TVA

Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

FEB 28 1996

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

Gentlemen:

In the Matter of) Docket No. 50-390
Tennessee Valley Authority)

WATTS BAR NUCLEAR PLANT (WBN) - PROPOSED LICENSE AMENDMENT, ICE BED SURVEILLANCE FREQUENCIES (TAC NO. 94424)

In accordance with 10 CFR 50.90, the Tennessee Valley Authority (TVA) requests that Appendix A of Facility Operating License NPF-90, Watts Bar Unit 1 Technical Specifications, be amended to extend the ice weighing and flow channel inspection surveillance frequencies from 9 months to 18 months. In support of this frequency change, the total ice bed weight would be increased from the current 2,360,875 lbs to 2,403,800 lbs to account for the anticipated additional ice sublimation. The minimum individual ice basket weight would be increased from 1214 lbs to 1236 lbs.

A description of the proposed amendment, and the bases for it, is included in Enclosure 1. TVA's analysis of the issue of no significant hazards consideration, as required by 10 CFR 50.91(a), is included in Enclosure 2. Proposed revised technical specification pages are included in Enclosure 3.

The proposed amendment has been reviewed by the Watts Bar Plant Operations Review Committee and the TVA Nuclear Safety Review Board.

The proposed amendment would allow TVA to perform ice weighing and flow channel inspections coincident with refueling outages, and would eliminate the plant transient associated with a mid-cycle

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outage. The surveillance frequency extension would also reduce the cumulative occupational exposure to personnel involved in performing the surveillances. Additionally, the reduction in surveillance testing will save TVA more than $100,000 over the life of the plant and, therefore, would be considered a cost beneficial licensing action. TVA requests that review and approval of this request be given a high priority.

In accordance with 10 CFR 50.91(b)(1), a copy of this proposed license amendment is being forwarded to the State Designee for the State of Tennessee.

If you should have any questions, please contact John Vorees at (423) 365-8819.

Sincerely,

D. V. Kehoe
Nuclear Assurance
and Licensing Manager

Sworn to and subscribed before me
this 28th day of February 1996

E. Jeannette Long
Notary Public
My Commission Expires July 1, 1997

Enclosures
cc: See page 3

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ENCLOSURE 1

PROPOSED LICENSE AMENDMENT - ICE BED SURVEILLANCE FREQUENCIES

Description of Proposed License Amendment

The proposed amendment would revise the Watts Bar Unit 1 Technical Specifications to change the surveillance frequency for verifying the total weight of stored ice, the azimuthal distribution of ice, and the accumulation of ice or frost on structural members comprising flow channels through the ice condenser, from 9 months to 18 months, and to change the total weight of stored ice and the minimum/average ice weight of ice baskets to support that frequency extension.

Specifically, the frequency for Surveillance Requirements(SR) 3.6.11.2, 3.6.11.3, and 3.6.11.4 would be revised from "9 months" to "18 months." SR 3.6.11.2 would be revised to change the total weight of stored ice from "≥2,360,875 lb" to "≥2,403,800 lb." SRs 3.6.11.2 and 3.6.11.3 would be revised to change the minimum/average ice weight of ice baskets from "≥1214 lb" to "≥1236 lb."

The Watts Bar Unit 1 Technical Specification Bases would be revised to support these changes.

Basis for Proposed License Amendment

SRs 3.6.11.2 and 3.6.11.3 currently require that each ice basket contain at least 1214 lbs of ice and that the average ice weight for each bay and each group-row combination not be less than 1214 lbs per basket at a 95 percent level of confidence at the start of the surveillance interval. WBNs current 1214 lb TS limit is based on a containment analysis that assumes an even distribution of 1093 lbs per ice basket throughout the ice condenser. The 1214 lb per ice basket TS limit contains a conservative allowance for ice loss through sublimation during the weighing interval between and a conservative allowance for ice weighing instrument error. These values are currently 10 percent and 1 percent, respectively. The above limits ensure, at a 95 percent level of confidence, a minimum total ice weight of 2,360,875 lbs.

Because of the increased time between ice weighing intervals (18 months vs. 9 months), the TS limit for the minimum ice basket is revised to specify a weight that is based on 12 percent sublimation and 1 percent instrument error. Therefore, the minimum ice basket weight will be: 1093 x 1.12 x 1.01 = 1236 lbs (approximately). This value will further translate into a total TS weight of 2,403,800 lbs at a 95 percent level of confidence. The current method for determining the 95 percent level of confidence will remain the same. The basis for the ice weight sublimation allowance is discussed in Section 14.1 of the attached evaluation.

Also, based on the past operating experience of other operating ice condenser plants, sufficient ice and flow channel area (SR 3.6.11.4) will be present at the end of an 18 month cycle to ensure that in the unlikely event of a LOCA, containment design pressure will not be exceeded. The current margin between the design pressure and the peak LOCA pressure will not be reduced. The basis for the increased flow channel inspection surveillance interval is discussed in Section 14.2 of the attached evaluation.

Environmental Consideration

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

WATTS BAR ICE CONDENSER
18 MONTH SURVEILLANCE PROGRAM
DESIGN CONFIGURATIONS COMPARISON SUMMARY
SUBLIMATION & FLOW CHANNEL BLOCKAGE ESTIMATES
Report No. MSE-REE-1530
January 24, 1996

1.0 PURPOSE

The following comparison summaries of the different Ice Condenser equipment are presented to show the commonality and differences of each Ice Condenser Plant. The intent is to present a frame of reference for evaluating the thermal performance (heat loads, ice sublimation, flow channel blockage, etc.) of one plant against another. Specifically, this information is summarized further, in Tables No. 1, 2 and 3, to compare the Watts Bar Unit No. 1 plant against the Catawba, D. C. Cook and Sequoyah Plants, which have already received approval to extend their Ice Condenser Technical Specification Surveillance period to 18 months. Table No. 4 projects the expected annual (12 month) and 18 month ice sublimation rates for Watts Bar, and Table No. 5 summarizes the results of flow channel blockage inspections at the TVA Sequoyah Plant Units 1 and 2 for the past 4 years.

