessible from the lower plenum and is maintained clear of ice accumulation. There is not a mechanistically credible method for ice to accumulate on the ice basket support platform during plant operation. Plant and industry experience has shown that the vertical flow area through the ice basket support platform remains clear of ice accumulation that could produce blockage. Normally only a glaze may develop or exist on the ice basket support platform which is not significant to blockage of flow area. Additionally, outage maintenance practices provide measures to clear the ice basket support platform following maintenance activities of any accumulation of ice that could block flow areas.

Activities that have a potential for significant degradation of flow channels should be limited to

outage periods. Performance of this SR following completion of these activities assures the ice bed is in an acceptable condition for the duration of the operating cycle.

Frost buildup or loose ice is not to be considered as flow channel blockage, whereas attached ice is considered blockage of a flow channel. Frost is the solid form of water that is loosely adherent, and can be brushed off with the open hand.

Insert C

... $\geq$ 1800 ppm and $\leq$ 2330 ppm ...

Insert D

Additionally, the minimum boron concentration setpoint is used to assure reactor subcriticality in a post LOCA environment, while the maximum boron concentration is used as the bounding value in the hot leg switchover timing calculation (Ref. 4). This is accomplished by obtaining at least 24 ice samples. Each sample is taken approximately one foot from the top of the ice of each randomly selected ice basket in each ice condenser bay. The SR is modified by a NOTE that allows the boron concentration and pH value obtained from averaging the individual samples' analysis results to satisfy the requirements of the SR. If either the average boron concentration or average pH value is outside their prescribed limit, then entry into ACTION Condition A is required.

Insert E

... 54 months is intended to be consistent with the expected length of three fuel cycles, and ...

Insert F

b. There are no normal operating mechanisms that significantly change the boron concentration of the stored ice, and pH remains within a 9.0 – 9.5 range when boron concentrations are above approximately 1200 ppm; and

Insert G

SR 3.6.12.4

This SR ensures that initial ice fill and any subsequent ice additions meet the boron concentration and pH requirements of SR 3.6.12.7. The SR is modified by a NOTE that allows the chemical analysis to be performed on either the liquid or resulting ice of each sodium tetraborate solution prepared. If ice is obtained from offsite sources, then chemical analysis data must be obtained for the ice supplied.

Enclosure 9

DUKE ENERGY CORPORATION

CATAWBA NUCLEAR STATION
UNIT 1 and UNIT 2

McGUIRE NUCLEAR STATION
UNIT 1 and UNIT 2

AMENDMENT EVALUATION REPORT

CONTENTS

EXECUTIVE SUMMARY

Duke Energy Corporation (Duke) is submitting this report in support of a request to the Nuclear Regulatory Commission (NRC) for review and approval of the proposed amendment to the Facility Operating Licenses (FOLs) of Catawba Nuclear Station Units 1 & 2, and McGuire Nuclear Station Units 1 & 2. This report contains a description and evaluation of the proposed changes.

The proposed amendment revises the Technical Specifications regarding each Unit's ice condenser ice bed. These changes are initiated as part of an Industry effort of working with NRC staff to enhance Technical Specifications related to ice condensers. This report includes changes to two TS surveillance requirements. The first is a revision of the ice bed chemical analysis and sampling surveillance. The second is a revision to the ice bed flow area verification surveillance. Both of these proposed changes have precedent of being approved in recent license amendments for the Watts Bar Nuclear Plant. Also, both of these changes are consistent with recently approved Westinghouse Owners Group improved Standardized Technical Specifications (NUREG 1431) changes.

The proposed changes submitted in this report have been evaluated by Duke and conclude a determination that this proposed amendment contains No Significant Hazards Considerations. Also, this report provides the basis for the categorical exclusion from performing an Environmental Assessment/Impact Statement.

