June 13, 1996

Mr. Oliver D. Kingsley, Jr.
President, TVA Nuclear and
Chief Nuclear Officer
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, Tennessee 37402-2801

SUBJECT: ISSUANCE OF AMENDMENT ON ICE BED SURVEILLANCE (TAC NO. M94424)

Dear Mr. Kingsley:

The Commission has issued the enclosed Amendment No. 2 to Facility Operating License No. NPF-90 for Watts Bar Nuclear Plant, Unit 1. This amendment is in response to your application dated February 28, as supplemented April 15, and June 3, 1996.

The proposed amendment would revise the Technical Specifications (TS) to increase the surveillance intervals for ice bed weight sampling and flow passage inspection from 9 months to 18 months. The TS would also be changed to provide an increased ice sublimation allowance, associated with the increased surveillance interval, by increasing the minimum total ice weight from 2,360,875 pounds to 2,403,800 pounds (1214 pounds/basket to 1236 pounds/basket).

A copy of the safety evaluation is also enclosed. Notice of issuance will be included in the Commission's biweekly Federal Register notice.

Sincerely,

ORIGINAL SIGNED BY:

Robert E. Martin, Senior Project Manager
Project Directorate II-3
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket No. 50-390

Enclosures: 1. Amendment No. 2 to NPF-90
2. Safety Evaluation

cc w/enclosures: See next page

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-390

WATTS BAR NUCLEAR PLANT, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 2
License No. NPF-90

1. The Nuclear Regulator Commission (the Commission) has found that:

    A. The application for amendment by Tennessee Valley Authority (the licensee) dated February 28, as supplemented April 15 and June 3, 1996, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act) and the Commission's rules and regulations set forth in 10 CFR Chapter I;

    B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

    C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

    D. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. NPF-90 is hereby amended to read as follows:

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A, as revised through Amendment No. 2 , and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into this license. TVA shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of its issuance, to be implemented no later than 30 days of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Frederick J. Hebdon, Director
Project Directorate II-3
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Technical
Specifications

Date of Issuance: June 13, 1996

ATTACHMENT TO AMENDMENT NO. 2

FACILITY OPERATING LICENSE NO. NPF-90

DOCKET NO. 50-390

Revise the Appendix A Technical Specifications by removing the pages identified below and inserting the enclosed pages. The revised pages are identified by the captioned amendment number and contain marginal lines indicating the area of change.

Remove Pages	Insert Pages
3.6-29	3.6-29
B 3.6-65	B 3.6-65
B 3.6-70	B 3.6-70
B 3.6-71	B 3.6-71
B 3.6-72	B 3.6-72

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.6.11.2	Verify total weight of stored ice is ≥ 2,403,800 lb by: a. Weighing a representative sample of ≥ 144 ice baskets and verifying each basket contains ≥ 1236 lb of ice; and b. Calculating total weight of stored ice, at a 95% confidence level, using all ice basket weights determined in SR 3.6.11.2.a.	18 months
SR 3.6.11.3	Verify azimuthal distribution of ice at a 95% confidence level by subdividing weights, as determined by SR 3.6.11.2.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 ≥ 1236 lb.	18 months
SR 3.6.11.4	Verify, by visual inspection, accumulation of ice or frost on structural members comprising flow channels through the ice condenser is ≤ 0.38 inch thick.	18 months

(continued)

B 3.6 CONTAINMENT SYSTEMS

B 3.6.11 Ice Bed

BASES

BACKGROUND

The ice bed consists of over 2,403,800 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 plant 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 plant 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 plant operation. The upper plenum area is used to facilitate surveillance and maintenance of the ice bed.

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

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.6.11.1 (continued)

temperature condition. This SR may be satisfied by use of the Ice Bed Temperature Monitoring System.

SR 3.6.11.2

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 < 1236 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 ≥ 1236 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 < 1236 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.

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.6.11.3

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 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 3.6.11.4

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

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.6.11.4 (continued)

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.

SR 3.6.11.5

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 term 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 3.6.11.6

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

(continued)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 2 TO FACILITY OPERATING LICENSE NO. NPF-90

TENNESSEE VALLEY AUTHORITY

WATTS BAR NUCLEAR PLANT, UNIT 1

DOCKET NO. 50-390

1.0 INTRODUCTION

By letter dated February 28, 1996, as supplemented April 15 and June 3, 1996, the Tennessee Valley Authority (the licensee) submitted a request for changes to the Watts Bar Nuclear Plant, Unit 1, (WBN) Technical Specifications (TS). The proposed amendment would revise the TS to increase the surveillance intervals for ice bed weight sampling and flow passage inspection from 9 months to 18 months. The TS would also be changed to provide an increased ice sublimation allowance, associated with the increased surveillance interval, by increasing the minimum total ice weight from 2,360,875 pounds to 2,403,800 pounds (1214 pounds/basket to 1236 pounds/basket). The April 15 and June 3, 1996, letters provided clarifying information that did not change the initial proposed no significant hazards consideration determination.

The request for an amendment of the WBN TS is a result of the facility design. Some ice condenser plants can readily weigh ice baskets during power operation because personnel access to the lower ice condenser area, which is a high radiation area, is not required, due to a different method of attaching the ice baskets to the lower support structure. However, at WBN a mid-cycle shutdown would be required for ice weighing at 9-month intervals since personnel would have to enter the lower area to release the ice baskets.

2.0 EVALUATION

2.1 Ice Condenser Safety Function

The purpose of the containment ice bed 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. The ice in the ice bed is in the form of borated flakes and is stored in 1944 cylindrical ice baskets located in the ice condenser. The ice condenser is an annular compartment enclosing approximately 300° of the perimeter of the upper containment compartment, and penetrating the operating deck so that a portion extends into the lower containment compartment. The annular compartment is arranged in 24 bays of 81 (9x9) baskets each.