2.0 TOP DECK STRUCTURE

The Top Deck Structure, is the uppermost or highest structure in the Ice Condenser Containment System and has the function to support under various load conditions the Ice Condenser Top Deck Blanket Doors, Plenum Bridge Crane, and Air Handling Units (AHU's) and their associated electrical equipment, glycol piping and electrical conduit. It also forms the ceiling or top thermal and vapor barrier boundary of the Upper Plenum Area during normal plant operations. The heat load through the Top Deck Structures and Blanket Doors is approximately 4 1/2% of the total heat load on the ice Condenser refrigeration system.

The Top Deck Structure provides for the free outflow of air and steam during LOCA conditions. All domestic Ice Condenser Plants have the same design configuration Top Deck Structure and Blanket Doors. Some minor differences occur in the details of the blanket door fabrication, method of attachment of the Radial Beams to the top of the crane wall, and Plenum Bridge Crane and Crane Rails.

The Top Deck Structure consists of the Radial Support Beams which are anchored in the top of the crane wall as cantilevered beams, AHU Support Beams which are circumferential beams spanning between selected radial beams, and Plenum Bridge Crane Rails which are attached to each Top Deck Radial Beam all around the containment building. A welded grating structure, attached to the top deck circumferential beams provides the base and support for the radially aligned flexible Top Deck Blanket

Doors, and accommodates traffic by inspectors and maintenance personnel.

The Top Deck Blanket Doors are attached to the top of the Crane Wall via hinge bar clamps. A pair of blanket doors covers one-half a bay area, extending from the radial centerline of the bay to the edge of the adjacent top deck radial beam. One blanket door assembly rests on the top deck grating, with the second blanket resting on the first one, bands touching.

3.0 UPPER PLENUM AREA

The Upper Plenum area is that portion of the Ice Condenser above the ice bed and Intermediate Deck up to the Top Deck Structure where the Air Handling Units (AHUs), Plenum Bridge Crane rails, glycol and condensate drain piping exist. It is the vertical insulated surfaces formed by the static insulation wall panels mainly on the Crane Wall and Containment vessel wall, and the Equipment Access Doors in the End Walls. The heat load through the walls of the Upper Plenum Area is approximately 6% of the total heat load on the Ice Condenser refrigeration system. There are two Upper Plenum Area configurations applicable for domestic Ice Condenser plants. All Equipment Access Doors are identical.

3.1 Configuration 1 Upper Plenum Area

The static insulation panels on the Crane and Containment Vessel walls are prefabricated self contained panels with fiberglass insulation batting inside and mounting brackets for attachment to wall studs. The individual panels are adjustable in thickness to accommodate variations in wall radial location. This configuration is applicable to the D. C. Cook Units 1 and 2, and Sequoyah Unit 1.

3.2 Configuration 2 Upper Plenum Area

The static insulation panels on the Crane and Containment Vessel Walls are formed by installing pillows of polyethylene bagged fiberglass between vertical support struts bolted to studs on the walls. The bagged insulation is then covered with galvanized sheet metal covers. Thickness adjustment of the insulation panels is accomplished by adjustment of the vertical strut members in or out from the wall surface. This configuration is applicable to Watts Bar Unit 1, Sequoyah Unit 2, Catawba Units 1 and 2, and McGuire Units 1 and 2.

4.0 INTERMEDIATE DECK STRUCTURE

The Intermediate Deck Structure forms the horizontal ceiling of the ice bed region and the floor for the upper plenum area. It serves as a thermal and vapor barrier, which allows limited air movement between these regions during normal plant operation and the free outflow of air and steam following a LOCA. All domestic Ice Condenser Containment plants have the same design configuration Intermediate Deck Structure and Doors.

The Intermediate deck is separated into 48 subsections, 2 subsections per each Ice Condenser Bay area, an inner and an outer subsection. Each subsection covers an area over a length of 3 lattice frames and width of approximately half the ice condenser annulus. Except for dimensional differences, the two subsections are identical.

Each subsection consists of 4 door panels mounted via hinges to a steel framing. The door panels are oriented in pairs back to back on common hinges. The framing is bolted to Intermediate Deck Support Beams which radially span the ice condenser annulus. The support beams are bolted to the tops of the Lattice Frame Support Columns.

The door panels are sandwich structures, consisting of a structural steel framing with a urethane foam insulation core and galvanized sheet steel covers bonded to the insulation and mechanically fastened and welded to the structural framing. During normal operations the door panels lay horizontally flat compressing a compliant bulb-type seal attached to the subsection framing.

5.0 CRANE WALL AND END WALL AIR DUCT PANELS AND CRADLE SUPPORTS

The Wall Air Duct Panels are designed to thermally insulate the ice bed, under normal operating conditions, from the heat conducted through the Crane and End Walls. They are designed to provide a circulation path for cold air and a heat transfer surface area next to the ice bed so that ice is maintained in its design temperature range. The Crane and End Wall Panels pick up approximately 20% of the total heat load on the Ice Condenser Refrigeration system. There are two basic configurations of Crane Wall and End Wall Air Duct designs.

5.1 Configuration 1 Crane Wall Air Duct

The original back-to-back air duct design configuration incorporated an insulation layer of rigid fiberglass board (Glastrate) between the front (downflow side) and the back (upflow side) of the air duct panel. This configuration is applicable for the D. C. Cook Unit 1 and 2, and Sequoyah 1 and 2 plants.

5.2 Configuration 2 Crane Wall Air Duct

The back-to-back air duct design was later changed to eliminate the glastrate insulation between the front and back air duct sections. This configuration is applicable to the Watts Bar 1, McGuire 1 and 2 and Catawba 1 and 2 plants.