DUKE ENERGY CORPORATION
CATAWBA NUCLEAR STATION (CNS)
UNIT 1 and UNIT 2
McGUIRE NUCLEAR STATION (MNS)
UNIT 1 and UNIT 2

AMENDMENT EVALUATION REPORT

PROPOSED
TECHNICAL SPECIFICATION (TS) CHANGES

PART 1. CHANGES TO ICE BED CHEMICAL ANALYSES AND SAMPLING

I. DESCRIPTION OF THE PROPOSED CHANGE

The proposed license amendment revises the Catawba Nuclear Station (CNS) Unit 1 and Unit 2, and the McGuire Nuclear Station (MNS) Unit 1 and Unit 2 Technical Specifications (TS). This proposed amendment affects the current CNS TS surveillance requirement (SR) 3.6.12.3, MNS TS SR 3.6.12.5, and associated TS Bases. The changes involve the methodology and frequency for the chemical analyses of the ice condenser ice bed (stored ice). Due to a proposed revision of the surveillance frequency, the change also results in renumbering the SRs. CNS's current SR 3.6.12.3 is renumbered to SR 3.6.12.7, and likewise MNS's current SR 3.6.12.5 to SR 3.6.12.7. Also, this proposed amendment adds a new TS SR to address sampling requirements for ice additions to the ice bed. The proposed new SR would be numbered as CNS TS SR 3.6.12.2 and MNS TS SR 3.6.12.4.

Specifically, the current CNS SR 3.6.12.3 and MNS SR 3.6.12.5 require that ice in the ice bed be verified to have a boron concentration of $\geq$ 1800 ppm and a pH of $\geq$ 9.0 and $\leq$ 9.5. The proposed amendment increases the number of samples from 9 to 24. The 24 samples are obtained by randomly selecting one ice basket to be sampled from each of the 24 ice bays. The acceptance criterion for boron concentration is changed to include an upper limit of 2330 ppm. A note is added to clarify that the SRs are satisfied if the boron concentration and pH values obtained from averaging the individual sample results are within the limits specified. The performance Frequency is increased from 18 months to 54 months.

A new SR is proposed. The proposed CNS SR 3.6.12.2 and MNS SR 3.6.12.4 require that ice additions to the ice condenser be verified by chemical analysis to meet the boron concentration and pH requirements of CNS's SR 3.6.12.7 and MNS's SR 3.6.12.7, respectively. A note is provided to clarify that this verification can be performed by chemical analysis of either the liquid solution or the resulting ice.

II. REASON FOR THE PROPOSED CHANGE

Recent industry issues that relate to the ice condenser prompted a review of related technical specifications. Through these reviews, differences were identified between each ice condenser plant's interpretation and implementation of the related technical specifications. Review of the differences regarding the ice sampling SR led to the proposed changes, as agreed to by all ice condenser utilities. The proposed changes will provide additional assurance that TS and accident analysis assumptions are maintained, and will facilitate the regulatory oversight process at each ice condenser plant.

The proposed new CNS SR 3.6.12.2 and MNS SR 3.6.12.4 alone provide adequate assurance that the boron concentration and pH requirements of the ice are maintained. However, the industry has elected to retain a modified version of the current CNS SR 3.6.12.3 and MNS SR 3.6.12.5, as added assurance that the stored ice maintains the required boron concentration and pH value, and to ensure no unexpected phenomena results in a chemical change in the ice.

III. SAFETY ANALYSIS

The ice condensers at CNS each consist of over 2,330,856 lbs. of ice, and at MNS each consist of over 2,099,790 lbs. of ice, stored in baskets. The primary purpose of an ice condenser is to provide a large heat sink in the event of a release of energy from a loss of coolant accident (LOCA) or a high energy line break (HELB) in containment. The ice would absorb energy and limit containment peak pressure and temperature during the accident. Limiting the pressure and temperature reduces the release of fission product radioactivity from containment to the environment in the event of one of the above design basis accidents (DBAs).

Other functions of the ice bed and melted ice are to (a) remove fission product iodine if released by the core, (b) contribute inventory in the form of melted ice to the containment sump for recirculation mode core cooling, and (c) minimize the occurrence of chloride and caustic stress corrosion of systems/components exposed to ECCS and Containment Spray fluids.

