Industry/TSTF Standard Technical Specification Change Traveler

Ice bed flow channel blockage surveillance requirement

Classification: 3) Improve Specifications

NUREGs Affected: ☐ 1430 ☑ 1431 ☐ 1432 ☐ 1433 ☐ 1434

Description:

The proposed change would revise the Ice Bed Technical Specifications (TS) and associated TS Bases in surveillance requirement (SR) 3.6.15.4.

The proposed change replaces the current visual inspection requirement that uses a 0.38 inch ice/frost buildup criteria. The proposed change is a visual surveillance program that provides at least 95 percent confidence level that flow blockage does not exceed the 15 percent blockage of the total flow area 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 54 (33 percent) of the 162 flow channels per bay to be inspected.

The proposed change revises SR 3.6.15.4 frequency interval from 9 months to 18 months for flow passage inspection of the ice condenser. The surveillance is intended to be performed following outage maintenance as an as left surveillance.

This change also proposes to revise the applicability from "flow channels through the ice condenser" to "flow channels through the ice bed". A proposed revision to the TS 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.

The proposal deletes the word "frost" from the SR. The Westinghouse bases for frost and ice as it applies to the SR have been added to the TS Bases to explain why frost is not an impediment to air/steam flow through the ice condenser.

Justification:

Recent industry events prompted the WOG Ice Condenser Mini-Group (ICMG) to review ice condenser technical specifications to identify enhancements that would provide direct correlation to design bases accident (DBA) analyses. DBA analyses demonstrate that design limits for pressurization of lower containment subcompartments and the steel containment vessel will not be exceeded with 15 percent blockage of the ice bed flow channels. Review of SR 3.6.15.4 determined that the 0.38 inch ice/frost buildup criteria does not adequately provide for the full intent of the surveillance. Through discussions with Westinghouse, the ICMG 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. However, the proposed change provides an acceptance criteria of <= 15 percent blockage, which is directly related to this functional requirement.

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 Bases of SR 3.6.15.4, and frost specifically excluded as flow channel blockage to preclude potential declarations of inoperability due to frost rather than ice.

Ice Condenser operability is assured by numerous means during operations. 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 all points are 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 to evaluate its ability to function. 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.

Ice Condenser operability is demonstrated by the performance of various procedures. Procedures verify the ice bed is in good physical condition. Procedures also validate assumptions used in the accident analysis. The 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.

The request to increase the surveillance interval from nine months to eighteen months would require the performance of such ice bed monitoring during refueling outages. ICMG members believe 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 nine 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 DBA analysis for operability determination.

Improved control of maintenance has limited those activities with the potential for significant flow channel blockage to during refueling outages. Verifying an ice bed is left with less than or equal to 15 % flow channel blockage at the conclusion of a refueling outage assures the ice bed will remain 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. Therefore, flow channel blockage surveillance should only be required at the conclusion of scheduled refueling outages. The surveillance will effectively demonstrate operability for an allowed 18 month surveillance period.

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Revision History

OG Revision 0 Revision Status: Closed

Revision Proposed by: McGuire

Revision Description:
Original Issue

Owners Group Review Information

Date Originated by OG: 11-Jun-99

Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 11-Jun-99

TSTF Review Information

TSTF Received Date: 11-Jun-99 Date Distributed for Review 11-Jun-99

OG Review Completed: ☑ BWOG ☑ WOG ☑ CEOG ☑ BWROG

OG Revision 0 **Revision Status: Closed**

TSTF Comments:
(No Comments)

TSTF Resolution: Approved Date: 15-Jun-99

NRC Review Information

NRC Received Date: 23-Jun-99

NRC Comments:
(No Comments)

Final Resolution: Superceded by Revision Final Resolution Date:

TSTF Revision 1 **Revision Status: Active** **Next Action: NRC**

Revision Proposed by: WOG

Revision Description:
Revision 1 provides clarification to the Bases of Specification 3.6.16 such that entry into Condition B is not required for personnel standing on or opening intermediate deck or upper deck doors for short durations for the performance of ice condenser related surveillances, minor maintenance, or routine tasks such as a system walkdown. This clarification only applies to tasks necessary to ensure ice condenser OPERABILITY, require only a minimal time to perform, and involve a small number of personnel. Condition B was provided for intermediate and upper deck doors found to be physically restrained from opening, and for any door conditions that threaten ice melt or sublimation, such as a door being found open or incapable of full closure. Performance of Required Action B.1 and B.2 are not necessary when momentarily opening a door (1) to determine if it is physically restrained, (2) to conduct minor maintenance activities such as ice removal, or (3) to perform routine tasks such as a system walkdowns.