5.3 CRANE WALL CRADLE SUPPORTS

The Cradle Supports for the Wall Air Duct Panels provides for the transfer of the radial and tangential loads from the lattice frame columns to the Crane and End Walls anchor embedments. The cradles attach to studs (collar studs) welded to the wall embedment plates. The cradle design incorporates transverse beam sections which are fabricated from standard structural sections (rectangular tubing) and to which the lattice frame column mounting lugs are attached. These transverse beams are attached to the rear mounting angle assemblies of the cradles by insulated bolts. The design configuration for the Cradle Supports are similar for all domestic Ice Condenser Plants. Minor differences exist in the fabrication details of the hardware.

The Crane and End Wall Air Duct Panels extend down from the bottom of the Upper Plenum Area down to the top of the Lower Support Structure (LSS) and are supported on the Inner Circumferential Beam and horizontal platform of the LSS.

6.0 CONTAINMENT WALL AIR DUCT WALL PANELS AND INSULATION

The Wall Air Duct Panels are designed to thermally insulate the ice bed, under normal operating conditions, from the heat conducted through the Containment Vessel Wall. They are designed to provide a circulation path for cold air and a heat transfer surface area next to the ice bed so that ice is maintained in its design temperature range. The Containment Wall Panels pick up approximately 20% of the total heat load on the Ice Condenser Refrigeration system. There are two configurations of Wall Panel Air Ducts for the Containment Wall side.

6.1 Configuration 1 Containment Wall Air Duct

The air duct assemblies are attached to structural support cradles which are bolted to weld studs on the containment vessel steel liner. Bagged insulation blankets or batting is installed prior to attachment of the wall panels and fills the gaps between wall panels and the vessel wall. This configuration is applicable to the D. C. Cook Units 1 and 2.

6.2 Configuration 2 Containment Wall Air Duct

The air duct assemblies are attached to vertical sheet metal mounting struts which are bolted to weld studs on the containment vessel steel liner. Blown foam insulation is then injected through installation holes in the struts to fill all the void spaces between the wall panels and the vessel wall. This configuration is applicable to Watts Bar Unit 1, Sequoyah Units 1 and 2, Catawba Units 1 and 2, and McGuire Units 1 and 2.

7.0 ICE BASKETS

The function of the ice baskets is to contain borated ice in 12 inch diameter columns 48 feet high and to provide good heat transfer from the steam to the ice in the event of a LOCA within the containment building. The function of the ice baskets is also to provide adequate structural support for the ice and to maintain the geometry for heat transfer during and following the worst design load cases.

The originally furnished basket columns were made up of 4 basket assemblies, each approximately 12 feet long, consisting of one bottom basket and 3 upper baskets, each coupled together with an internal coupling ring. The bottom basket assembly has a bottom attachment hold down assembly for connection to the Lower Support Structure (LSS). Each basket assembly has a midspan internal stiffener ring, similar in configuration to the coupling ring. The coupling and stiffener rings are located every 6 feet along the length of the ice basket column assembly, corresponding to the locations of each Lattice Frame Support, and provide localized reinforcement against impact loadings during postulated seismic and blowdown events. The coupling and stiffener rings have an internal flange and cruciform insert support which serve to prevent ice from falling down during and after a LOCA event.

All originally furnished ice basket assemblies are identical for all domestic ice condenser plants. The only real difference would be the Clevis Mounting Bracket on the Basket Bottom Attachment Assembly for the D. C. Cook Plants is a stainless steel weldment while all other domestic plants have a cast stainless steel Mounting Bracket.

8.0 LOWER SUPPORT STRUCTURE

The function of the Lower Support Structure (LSS) is to support and hold down the loaded ice basket columns in the required array and maintain the integrity of the Ice Condenser. It provides attachment for Lattice Frame Support Columns, Lower Inlet Door Shock Absorbers, Ice Basket holddown devices, Flow Turning Vanes and a Containment Wall Jet Impingement Shield.

The LSS provides a horizontal platform for the bottom of the Ice Condenser Ice Bed. This horizontal platform assembly is supported by 25 Radial Portal Frame Assemblies spaced approximately 13 degrees apart between adjacent portal frames. The entire structure forms a total of 24 equal sized portal bays. Each Radial Portal Frame Assembly is comprised of 3 columns which are pinned to the Ice Condenser Support Floor via floor pier embedments.

The platform assembly is comprised of inner and outer platform assemblies which span between the Radial Portal Frames. The inner platform assembly is comprised of the inner circumferential beam and half the middle circumferential beam with radial beams spanning between, and the outer platform assembly is comprised of the outer circumferential beam and the other half of the middle circumferential beam with radial beams spanning between. The ice basket hold down devices attach to the radial beam members of the inner and outer platform assemblies. The inner and outer circumferential beams are straight wide flange beams, while the straight middle circumferential beam is made by bolting two channel sections back to back. The Lattice Frame Columns bolt to the inner and outer circumferential beams. The insulated air duct panels on the Crane Wall are supported by the inner circumferential beams, the Containment Wall air duct panels rest on the Ice Condenser floor.

8.1 Configuration 1 (LSS)

This configuration has an A-B Column Line Portal Frame fabricated as a full height box section. The Containment Wall Flow Impingement Plate is fabricated from T-Beams welded to a 3/4' plate with slotted holes cut in it. The Ice Basket tie down attachments to the inner and outer horizontal platforms are 9 continuous circumferential bars 2" high x 1" thick, connecting to each radial beam for the entire length around the ice condenser. The inner and outer horizontal platform radial beam members are a box beam member fabricated from a C10x25 channel section and 1/4" thick plate steel. This configuration is applicable to the D. C. Cook Units 1 and 2 and the Sequoyah Unit 1 plants.

