TVA

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Robert A. Fenech
Vice President, Sequoyah Nuclear Plant

December 31, 1992

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

Gentlemen:

TENNESSEE VALLEY AUTHORITY - SEQUOYAH NUCLEAR PLANT UNITS 1 AND 2 - DOCKET NOS. 50-327 AND 50-328 - FACILITY OPERATING LICENSES DPR-77 AND DPR-79 - LICENSEE EVENT REPORT (LER) 50-327/92023

The enclosed LER provides details concerning ice condenser ice weights being lower than the design analysis assumption. This event is being reported in accordance with 10 CFR 50.73(a)(2)(ii)(B) as a condition outside the design basis of the plant.

Sincerely,

Robert A. Fenech

Robert A. Fenech

Enclosure
cc: See page 2

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cc (Enclosure):

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LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Sequoyah Nuclear Plant, Unit 1	0|5|0|0|0|3|2|7	1 OF 0|7

TITLE (4) Low Ice Condenser Ice Weights Result in the Plant Operating Outside the Design Basis

EVENT DAY (5) MONTH	DAY	YEAR	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	REPORT DATE (7) MONTH	DAY	YEAR	OTHER FACILITIES INVOLVED (8) FACILITY NAMES	DOCKET NUMBER(S)
1 2	0 1	9 2	9 2	0 2 3	0 0	1 2	3 1	9 2	Sequoyah, Unit 2	0|5|0|0|0|3|2|8
										0|5|0|0|0| |

OPERATING MODE (9): 1

POWER LEVEL (10): 1 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following)(11)

20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
20.405(a)(1)(iv)	XX 50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (AREA CODE)
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COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)

		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On December 1, 1992, an evaluation determined that for some length of time during both Unit 1 Cycles 4 and 5, the ice condenser had operated below the required 993-pound design analysis assumption for ice basket weights. Further investigation identified that Unit 2 had also operated below the design assumption during Cycle 4. This condition was discovered as a result of a Site Quality audit. The audit identified several as-found ice basket weights that were lower than the design assumption. An evaluation was performed to determine the effect on the design assumption of the low-weight baskets. The evaluation concluded that if a row-group in the ice condenser has an ice weight less than 993 pounds per basket, the ice condenser would have operated outside its design analysis assumption. The evaluation further concluded that although the ice condenser had operated outside its design assumption, this would have had little or no affect on the containment pressure or temperature analysis. The apparent root cause of this event was an inadequate as-left surveillance test. In order to prevent recurrence of this event, the surveillance instructions will be revised to perform an as-left test that will ensure that the design analysis assumption of the ice condenser is maintained.

I. PLANT CONDITIONS

Units 1 and 2 were operating at approximately 100 percent rated thermal power.

II. DESCRIPTION OF EVENTS

A. Event

On December 1, 1992, an evaluation determined that for some length of time during both Unit 1 Cycles 4 and 5, the ice condenser (EIIS Code BC) had operated outside the required 993-pound design analysis assumption for ice basket weights. Further investigation identified that Unit 2 had also operated outside the design assumption during Cycle 4.

The ice condenser is a complex structure that covers a 300-degree area inside the containment between the containment steel shell and the crane wall. It has 24 bays, each consisting of nine columns and nine rows of 12-inch diameter, 48-foot long ice baskets. There are 1,944 ice baskets in the ice condenser. The ice condenser is also divided into three groups. Group 1 consists of Bays 1 through 8; Group 2, Bays 9 through 16; and Group 3, Bays 17 through 24. The ice condenser is designed to absorb the thermal energy released as a result of a loss of coolant accident (LOCA), steamline break, or other high energy line breaks in containment. The ice baskets are arranged to promote heat transfer from steam to ice during and following these accidents in order to minimize the peak temperature and pressure that would result in containment from these events. The technical specifications (TSs) ensure that ice is distributed uniformly throughout the ice condenser by testing each bay for uniform distribution. A sampling approach is used that provides a 95-percent confidence level in the measured average ice weights. TSs also test for uniform distribution among row-groups. A row-group consists of a certain row within an ice condenser group. For example, Row 1 Group 1 would include all Row 1 baskets within Bays 1 through 8.

On August 14, 1992, a routine Site Quality audit was initiated on surveillance instructions (SIs) related to ice condenser maintenance activities. The audit finding identified as-found ice basket weights in the Row 1 Group 1 portion of the ice condenser that were less than the 993 pounds assumed in the containment accident analysis described in the Updated Final Safety Analysis Report (UFSAR). This finding was documented in Finding Identification Report SQFIR920068208. As part of the corrective action for the report, an engineering evaluation was performed. This evaluation was performed to determine the effect of low ice weight baskets on the design of the ice condenser. The evaluation concluded that if a row-group in the ice condenser had an ice weight of less than 993 pounds per basket, then the ice condenser was outside the design analysis assumption. A review of as-found data from Unit 1 Cycles 4 and 5 identified that the average ice weight for Row 1 Group 1, at a 95-percent confidence, was 944 and 827 pounds per basket, respectively. A review of as-found data for Unit 2 Cycle 4 identified that the Row 1 Group 3 ice weight, at a 95-percent confidence, was 982 pounds per basket. Based on this information, this condition is being reported as a condition in which the plant was outside the design basis.