The proposed Bases changes is consistent with the July 19, 1999 Watts Bar Nuclear Plant license amendment request associated with TSTF-336, Revision 0.

TSTF Review Information

TSTF Received Date: 20-Jul-00 Date Distributed for Review 20-Jul-00

OG Review Completed: ☑ BWOG ☑ WOG ☑ CEOG ☑ BWROG

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NRC Review Information

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(No Comments)

Final Resolution: NRC Action Pending Final Resolution Date:

Incorporation Into the NUREGs

File to BBS/LAN Date: TSTF Informed Date: TSTF Approved Date:

NUREG Rev Incorporated:

Affected Technical Specifications

Bkgnd 3.6.15 Bases	Ice Bed (Ice Condenser)
SR 3.6.15.4	Ice Bed (Ice Condenser)
SR 3.6.15.4 Bases	Ice Bed (Ice Condenser)
Action 3.6.16.B Bases	Ice Condenser Doors (Ice Condenser)

TSTF-336, Rev 1

Attachment 1
Technical Specification 3.6.15
No Significant Hazards Consideration

NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

[Utility Name] has concluded that operation of **[Plant Name]** Unit **[X]**, in accordance with the proposed change to the technical specifications [or operating license(s)], does not involve a significant hazards consideration. **[Utility Name]**'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 amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.**

Neither the TS amendment nor the TS Bases change can increase the probability of occurrence of any analyzed accident because they are not the result or cause of any physical modification to ice condenser structures. For the current design of the ice condenser, there is no correlation between any credible failure of it and the initiation of any previously analyzed event.

Regarding the consequences of analyzed accidents, the ice condenser is an engineered safety feature designed, in part, to limit the containment sub-compartment and steel containment 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 channels is less than or equal to 15 percent, or if the total flow area blocked within each lumped analysis section is less than or equal to the 15 percent assumed in the safety analysis. The present 0.38 inch frost/ice buildup surveillance criteria only addresses the acceptability of any given flow channel, and has no direct correlation between flow channels exceeding this criteria and percent of total flow channel blockage. In fact, it was never the intent of the current 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 channel requirements are met without additional evaluations, and thus will not increase the consequences of a LOCA or HELB.

The proposed amendment also revises the surveillance frequency from every 9 months to every 18 months such that it will coincide with refueling outages. The elimination of the mid-cycle surveillance does not significantly increase the consequence of an accident previously evaluated. Improved control of maintenance has limited those activities with the potential for significant flow channel blockage to during refueling outages. Verifying an ice bed is left with less than or equal to 15 % flow channel blockage at the conclusion of a refueling outage assures the ice bed will remain in an acceptable condition for the duration of the operating cycle. During the operating cycle, a certain 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. The surveillance will effectively demonstrate operability for an allowed 18 month surveillance period. Therefore, increasing the surveillance frequency does not affect the Ice Condenser operation or accident response. Limiting ice bed flow channel blockage to less than or equal to 15 % ensures operation is consistent with the assumptions of the design basis accident (DBA) analyses. Therefore, the proposed amendment will not increase the consequences of any accident previously evaluated.

B. **<u>The proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.</u>**

For such a possibility to exist, there would have to be either a physical change to the ice condenser, or some change in how it is operated or physically maintained. None of the above is true for the proposed TS amendment and TS Bases change. There is no change to the existing design requirements or inputs/results of any accident analysis calculations.

C. **<u>The proposed amendment does not involve a significant reduction in a margin of safety.</u>**

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. SR 3.6.15.4 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 for SR 3.6.15.4, 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 analysis, will not reduce the margin of safety of any TS.

