NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Sequoyah, Unit 2	0 5 0 0 0 3 2 8	1 OF 1 0

TITLE (4) Ice Buildup In The Flow Passages Of The Ice Condenser Due To Sublimation Which Could Result In Increased Containment Pressures

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
0 1	1 9	8 8	8 8	— 0 0 3 —	0 1	0 4	0 8	8 8		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9): 5

POWER LEVEL (10): 0 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)	XX 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)	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
K. E. Meade, Plant Operations Review Staff	AREA CODE 6 1 5 870-6250

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): YES (If yes, complete EXPECTED SUBMISSION DATE) — XX NO

EXPECTED SUBMISSION DATE (15): MONTH | DAY | YEAR

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

This LER is being revised to detail the root causes and actions to prevent recurrence of this condition.

This LER is being submitted as a voluntary report to inform NRC of the degradation found while inspecting the unit 2 ice condenser.

On January 19, 1988, with units 1 and 2 in mode 5 (0 percent power, 4 psig, 124 degrees F and 0 percent power, 110 psig, 117 degrees F, respectively), an inspection of the unit 2 ice condenser revealed that accumulation of ice or frost in the flow passages represented a degraded condition. Technical Specification (TS) 3.6.5.1 indicates more than one restricted flow passage per ice condenser bay, there are 24 bays in the ice condenser, is evidence of abnormal degradation of the ice condenser. A special maintenance instruction (SMI) was written by TVA and Westinghouse to determine the extent of the degradation in order to justify that Sequoyah Nuclear Plant (SQN) meet the intent of TS 3.6.5.1. Westinghouse had previously completed a computer analysis which concluded with 15 percent of the ice condenser flow passages blocked, the containment pressure would be within design limits. The SMI was written with an acceptance criteria of less than 15 percent total flow passage blockage. The SMI was performed, acceptance criteria was met, and ice condenser was determined to meet the requirements of TS 3.6.5.1.

The cause of this event was determined to be the failure to convert the original design requirements into a verifiable, repeatable surveillance requirement. In order to prevent recurrence of this event, SI-106, "Ice Condenser - Ice Bed," will be revised to incorporate the methodology used in the SMI to determine operability of the ice condenser.

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

DESCRIPTION OF EVENT

This LER is being submitted as a voluntary report to inform NRC of the degradation found while inspecting the unit 2 ice condenser.

On January 19, 1988, with units 1 and 2 in mode 5 (0 percent power, 4 psig, 124 degrees F and 0 percent power, 110 psig, 117 degrees F, respectively), an inspection of the unit 2 ice condenser (EIIS Code BC) revealed that accumulation of ice or frost in the flow passages represented a degraded condition. Technical Specification (TS) 3.6.5.1 indicates more than one restricted flow passage per ice condenser bay, (24 bays in the ice condenser) is evidence of abnormal degradation of the ice condenser. Figures 1 and 2 are diagrams of the ice condenser and an ice condenser bay, respectively.

Surveillance Instruction (SI)-106, "Ice Condenser - Ice Bed," was being performed before unit 2 entered mode 4. Upon completion of the visual SI, it was determined that approximately 16 of the 24 ice condenser bays failed to meet the surveillance requirement (SR) of less than or equal to .38 inch of ice or frost accumulation on flow passages between ice baskets, past lattice frames, through the intermediate and top deck floor grating, or past the lower inlet plenum support structures and turning vanes. At that time, it was decided to defrost the ice condenser to remove the excess ice buildup. After an approximate 24-hour defrost cycle, the ice condenser was reinspected. Significant reductions in excess ice buildup had occurred, especially in the outer basket; however, approximately 1/3 of the bays still could not pass the .38 inch acceptance criteria.

At this time, manual chipping and scraping of the ice in the flow passages was started. Parallel to that effort, Westinghouse was contacted to determine the requirements of an operable ice bed. Westinghouse indicated the purpose for maintaining ice/frost free flow passages was to ensure the lower compartments of containment were not overpressurized during the first [illegible] seconds of a large break loss of coolant accident (LOCA). Westinghouse also indicated that a computer analysis of the Sequoyah Nuclear Plant (SQN) ice condenser had been run with 15 percent total flow passage blockage. This analysis concluded the pressure from this condition would be within the design limits of containment. Thus, Westinghouse and TVA decided that the ice condenser had evidence of abnormal degradation but was not inoperable. An operable ice condenser consisted of an ice bed with less than 15 percent total flow passage blockage, where a flow passage is as shown in Figure 3.