B. Inoperable Structures, Components, or Systems That Contributed to the Event

None.

C. Dates and Approximate Times of Major Occurrences

1979	Unit 1 initially loaded the ice condenser. The TSs required 2,721,790 total pounds of ice mass in the ice condenser and a distribution of 1,400 pounds per basket. The Final Safety Analysis Report (FSAR) design analysis assumption required 1,260 pounds per basket.
1981	Unit 1 TSs changed, and Unit 2 TSs for initial ice loading required 2,333,100 total pounds of ice mass in the ice condenser and distribution of 1,200 pounds per basket. The UFSAR design analysis assumption required 1,080 pounds per basket.
1984	The Unit 1 Cycle 2 refueling outage identified that the as-found Row 1 Group 3 ice weight, at a 95-percent confidence, was 1,074 pounds per basket. The design analysis assumption was 1,080 pounds per basket. This condition was reported in LER 50-327/84019. The Row 1 Group 3 ice baskets were refilled to an as-left condition of 1,411 pounds of ice per basket, at a 95 percent confidence.
1990	The Units 1 and 2 TSs were revised to lower the required ice condenser ice weights to 2,245,320 pounds of total ice mass and a distribution of at least 1,155 pounds per basket. The UFSAR design analysis assumption required 993 pounds per basket.
1990	The Unit 1 Cycle 4 refueling outage identified the as-found Row 1 Group 1 ice weight, at a 95-percent confidence, to be 944 pounds per basket. The Row 1 Group 1 ice baskets were refilled to an as-left condition of 1,213 pounds of ice per basket, at a 95-percent confidence.
1990	The Unit 2 Cycle 4 refueling outage identified the as-found Row 1 Group 3 ice weight, at a 95-percent confidence, to be 982 pounds per basket. The Row 1 Group 3 ice baskets were refilled to an as-left condition of 1,214 pounds of ice per basket, at a 95-percent confidence.

1991 The Unit 1 Cycle 5 refueling outage identified the as-found Row 1 Group 1 ice weight, at a 95-percent confidence, to be 827 pounds per basket. The Row 1 Group 1 ice baskets were refilled to an as-left condition of 1,189 pounds of ice per basket, at a 95-percent confidence.

1992 On August 14, Site Quality identified the as-found low ice basket weights in SQFIR920068208.

1992 On December 1, based on the completed Nuclear Engineering evaluation, SQN concluded that the low as-found ice weights would have resulted in the units operating outside the design analysis assumption of the plant during some portion of the past cycles.

D. Other Systems or Secondary Functions Affected

None.

E. Method of Discovery

This condition was discovered as a result of a Site Quality audit of past ice condenser maintenance activities.

F. Operator Action

Not applicable - no operator action was required.

G. Safety System Response

Not applicable - no safety system response was required.

III. CAUSE OF EVENT

A. Root Cause

The apparent root cause of this event was an inadequate as-left surveillance test. When the initial TS was written, it did not account for uneven sublimation rates throughout the entire ice condenser. The areas of the ice condenser closest to the outsides of the ice bed sublimate at a higher rate than the center of the ice bed. This data was not factored into the surveillance testing to ensure that the as-left condition of the ice condenser would ensure that the design analysis assumption of 993 pounds of ice per basket was met for an entire cycle.

IV. ANALYSIS OF EVENT

An evaluation was performed to analyze the four different cycles that had low ice weights in certain row-groups. Unit 1 had one row-group that had a low weight during Cycles 2, 4, and 5. One row-group also had a low weight during Cycle 4 for Unit 2.

The design analysis assumption during Cycle 2 was 1,080 pounds per basket as compared to the current value of 993 pounds. The as-found average row-group weight, at a 95-percent confidence, was 1,074 pounds, which is well above the current requirements. Thus, it can readily be concluded that the low weight found after Cycle 2 had no safety significance.

The lowest row-group average basket weight occurred during Cycle 5 for Unit 1. The 95-percent confidence level average weight of 827 pounds bound the conditions found during Cycle 4 on both units. The following evaluation is based on the Cycle 5 data and is, thus, applicable to and bounds the Cycle 4 conditions for both Units 1 and 2. The evaluation addresses the long-term peak pressure analysis and peak containment temperature analysis.