8.2 Configuration 2 (LSS)

The A-B Column Line Portal Frame Assembly has a 2" thick steel plate connecting the columns full height. The Containment Wall Flow Impingement Shield is a weld fabricated section made up of horizontal H-Beams. The ice basket hold down plates attached to the horizontal platform radial beam members are individual 2" high x 1" thick x 3 1/2" long steel plates. The inner and outer horizontal platform radial beams are 2" thick x 9" or 10" high solid steel bars. This configuration is applicable to the Watts Bar Unit 1 and Sequoyah Unit 2 plants.

8.3 Configuration 3 (LSS)

This configuration is identical to Configuration 2, except that plate coil heat exchanger panels are attached to the LSS Inner Circumferential Beams. The coils are piped to the floor cooling system and the intent of this hardware is to intercept heat being conducted through the crane wall above the LID's and the convective air currents coming off the LID's. This configuration is applicable to the McGuire Units 1 and 2 and Catawba Units 1 and 2 plants.

9.0 LOWER INLET DOORS

The Ice Condenser Lower Inlet Doors (LID) form the barrier to air flow through the inlet ports of the ice condenser crane wall for normal unit operation. They also provide the continuation of thermal insulation around the lower section of the crane wall to minimize heat input that could promote sublimation and mass transfer of ice in the ice condenser compartment. Approximately 1 1/2% of the total heat load on the Ice Condenser refrigeration system is the result of conduction through the LIDs. Another 2% of the total heat load is attributed to air leakage out of the LIDs.

In the event of a LOCA or HELB, causing a pressure increase in the lower compartment, the doors open, venting air and steam relatively evenly into all sections of the ice condenser. The doors are of a simple mechanical design to minimize the possibility of malfunction.

Twenty-four pairs of inlet doors are located on the ice condenser side of the inlet ports in the crane wall at an elevation slightly above the ice condenser floor. Each door panel is 92.5" high, 42" wide and 7 1/2" thick. Each door panel is hinged vertically on a common structural frame which is bolted to embedment plates in the crane wall.

Each door panel consists of a 1/2" thick fiber reinforced polyester (FPR) face plate stiffened by 6 structural ribs, bolted to the plate. The FPR plate is designed to take vertical bending moments resulting from pressure generated from a LOCA and from subsequent stopping forces on the door. The ribs are designed to take horizontal bending moments and reactions, as well as tensile loads resulting from the door angular velocity, and transmit them to the crane wall via the hinges and door frame.

Seven inches of urethane foam insulation is bonded to the back of the FPR plate to provide thermal insulation. Heat conducted through the LID into the Ice Condenser accounts for about 1.5% of its total heat load. The front and back surfaces of the door are protected by a 26 gauge stainless steel sheet cover which provides a complete vapor barrier around the insulation. The urethane foam insulation and stainless steel covers do not carry door moments and shearing forces.

Three door hinge assemblies are provided for each door panel. Each assembly is connected to two of the door structural ribs, and the bearing housing is bolted to the structural framing with 4 bolts. Loads from each of the two ribs are transmitted to a single 1.572" dia. hinge shaft through brass bushings. The brass bushings have a spherical outer surface which prevents binding which might otherwise be caused by door rib and hinge bar flexure during loading conditions. The hinge shaft is supported by two self-aligning, spherical roller bearings in the cast steel housing. The hinges are designed to prevent galling and self-welding.

The door panel is sealed to the frame by a compliant rubber bulb seal which attaches to support channels welded to the structural framing. During normal operations these seals are compressed by the cold air head of the ice bed acting on the back of the door panels. Air leakage past the door seals is estimated at accounting for about 2% of the total heat load on the Ice Condenser.

Each door panel is provided with 4 flow positioning springs. One end of each spring is attached to the front of the door panel and the other to a spring housing mounted on the structural framing. These springs provide a door return torque proportional to the door opening angle and thus satisfy the requirement for flow proportioning. In addition they assure that the door closes in the event they are inadvertently opened during normal operations. The LID door panels and associated hardware are identical for all domestic Ice Condenser plants.

Each door panel has a shock absorbing device (Shock Absorber) behind it attached to the Lower Support Structure (LSS) portal framing. The shock absorbers prevent the door panels from being destroyed during opening impact under design LOCA conditions, and they distribute and limit the door impact loads on the LSS.

There are three configurations of LID structural framing which attach the LID to the Crane Wall.

9.1 Configuration 1 LID Framing

This configuration arrangement utilizes the combined attachment of the LID structural framing to the Crane Wall at the portal opening with Tie Bars and bolting through the framing. The Tie Bars connect each LID frame to the adjacent frames on each side of it, and at the end door frames the Tie Bars attach to the Crane Wall. This method of attachment redistributes the reaction loads on the door frames and limits the reaction loads directly into the Crane Wall attachments. This configuration is applicable only for the D. C. Cook Unit 1 plant.

9.2 Configuration 2 LID Framing

This configuration is commonly referred to as the "Belly Band" Support or attachment configuration for the LID frame attachment to the Crane Wall. For this arrangement structural shape members and threaded rods are used to tie each LID frame to the Crane Wall by spanning around the concrete at the portal openings and Tie-Bars weld connect each frame to adjacent frames. Each individual frame is also bolted through the frame to crane wall embedment plates with high strength cap screws This attachment was necessary because there wasn't enough steel reinforcement in the Sequoyah Unit 1 Crane Wall design to take the reaction loads and moments from the LIDs during Design Basis events. This configuration is applicable only for the Sequoyah Unit 1 plant.

9.3 Configuration 3 LID Framing

This is the normal intended attachment of the LID framing to the crane wall with high strength cap screws through bolt holes in the framing and into drilled and tapped holes in Crane Wall embedment plates . This configuration is applicable to the Watts Bar Unit 1, Sequoyah Unit 2, McGuire Units 1 and 2, and Catawba Units 1 and 2 plants.

