U.S. NUCLEAR REGULATORY COMMISSION

REGION II

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Report No:	50-327/98-13, 50-328/98-13
Licensee:	Tennessee Valley Authority (TVA)
Facility:	Sequoyah Nuclear Plant, Units 1 & 2
Location:	Sequoyah Access Road Hamilton County, TN 37379
Dates:	September 14 through October 16, 1998
Inspectors:	N. Economos, Senior Reactor Inspector, DRS, RII (Lead Inspector) P. Van Doorn, Senior Resident Inspector, Watts Barr, RII R. Telson, Resident Inspector, Sequoyah, RII D. Starkey, Resident Inspector, Sequoyah, RII
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Enclosure 2

EXECUTIVE SUMMARY

Sequoyah Nuclear Plant, Units 1 & 2
NRC Inspection Report 50-327/98-13, 50-328/98-13

This inspection included aspects of licensee maintenance, testing, engineering, self-assessment, and problem evaluations of the licensee's Ice Condenser (IC) System.

Maintenance

- Field observations of Unit 1 IC outage activities found that personnel followed procedures during ice weighing and servicing activities. Obtaining weight measurement was performed with considerable difficulty or not possible on many baskets due to baskets being frozen to lattice framework. Thorough oversight of contractor activities was noted during these evolutions. (Section M1.1).

- The licensee had provided reasonable controls for debris in the IC and was thoroughly documenting and adequately evaluating debris which could not be removed.(Section M1.2).

- The licensee failed to properly tape IC upper blankets leading to a licensee-identified, non-cited violation.(Section M2.1).

- Intermediate deck door surveillances were properly performed, however, intermediate deck door hold down bolts were improperly configured on Unit 2 resulting in an NRC identified violation. (Section M2.2)

- The licensee's technique for servicing ice baskets contributed to many baskets freezing in-place, resulting in damage to ice baskets occurring during ice basket servicing. A licensee-identified non-cited violation (NCV) was identified for the failure to promptly identify and correct damaged ice baskets. (Section M2.3)

- The licensee effectively completed the replacement of one damaged basket and effectively conducted an operability determination for 51 Unit 1 damaged ice baskets. An NRC review of the licensee's operability determination was identified as a continuation of an existing Unresolved Item (URI). (Section M2.3)

- The licensee's use of thermal drilling appeared to increase the ice density beyond that expected from normal ice-use compaction. A URI was identified to review the licensee's evaluation of this issue. (Section M2.4)

- Appropriate control of IC screws was noted. (Section M2.5).

- Lower plenum inspections found adequate housekeeping. Ice voiding was noted and a URI was identified to review the licensee's evaluation of this issue. As-left ice flow blockage was noted in rows 8 and 9, which was found to be acceptable by the NRC. (Section M2.6)

- A review of nine IC surveillance procedures showed that the procedures were clearly written and met Technical Specification (TS) requirements. (Section M3.1).

- A review of documentation for eight surveillances disclosed that IC surveillance results met procedural and TS requirements. (Section M3.2).

- Observations and detailed data reviews provided assurance that sufficient ice remained in the IC to meet the design basis. (Section M3.3).

- A high number of frozen baskets challenged the ability of the licensee to obtain a representative sample required by TS. NRC review of this issue was identified as a continuation of an existing URI. (Section M3.3).

Engineering

- The licensee's program for monitoring IC lower plenum floor movement was thorough and assured lower inlet door operability. (Section E2.1).

- A review of problem evaluation reports issued since 1992 showed that licensee evaluations of IC problems for 10 CFR 50.73 reportability were performed adequately. (Section E4.1).

- A poorly documented engineering evaluation for improper taping of IC blankets was identified as a minor violation. (Section E4.1).

- A generally thorough IC self-assessment was noted and independent assessments of IC activities were thorough. (Section E7.1).

Report Details

Summary of Plant Status

Unit 1 began this inspection period in Mode 6 in the Cycle 9 refueling outage. At the end of the period, Unit 1 was in Mode 5. Unit 2 remained at 100% power during this inspection period.

II. Maintenance

M1 Conduct of Maintenance

M1.1 Field Observations - General

a. Inspection Scope (61726) (62707)

The inspectors conducted field observations of various Unit 1 and Unit 2 activities including both Technical Specification (TS) and non-TS ice basket weighing, ice basket servicing, ice basket drilling, intermediate deck door inspection, and contractor oversight activities. These activities involved at least 16 entries into the ice condenser (IC), observations of each of the three types of weighing methods and included day, evening and night shifts.

b. Observations and Findings

Personnel followed procedures during the various evolutions. Contractor oversight was thorough. Licensee foreman oversight was being provided for most of the time that activities were in progress and a contractor foreman was routinely present as well. Weighing was performed with a four-person crew composed of two personnel performing weighing, the data taker, and one person at the bottom of the basket (with a foreman also present at the top). In addition, periodic oversight by a maintenance engineer, a systems engineer, and the Mechanical Maintenance Manager was also noted. The inspectors observed that the craft experienced significant difficulty getting verifiable weights in certain rows due most probably to ice accumulation from thermal drilling, leading to frozen baskets. The observed techniques for weighing baskets provided reasonable assurance that the weighing process provided consistent and accurate weights with minor variances. The procedures governing the above activities were as follows:

- SI-106.2, Ice Condenser-Ice Bed Unit 1, Revision 7
- 0-MI-MXX-061-001.0, Ice Condenser Ice Servicing, Revision 6

Personnel followed procedures during ice weighing and servicing activities. Obtaining weight measurement was performed with considerable difficulty or not possible on many baskets due to baskets being frozen to the lattice framework. Thorough licensee oversight of contractor activities was noted.