The proposed changes do not alter the above functions in any way. Allowing acceptance criteria to be based on the averaged analysis results of the individual samples is consistent with the accident analysis assumption that the bulk containment sump pH and boron concentration will not be altered from their accident analysis assumed values following complete ice melt. Thus, application of the acceptance criteria to the analysis results of each sample is not required. Additionally, industry experience has shown that analysis results have rarely been outside the acceptance criteria. This is because pH remains in the specified range once boron concentration is above 1100-1200 ppm, and there are no normal operating mechanisms for the boron concentration to significantly change. A review of past history of sampling analysis results at both CNS and MNS concluded that consistently the boron and pH of the ice beds have been well within limits. These conclusions, and adding the new CNS SR 3.6.12.2 and MNS SR 3.6.12.4

supports changing the performance frequency from 18 to 54 months, which is expected to be the equivalence of three fuel cycles. For newly added ice, there is no significant difference in sampling the liquid solution from which it is made, or the resultant ice.

The TS surveillance limit on required boron concentration has been conservatively changed by the addition of an upper limit of 2330 ppm. CNS's and MNS's Updated Final Safety Analysis Report (UFSAR)[3] document the input parameters for the boron precipitation analysis. These input parameters establish a maximum boron concentration of 2330 ppm for both CNS's and MNS's ice beds. The boron precipitation analysis shows that the maximum boron concentration in the reactor vessel following a hypothetical loss of coolant accident is below the NRC staff accepted maximum limit. Both CNS and MNS have procedural controls that have maintained borax ice making solution within the TS lower limit of 1800 ppm and the UFSAR documented upper limit of 2330 ppm. The addition of the TS upper limit requirement on boron concentration does not require any changes to existing maintenance practices for targeting boron concentration.

PART 2. CHANGES TO ICE BED FLOW AREA VERIFICATION

IV. DESCRIPTION OF THE PROPOSED CHANGE

The proposed license amendment revises the Catawba Nuclear Station (CNS) Unit 1 and Unit 2, and the McGuire Nuclear Station (MNS) Unit 1 and Unit 2 Technical Specifications (TS). The proposed revision will affect the current CNS TS surveillance requirement (SR) 3.6.12.2, MNS TS SR 3.6.12.4, and associated TS Bases. The revision will alter the acceptance criterion and surveillance frequency in these surveillance requirements. Also, due to the addition of a new SR described in Part 1 of this report, the proposed change results in renumbering the SRs. CNS's current SR 3.6.12.2 is renumbered to SR 3.6.12.3, and likewise MNS's current SR 3.6.12.4 to SR 3.6.12.5.

Specifically, the current CNS SR 3.6.12.2 and MNS SR 3.6.12.4 require a visual inspection of the air/steam flow area within the ice condensers. This proposed amendment replaces the current visual inspection requirement that uses a 0.38 inch ice/frost buildup criteria with a visual surveillance program that provides a 95 percent confidence level that flow blockage does not exceed the 15 percent assumed in the accident analyses. Whereas, the 0.38 inch program required inspection of as few as two flow channels per ice condenser bay, the new program will require at least 33 percent of the flow area per bay to be inspected. Also, this proposed change revises the frequency interval from 9 months to 18 months for flow area inspection of the ice condenser. The surveillance is intended to be performed following outage maintenance as an "as-left" surveillance.

This change also revises the applicability from "flow channels through the ice condenser" to "flow channels through the ice bed." An associated revision to the TS

[3]CNS Updated Final Safety Analysis Report UFSAR § 6.3.3; CNS UFSAR Table 6-99; MNS UFSAR § 6.3.3.10; and MNS UFSAR Table 6-137.

Bases clarifies which structures are to be inspected. The revision limits the structures to be inspected to only include "between ice baskets" and "past lattice frames and wall panels." The TS Bases revision also is expanded to explain why other structures within the ice condenser are not inspected per the SR. This change also deletes "frost" from the SR. The Westinghouse definitions for frost and ice have been added to the TS Bases to explain why frost is not an impediment to air/steam flow through the ice condenser.