10.0 LID SHOCK ABSORBER

The Shock Absorbers have the function of dissipating the large kinetic energies resulting from pressures acting on the LIDs during a LOCA event. Each door is provided with a shock absorber assembly which is bolted to the LSS portal framing.

In operation, the door panel first contacts the shock absorber at an opening angle of 55 degrees and crushes it to approximately 30 percent of its original thickness. Stopping forces are distributed evenly over the outer two-thirds of the door panel, centered about the door center of percussion. Forces and bending moments on the door are minimized, and, once the door is opened, there is negligible tendency for the door to bounce closed again. There are two shock absorber configuration types that can be utilized in ice condenser plants.

10.1 Configuration 1 Shock Absorber

This Shock Absorber is a wedge shaped phenolic foam pad, 89" high x 32" wide x 28" thick at its maximum section, refer to Figure No. 12. The pad is bonded to a base plate which bolts to the LSS. The pad is covered with a flexible, fiberglass filament reinforced plastic sheet to prevent water ingress during operation and to retain foam particles following a LOCA. The plastic cover is in turn protected on the front, top and bottom by a thin stainless steel cover, and the remaining sides by a stainless steel wire mesh cloth material. Energy is dissipated by the crushing of the phenolic foam material. This configuration is applicable for the D. C. Cook Units 1 and 2, and Sequoyah Unit 1 plants.

10.2 Configuration 2 Shock Absorber

Configuration 2 is called an air-box type shock absorber. In place of the phenolic foam wedge a stainless steel sheet metal box structure dissipates the design kinetic energies by the compression of the air trapped inside the sheet metal box structure, by the controlled release of that compressed air through metering orifices located at the top and bottom of the sheet metal box, and by the collapse and deformation of sheet metal. This configuration is applicable to the Watts Bar Unit 1, Sequoyah Unit 2, McGuire Units 1 and 2, and Catawba Units 1 and 2 plants.

11.0 FLOOR STRUCTURE

The functions of the Ice Condenser Floor Structure are defined as follows;

1. The floor cooling system has sufficient heat removal capacity to absorb 90 percent of the heat flowing towards the ice compartment, or ice bed, from the lower crane wall and lower compartment, below the ice condenser, with the cooling system operating at normal minimum capacity.

2. The cooling system is designed so that the floor may be heated for defrosting by heating the circulated ethylene glycol solution.

3. Following the malfunction of the cooling equipment, sufficient thermal resistance to the flow of heat into the ice bed is provided to maintain the ice load for a period of one week.

4. The floor's top wear slab transfers the ice condenser design floor loads to the concrete support walls below.

The Ice Condenser Floor, a cantilevered structure off of the Crane Wall, is a cooled concrete surface with embedded piping for a circulated liquid coolant (ethylene glycol/water 50/50). The entire floor structure is supported by concentric reinforced concrete support curbs within the concrete floor structure. The spaces between the concrete support curbs is lined with a vapor barrier material and filled with insulation (foam concrete) to minimize heat flow from the equipment rooms below to the ice condenser floor top surface wear slab. The heat load picked up by the floor cooling system is approximately 15% of the total refrigeration system heat load. Another approximately 7% of the total heat load is the result of floor drains and conduction through the Lower Support Structure floor embedments.

The top surface wear slab is cut out around the Lower Support Structure (LSS) Pedestal Floor Embedments. None of the LSS bears upon the floor wear slab. The entire floor structure is supported off the crane wall and end walls.

The floor structure is located at an elevation below the Lower Inlet Door Assemblies such that ice fallout from the ice basket columns during a seismic event will not interfere with the opening of the Lower Inlet Doors during a LOCA event. There are 4 different floor configurations among the domestic Ice Condenser Plants.

11.1 Configuration 1 Floor Structure

The structural Ice Condenser floor is tied into the structural floor of the compartments below it by support columns out at the end of the cantilevered floors. This approach utilizes both floors to resist the design loads imposed from design basis accident and seismic events.

The structural floor has reinforced concrete inner and outer circumferential curbs and radial curbs between each bay area which forms 14 1/2" deep cavities for foam concrete insulation. This configuration is applicable to D. C. Cook Units 1 and 2.

11.2 Configuration 2 Floor Structure

The cantilevered structural floor is a post-tensioned design connecting through the crane wall. The floor has a reinforced outer circumferential curb and radial curbs between each bay area. The curbs and the crane wall form 15" deep cavities for the foam concrete insulation. This as-designed configuration is comparable thermally to configuration 1. This configuration is applicable to Sequoyah Units 1 and 2.

The foam concrete floor insulation at both Sequoyah Units has been degraded thermally and structurally due to water saturation and foam fracturing from periodic freeze/thaw cycling. The degree of thermal degradation relative to the as-designed configuration has not been determined.

11.3 Configuration 3 Floor Structure

The cantilevered structural floor has a reinforced concrete outer circumferential curb and no inner circumferential curb or radial curbs. The outer curb and the crane wall and end walls form a 9" deep cavity for the foam concrete insulation. This configuration is applicable to the McGuire Units 1 and 2 and Catawba Units 1 and 2 plants.

11.4 Configuration 4 Floor Structure

The cantilevered 24" thick structural floor has a reinforced concrete outer circumferential curb and radial curbs between each bay area. The outer curb, radial curbs, and Crane Wall form 10" deep cavities for the foam concrete insulation. This design results in a 30% reduction in the heat conducted through the floor into the floor cooling system and ice condenser, as compared to Configurations 1 and 2. The reduced floor heat load equates to an approximate 5% reduction in the total heat load on the Ice Condenser refrigeration system. This configuration is applicable to Watts Bar Unit 1.

12.0 CONTAINMENT LOWER COMPARTMENT CHILLED WATER AIR COOLERS

Most domestic Ice Condenser Plants have raw service water air cooling units to remove heat from their lower containment compartment. These plants will typically have lower compartment temperatures of approximately 100-120° F.