M1.2 Foreign Material Exclusion Controls (62707)(37551)

The inspectors reviewed licensee procedural controls for foreign material exclusion and results of licensee inspections and evaluations. Final inspections and records of unremovable debris were performed in accordance with Surveillance Instruction (SI)-106.2, Ice Condenser-Ice Bed, and 106.3 for Unit 1 and Unit 2, respectively. The licensee's past maintenance practices and extensive maintenance activities required in the IC had resulted in many pieces of debris; however, the licensee had established a detailed list of debris for each unit, much of which was contained within the baskets. Evaluations were conducted to assure that the debris would not likely clog floor drains or leave the upper plenum to clog the upper to lower containment drains. The inspectors reviewed the licensee's evaluations and considered the conclusions to be reasonable. The licensee had provided reasonable controls for debris and was thoroughly documenting and adequately evaluating debris which could not be removed.

M2 Maintenance and Material Condition of Facilities and Equipment

M2.1 Observation of Unit 1 Upper Deck Blankets

a. Inspection Scope (62707)

The inspectors observed the Unit 1 upper deck blankets for adequacy of material condition. The inspectors also reviewed the licensee's evaluation of Problem Evaluation Report (PER) SQ981146 which documented taping that was not in accordance with requirements, reviewed procedures and drawings for installation of tape, and observed portions of repairs made to Unit 1 and Unit 2 tape.

b. Observations and Findings

Requirements for taping are contained in Westinghouse Drawing 1186F75, Revision 7. This drawing required radial tape to be one piece and contained at the blanket hinge end with clips to assure the tape was retained during a design basis event. In addition, circumferential tape at the outer wall was supposed to be stapled to the blankets. The inspection disclosed many pieces of tape, apparently added over a number of years for patching and assisting in holding down older tape, which had not been placed under the clips. Also, the circumferential tape had not been stapled. The licensee had identified this condition on PER SQ981146. The retaping had been performed previously by using work orders (WOs). These WOs did not have sufficient information in them to assure taping was adequately performed. Examples were WOs 96-039208-000 and 94-02547-00. The licensee issued new guidance via preventive maintenance (PM) instructions, PMs 063600412 and 063600413 for Units 1 and 2, respectively, which contained the proper requirements. The portion of the retaping performed during the inspection was adequately conducted.

Consistent with Section VII.B.1 of the NRC Enforcement Policy, this non-repetitive, licensee-identified failure to provide adequate WO instructions for taping of IC upper deck blankets is identified as Non-Cited Violation (NCV) 50-327,328/98-13-01: Failure to Provide Adequate Procedures for Taping of Upper Ice Condenser Blankets. In addition, the licensee's initial evaluation of the condition was not well documented and is further discussed in Section E4.1.

c. Conclusions

A licensee-identified NCV was identified for the failure to properly tape upper blankets on the IC.

M2.2 Intermediate Deck Door Frame Hold Down Bolts Improperly Configured (Unit 2)

a. Inspection Scope (62700) (40500)

The inspectors verified the adequacy of performing TS-required surveillances on the Unit 2 intermediate deck doors as implemented by Procedure SI-108.4, Rev. 6. Ice Condenser (IC) Intermediate and Lower Inlet Doors. This observation included condition of bolting, intermediate deck doors, and intermediate deck door frames.

b. Observations and Findings

On September 16, 1998, the inspectors accompanied the licensee's inspector into Unit 2 to observe a weekly (7 day) surveillance of the intermediate deck doors as required by TS 4.6.5.3.2. This TS requires that the intermediate deck doors be verified by visual inspection to be closed and free of frost accumulation. This requirement is implemented through Procedure SI-108.4. During this inspection, the inspectors observed that the intermediate deck doors exhibited no visible structural deterioration, and that they were closed and free of frost accumulation. However, during this inspection the NRC inspectors observed that a significant number of the bolts used to secure the IC intermediate deck door frames to the radial beams were not properly configured or torqued to specified requirements. Typical examples included bolts with missing washers or with washers too small for the application; bolts not fully engaged or inadequately tightened and bolt holes without the required hold down 3/8" bolts installed. This condition was contrary to Maintenance Instruction O-MI-MXX-061-001.0, Rev. 6, Ice Condenser Ice Servicing, which required the subject bolts to be installed per Westinghouse Drawing T189E83 and torqued to between 9-11 ft lbs. The above-mentioned condition was described to the licensee who confirmed it by an inspection performed on September 19, 1998.

On October 5, 1998, the licensee issued Design Change Notice (DCN) S14362, PER 981288 PER and work request (WR) C397003, to perform the necessary repair/replacement. On September 18, 1998, the licensee issued Technical Operability Evaluation (TOE) 2-98-061-1288, Rev. 00, to evaluate material condition and determine its impact on operability. TOE 2-98-061-1288 indicated that this material condition

problem was not an operability issue. The inspectors evaluated the operability determination to be reasonable.

The problem was classified as a Level C PER, which does not require a root cause analysis according to Procedure SPP-3.1 Corrective Action Program. However based on observations, document reviews and discussions, the inpectors determined that the cause of this problem was due to craft reassembly errors. The inspectors determined that the licensee had taken appropriate actions to correct the problem and had revised the applicable procedure and the referenced drawing to prevent a recurrence. With respect to Unit 1, the intermediate deck door framing had already been removed at the start of the inspection. The inspectors verified that the Unit 1 intermediate deck doors' reassembly was correctly implemented prior to restart.

This failure to properly install certain hold down bolts to secure the intermediate deck door frames to the radial beams in accordance with applicable procedures and drawings is identified as Violation (VIO) 50-328/98-13-02: Failure to Follow Intermediate Deck Door Installation Requirements.

c. Conclusions

The TS required surveillance for intermediate deck doors was performed by adequately trained personnel who were thoroughly familiar with the requirements. A violation was identified concerning improperly configured intermediate deck door frame hold down bolts. The licensee's corrective actions, operability evaluation and documentation were adequate.