The primary containment design pressure is based upon the peak calculated containment pressure during a double-ended pump suction LOCA. For the LOCA analysis, the peak containment pressure occurs following ice bed meltout, and the time of meltout is dependent on the total amount of ice and its distribution throughout the ice bed. Since the data shows that there is a potential for one section of the ice condenser to have an average weight less than the analytical limit, it is necessary to address the potential for and the effects of a portion of Row 1 Group 1 melting out at a time earlier than assumed in the FSAR containment analysis.

The data showed that the majority of the baskets in Row 1 Group 1 had more ice in them than was needed to meet the design analysis assumption of 993 pounds per basket. The number of baskets sampled was small, and the consequences of the small sample with large weight deviations were that the resulting standard deviation was large and the average weight, at a 95-percent confidence, was less than the design analysis assumption even though the absolute average was acceptable. From this it can be concluded that most of the baskets in this row group would have ice in them at 3,000 seconds after a LOCA. The surveillance data established that the other row-groups will have ice remaining at 3,000 seconds based on current FSAR analysis and mass and energy release assumptions.

The data also shows that an acceptable total amount of ice was present and that on a per-bay basis, the ice was adequately distributed. Because of this, it is expected that acceptably-loaded baskets would be in close proximity to the light baskets.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
Sequoyah Nuclear Plant, Unit 1	0 5 0 0 0 3 2 7	9 2	0 2 3	0 0	0 6 OF 0 7

TEXT (If more space is required, use additional NRC Form 366A's) (17)

If a basket was completely melted out, a 1-foot diameter channel would exist through the ice bed. However, the additional surrounding baskets would continue to condense the steam. Such a channel is equivalent to a 0.8-square foot area. The UFSAR provides a discussion of the sensitivity of peak containment pressure to various size openings in the divider deck, allowing the ice condenser to be bypassed. The UFSAR analysis assumes a bypass of 5 square feet of which only 2.2 square feet have been identified. The 2.2 square feet are to account for the two refueling drain holes. The remainder is to provide conservatism to account for small openings that cannot be measured, such as gaps between the slabs of the missile shield. The sensitivity analyses show acceptable results for direct bypass up to 34 square feet. This area minus the drain holes would be equivalent to 40 empty ice baskets. Because of the close proximity of low weight baskets in the ice bed to other baskets containing ice, a larger bypass area in the ice bed would be acceptable because of the ability to condense steam on adjacent baskets and cold surfaces.

TVA and Duke Power had Battelle Northwest Labs perform a number of evaluations of the ice condenser in the early 1970s. One report was on transient ice distribution and burn-through. This report found that if a channel was formed, crossflow in the ice bed would redistribute the steam and delay or prevent premature burn-through. This would be the result of a lower condensation rate in the area where there was less ice. The flow will go to areas where there is a higher condensation rate.

The primary containment peak environmental temperature is a composite profile based upon 0.6-square foot and smaller breaks of the main steam line inside containment. The total amount of energy released into the containment is much lower during a steam line break than during a LOCA. In addition, there are no long-term energy releases once the steam generator is isolated and blows dry. For a small steam line break, the time required to completely blow down the generator is about 20 minutes. The time decreases as the break size increases. Because of the limited inventory in a steam generator and the short duration of the mass and energy releases, substantially less ice is required to mitigate this event than a LOCA. Steam line breaks will melt less than half of the ice in the bed. As such, the impact of light baskets is much less than for the case of the LOCA.

This evaluation concluded that there would be an insignificant effect on the analyses, the peak accident pressure would be less than the design pressure, and there would be no effect on the peak temperature. Therefore, there was no risk to the health and safety of the public as a result of this event.

V. CORRECTIVE ACTION

A. Immediate Action

An operability evaluation was immediately performed in order to ensure that the present operating cycles would not result in the same condition. The evaluation concluded that due to the improved ice inspections and ice additions that occurred during the last refue'ing outages, the ice condenser would perform its design function for the entire cycle.

B. Action to Prevent Recurrence

SI-106.2 and SI-106.3, "Ice Condenser ıce Bed," for Units 1 and 2 respectively, will be revised to perform an as-left test that will ensure that the design analysis assumption of the ice condenser is maintained.

IV. ADDITIONAL INFORMATION

A. Failed Components

None.

B. Previous Similar Events

A review of previous reportable events identified one previous occurrence of this condition. LER 50-327/84019 identified that during Unit 1 Cycle 2 the Row 1 Group 3 ice weights were below the design analysis assumption. Had an adequate root cause evaluation been performed at that time, the conditions reported in this LER may have been able to be prevented. Presently, all reportable events receive a full root cause evaluation. This evaluation identifies appropriate root causes and associated corrective actions.

VII. COMMITMENTS

SI-106.2 and SI-106.3 will be revised by April 1, 1993, to perform an as-left test that will ensure that the design analysis assumption of the ice condenser is maintained.