The Catawba Plant Units 1 and 2 have chilled water air cooling units in the lower containment compartments which keep the lower compartments temperatures 80°F to <90°F. For these air chillers, 3600 gpm of refrigerated water (42-44°F) is circulated to large copper air cooling coils, providing 1200 tons of refrigeration for the containment building. The lower compartment air temperature from the chiller water coolers results in a lower ice condenser heat load. It has been estimated that the reduced lower containment volume temperature could result in an approximate 5% reduction of the total heat load on the Ice Condenser refrigeration system.

Watts Bar Unit 1 has lower containment compartment air coolers supplied with raw service water and provides approximately 340 tons of refrigeration to the containment building.

13.0 CONTAINMENT VESSEL/SHIELD BUILDING ANNULUS

All domestic Ice Condenser Plants, except the D. C. Cook Units 1 and 2, have an annulus region between their steel containment vessel liner and their concrete shield building wall. The annulus is approximately 8 feet wide and provides an air insulation gap and a means of spreading environmental heat loads (no hot spots). The steel vessel liner for the D. C. Cook Plants is directly up against the shield building concrete.

14.0 COMPARISON & RESULTS SUMMARY

14.1 ICE WEIGHT SUBLIMATION ALLOWANCE

A qualitative analysis comparison of equipment, plant configuration and heat loads is presented in Table No. 3, where the Catawba, D. C. Cook, and Sequoyah Ice Condenser plant designs are rated against the Watts Bar plant design. The results show that the Watts Bar plant is better thermally than the D. C. Cook and the Sequoyah Ice Condenser plant designs. The obvious conclusion from this comparison is that Watts Bar should have lower refrigeration heat loads and lower ice sublimation losses than either of these two plants.

Catawba, on the other hand, is better overall thermally than Watts Bar, mainly because of their Containment Lower Compartment chilled water air coolers. It was estimated that the net effect of these air coolers is to produce a 4 percent lower refrigeration system heat load than Watts Bar.

The majority of the plant ice sublimation data available at the present time comes from the Duke Power Catawba Plants. Duke Power's Catawba Plant took the lead of all the Ice Condenser Plants when it came to weighing and collecting data that can support an ongoing trending evaluation relative to ice sublimation. Catawba was the first plant to obtain and use the B&W Nuclear Technologies "ICEMAN" hardware and software which allows a plant to record, store and manipulate this information.

A conservative approach to estimate the potential ice sublimation losses at Watts Bar, knowing the Catawba plant data, is to add the resulting ice sublimation from this heat load differential to the Catawba sublimation data. It is assumed that the net difference on the plants refrigeration system heat load bypasses the ice condenser refrigerated boundaries and gets into the ice bed before eventually being removed by the refrigerated air duct wall panels. More realistically, a large portion of this heat would be intercepted by the floor cooling system before reaching the ice bed.
For the Ice Condenser geometry the relationship $Q_{Sublimation}/Q_{Total} = 0.061$ has been established for the heat load coming in from the lower Ice Condenser regions. The effect of $Q_{Sublimation}$ on the annual ice bed sublimation is then determined by the following relationship;

$$\%_{Sublimation} = \frac{Q_{Sublimation} \text{Btu/hr} \times 8760 \text{ hr/year}}{1220 \text{ Btu/lb}_m\text{ice} \times 2.45\times10^6 \text{ lb}_m\text{ice}} \times 100$$

If an additional 4 percent of the plants total refrigeration load were induced into the bottom area of an ice condenser it's effect could be an additional 0.5 percent annual ice sublimation loss as an overall average. In Table No. 2, this additional sublimation has been added to the Catawba Group Average Annual and Bay Average Annual Sublimation percentages (conservative) to project the corresponding Watts Bar rates of 1.8% + 0.5% = 2.3 percent. The Watts Bar Crane Wall Row Average, and the Crane Wall Row Groups 1, 2 and 3 Average Annual Sublimation rates were then obtained by ratioing up the corresponding largest Catawba (Unit 1 or Unit 2) annual sublimation percentages against the new projected Group or Bay averages.

If it is assumed that sublimation is a linear function, as was done in the Duke Power Catawba and the TVA Sequoyah requests for Technical Specification changes, for extending Ice Condenser Surveillances from 9 months to 18 months, then the projected sublimation for an 18 month operating period, as well as, the 12 month period, are presented in Table No. 4. The resulting calculated 18 month sublimation rates for Group, Bay, and Crane Wall Row averages are still within the original 10 percent allowance for sublimation loss (difference between Technical Specification minimum ice weight and the minimum Analysis weight). However, the projected 18 month sublimation rates for Crane Wall Row Group 1 and 3 averages are higher, at 10.56 percent and 11.5 percent, respectively. Therefore, it is recommended that the Sublimation Allowance be increased from 10 percent to 12 percent, as is shown in Table No. 1, to account for these projected specific population sublimation rates.

14.2 FLOW CHANNEL BLOCKAGE ALLOWANCE

The TVA Sequoyah Plant is the only Ice Condenser Plant that has detailed inspection records that can be used to quantitively determine how flow channel passageway blockages, from ice and frost accumulations, are occurring or changing during normal plant operations.

The Sequoyah Nuclear Plant Units 1 and 2 changed their Technical Specification inspection procedures for determining ice bed flow channel passageway blockages in the 1987-88 time frame, from a random inspection of 2 flow channels per ice condenser bay looking for ice accumulations greater than or equal to 3/8 inch in thickness, to a procedure where 33% or 100% (if the 33% inspection fails) of 162 designated flow channels in each of the 24 ice condenser bays are inspected and *blockages of 0, 25, 50, 75 or 100 percent are determined for each inspected flow channel and a statistical average blockage per bay is determined. The average determined bay blockage must be below 15%. The Duke Catawba and American Electric Power Service Corp. (AEPSC) D. C. Cook Plants still determine flow channel blockages by the original inspection of 2 random flow channels per bay.