A special maintenance instruction (SMI) was prepared to inspect the ice condenser to determine if less than 15 percent total flow passage blockage existed. During the period of time the conversation with Westinghouse occurred, maintenance personnel continued to manually chip and scrape ice/frost such that only three bays had not passed the SR. The SMI was written so the three bays which had yet to pass the SR received a 100 percent inspection. The other 21 bays which had passed the SR would have 33 percent of the bay inspected, increased to 100 percent if that portion did not meet the acceptance criteria. The flow passage, as previously defined, would be inspected on half of the passage basis. If 1/4 of the area of the half passage was blocked, then half of the existing flow passage is considered to be completely blocked. Blockage in a channel at one location is assumed to block the entire height of the channel. This is conservative since it ignores that in actuality, crossflow through the ice bed would lessen the impact of blockage at one location.

The SMI was performed on January 31, 1988. The acceptance criteria of the SMI was met, and the ice condenser was determined to meet the requirements of TS 3.6.5.1 on February 1, 1988.

CAUSE OF EVENT

The following have been determined to be the causes of this event:

1. Conversion of the original design requirements into a verifiable, repeatable SR was not accomplished during the original writing of the Sequoyah TSs and SIs.
   1. SI-106 acceptance criteria vague.
   2. SI-106 not repeatable; statistically unsound.
   3. SI-106 methodology too loose; easily influenced by human opinion.
   4. SI-106 acceptance criteria is taken directly from the Sequoyah TS SR 4.6.5.1.b.3, which itself possesses the faults described above for SI-106.

2. A programmatic method of cleaning the flow passages was employed previously, but it was never formalized into a procedure.

3. Water from the upper plenum of the ice condenser due to (1) ruptured drain lines from the air handling units (AHU) and (2) failure of the AHU drip pan heaters, drained into the ice bed creating ice blockages in some flow passages. Less than optimum quality heat trace was originally installed on the subject drain lines and, prior to 1987, no preventive maintenance program was in place to ensure that heat trace failures would be discovered and repaired on a timely basis. Periodic failure of the drain pan heaters is expected; however, prior to 1987, no preventive maintenance program was in place to ensure that drain pan heater failures would be discovered and repaired on a timely basis.

4. During ice basket servicing (ice addition), ice is unavoidably spilled onto the ice basket support lattice. When left unattended, the spilled ice undergoes a thawing-compacting-refreezing process, particularly if the maximum defrost temperature is exceeded. The spilled ice is then converted to a form that tightly adheres to the support lattice and is extremely difficult to remove. Ice condenser servicing procedure, Maintenance Instruction (MI) 5.3, does not adequately emphasize the need to prevent or clean up ice spillage occurring during ice addition. The ice condenser defrost procedure, System Operating Instruction (SOI) 61.1C, does not specify the key ice bed temperature elements (RTDs) to monitor and how to monitor them during an ice condenser defrost.

5. Heretofore, it was assumed that the ice condenser would be operated at the lowest temperature achievable. This practice however accelerates the sublimation process, subsequent frost buildup on the wall panels, and ultimately some flow passage blockage in basket rows 1 and 9. The physics of the sublimation/mass transfer process is such that free moisture in the ice bed region collects on the coldest surface available in the region. The wall panels are by design the primary means of cooling the ice and are therefore the coldest object in the ice bed region.

6. Air/moisture inleakage at the top of the ice condenser may contribute to frost buildup in the ice bed, but to what extent is not readily quantifiable. The ice condenser top deck curtain is not sealed in an airtight fashion. Complete sealing is not possible due to the need to allow for normal expansion and contraction of the air inside of the ice condenser as operating temperatures vary.

7. Air/moisture outleakage at the bottom of the ice condenser may contribute somewhat to frost buildup in the ice bed region, but to what extent is not readily quantifiable. The ice condenser lower inlet door leakage is greater than anticipated in the original design; however, extensive efforts to pinpoint the exact location have so far been unsuccessful due to the large area involved with respect to the low volume of flow.

ANALYSIS OF CONDITION

This condition is being reported as a voluntary report to inform NRC of degradation found in the unit 2 ice condenser.

The TS bases state that the purpose of the ice condenser is to ensure that the containment design pressure of 12 psig is not exceeded in the event of a LOCA. TS SR 4.6.5.1 was developed to assure that the ice condenser is capable of performing this function. SI-106 for this TS will identify if there is a degradation of the ice condenser. To provide a basis for determining operability, an SMI was prepared. This SMI, in conjunction with the other ice condenser SIs, provides a repeatable, quantifiable, and verifiable method to determine the extent of degradation to help establish that Sequoyah meets the intent of TS 3/4.6.5.1.