V. REASON FOR THE PROPOSED CHANGE

Recent industry events related to the ice condenser prompted Duke Energy Corporation's (Duke's) review of related technical specifications. Related accident analyses show that over pressurization of lower containment subcompartments and the steel vessel will not occur with up to 15 percent blockage of the design ice condenser flow paths. Review of current CNS SR 3.6.12.2 and MNS SR 3.6.12.4 determined that neither adequately provide for the full intent of the surveillance. Through discussions with Westinghouse, Duke has determined that there is no direct correlation between the existing standard TS 0.38 inch criteria for ice/frost accumulation on flow area structural members and the percentage of overall flow blockage assumed in the plant analyses for CNS and MNS. However, the proposed amendment provides an acceptance criteria of ≤ 15 percent blockage, which is directly related to this functional requirement.

Because frost, as recognized by Westinghouse, is not an impediment to steam and air flow, the Westinghouse definitions for frost and ice have been added to the associated TS Bases, and frost specifically excluded as flow path blockage. This change should preclude potential declarations of inoperability due to frost rather than ice.

The first line of defense to determine the operability of the ice condenser lies with the operator. The ice bed temperature is monitored at least once every twelve hours to ensure temperatures are less than or equal to 27°F. This is accomplished in a conservative manner by reviewing numerous points throughout the ice condenser to ensure the maximum ice bed temperature is less than or equal to 27°F. In addition to the surveillance requirements, there are alarms in the control room that will indicate to the operator if any of the points being recorded reach 27°F. Also, weekly operator tours require the operators to walkdown the refrigeration system. This includes walking down the chillers, air handling units, and glycol pumps to ensure that they are in proper working order. The tours also require the operators to inspect the intermediate deck doors to ensure they are not frozen shut. This helps to ensure that no abnormal degradation of the ice condenser is occurring due to condensation or frozen drain lines in localized areas.

The next line of defense is the performance of various procedures to ensure the ice bed is in good physical condition. These procedures validate assumptions used in the accident analysis. Flow passage inspection is performed to ensure the absence of abnormal ice bed degradation as would be indicated if accumulations exceed the SR acceptance criteria.

Duke procedures for inspection of ice condenser flow passages will provide a determination of blockage for each inspected flow passage. The current method determines individual flow passage blockage to 0%, 25%, 50%, 75%, or 100% by visual inspection. The qualification will include visual acuity standards that meet or exceed relevant VT-2 requirements.[4] The relevant VT-2 requirements are only those requirements regarding demonstrating far-distance visual acuity. These procedures will provide for inspection of the flow areas by looking down from the top of the ice bed, and where view is achievable up from the bottom of the ice bed. Minimum lighting requirements will be provided and will include lighting and back lighting with the appropriate intensity to achieve full view of the flow area and minimize glare. Any flow areas that can not be verified to be open will be conservatively evaluated as 100% blocked. Flow area blockage determination uncertainty due to inspection methods will be accounted for by procedural controls that establish acceptance criteria less than the TS required limit of 15%.

The request to increase the surveillance interval from 9 months to 18 months would allow the performance of such ice bed monitoring during refueling outages. Duke believes that industry improvements in ice bed inspection results, due to modified maintenance techniques that have been implemented, provide adequate assurance that the ice condenser can meet and even exceed its design function without performing the surveillance on a 9 month frequency.

Examples of Operating Experience and Industry concerted improvements:

- Improved control of doors during maintenance including appropriate penetrations for hoses to minimize ice condenser heat and humidity gains.
- Improved management of wall and floor defrost cycles (if used, occurs only during outages).
- Improved preventative maintenance programs on Ice Condenser cooling systems.
- Increased priority on repair of Ice Condenser cooling systems.
- Improved training and procedures for emptying and refilling of baskets, and subsequent clean up.
- Improved training and procedures for flow passage surveillances.
- Proposed increase in minimum sample size requirement for flow passage surveillance.
- Proposed surveillance acceptance criterion that effectively aligns with design basis accident (DBA) analysis for operability determination.

VI. <u>SAFETY ANALYSIS</u>

The ice condensers at CNS each consist of over 2,330,856 lbs. of ice, and at MNS each consist of over 2,099,790 lbs. of ice, stored in baskets within the ice condenser. The primary purpose of an ice condenser is to provide a large heat sink in the event of a release of energy from a loss of coolant accident (LOCA) or a high energy line break

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[4]American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, IWA 2300, "Qualifications of Nondestructive Examination Personnel," 1989 Edition.