M2.3 Damaged Ice Condenser Ice Baskets - Material Condition (Unit 1)

a. Inspection Scope (62700)

The inspectors reviewed and evaluated the adequacy of identification and repair/replacement of degraded IC ice baskets. As-found conditions were evaluated with respect to TS, the Final Safety Analysis Report (FSAR), design criteria, and applicable licensee drawings and procedures.

b. Observations and Findings

b.1. Material Condition

In May 1998, during a forced Unit 1 outage, approximately 10 ice baskets were identified with denting and damage. In response to the 10 damaged ice baskets, the licensee issued PER No. SQ980597, Rev. 0, dated May 20, 1998, to document the problem and to track the corrective actions taken. In addition, as discussed in NRC Inspection Report 50-327, 328/98-06, the licensee issued TOE No. 1-98-061-0597, Rev. 0, dated May 20, 1998, which determined that these damaged ice baskets would not have any impact on IC operability. This TOE was determined to be reasonable to the

NRC inspectors. The licensee also determined that a clearer acceptance criteria for basket damage was needed.

As such, acceptance criteria for punctured and/or dented ice baskets were developed by Westinghouse and documented under Task No. TVA-98-083, dated September 18, 1998. On this basis, during the Unit 1 refueling outage, the licensee visually inspected the ice baskets from the top and bottom with the aid of a drop light. During this inspection the licensee identified approximately 60 baskets (10 from the May 1998 forced outage), exhibiting various degrees of damage. Through discussions with the system engineer and by inspection, the inspectors determined that the baskets were most probably damaged from the licensee's servicing technique used to free-up, frozen-in-place ice baskets, further discussed in Section M2.4.

The servicing technique involved the use of thermal drills to open holes in the ice inside the ice basket to facilitate ice replenishment. However, this technique also promotes ice formation which generally accumulates on the lattice frame surrounding the ice baskets and contributes to the baskets freezing in-place. To overcome this problem, the licensee uses Procedure O-MI-MXX-061-001.01 and Procedure SI-106.2. These procedures allow an upward thrust of 4,000 lbs. to be applied to the bottom of the basket while a lifting force of 3,000 is normally applied at the top simultaneously, to assist in freeing frozen-in-place ice baskets. Repeated attempts to free frozen-in-place ice baskets with an equal or greater amount of thrust, applied preferentially on the bottom of the basket can cause the basket to collapse in certain areas.

In addition, the inspectors noted that out of the 60 damaged ice baskets, the licensee determined that 51 did not meet the acceptance criteria from Task No. TVA-98-083 and would require repair, modification or replacement. The licensee decided to modify these basket under DCN T14253C, which was not started until the plant was in the process of returning to power. This modification is discussed in subsection b.3 below. Six of the 60 damaged ice baskets met the acceptance criteria and no further work was required. The remaining three damaged baskets were replaced because their location, with respect to the geometric center of their respective bays, did not lend them as good modification candidates. For the most part, the identified damage was located on the lower section of the ice basket column. Based on observations, discussion and document reviews, the inspectors determined that the licensee had numerous opportunities to identify and to promptly correct the damaged ice baskets during previous inspections, maintenance and/or during material condition walkdowns. However, because the initial condition of the baskets was identified and evaluated by the licensee during the Unit 1 forced outage in May 1998, consistent with Section VII.B.1 of the NRC Enforcement Policy, this non-repetitive license-identified failure to promptly identify and correct these damaged ice baskets is identified as NCV 50-327/98-13-03: Failure to Promptly Identify and Correct Damaged Ice Baskets.

b.2. Operability Determination

The licensee issued Rev. 1 to TOE 1-98-061-0597 on September 30, 1998, in order to address the operability effects on the IC by the additional 51 identified damaged baskets. Rev. 1, which determined that IC operability was met, was issued primarily to address continued operability with the 51 damaged baskets after start-up of Unit 1 until the baskets were modified. The modification implemented under DCN T14253C would install structural supports to the upper ice basket sections. The inspectors determined that further NRC review of TOE 1-98-061-0597, Rev. 1 was necessary to evaluate the adequacy of the licensee's position. An unresolved item (URI), 50-327, 328/98-06-01, had been identified to evaluate the effects of damaged ice baskets from the April 1998 Unit 1 forced outage. Based on this preexisting NRC item, NRC review of the operability determination for the damaged baskets identified during the Unit 1 refueling outage is identified as a continuation of this URI and is further addressed in Section M8.2.

b.3. Repair and Modification

One of the corrective actions from the May 1998 PER was a work order to replace one of the 10 ice baskets in Bay 7 at the H3 location. This basket had numerous torn ligaments (i.e., five vertical and six horizontal). The repair involved removal of the lower 12 foot section and its replacement with a like section along with a new bottom section. The WO issued for this repair was No. 98-006394-000 dated May 20, 1998, and the repair was performed on September 18, 1998. By review, the inspectors verified that the WO provided adequate instructions for removal and replacement of the basket and that the work package included material information for materials used to carry out this task.

The licensee issued DCN T14253C and appropriate work orders to carry out the modification on the 51 damaged ice baskets. The inspectors determined that the DCN accomplished the following with respect to basket repair: damaged ice baskets were to be provided with supports to protect them from design basis compressive stresses which could contribute to their collapse, and two-foot basket subassemblies provided for possible use in IC rows 1, 2, 8 and 9. The inspectors noted that the 10 CFR 50.59 screening review for DCN T14253C referenced a safety evaluation (SE) conducted under DCN S14177A, which documented several discrepancies in the IC design documentation identified during a self-assessment audit and PER SQ98071PER. One of the discrepancies was the modification of the IC ice baskets due to damage. The inspectors reviewed the SE and determined that it was acceptable for the basket repair and use of two-foot length basket subassemblies. All 51 baskets modifications were completed on October 16, 1998.

c. Conclusions

The licensee's technique for servicing ice baskets contributed to many baskets freezing in-place, resulting in damage to ice baskets occurring during ice basket servicing. A licensee-identified NCV was identified for the failure to promptly identify and correct

damaged ice baskets. The licensee effectively completed the replacement of one damaged basket and conducted an operability determination for the 51 Unit 1 damaged ice baskets. An NRC review of the licensee's operability determination was identified as a continuation of an existing URI.