The containment design pressure at Sequoyah is based on analyses by Westinghouse of a double ended LOCA. Two different analyses were performed. The first was a short-term subcompartment pressure analysis using the TMD computer code. This analysis determined short duration pressure transients across interior concrete walls and inside of the ice condenser during the blowdown period. The second analysis using the LOTIC computer code determined the peak containment pressure which occurs after all of the ice has melted. SR 4.6.5.1.b.3 assures that the actual flow areas in the plant are consistent with the ice condenser flow areas used in the TMD analyses. The TMD analyses are conservative analyses that assume an instantaneous double ended rupture of one of the main reactor coolant pipes (EIIS Code AB). The mass and energy releases used in these analyses were increased by 10 percent over those calculated by the SATAN computer code, and no structural heat sinks were modeled to provide additional conservatism in the calculation of the pressure rise. Westinghouse performed sensitivity studies of flow blockages in the ice condenser which established that the containment pressure was less than 12 psig for an effective blockage of 15 percent of the total available flow area in the ice bed (i.e., 24 bays). An additional conservatism in the sensitivity studies was that the blockages were always fixed at a constant value.

The SMI provided conservative guidelines that determine if the open area around adjacent ice baskets was unblocked on a half channel basis. The guidelines were based on a simple determination that an area is completely blocked (1/2 open) or unblocked. The acceptance criteria is that of the channels sampled that the blockage in any bay is less than 15 percent. Of the 24 bays in the ice condenser, the 3 bays which failed the current SR were 100 percent inspected using the subject SMI. In the remaining 21 bays, 33 percent of the channels were inspected using the SMI unless excessive blockage was discovered. The inspection was expanded to 100 percent of the bay if the initial acceptance criteria was not met.

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

The SMI required inspection of the open area between the lattice frames. This was considered to be acceptable and conservative for the following reasons. The conditions between the lattice frames are indicative of the conditions in the immediate vicinity of the frames. This conclusion was made based on inspections in the ice condenser. Next, if a portion of either half of the lattice opening is blocked by more than 1/4 of the area of the half opening, then half of the entire channel is considered to be completely blocked for the purpose of determining if the 15 percent blockage criteria is exceeded. Blockages in a channel at one location are assumed to block the entire height of the channel. This conservatively ignores that in actuality crossflow through the ice bed would lessen the impact of a blockage at one location.

The purpose of SR 4.6.5.1.b.3 is to assure that the flow areas in the ice condenser are consistent with those used in the TMD analysis for Sequoyah. The SMI acceptance criteria were established to provide this assurance. Thus, the intent of TS 3.6.5.1 is met, and the ice condenser is operable for modes 1, 2, 3, and 4 once this criteria was met.

CORRECTIVE ACTIONS

The immediate corrective action was to defrost the ice condenser, as well as manually chipping and scraping the ice to remove excessive ice/frost buildup in the flow passages. An SMI was performed which proved operability of the ice bed.

The following actions will be accomplished to prevent recurrence of this event:

Short-Term Actions

1. Using the information acquired via the TVA/Westinghouse Safety Evaluation Report (SER) and Special Maintenance Instruction (SMI) 2-61-2, revise SI-106 to incorporate the methodology of the SER and SMI to determine ice condenser operability. The revision will also provide a means to initiate ice removal if blockages are not of an acceptable nature (i.e., hard packed). A detailed training session for performers of SI-106 shall be conducted before use of this new revision. This requirement will be added to the Prerequisite of SI-106 and is expected to be completed by June 15, 1988.

2. Develop and implement a preventive maintenance instruction (PM) to monitor frost accumulation to gather engineering data on a monthly basis during operation. This data will provide a greater understanding of the frost accumulation process and potentially reveal additional measures that may be used to combat the sublimation/frost accumulation process. The PM will monitor ice baskets of known frost accumulation as baselined by SMI-2-61-2 in January 1988. The PM will be completed by June 15, 1988.

*U.S.GPO 1986-0-624-538/455

3. Develop an MI for removal of ice build-up from the ice condenser flow passages. This MI will include measures to ensure that all tools, equipment, etc., will be removed such that the ice condenser will meet the requirements of SI-187. This MI will be completed by June 15, 1988.