(HELB) in containment. The ice would absorb energy and limit containment peak pressure and temperature during the accident. Limiting the pressure and temperature reduces the release of fission product radioactivity from containment to the environment in the event of one of the above design basis accidents (DBAs).

The ice condenser is an annular compartment enclosing about 300º 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 portion has a series of hinged doors (lower inlet doors) exposed to the atmosphere of the lower containment compartment, which, for normal plant operation, are designed to remain closed. At the top of the ice condenser is another set of doors (upper deck panels) that are exposed to the upper containment atmosphere, and also remain closed during normal plant operation. A third set of doors (intermediate deck doors), located below the top deck panels, form the floor of a plenum at the upper part of the ice condenser. These doors also remain closed during normal plant operation. The upper plenum area is used to facilitate surveillance and maintenance of the ice bed.

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

Should a LOCA or HELB occur, the ice condenser inlet doors (lower containment area) 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 then causes the intermediate deck doors and top deck panels to open (or for a small pressure increase associated with certain small break LOCAs, bypass through curtains), which allows the air/steam to flow out of the ice condenser into the upper compartment. Steam condensation within the ice condenser limits the pressure and temperature buildup within containment. A divider barrier separates the upper and lower compartments and ensures steam is directed into the ice condenser. The ice, together with the containment spray, is adequate to absorb the initial blowdown of steam and water from a LOCA or HELB and the additional heat loads that would enter containment during several hours following initial blowdown.

Other functions of the ice bed and melted ice are to (a) remove fission product iodine if released by the core, (b) minimize the occurrence of chloride and caustic stress corrosion of systems/components exposed to ECCS and Containment Spray fluids, and (c) contribute inventory in the form of melted ice to the containment sump for recirculation mode core cooling.

Proper operation of the ice condenser requires the ice to be distributed throughout the ice condenser and for open flow paths to exist around the ice baskets consistent with DBA assumptions. This is especially important during the initial blowdown so that (1) the steam and water mixture entering the lower compartment do not pass through only part of the ice condenser depleting the ice there while bypassing the ice in other portions of the ice condenser, and (2) to ensure there is sufficient air and steam flow (i.e., no

significant obstruction to flow) through the ice condenser to prevent lower compartment overpressurization, as this could result in structural failure of the subcompartment walls or containment vessel. Analysis has shown that overpressurization of the lower compartment will not occur provided the overall blockage does not exceed the 15 percent section blockage assumed in the TMD code analysis. This analysis is not a detailed flow channel analysis. Instead, it lumps the ice condenser bays into six sections of 2.75, 3.25, 6.50, 4.50, 3.50, and 3.50 bays.[5] Sensitivity analyses performed in the 1970's showed that up to 15 percent of the flow area can be blocked. According to Westinghouse, an acceptable level of blockage is one that meets the 15 percent criterion based upon the TMD lumping method. That is, there can be individual bays with blockage of greater than 15 percent, or even individual channels blocked, provided the highest calculated percent blockage in any of the TMD lumped sections does not exceed 15 percent.

The current CNS SR 3.6.12.2 and MNS SR 3.6.12.4 inspection criteria of 0.38 inch ice buildup implies that it is acceptable to have this much accumulation over the entire ice condenser. However, a uniform 0.38 inch ice buildup on all the ice baskets and lattice frame surfaces is equivalent to approximately 50 percent flow blockage. According to Westinghouse, selection of the 0.38 inch ice buildup limit was not based on a quantitative reason associated with the accident analyses or any specific analysis. Rather, the intent of the 0.38 inch value was to ensure that ice condenser flow paths were maintained, and that there was no occurrence of gross ice buildup, significant flow blockage between ice baskets, or gross degradation of refrigeration and/or air circulation equipment and systems. The 0.38 inch value was selected as being equivalent to the thickness of the structural cross members in the lattice frame support. This provided the inspector or personnel performing the surveillance with a convenient "in-place" gauge to assess whether surveillance requirements were or were not being met. The 0.38 inch criterion is to be used for the purpose of initiating a more detailed inspection, and not necessarily to verify adequacy of the 15 percent ice condenser flow blockage limits imposed by the accident analyses. The detailed inspection confirms that the accident analysis ice buildup limit would not be exceeded.