M2.4 Servicing of Ice Baskets

a. Inspection Scope (62700)

Determine the effects of IC ice basket servicing using thermal drilling on the ice mass density.

b. Observations and Findings

FSAR Section 6.5.4.2 System Design, describes the ice baskets as being essentially 48 feet long and filled with flake ice; Section 6.5.15.4.1 Testing and Inspections, states in part, that ice basket tests performed in 1969 used flake ice and that flake ice represented the basis for the configuration used in the ice condenser. The inspectors determined that sublimation causes many ice baskets to lose ice mass during the fuel cycle. Because the rate of sublimation varies across the ice bed, some baskets depending on their location tend to lose substantially more ice mass than others. This also results in the loss of uniformity of the ice mass in many baskets. To overcome this problem, effected baskets are replenished with flake ice. Sublimation also causes the ice mass to take on such forms as coning and voids which can appear throughout the length of these baskets but are observed at the top and bottom sections of the affected ice baskets. In order to prepare the baskets to accept replenishment ice, the licensee uses a thermal drilling technique.

This technique uses a heavy cylindrical projectile-like object that is connected to a cable and is equipped with electric heating elements that can generate temperature between 600°F to 800°F. The thermal drill is guided down the ice column inside the ice basket either manually or automatically to open a hole by melting the ice in the immediate area. The water generated from this process, flows down the hole and refreezes, permeates into the ice mass increasing the ice density, or runs out the sides of the basket and down the lattice frame. The inspectors expressed concern over the effect that the licensee-created ice density changes from thermal drilling had on the heat transfer capability analyzed from the natural densification process for in-use flake ice compaction. Subsequent to the onsite portion of the inspection, on October 7, 1998, Region II and the licensee discussed density changes in the ice mass from thermal drilling and its potential impact on design calculations and the IC ability to perform its design safety function. In response to this discussion, the licensee stated that a review of this potential density change effect would be conducted. Pending NRC evaluation of this review, this issue is identified as one example of URI 50-327,328/98-13-04: Evaluation of Ice Density Increase and Effects of Ice Voiding.

c. Conclusion

The licensee's use of thermal drilling appeared to increase the ice density beyond that expected from normal ice-use compaction. A URI was identified to review the licensee's evaluation of this issue.

M2.5 Storage and Control of IC Ice Basket Screws and Ice Baskets

a. Inspection Scope (62700)

The inspectors determined by inspection, document review and discussions with cognizant personnel the adequacy of storage and control of IC replacement ice basket screws, and ice baskets.

b. Replacement Sheet Metal Screws and Ice Baskets

By observation and document review the inspectors inspected the licensee's storage facilities for ice baskets and ice basket sheet metal screws. Within these areas the inspectors noted the following:

b.1. Ice Basket Sheet Metal Screws :

On April 14, 1988 the licensee received a shipment of 6000 commercial grade sheet-metal screws (screws) for use on IC ice baskets as fasteners. The screws were purchased from Cardinal Industrial Products, under requisition number 35345B, Contract No. 88NNt-35345B. The contract specified that they were to be tapping self-forming type F screws and were to be made from carbon steel material in accordance with ANSI standard 18.6.4. Screw size was to be 10-32 x 0.5 inches long, zinc plated. The screws were identified as commercial grade QA Level III material and, as such, did not require a certificate of compliance or a material analysis report. The screws were receipt inspected at Sequoyah on April 14, 1988.

On March 31, 1993 the licensee issued PER No. SQPER930090 to document that the subject screws were procured without listing the requirements specified in FSAR Section 6.5.4.4 (i.e., carbon steel material, type C-1022), heat treated to a Rockwell C hardness of RC52 and minimum yield of 130 KSI. The PER indicated that referenced Westinghouse Drawing 1191E57 provided no minimum tensile strength requirements. However, upon further review of the FSAR and WCAP-83004, the licensee determined that the subject screws were to have a minimum strength of 140 KSI. On April 1, 1993, approximately 700 screws had been brought out of Power Stores; however, it was uncertain how many, if any, had been used in IC ice baskets. An operability evaluation, dated April 16, 1993 (determined to be satisfactory by the NRC inspectors), concluded that even if the screws were to fail in the application, the ice baskets would still meet design requirements during a design basis accident. On April 6, 1993, the balance of the 1983 screw shipment in storage was tagged as nonconforming material. On April 20, 1993, mechanical and chemical tests were performed on a representative

sample of six original Westinghouse screws and six replacement screws. The six replacement screws were part of a 100 screw sample picked at random to meet MIL-STD-105D requirements. The Westinghouse screws were retrieved from spare ice baskets as they were the only on-site source except for those in the in-place IC baskets. The investigation showed that the micro-structures on all tested samples were similar and consisted of tempered martensite. Hardness values, converted from the superficial scale (30N), to the Rockwell C scale ranged between RC 34 and RC 44. The tensile strength as determined by hardness conversion, exceeded the minimum 140 KSI. Following this investigation the licensee examined the remaining 94 screws from this group to provide adequate assurance that the population tested was representative of the screws in stock. By review, the inspectors determined that both properties were relatively similar and within the acceptance criteria of the specification. On April 20, 1993, following completion of the product form verification process, the licensee verified that material (i.e., screws from the new supplier), met material requirements and that their mechanical properties were well within the range of values obtained from the Westinghouse sample. Based on these results, the licensee issued DCN S09495A dated April 23, 1993, to revise Westinghouse Dwg. 1191E57SH.1 and performed an upgrade of the commercial grade screws, changing them from QA Level III to QA Level II safety-related and authorized a conditional usage for field application with increased documentation. On August 3, 1993, the nonconforming tags were pulled from the subject screws in response to the metallurgical results and the operability evaluation.

On February 10, 1994 the licensee received a shipment of 6100 QA Level I quality screws that were made from the same material (C-1022), and with a minimum tensile strength of 140 KSI.