4. Evaluate and revise MI-5.3 to adequately emphasize the need to prevent or clean up ice spillage occurring during ice addition. This revision will be completed by June 30, 1988.

Long-Term Actions

1. TVA shall work jointly with Westinghouse and other utilities as available to develop a revised surveillance requirement that is clear, concise, repeatable, and statistically sound. The TS change may also include revision of the performance frequency from 12 months to 18 months (every refueling outage). This effort should be completed by September 30, 1988.

2. Upon completion of the above corrective action, TVA will submit a TS change request to NRC to incorporate the newly developed SR into the Sequoyah TSs. The TS change is expected to be sent to NRC by October 15, 1988.

3. Evaluate available information in the industry, review and revise SOI-61.1A and SI-2 accordingly to specify the most optimum operating range (temperature) necessary to minimize ice sublimation and frost buildup. These revisions are expected to be completed by August 31, 1988.

4. Category D Field Change Request (CAT D FCR 3637) should be implemented to seal the top deck curtain as much as possible and minimize air/moisture inleakage at the top of the ice condenser. ECN L6468 has been issued by DNE to implement this change. This modification should be completed by February 28, 1989.

5. Evaluate and revise SOI-61.1C to specify the key ice bed temperature indication RTDs to monitor, and how to monitor them during an ice condenser defrost. This action should be completed by November 30, 1988.

ADDITIONAL INFORMATION

There have been no previous LERs submitted concerning flow path blockage in the SQN ice condensers.