The proposed amendment also revises the surveillance frequency from every 9 months to every 18 months such that it will coincide with refueling outages. Verifying an ice bed is left with less than or equal to 15 % flow channel blockage at the conclusion of a refueling outage assures the ice bed will remain in an acceptable condition for the duration of the operating cycle. During the operating cycle, a certain 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.

ENVIRONMENTAL IMPACT CONSIDERATION

The proposed change does 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 change meets 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 change is not required.

TSTF-336, Rev. 1

Attachment 2
NUREG 1431, Revision 1
Technical Specification 3.6.15
Marked Up Pages

TS TF-336, Rev 1

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.15.2	Verify total weight of stored ice is ≥ [2,721,600] lb by: a. Weighing a representative sample of ≥ 144 ice baskets and verifying each basket contains ≥ [1400] lb of ice; and b. Calculating total weight of stored ice, at a 95% confidence level, using all ice basket weights determined in SR 3.6.15.2.a.	9 months
SR 3.6.15.3	Verify azimuthal distribution of ice at a 95% confidence level by subdividing weights, as determined by SR 3.6.15.2.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 ≥ [1400] lb.	9 months
SR 3.6.15.4	Verify, by visual inspection, accumulation of ice ~~or frost~~ on structural members comprising flow channels through the ice ~~condenser is ≤ [0.38] inch thick.~~ bed is ≤ 15 percent blockage of the total flow area for each safety analysis section.	~~9~~ 18 months

(continued)

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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

This SR ensures that the 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 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, a gross buildup of ice on these structures would be required to degrade air and steam flow. Therefore, these structures are excluded as part of a flow channel for application of the 15 percent blockage criteria. Industry experience has shown that removal of ice from the excluded structures during the refueling outage is sufficient to ensure they remain operable throughout the operating cycle. 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 no 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.

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.

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B 3.6 CONTAINMENT SYSTEMS

B 3.6.15 Ice Bed (Ice Condenser)

ADD

1944

BASES

BACKGROUND

The ice bed consists of over [2,721,600] lb of ice stored in 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

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BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.6.15.3

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 3.6.15.4

Insert B

~~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~~

continued)

TSTF-336, Rev 1

BASES

SURVEILLANCE REQUIREMENTS

SR 3.6.15.4 (continued)

~~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.~~

SR 3.6.15.5

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], 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

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

b. Operating experience has demonstrated that meeting the boron concentration and pH requirements has never 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 3.6.15.6

This SR ensures that a representative sampling 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

(continued)

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BASES

ACTIONS (continued)

A.1

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

B.1 and B.2

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

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

C.1

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

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TSTF-336, Rev.1

Attachment 3
NUREG 1431, Revision 1
Technical Specification 3.6.15
Revised Pages

SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
SR 3.6.15.2	Verify total weight of stored ice is ≥ [2,721,600] lb by: a. Weighing a representative sample of ≥ 144 ice baskets and verifying each basket contains ≥ [1400] lb of ice; and b. Calculating total weight of stored ice, at a 95% confidence level, using all ice basket weights determined in SR 3.6.15.2.a.	9 months
SR 3.6.15.3	Verify azimuthal distribution of ice at a 95% confidence level by subdividing weights, as determined by SR 3.6.15.2.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 ≥ [1400] lb.	9 months
SR 3.6.15.4	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

(continued)

B 3.6 CONTAINMENT SYSTEMS

B 3.6.15 Ice Bed (Ice Condenser)

BASES

BACKGROUND

The ice bed consists of over [2,721,600] 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

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BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.6.15.3

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 3.6.15.4

This SR ensures that the 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 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, a gross buildup of ice on these structures would be required to degrade air and steam flow. Therefore, these structures are excluded as part of a flow channel for application of the 15 percent blockage criteria. Industry experience has shown that removal of ice from the excluded structures during the refueling outage is sufficient to ensure they remain operable

(continued)

SURVEILLANCE REQUIREMENTS

SR 3.6.15.4 (continued)

throughout the operating cycle. 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 no 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.

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 3.6.15.5

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], 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

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