On May 29 , 1998, the licensee sent three groups of screws to the TVA Central Laboratory Services for a metallurgical investigation of hardness. Two groups totaling 17 screws, were from the 1988 commercial grade shipment that had been upgraded to QA Level II from commercial grade. The third group consisting of 12 screws, belonged to the QA Level I shipment received on February 10, 1994. Examinations performed on the three groups included hardness of the core, the case and of the cross-sectional surfaces. Results from this metallurgical examination showed that one of the 17 commercial grade screws failed to meet minimum hardness requirements. The licensee resolved this problem by expanding the examination sample to a total of 97 commercial grade screws in order to demonstrate that the statistical test addressed an infinite screw population and a 95 percent level of confidence that 95 percent of the screws met minimum hardness requirements. Hardness tests on this expanded sample produced no failures, and exhibited no evidence of case hardening. Some of the commercial grade and QA Level I screws exhibited a very thin, fully hardened layer at or near the threaded surfaces. This meant that the screws had been probably carburized. Also the report indicated that the commercial grade screws exhibited some evidence of laps and cracks at the root and the tips of the threads respectively. Because of the conditions described above, although the commercial grade screws were still considered as structurally acceptable, the licensee surplussed the commercial screws and removed them from Power Stores on September 30, 1998.

b.2. Control and Issue of Ice Baskets

The inspectors reviewed two WOs used to replace certain damaged ice basket sections during this U1C9 outage. The WOs and the scope of work performed was as follows:

WO	Location	Work Performed
98-006408-00	Bay 18, Row E1	Remove and replace damaged bottom basket assembly.
98-006394-000	Bay 7, Row H3	Remove and replace torn/damaged lower 12 ft. basket section.
98-006394-000	Bay 19, Row G6 Bay 17, Row B3	Remove and replace damaged 12 ft. basket sections.

Work records reviewed were well written and included pre-job briefings, detailed instructions with reference to applicable procedure sections, connecting bolt and screw torquing requirements and signed requisition slips for material used to perform this task. The inspectors noted that screws used for basket replacements on the above WOs were from the QA Level I quality group. The inspectors observed the completed corrective maintenance on the subject ice baskets and determined that it met procedure requirements with evidence of good workmanship. Replacement basket sections were properly stored outdoors with access control limited to authorized personnel only. The ice basket sheet metal screws used for this repair/replacement activity were stored inside in a specified area. Screws were designated for IC work only and were issued for specific WOs to authorized personnel. The quantity of material issued was documented on the applicable requisition.

c. Conclusion

By document review and work observation the inspectors determined that the licensee maintained close control of replacement ice basket material. Commercial grade screws were adequately investigated and subsequently removed from service when surface imperfections and nonuniform surface hardness were identified. The licensee's decision to replace commercial grade with QA Level I screws was appropriate and demonstrated conservatism.

M2.6 Final Walkdown Inspection of Lower IC

a. Inspection Scope (62700)

Determine by observation and document review the adequacy of material condition prior to entering Mode 4.

b. Observations and Findings

The licensee conducted a containment inspection prior to entry into Mode 4 from Mode 5 to verify that no loose debris, equipment or tools were present and that all floor drains had been checked and free of obstructions. As a part of this inspection, the licensee's system engineer also performed a lower IC plenum inspection as a final check to assure that lower inlet doors, monitoring equipment, tools and housekeeping in this area were in order. Adverse conditions were logged and corrective actions taken as required. On October 6, 1998, after the licensee had completed the final walkdown, the inspectors, accompanied by the licensee's cognizant engineer, entered the lower IC plenum to inspect for loose debris in and around the lower sections of the ice baskets and turning vanes. In addition, the inspectors observed floor monitoring instrumentation, floor drains and general housekeeping. Special emphasis was placed on the condition of the lower ice basket sections for material condition, including freedom of flow passage from blockage, damage to baskets and the uniformity of ice content in the lower sections.

During this inspection, the inspectors noted that the lower section of a significant number of baskets were not full as evidenced by voids and coning, and in one case in bay 1, the ice basket exhibited no evidence of ice in the lower six to eight foot section. In general, this nonuniform ice distribution did not appear to be in agreement with SQN-DC-V-27.1, Design Criteria Document for IC System, which assumes that the ice weight was uniformly distributed throughout the entire ice bed. In general, the licensee relies heavily on as-left weight measurements obtained by weighing free baskets after servicing and the TS required representative sample of 144 baskets to determine ice weight inventory. The licensee uses the weight data from these two sources to estimate the amount of ice in the ice bed. Using basket weight as a primary indicator of ice adequacy, the license does not significantly emphasize as-left voids and coning. Subsequent to the onsite portion of the inspection, on November 9, 1998, Region II and the licensee discussed the potential impact of non-uniform as-left ice voids and coning on the design basis and the ability of the IC to perform its intended safety function. In response to this discussion, the licensee stated that a review of the potential voiding and coning effects would be conducted. Pending NRC evaluation of the review, this issue is identified as a second example of URI 50-327, 328/98-13-04: Evaluation of Ice Density Increase and Effects of Ice Voiding.

In addition, flow channels in IC rows 8 and 9, appeared to be completely blocked. The lower IC sections of the ice baskets in rows 8 and 9 exhibited heavy ice accumulation. Review of flow passage inspection results however, disclosed that TS requirements were being met. The condition described was observed after all the ice bed servicing was completed and after the licensee's final walkdown of the lower plenum had been completed, just prior to the plant going to full power. The inspectors determined that rows 8 and 9 were difficult to clean during the refueling outage and therefore, the licensee cleaned the IC flow channels to less than an overall administrative 10 percent ice blockage limit prior to startup. The licensee stated that this 10 percent level would ensure that the TS 15 percent limit would not be exceeded during the operating cycle. Subsequent to the onsite portion of the inspection, the inspectors questioned the licensee's basis for ensuring that the 15 percent limit was not exceeded during the operating cycle, since certain amount of known flow blockage remained at startup. The

licensee provided to the inspectors sufficient information to demonstrate that ice blockage buildup did not exceed the 15 percent TS limit during the operating cycle.

Conclusion

Lower plenum inspections found adequate housekeeping. Ice voiding was noted and a URI was identified to review the licensee's evaluation of this issue. As-left ice flow blockage was noted in rows 8 and 9, which was found to be acceptable by the NRC.