The proposed amendment provides a methodology for evaluating ice condenser flow blockage that is more conservative than the 0.38 inch criteria. First, it provides results in terms of percent flow blockage, which is directly related to the accident analysis limitations. Secondly, it requires a minimum of 33 percent of the flow area per bay be inspected, as compared to a minimum of 2 passages per bay under the 0.38 inch criteria. The increased sampling provides an increased confidence level in the results of the inspection. Thus, the proposed amendment improves assurance that actual ice condenser flow blockage is known and being maintained within accident analysis assumptions.

The current TS Bases for CNS's SR 3.6.12.2 and MNS's SR 3.6.12.4 identifies the ice condenser flow area to include the lower inlet plenum support structures, turning vanes, ice baskets, lattice frames, and intermediate and top deck floor gratings. As identified by Westinghouse, the most restrictive flow area location is at a lattice frame elevation.

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[5]CNS UFSAR, Figure 6-27, Plan View of Ice Condenser Elevation – Ice Condenser Compartments; and MNS UFSAR, Figure 6-31, Plan View at Ice Condenser Elevation – Ice Condenser Compartments.

For this reason the proposed change now defines flow area, as it applies to the 15 percent flow blockage criteria, to be that area between ice baskets and past lattice frames and wall panels. As neither CNS nor MNS have an intermediate floor grating, it has been deleted from the definition. Because it would require a gross buildup of ice on the lower inlet plenum support structures, turning vanes, and upper deck floor grating before degradation in air and steam flow occurred, these structures have been excluded as part of the flow area for application of the 15 percent blockage criteria. Plant and industry experience have shown that removal of ice from the exempt structures during the refueling outage is sufficient to ensure their operability throughout the operating cycle. Therefore, plant procedures will require a 100 percent inspection and evaluation for any gross ice buildup on the excluded structures, and the removal of significant ice accumulations.

The associated TS Bases change clarifies that Duke is committed to performing visual inspections of at least 33 percent of the flow channels (54 of 162 per bay). An inspection of at least 33 percent of flow channels with the use of a statistical methodology such as that described by Westinghouse letter, will provide a 95 percent confidence that flow blockage does not exceed the allowed 15 percent.[6] Also, Duke may perform full visual inspections of all flow channels (162 of 162 per bay), which provides verification that exceeds 95% confidence by application of a arithmetic mean, and would not require the application of a population sample statistical methodology.

Also included in the change to the associated TS Bases is the exclusion of frost from flow blockage determinations. The Bases change defines frost as ice which is loosely adherent, and can be easily brushed or knocked off by the hand. Westinghouse concurs that loose ice is judged to either melt or be blown out very quickly during a DBA. Thus, excluding frost from the flow blockage determination does not impact the safety analyses.

The increase in the surveillance interval from 9 months to 18 months is adequate assurance of operability for the entire operating cycle. Management of ice condenser maintenance activities has successfully limited activities with the potential for significant flow channel degradation to the refueling outage. By verifying an ice bed condition of less than or equal to 15 % flow channel blockage following completion of these maintenance activities, the surveillance assures the ice bed is in an acceptable condition for the duration of the operating cycle. During the operating cycle, an expected amount of ice sublimates and reforms as frost on the colder surfaces in the Ice Condenser. However, frost does not degrade flow channel flow area per the Westinghouse definition of frost. Therefore, the surveillance will effectively demonstrate operability for an allowed 18 month cycle.

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[6]Letter, Westinghouse, to Tennessee Valley Authority (TVA), dated June 23, 1988, providing surveillance techniques for complying with Sequoyah Nuclear Station (SQN) TS for inspection of ice basket flow passages (ADAMS # ML003723860);
Letter, NRC to TVA, dated January 30, 1989, transmitting Amendments Nos. 98 and 87 to Facility Operating License (FOL) for the SQN Units 1 & 2; and
Letter, NRC to TVA, dated July 17, 2000, transmitting Amendment No. 25 to FOL for Watts Bar Nuclear Plant, Unit 1.