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

ICE CONDENSER
NUMBERING OF BAYS

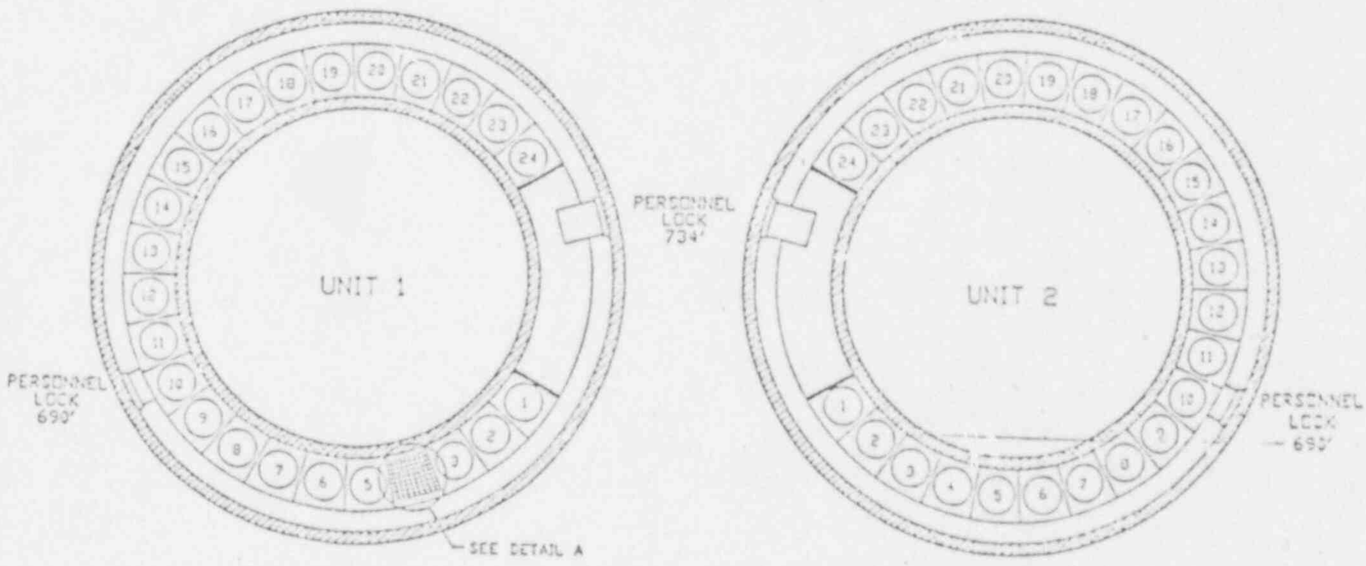

FIGURE 1

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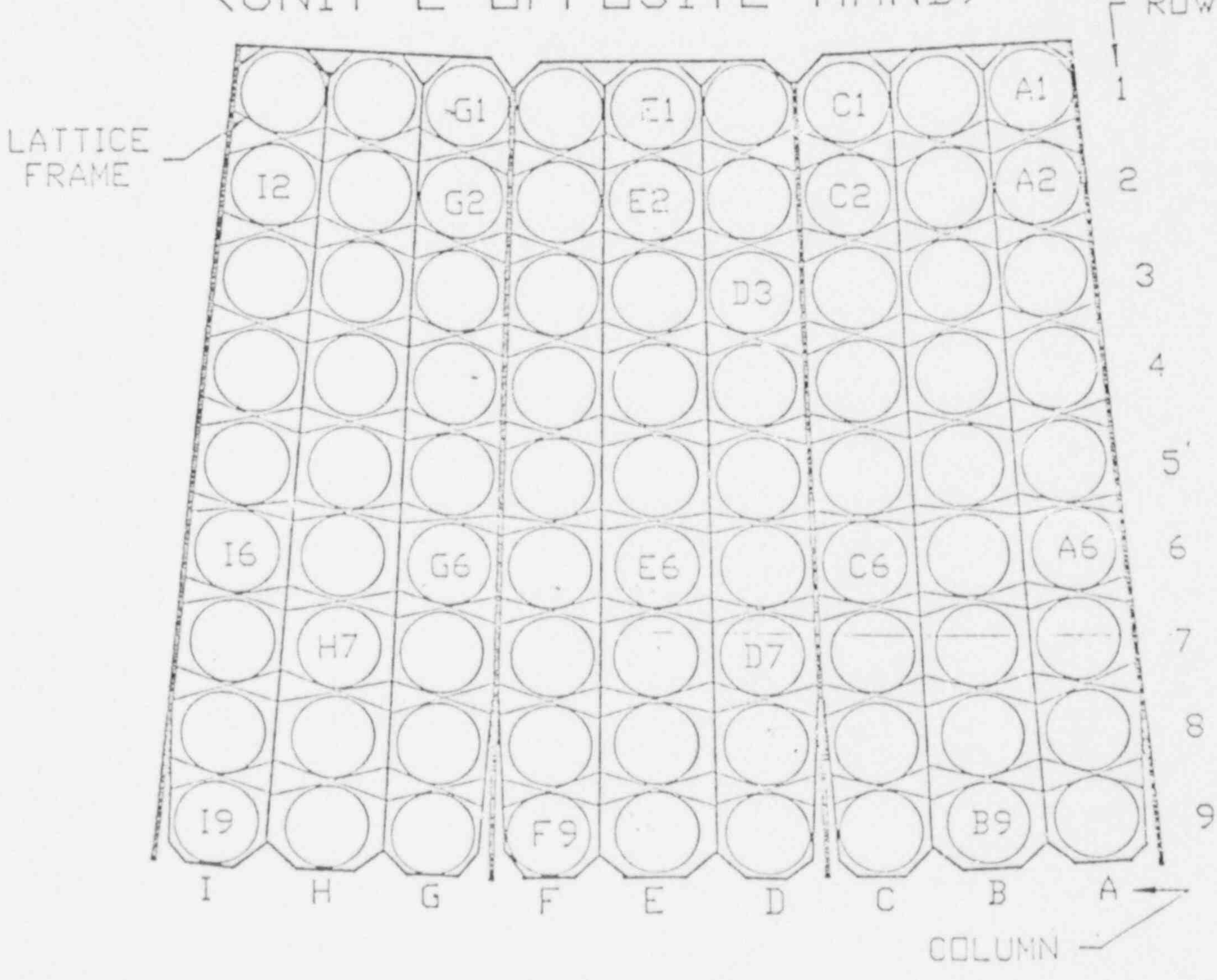
TEXT (If more space is required, use additional NRC Form 366A's) (17)

ICE BASKETS NUMBERING SEQUENCE
TYPICAL FOR UNIT 1 ICE CONDENSER
(UNIT 2 OPPOSITE HAND)



(BAY SHOWN WITH BEAMS AND DOOR FRAMES REMOVED)

DETAIL A
FIGURE 2

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
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TEXT (If more space is required, use additional NRC Form 366A's) (17)

ICE CONDENSER FLOW PASSAGE
(AREA INSIDE TRIANGLE)