M3 Maintenance Procedure and Documentation

M3.1 Review of Surveillance Procedures

a. Inspection Scope (61726)

The inspectors reviewed the most current Unit 1 SIs for conformance to TS requirements and general adequacy given recent industry issues. Similar procedures were developed by the licensee for Unit 2 and two procedures were common to both units. This review included SIs for TS Surveillance Requirements (SR) 4.6.5.1, 4.6.5.2, 4.6.5.3.1, 4.6.5.3.2, 4.6.5.3.3, 4.6.5.4.b, and 4.6.5.7. The following procedures were included in the review process:

- SI-106.2, Ice Condenser-Ice Bed Unit 1, Revision 7
- SI-108.1, Ice Condenser Intermediate Deck Doors-Visual Inspection, Lift Test and Ice Removal, Revision 5
- SI-108.4, Ice Condenser Intermediate and Lower Inlet Doors and Vent Curtains, Revision 6
- 1-SI-CEM-061-058.0, Ice Condenser Chemistry-Unit 1, Revision 1
- 1-SI-IXX-061-138.0, Backup Ice Condenser Temperature Monitoring, Revision 2
- 0-SI-MIN-061-003.0, Ice Condenser-Ice Baskets, Revision 1
- 0-SI-MIN-061-004.0, Ice Condenser Top Deck Doors, Revision 2
- 1-SI-MIN-061-107.0, Ice Condenser Floor Drains, Revision 1
- 1-SI-OPS-000-002.0, Shift Log, Revision 39

b. Observations and Findings

The procedures reviewed were clearly written and met TS requirements. The inspectors questioned why the top deck inspection did not include the upper vent assembly

(curtain) and whether other inspections would be appropriate such as for top deck door (blanket) damage and condition of tape. The TS for the vent assemblies inspection was included in the section for intermediate deck doors (SR 4.6.5.3.2) and, therefore, did not clearly require inspection of the upper curtain. The licensee agreed that procedure improvements were appropriate and indicated that the upper vent curtain inspection would be added to SI-108.4 along with the corresponding Unit 2 procedure, and improvements would be initiated to 0-SI-MIN-061-004.0.

c. Conclusions

A review of nine IC surveillance procedures showed that these procedures were clearly written and met TS requirements. Two areas for procedure improvement were noted.

M3.2 Review of Surveillance Results

a. Inspection Scope (61726)

The inspectors reviewed documentation of selected results of the previous Unit 1 and Unit 2 outage surveillance inspections and also reviewed results of the current Unit 1 outage inspections for conformance to TS requirements. The following results were included in this review:

- Ice Condenser Floor Drains (1 and 2-SI-MIN-061-107.0, Revision 1)
- Ice Condenser Top Deck Doors (0-SI-MIN-061-004.0, Revision 1)
- Ice Condenser Ice Baskets (0-SI-MIN-061-003.0, Revision 0)
- Ice Condenser Chemistry (1 and 2-SI-CEM-061-058.0, Revision 0)
- Ice Condenser-Ice Bed Unit 1 (SI-106.2, Revision 5)
- Ice Condenser Intermediate Deck Doors-Visual Inspection, Lift Test and Ice Removal Unit 2 (SI-108.2, Revision 4)
- Ice Condenser Intermediate and Lower Inlet Doors and Vent Curtains Unit 1 (SI-108.4, Revision 5)
- Ice Condenser Intermediate and Lower Inlet Doors and Vent Curtains Unit 2 (SI-108.5, Revision 4)

b. Observations and Findings

The results reviewed met procedural and TS requirements and documentation was adequate. Additional detailed reviews of ice weight data is described in Section M3.3

c. Conclusions

A review of documentation for eight surveillances disclosed that IC surveillance results met procedural and TS requirements.

M3.3 Review of Ice Weight Data

a. Inspection Scope (61726) (37551)

The inspectors reviewed ice weighing requirements contained in licensee procedure SI-106.2, Ice Condenser-Ice Bed Unit 1, Revision 1. The inspectors also reviewed Unit 1 as-found, as-left, and TS ice weight data for the last three refueling cycles (7, 8, and 9); reviewed the TS ice weighing sample plan; reviewed selected field weighing data sheets; reviewed Unit 1 sublimation data for the last two cycles; evaluated the licensee's guidance for heavyweight baskets and results; and held discussions with licensee engineers concerning weighing information.

b. Observations and Findings

The licensee weighed as many free baskets as possible at the beginning of the outage (before servicing) and again after servicing at the end of the outage. Also, the licensee selected a representative sample of 144 ice baskets. This sample was consistent with TS 4.6.5.1.d.2 requirements. In some cases, the as-left post servicing weighing was the same as the TS weighing; however, in most cases the TS weighing was a second weighing of the as-left condition. Interim informational weighing was also done for some baskets. Weighing was not allowed in Modes 1 through 4. The licensee's procedure also required an as-found and an as-left weight of 72 baskets to evaluate sublimation rates. These baskets had been randomly picked previously and the same 72 baskets were required to be weighed each outage.

The TS requires a "representative" sample of at least 144 baskets, one each from rows 1, 2, 4, 6, 8 and 9 of each bay. A basket from an adjacent bay in the same row is allowed if a basket cannot be obtained from the designated row. The total ice weight must be calculated at a 95 percent confidence level.

Licensee procedure SI-106.2 adequately incorporated TS requirements for weighing a sample of 144 baskets and additional baskets if necessary. The procedure also required that the average weight be calculated to assure the average was at least 1,071 pounds per basket at a 95 percent confidence level as required by TS. The licensee performed the TS sampling at the end of the outage, after servicing. This was based on the licensee's interpretation that the intent of the TS surveillance was to assure that sufficient ice existed for the ensuing operating cycle. This was considered acceptable. Average weights per bay for those baskets able to be weighed were well above the TS minimum. The TS sample analysis computed an average weight at a 95 percent confidence level of 1332 pounds.

Additional baskets weighed provided added assurance that the IC contained sufficient ice. For example, although many baskets were frozen in rows 1 and 2, approximately one-third of the row 1 and 2 baskets were weighed at some point in the outage. The licensee serviced all baskets based on weight and/or visual inspection for voids, which were typically visible from the lower plenum, if they occurred. Data for baskets able to be weighed confirmed that servicing was typically successful in replenishing the baskets to above the TS minimum.