PART 3. COMBINED CONSIDERATION

VII. NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

Duke Energy Corporation (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)(1), of the three standards set forth in 10 CFR 50.92(c).

A. The Proposed Change Does Not Involve A Significant Increase In The Probability Or Consequences Of An Accident Previously Evaluated.

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. The proposed changes to the TSs and associated TS Bases are solely to revise and provide clarification of the ice sampling and chemical analysis requirements, and flow area verification requirements. Since these proposed changes do not result in, or require, any physical change to the ice condenser, then there can be no change in the probability of an accident previously evaluated in the SAR.

In order for the consequences of any previously evaluated event to be changed, there would have to be a change in the ice condenser's physical operation during a LOCA or HELB, or in the chemical composition of the stored ice.

The proposed changes add an upper limit on boron concentration, which is the bounding value for the boron precipitation analysis. The upper limit boron concentration is an existing DBA analysis input limit that is controlled by existing procedure. Therefore, the addition of a TS requirement for an upper limit on boron concentration does not affect the physical operation or condition of the ice condenser.

Though the frequency of the existing surveillance requirement for sampling the stored ice is changed from once every 18 months to once every 54 months, the sampling requirements are strengthened overall with the requirement to obtain one randomly selected sample from each ice condenser bay (24 total samples) rather than nine "representative" samples, and the addition of a new surveillance requirement to verify each addition of ice meets the existing requirements for boron concentration and pH value.

The proposed changes clarify that each sample of stored ice is individually analyzed for boron concentration and pH, and that the acceptance criteria for each parameter is based on the average values obtained for the 24 samples. This is consistent with the bases for the boron concentration of the ice, which is to ensure the accident analysis assumptions for containment sump pH and boron concentration are not altered following complete melting of the ice condenser. Historically, chemical analysis of the stored ice has had a very limited number of instances where an individual sample did not meet the boron or pH requirements, with all subsequent evaluations (follow up sampling) showing the ice condenser as a whole was well within these requirements. Requiring chemical analysis of each sample is provided to preclude the practice of melting all samples together before performing the analysis, and to ensure the licensee is alerted to any localized anomalies for investigation and resolution without the burden of entering a 24 hour ACTION Condition, provided the averaged results are acceptable.

The proposed changes revise and clarify the flow area verification requirements. Regarding the consequences of analyzed accidents, the ice condenser is an engineered safety feature designed, in part, to limit the containment subcompartment and steel vessel pressures immediately following the initiation of a LOCA or HELB. Conservative sub-compartment pressure analysis shows this criteria will be met if the reduction in the flow area per bay provided for ice condenser air/steam flow paths is $\leq$ 15 percent, or if the total flow area blocked within each lumped analysis section is $\leq$ 15 percent as assumed in the safety analysis. The present 0.38 inch frost/ice buildup surveillance criteria only addresses the acceptability of any given flow path, and has no existing correlation between flow paths exceeding this criteria and percent of total flow path blockage. In fact, it was never the intent of the current surveillance requirement (SR) to make such a correlation. If problems were encountered in meeting the 0.38 inch criteria, it was expected that additional inspection and analysis, such as provided in the proposed amendment, would be performed to make such a determination. Thus, the proposed amendment for flow blockage determination provides the necessary assurance that flow path requirements are met without additional evaluations.

The proposed amendment also revises the flow area verification surveillance frequency from every 9 months to every 18 months such that it will coincide with refueling outages. Management of ice condenser maintenance activities has successfully limited activities with the potential for significant flow channel degradation to the refueling outage. By verifying an ice bed condition of less than or equal to 15 % flow channel blockage following completion of these maintenance activities, the surveillance assures the ice bed is in an acceptable condition for the duration of the operating cycle. During the operating cycle, an expected amount of ice sublimates and reforms as frost on the colder surfaces in the Ice Condenser. However, frost does not degrade flow channel flow area per the Westinghouse definition of frost. The surveillance will effectively demonstrate operability for an allowed 18 month cycle. Therefore, increasing the surveillance frequency does not affect the ice condenser operation or accident response. An ice bed condition of

less than or equal to 15 % flow channel blockage is assured to be maintained for the operating cycle to address the limiting design basis accident(s) (DBAs).