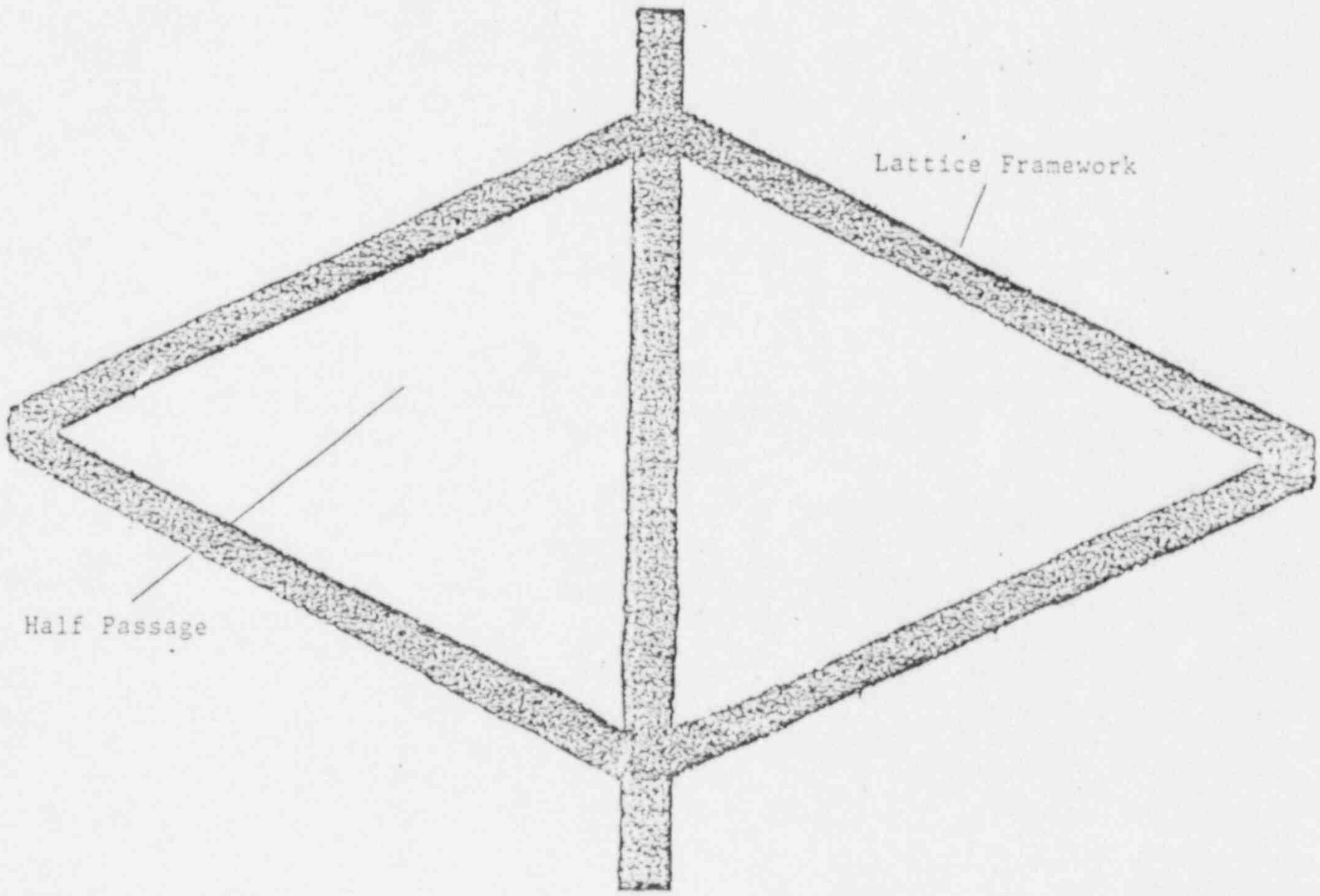

FIGURE 3

TENNESSEE VALLEY AUTHORITY
Sequoyah Nuclear Plant
Post Office Box 2000
Soddy-Daisy, Tennessee 37379

April 11, 1988

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Gentlemen:

TENNESSEE VALLEY AUTHORITY - SEQUOYAH NUCLEAR PLANT UNIT 2 - DOCKET NO. 50-328 - FACILITY OPERATING LICENSE DPR-79 - REPORTABLE OCCURRENCE REPORT SQRO-50-328/88003 REVISION 1

The enclosed licensee event report which provides details concerning ice buildup in the flow passages of the ice condenser due to sublimation which could result in increased containment pressures is being revised to update the cause and corrective action sections of this report. This is a voluntary LER.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

S. J. Smith
Plant Manager

Enclosure
cc (Enclosure):

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NRC Inspector, Sequoyah Nuclear Plant

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