The procedure provided for an evaluation of heavy baskets as well. An evaluation for overweight baskets identified one basket which was overweight during as-found weighing and one basket found overweight during as-left weighing. However, the zone average was acceptable which met the vendor guidance (Westinghouse letters TVA-98-101 dated September 30, 1998, and TVA-98-088 dated September 22, 1998).

The inspectors noted some differences between some field data sheet weights and the final TS weight data. Minor differences, on the order of 15 pounds or less, were explainable by normal variance. Further review of data disclosed that those with larger increased weight could be explained by the fact that the baskets had been serviced between weighings. Baskets which had larger decreased weight were explained by the licensee to have occurred because increased temperatures had been experienced in the IC during testing. The inspectors confirmed the increased temperature had occurred via review of temperature charts. One field data sheet weight for basket 8F1 was deemed to be in error. One basket, 2H9, showed an especially large decrease in weight of 244 pounds between the initial field weight and the final TS weight. The licensee indicated that this basket was in a zone where ice was being cleaned from flow passages including the outside surface of the baskets. Some of the decrease was probably due to this ice removal from the outside surface. The licensee's explanations appeared reasonable.

The licensee weighed each of the 72 required baskets for sublimation rates for the last two outages. Average annual sublimation rates for Cycle 8 and Cycle 9 were 1.9 percent and 3.25 percent respectively. Sublimation rates varied, however, with the inner two rows, Nos. 1 and 2, typically showing the greatest sublimation rates while some baskets showed increases indicating some migration. This rate for rows 1 and 2 for the Cycle 9 refueling approximated 7.8 percent versus the 15 percent assumed for design margin. The TS required weight allows for a sublimation rate of 15 percent plus a 1 percent error margin to the safety analysis minimum allowable requirement of 922 pounds per basket so the rates experienced were well within the margin allowed.

Based on the review of all the data described above, field inspections described in Section M1.1, sublimation rates being experienced, and discussions with licensee personnel, the inspectors considered that with reasonable assurance the ice bed contained sufficient ice weight to meet design basis requirements. However, the inspectors were concerned with the licensee's ability to demonstrate meeting the TS basis for verifying sufficient ice weight.

Although the TS allows alternate samples, the inspectors questioned whether the intent of the TS was being met regarding "representative" samples to support the statistical 95 percent confidence calculation. Only by review of additional weight data were the inspectors able to gain a reasonable assurance of sufficient ice.

Several ice basket sampling uncertainties were identified. Between 850 and 900 baskets were found to be frozen at the beginning and end of the current outage. Over the last three outages approximately 450 baskets have not been weighed during any of the three outages. Of the 144 samples picked to be weighed for the TS sample, 70 alternative baskets (allowed by the TS) had to be picked due to frozen baskets. Most of the time a different set of baskets for the 144 sample is weighed; however, nine of the same baskets were weighed the last four outages. A URI, 50-327,328/98-04-02 had already been identified to generally evaluate the licensee's use of "representative" ice baskets for TS weighing. Subsequent to the on-site portion of the inspection, on November 8, 1998, Region II and the licensee discussed this continued NRC concern as to whether the number of unweighable ice baskets negatively effected the licensee's ability to select a statistical "representative" sample of ice baskets to demonstrate the 95 percent sufficient ice-weight confidence level. In response to this discussion, the license stated that a review of the effects of unweighable baskets on meeting the 95 percent confidence level would be conducted. Pending NRC evaluation of the review, this issue is identified as a continuation of URI 50-327,328/98-04-02 and is further discussed in Section M8.1.

c. Conclusions

Observations and detailed data reviews provided assurance that sufficient ice remained in the IC to meet the design basis. However, the high number of frozen baskets challenged the ability of the licensee to obtain a statistically valid "representative" sample required by TS. NRC review of the issue was identified as a continuation of an existing URI.

M8 Miscellaneous Maintenance Issues (92902)

M8.1 (Open)Unresolved Item (URI) 50-327,328/98-04-02: Potential Inadequate Sampling of Ice Condenser Ice Baskets and Ice Basket Weights Due to Frozen Baskets. This item involved whether the TS required "representative" sample could be obtained due to many frozen baskets which were unable to be weighed. Detailed review of weight data was performed as described in Section M3.3 Based on this inspection, this item was left open pending NRC evaluation of a licensee review of this issue.

M8.2 (Open) URI 50-327,328/98-06-01: Potential Deficiencies in Maintenance and Inspection Procedures which Resulted in Ice Condenser Ice Basket Damage and Did Not Promptly Identify the Damage. This item involved a question as to the adequacy of maintenance procedures to have identified damaged baskets due to excessive force placed on the bottom of the basket. The licensee had found 10 damaged baskets, accepted by the NRC as not having an effect on operability. Additional inspections during the current

outage found an additional 50 baskets damaged due to force being placed on the bottom of the basket. A review of the licensee's corrective actions for this problem was conducted and documented in Section M2.3. Based on this review, this item was left open pending NRC review of the licensee's revised operability evaluation for past operability and start-up operability with 51 damaged ice baskets.

III. Engineering

E2 Engineering Support of Facilities and Equipment

E2.1 Floor Movement Data Review

a. Inspection Scope (37551)

The inspectors reviewed the licensee's procedure for monitoring floor movement and reviewed recent floor movement data for each Unit. The procedure reviewed was 0-PI-SXX-061-001.0, Ice Condenser Lower Plenum Floor Monitoring, Revision 4.

b. Observations and Findings

Due to a previous problem with floor upheaval and subsequent blockage of inlet doors, the licensee had developed a continuous floor monitoring system. Transducers were mounted in the lower plenum to monitor distance between the floor and the turning vanes and the floor and the bottom sill of the inlet doors. Data was being forwarded to the system engineer's office computer for compilation. The licensee program provided assurance that adequate clearance would be maintained to assure inlet doors would open when called upon.

c. Conclusion

The licensee's program for monitoring lower plenum floor movement was thorough and assured lower inlet door operability.