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. The Proposed Change Does Not Create The Possibility Of A New Or Different Kind Of Accident From Any Accident Previously Evaluated

Because the TSs and TS Bases changes do not involve any physical changes to the ice condenser, any physical or chemical changes to the ice contained therein, or make any changes in the operational or maintenance aspects of the ice condenser as required by the TSs, there can be no new accidents created from those already identified and evaluated.

C. The Proposed Change Does Not Involve A Significant Reduction In A Margin Of Safety

The ice condenser Technical Specifications ensure that during a LOCA or HELB the ice condenser will initially pass sufficient air and steam mass to preclude over pressurizing lower containment, that it will absorb sufficient heat energy initially and over a prescribed time period to assist in precluding containment vessel failure, and that it will not alter the bulk containment sump pH and boron concentration assumed in the accident analyses.

Since the proposed changes do not physically alter the ice condenser, but rather only serve to strengthen and clarify ice sampling and analysis requirements, the only area of potential concern is the effect these changes could have on bulk containment sump pH and boron concentration following ice melt. However, this is not affected because there is no change in the existing requirements for pH and boron concentration, except to add an upper limit on boron concentration. This upper limit is the bounding value for the boron precipitation analysis. The upper limit boron concentration is an existing design bases limit that is controlled by existing procedure. Therefore, the addition of a TS requirement for an upper limit on boron concentration does not affect the physical operation or condition of the ice condenser.

Averaging the pH and boron values obtained from analysis of the individual samples taken is not a new practice, just one that was not consistently used by all ice condenser plants. Using the averaged values provides an equivalent bulk value for the ice condenser, which is consistent with the accident analysis for the bulk pH and boron concentration of the containment sump following ice melt.

Changing the performance Frequency for sampling the stored ice does not reduce any margin of safety because (1) the newly proposed surveillance ensures ice additions meet the existing boron concentration and pH requirements, (2) there are no normal operating mechanisms, including sublimation, that reduce the ice

condenser bulk pH and boron concentration, and (3) the number of required samples has been increased from 9 to 24 (one randomly selected ice basket per bay), which is approximately the same number of samples that would have been taken in the same time period under the existing requirements.

Design Basis Accident analyses have shown that with 85 percent of the total flow area available (uniformly distributed), the ice condenser will perform its intended function. Thus, the safety limit for ice condenser operability is a maximum 15 percent blockage of flow channels. The existing TS surveillance requirement currently uses a specific value of 0.38 inch buildup to determine if unacceptable frost/ice blockage exists in the ice condenser. However, this specific value does not have a direct correlation to the safety limit for blockage of ice condenser flow area. The proposed TS amendment requires more extensive visual inspection (33 percent of the flow area/bay) than is currently described (2 flow channels/bay) in the TS Bases, thus providing greater reliability and a direct relationship to the analytical safety limits. Changing the TS to implement a surveillance program that is more reliable and uses acceptance criteria of less than or equal to 15 percent flow blockage, as allowed by the TMD code analysis, will not reduce the margin of safety of any TS.

The proposed amendment also revises the surveillance frequency of flow area inspection from every 9 months to every 18 months such that it will coincide with refueling outages. Management of ice condenser maintenance activities has successfully limited activities with the potential for significant flow channel degradation to the refueling outage. By verifying an ice bed condition of less than or equal to 15 % flow channel blockage following completion of these maintenance activities, the surveillance assures the ice bed is in an acceptable condition for the duration of the operating cycle. During the operating cycle, an expected amount of ice sublimates and reforms as frost on the colder surfaces in the Ice Condenser. However, frost has been determined to not degrade flow channel flow area. Thus, design limits for the continued safe function of containment sub-compartment walls and the steel containment vessel are not exceeded due to this change.

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

VIII. ENVIRONMENTAL IMPACT 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.