Sequoyah Unit 1 and Unit 2 Flow Channel Blockage Inspection data from 1990 through 1995 has been evaluated and a summary presented in Table No. 5 of this report. The data shows that, for the most part, ice and/or frost accumulations in the flow channels tend to redistribute from one bay to another with a general gradual reduction in blockages. Specifically, bays that start with higher percentages of blockages tend to experience a general loss of flow channel blockages from one inspection period to the next, while bays with clean passageways tend to experience the higher increases in blockage. The largest blockage changes, increases or decreases, as identified in Table No. 5, were consistently bays that were, very clean or had the highest blockages, respectively, from one as-left inspection period to the next as-found inspection period.

Changes in flow channel blockages should follow proportionally with how sublimation is occurring in the ice bed. If sublimation losses are generally high, then a proportional increase in frosting of flow channels will occur. If sublimation is small or smaller for one operation period over another, then flow channel blockage will be small or the trend is a general reduction in blockages. This is shown in the 1993 sublimation data presented in Table No. 2 and the 1993 flow channel blockage data presented in Table No. 5 for Sequoyah Unit 2, where sublimation rates were low and the corresponding flow channel blockages were decreasing. The 1993 period for Sequoyah Unit 2 is the only time where corresponding sublimation and flow channel blockage data are available.

Based on the above observations and deductions from the data collected at Sequoyah, and from the fact that vigorous flow channel passageway cleaning is a consistent part of ice bed maintenance during refueling outages at all ice condenser plants, it is concluded that extending the surveillance period for flow channel inspections from once every 9 month period to once every 18 month period is justifiable for the Watts Bar Plant.

E1 (A-15)

COMPARISON OF ICE CONDENSER PLANTS WITH 18 MONTH TS SURVEILLANCE CYCLES

	TVA/old	TVA/new	DCP/old	DCP/new	AEP/old	AEP/new	WAT/old	WAT/new
TS Change Granted		3/2/90		Early 1991		8/23/94		
TS Change Requested		1/12/90		12/11/90		11/15/93		
TS Ice Weighing Period Mth	9	18	9	18	9	18	9	18
TS Flow Passageway Inspection Period Mth	12	12	9	9	9	18	9	18
TS Minimum IceWt/basket Lbs	1200	1155	1218	1273	1220	1220	1214	1236
Analysis Ice Wt/basket Lbs	1080	993	1097	1097	1087	1087	1093	1093
Sublimation Allowance %	10	15	10	15	10	10	10	12
Sublimation Allowance Lbs	108	149	109	164	122	122	109	131
Measurement Allowance %	1	1	1.1	1.1	1	1	1	1
Measurement Allowance Lbs	12	13	12	12	11	11	12	12
Total TS Ice Inventory Lbs	2333100	2245320	2368652	2475252	2371450	2371450	2360875	2403800
Analysis Ice Inventory Lbs	2100000	1930000	2132000	2132000	2110000	2110000	2125000	2125000

TVA - Sequoyah Units 1 and 2
DCP - Catawba Units 1 and 2
AEP - D. C. Cook Units 1 and 2
WAT - Watts Bar Unit 1

Table No. 1

E1 (A-16)

ANNUAL SUBLIMATION PERCENTAGE COMPARISONS OF ICE CONDENSER PLANTS

Basket Population		TVA (1990)	TVA (1992)	TVA (1993)	DCP (1993)	AEP (1991)	WAT
Crane Wall Row Avg Annual Sublimation	U1			10.97	4.47		6.05*
	U2	10.52	7.43	-1.67	4.74		
Crane Wall Row Gr 1 Avg Annual Sublimation	U1			10.7	5.37		6.9*
	U2	14	6.77	4.34	5.41		
Crane Wall Row Gr 2 Avg Annual Sublimation	U1			8.78	3.27		3.52*
	U2	5	7.95	-3.57	2.75		
Crane Wall Row Gr 3 Avg Annual Sublimation	U1			13.43	4.79		7.74*
	U2	12.57	7.58	-5.77	6.06		
Group Avg Annual Sublimation	U1			4.94	1.58	0.93	2.3*
	U2		2.92	2.85	1.8	2.0	
Bay or Overall Avg Annual Sublimation	U1			4.25	1.6	1.6	2.3*
	U2	4.14	1.25	3.92	1.8	2.4	

* - Projected estimate based against the highest DCP sublimation data and WAT having a 4% higher heat load.

TVA - Sequoyah Units 1 and 2
DCP - Catawba Units 1 and 2
AEP - D. C. Cook Units 1 and 2
WAT - Watts Bar Unit 1

Table No. 2

HEAT LOAD COMPARISONS AGAINST WATTS BAR UNIT 1

Ice Condenser Equipment	Catawba 1 & 2	Cook 1 & 2	Sequoyah 1 & 2
Top Deck Structure	Same	Same	Same
Upper Plenum Area	Same	Plus	Plus
Intermediate Deck	Same	Same	Same
Crane Wall Air Ducts & Cradles	Same	Plus	Plus
Vessel Wall Air Ducts & Insulation	Same	Plus	Same
Ice Baskets	Same	Same	Same
Lower Support Structure	Minus (0.2%)	Same	Same
Lower Inlet Doors	Same	Same	Same
LID Shock Absorbers	Same	Same	Same
Vessel/Shield Building Annulus	Same	Plus	Same
Floor	Plus (1.4%)	Plus	Plus
Lower Compartment Coolers	Minus (5.2%)	Same	Same
Total Heat Load	Minus (4%)	Plus	Plus

Plus or Minus - Indicates that the heat load on the refrigeration system (total heat load) from that particular area is higher or lower, respectively, in relationship to that at the Watts Bar Plant.