E4 Engineering Staff Knowledge and Performance

E4.1 Reportability Evaluation

a. Inspection Scope (37551) (40500)

The inspectors reviewed IC PERs to evaluate whether personnel had adequately evaluated the issues for reportability to the NRC.

b. Observations and Findings

The licensee's list of approximately 122 PERs, Incident Investigations (IIs), and Finding Identification Reports initiated for the IC system since January 1992 was reviewed for possible reportable problems in accordance with 10 CFR 50.73. Twenty-two of the documents were selected for more detailed review. Four of these problems reviewed were considered reportable. The licensee had covered each issue in an II, and these were properly reported during the 1992 and early 1993 time frame. These involved lower inlet door inoperability due to wear slab movement, ice weight below design analysis assumptions, and two missed surveillances. The most serious of these issues was the wear slab movement problem which was thoroughly addressed by NRC when it occurred. The licensee implemented a floor monitoring system as a result of this event (see Section E2.1).

During the review, the inspectors noted that TOE 2-98-61-1146, an operability determination involving upper deck blanket taping, was poorly documented, in that, thoroughness was lacking. For example, the licensee stated that the majority of the tape would remain in upper containment and the size of the individual tape strips was not sufficient to block the 14-inch drains. No qualification was performed to support this general statement. The licensee had not performed a field inspection to determine the amount of tape to be evaluated. The licensee indicated that the general qualitative statements in the TOE were based on a discussion with several engineers held in the office. The inspectors determined through field inspections that hundreds of square feet of tape were present on the top deck blankets and not secured (see Section M2.1). The licensee's reevaluation assumed the existence of 1500 square feet. The licensee, subsequent to the inspectors' questioning, reevaluated the problem using upper containment area, amount of tape, zone of influence for the drains from upper to lower containment, and drain design. This evaluation showed that an operability problem was improbable; however, the original TOE was considered to be an example of a poorly documented operability evaluation. Procedure SPP-10.6, Engineering Evaluations for Operability Determinations, Revision 0, Section 3.4, requires direct field observation as necessary for evaluations and states "Evaluate each applicable effect and describe why it will or will not prevent the SSC from performing/supporting its intended safety function(s)." The licensee failed to follow this procedure. This failure constitutes a violation of minor significance and is not subject to formal enforcement action.

c. Conclusions

A review of PERs issued since 1992 showed that licensee evaluations of IC problems for reportability were performed adequately. One example of a poorly documented operability evaluation was identified as a minor violation.

E7 Quality Assurance in Engineering Activities

E7.1 Self-Assessment Review

a. Inspection Scope (37551)(40500)

The inspectors reviewed the documentation of Ice Condenser Self Assessment Report No. SQ-SA-E&M-98-018 dated May 11, 1998, and also reviewed documentation of Nuclear Assurance (NA) department observations of IC activities.

b. Observations and Findings

The licensee conducted the assessment due to recent industry issues. The assessment appeared thorough and a number of good findings and areas for improvement were noted. These involved procedure enhancements, training enhancements, TS enhancements, damaged baskets, the need to develop a method for freeing frozen baskets, the need to evaluate overweight baskets, several FSAR discrepancies, and minor material condition problems. While the assessment was generally thorough, not all material problems were noted (see Section M2.2).

The NA assessment observations were thorough, covering multiple areas and including backshift and weekend observations. A large portion of the assessor's time had been spent observing weighing and servicing of ice baskets. Additional observations of important tests yet to be performed were planned. Discussions with the assessor disclosed that he was very familiar with the IC and had been a team member on assessments at both Sequoyah and Watts Bar. Two areas for improvement had been identified by the assessor at the end of the inspection.

c. Conclusions

A generally thorough IC self-assessment was noted. Also, independent assessment of IC activities were thorough.

V. Management Meetings

X1 Exit Meeting Summary

The inspectors presented the inspection results to members of licensee management at the conclusion of the inspection on October 2, 1998 and during a phone call on November 9, 1998. The licensee acknowledged the findings presented.

During the inspection period, the inspectors asked the licensee whether any materials would be considered proprietary. One proprietary document was reviewed and returned to the licensee.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

M. Bajestani, Site Vice President
J. Rathjen, System Engineer
R. Rogers, System Engineering Manager
P. Salas, Manager of Licensing and Industry Affairs
J. Valente, Engineering & Materials Manager

NRC

M. Shannon, Senior Resident Inspector

INSPECTION PROCEDURES USED

IP 37551:	Onsite Engineering
IP 40500:	Effectiveness of Licensee Controls in Identifying, Resolving, and Preventing Problems
IP 61726:	Surveillance Observations
IP 62707:	Maintenance Observations
IP 92902:	Followup - Maintenance

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-327,328/98-13-01	NCV	Failure to Provide Adequate Procedures for Taping of Upper Ice Condenser Blankets (Section M2.1)
50-328/98-13-02	VIO	Failure to Follow Intermediate Deck Door Installation Requirements (Section M2.2)
50-327/98-13-03	NCV	Failure to Promptly Identify and Correct Damaged Ice Baskets. (Section M2.3)
50-327,328/98-13-04	URI	Evaluation of Ice Density Increase and Effects of Ice Voiding (Sections M2.4 and M2.6)

Closed

50-327,328/98-13-01	NCV	Failure to Provide Adequate Procedures for Taping of Upper Ice Condenser Blankets (Section M2.1)
50-327/98-13-03	NCV	Failure to Promptly Identify and Correct Damaged Ice Baskets. (Section M2.3)

50-327/98-13-03	NCV	Failure to Promptly Identify and Correct Damaged Ice Baskets. (Section M2.3)

Discussed

50-327,328/98-04-02	URI	Potential Inadequate Sampling of Ice Condenser Ice Baskets and Ice Basket Weights Due to Frozen Baskets (Section M8.1)
50-327,328/98-06-01	URI	Potential Deficiencies in Maintenance and Inspection Procedures which Resulted in Ice Condenser Ice Basket Damage and Did Not Promptly Identify the Damage (Section M8.2)