ENCLOSURE

In the event of a DBA, the ice condenser inlet doors (located below the operating deck) will 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 intermediate and top deck doors to open, which allows the air to flow out of the ice condenser into the upper compartment. Condensed steam and melted ice will drain to the lower compartment. The 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. The quantity of ice provided is adequate to absorb the energy contained in the initial blowdown of steam and water from a DBA and much of the residual heat load that would enter containment following the initial blowdown. The containment spray system, an active system, would subsequently remove the remaining heat. During the post-blowdown period, an Air Return System (ARS) would return upper compartment air through the divider barrier to the lower compartment. This would serve 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.

An additional function of the ice bed is to provide a source of borated water (via the containment sump) for long term Emergency Core Cooling System (ECCS). 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 chloride and caustic stress corrosion on mechanical systems and components exposed to ECCS and Containment Spray System fluids in the recirculation mode of operation.

2.2 Quantity and Distribution of Ice Within Ice Beds

The total quantity of ice in the ice bed must be sufficient such that by the time of ice meltout, the containment atmosphere heat load is within the heat removal capacity of one train of the containment recirculation spray system. It is also important for the ice to be uniformly distributed around the 24 ice condenser bays and for open flow paths to exist around ice baskets so that during blowdown the steam and water mixture entering the lower compartment does not pass through only part of the ice condenser depleting the ice there while bypassing the ice in other bays. The amount of ice required for ice condenser operability, as determined by analyses, is 2,125,000 pounds. A 10% factor for sublimation and a 1% factor for weighing measurement error was originally provided such that the minimum as-left weight requirement is 2,360,875 pounds (2,125,000 x 1.1 x 1.01 = 2,360,875).

Two related phenomena that can degrade the ice bed are:

a. Loss and migration 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 degradation phenomena are minimized by minimizing air leakage into and out of the ice condenser.

In order to ensure an adequate quantity and distribution of ice, operability and surveillance requirements are specified in the TS. The WBN TS implement an ice weighing program and visual inspection program. The weighing program verifies that excessive ice has not been lost due to melting or sublimation, and the visual inspection program ensures that flow passages are not obstructed. (In addition, other surveillance requirements ensure adequate boron concentration and structural integrity of baskets.)

2.3 Ice Weighing Interval

In a newly constructed ice condenser plant, it is possible that the air flow patterns and ethylene-glycol flow patterns in various parts of the ice condenser are not optimally balanced and may therefore promote sublimation or migration of ice. In addition, air leaks may exist which were not revealed by preoperational testing. Due to the lack of baseline ice performance data, a mid-cycle ice weight sampling is considered appropriate to provide increased confidence that design basis sublimation allowances are not being exceeded in such a manner that the ice bed may become inoperable prior to the end of cycle. The licensee's application eliminates the mid-cycle weighing and accounts for the increased surveillance interval by increasing the sublimation allowance from 10% to 12%, an action which increases the minimum ice weight from 2,360,875 pounds to 2,403,800 pounds (1214 pounds/basket to 1236 pounds/basket).

In 1991, the Catawba 1 & 2 TS were amended to increase the 9-month intervals to 18 months. The sublimation allowance was increased from 10 to 15%, notwithstanding the fact that considerable plant-specific sublimation data had been acquired by that time, showing that the baskets in the worst row (adjacent to the crane wall) were experiencing only 5%/yr average sublimation. Other facilities had been granted similar amendments based on plant-specific data. The WBN licensee has since confirmed (letter dated April 15, 1996) that the actual September 1995 ice loading for the current initial cycle of operation was 2,877,685 pounds, a value that actually provides a 34.08% sublimation allowance, ($2,125,000 \times 1.3408 \times 1.01 \approx 2,877,685$ pounds). Based on this actual ice load, it is clear that a very large ice sublimation allowance currently exists, making a mid-cycle ice surveillance unnecessary during the first cycle. The staff concludes that the 12% sublimation allowance specified in the proposed TS is acceptable on the basis that it provides a conservative sublimation margin from the standpoint of operating experience of other similar ice condenser facilities, and that there is a large additional margin sufficient to account for any additional sublimation that might result from any as-yet uncorrected air leaks or flow imbalances. Further, the licensee has committed in its letter dated June 3, 1996, to provide a Special Report following the first 18 month ice surveillance, on the actual sublimation rates experienced in the first operating cycle.

2.4 Flow Passage Inspections

Ice that sublimes in one area of the ice bed may collect as frost in another area. This phenomenon (ice migration), if excessive, could result in blockage of flow passages between ice baskets which in turn could cause off-design thermal-hydraulic performance of the ice condenser under accident conditions. Visual inspections at 9-month intervals are currently required by the TS to verify that flow passages are not excessively obstructed. The proposed amendment would extend the interval to 18 months thereby eliminating the requirement for mid-cycle inspections. The licensee's position is based on 1992-1995 Sequoyah data which indicates that frost in narrowed passages will redistribute in such a manner as to reduce the blockage. Whereas this phenomenon has not previously been reported to the staff, the licensee's data (Table 5 of the application), does indicate that the effect can be significant. Also, operating experience has generally indicated that blockage of flow passages is the result of ice spillage during ice basket replenishment operations during outages, and that with proper cleanup prior to resuming power operation, flow passage blockage is not a problem (Ref: D.C. Cook Amendments issued May 28, 1987). Based on operating experience at other facilities, the extension of the surveillance interval to 18 months is acceptable for WBN.

3.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Tennessee State official was notified of the proposed issuance of the amendment. The State official had no comments.

4.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and changes surveillance requirements. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (61 FR 15998 dated April 10, 1996). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

5.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: W. Long

Date: June 13, 1996