Table No. 3

PROJECTED WATTS BAR ICE SUBLIMATION PERCENTAGES

Basket Population	Watts Bar 12 Mth	Watts Bar 18 Mth
Crane Wall Row Average Sublimation	6.05	9.08
Crane Wall Row Group 1 Avg Sublimation	6.9	10.35
Crane Wall Row Group 2 Avg Sublimation	3.52	5.28
Crane Wall Row Group 3 Avg Sublimation	7.74	11.6
Group Average Sublimation	2.3	3.45
Bay Average Sublimation	2.3	3.45

Table No. 4

SEQUOYAH FLOW CHANNEL BLOCKAGE PERCENT ANNUAL CHANGES

Flow Channel Population		TVA (1992)	TVA (1993)	TVA (1994)	TVA (1995)
Group 1 Bay Annual Average	U1 U2	-2.03 N/A	N/A -0.93	2.72 -2.38	-4.91 N/A
Group 2 Bay Annual Average	U1 U2	-0.42 N/A	N/A -5.3	2.19 -1.25	-1.91 N/A
Group 3 Bay Annual Average	U1 U2	-2.54 N/A	N/A -1.43	2.57 0.43	-3.90 N/A
Bay Annual Average	U1 U2	-1.66 N/A	N/A -2.55	2.49 -1.07	-3.57 N/A
Largest Blockage Increase/ Bay#	U1 U2	7.1 / Bay 14 N/A	N/A 7.78 / Bay 17	7.08 / Bay 3 4.2 / Bay 22	1.39 / Bay 20 N/A
Largest Blockage Decrease/ Bay#	U1 U2	-8.5 /Bay 22 N/A	N/A -8.69 / Bay 10	-7.16 / Bay 20 -6.2 / Bay 12	-8.3 / Bay 23

N/A - Data not available for that specific year.

Negative (-) percentages indicate an as-found reduction in flow channel blockage from previous as-left recorded measurements.

Table No. 5

ENCLOSURE 2

NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

Description of Proposed License Amendment

The proposed amendment would revise the Watts Bar Unit 1 Technical Specifications to change the surveillance frequency for verifying the total weight of stored ice, the azimuthal distribution of ice, and the accumulation of ice or frost on structural members comprising flow channels through the ice condenser, from 9 months to 18 months, and to change the total weight of stored ice and the average ice weight of sample baskets to support that frequency extension.

Specifically, the frequency for Surveillance Requirements(SR) 3.6.11.2, 3.6.11.3, and 3.6.11.4 would be revised from "9 months" to "18 months." SR 3.6.11.2 would be revised to change the total weight of stored ice from "≥2,360,875 lb" to "≥2,403,800 lb." SR 3.6.11.3 would be revised to change the average ice weight of sample baskets from "≥1214 lb" to "≥1236 lb."

The Watts Bar Unit 1 Technical Specification Bases would be revised to support these changes.

Basis for No Significant Hazards Consideration Determination

The Nuclear Regulatory Commission has provided standards for determining whether a significant hazards consideration exists (10 CFR 50.92 (c)). A proposed amendment to an operating license for a facility involves no significant hazards consideration if operation of the facility in accordance with the proposed amendment would not (1) involve a significant increase in the probability or consequences of an accident previously evaluated; or (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety. Each standard is discussed below for the proposed amendment.

(1) Operation of the facility in accordance with the proposed amendment would not involve a significant increase in the probability or consequences of an accident previously evaluated.

The ice condenser system is provided to absorb thermal energy release following a LOCA or high energy line break (HELB) and to limit the peak pressure inside containment. The containment analysis for Watts Bar is based on a minimum of 1093 lbs of ice per ice basket evenly distributed throughout the ice condenser, and the subcompartment analysis is based on 85 percent of the available flow area (flow channels) being open uniformly throughout the ice condenser. For the predicted sublimation rate of up to 12 percent for 18 months, an average ice basket weight of 1093 lbs at the end of the 18 month period would still be available. An evaluation of the operating history of the other operating ice condenser plants shows that after 18 months 85 percent of the flow channels will still be available.

Based on TVA's evaluation, TVA considers the revised minimum ice weight to be acceptable for satisfying the safety function of the ice condenser for the proposed 18 month ice weighing interval. Based on TVA's findings from the review of historical inspection data for flow channel blockage, TVA considers the extended 18 month inspection interval to be acceptable for satisfying the requirement to have at least 85 percent of the flow channels free from blockage.

(2) Operation of the facility in accordance with the proposed amendment would not create the possibility of a new or different kind of accident from any accident previously evaluated.

TVA's request for an 18 month ice weighing and flow channel inspection interval will not result in a new or different kind of accident from that previously analyzed in WBN's Final Safety Analysis Report. WBN's ice condenser serves to limit the peak pressure inside the containment following a LOCA. TVA has evaluated the containment pressure analysis for WBN and determined that sufficient ice would be present at all times to keep the peak containment pressure below WBN's containment design pressure.

(3) Operation of the facility in accordance with the proposed amendment would not involve a significant reduction in a margin of safety.

The ice condenser system is provided to absorb thermal energy release following a LOCA and to limit the peak pressure inside containment. The current ice condenser analysis for WBN is based on a minimum of 1093 lbs of ice per basket and at least 85 percent of the flow channels around the ice baskets being available.

The analysis shows that using an average ice basket weight of 1236 lbs and a sublimation rate allowance of 12 percent, all bays would have an average ice basket weight of 1093 lbs, and 85 percent of all the flow passageways are available, at the end of the 18 month interval.

Summary

Based on the above analysis, TVA has determined that operation of Watts Bar in accordance with the proposed amendment would not (1) involve a significant increase in the probability or consequences of an accident previously evaluated, (2) create the possibility of a new or different kind of accident from any accident previously evaluated, or (3) involve a significant reduction in a margin of safety; therefore operation of Watts Bar in accordance with the proposed amendment would not involve a significant hazards consideration as defined in 10 CFR 50.92.