APPENDIX B

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report: 50-498/94-07
50-499/94-07

Operating License: NPF-76
NPF-80

Licensee: Houston Lighting & Power Company
P.O. Box 1700
Houston, Texas 77251

Facility Name: South Texas Project Electric Generating Station,
Units 1 and 2

Inspection At: Matagorda County, Texas

Inspection Conducted: January 11-20, 1994

Inspectors: D. P. Loveless, Senior Resident Inspector
J. M. Keeton, Resident Inspector

Approved: W D Johnson
W. D. Johnson, Chief, Project Section A

2/4/94
Date

Inspection Summary

Areas Inspected (Units 1 and 2): Unannounced, special, reactive inspection of the licensee's emergency core cooling system sump enclosures to determine the circumstances surrounding and the cause of holes and gaps that could allow sump water to bypass the trash gratings, curbs, and screens.

Results (Units 1 and 2):

- Three examples were identified where the installation of the emergency containment sumps did not meet the licensee's commitments (Sections 2.3 and 2.4).

- One violation was identified, with five examples of failure to assure that the design basis of the sump enclosures was adequately controlled (Section 2.4).

- Two modifications had been performed since the emergency sumps were installed. Although the design of neither modification appeared to contribute to the deficiencies identified by this inspection, the modification processes presented opportunities for licensee personnel to identify these deficiencies (Section 2.5).

- The licensee's surveillance procedure was determined to be inadequate to ensure that inspections were performed in accordance with Technical Specifications. This resulted in the majority of inspections performed since 1987 being inadequate (Section 2.6).

- One violation was identified for failure to perform an adequate inspection of the emergency containment sumps within the surveillance interval in accordance with Technical Specification 4.5.2.d (Section 2.6).

- A previous industry operational experience report was not adequately addressed, and the reviewers failed to identify and correct the sump enclosure deficiencies (Section 2.8.3).

- It was unclear whether licensee personnel would have identified the deficiencies in the sump enclosure prior to the restart of Unit 1 based on their review of Supplement 1 to Information Notice 89-77 (Section 2.8.4).

- Prompt and effective corrective actions for the specific sump enclosure deficiencies were taken by installing the necessary modifications to close the holes found in the sump enclosures. Additionally, the surveillance procedure was revised to correct the inadequacies (Sections 2.9 and 2.10).

- Although the licensee took prompt actions to correct the specific deficiencies with the containment sump enclosures, following installation of the licensee's modifications, the inspectors identified additional examples of holes which could bypass the sump screens (Section 2.10).

- The inspectors concluded that the licensee's preliminary assessment of the safety significance of the deficiencies identified in the emergency containment sump enclosures was insufficient to determine the safety impact of these deficiencies on past operations of the South Texas Project (Section 2.11).

Summary of Inspection Findings:

- Violation 498;499/94007-01 was opened (Section 2.4).
- Violation 498/94007-02 was opened (Section 2.6).

Attachments:

- Attachment 1 - Persons Contacted and Exit Meeting
- Attachment 2 - Drawings of the Emergency Containment Sump

DETAILS

1 PLANT STATUS

1.1 Unit 1 Plant Status

Throughout this inspection period, the Unit 1 reactor was in Mode 5. This inspection covered a review of activities which took place during times that the reactor was in various modes of operation, including power operations. Most of these activities involved modes which required the emergency containment sumps to be operable. Most recently, the reactor was in Mode 3 on August 12-13, 1993.

1.2 Unit 2 Plant Status

Throughout this inspection period, the Unit 2 reactor was shut down and defueled. This inspection covered a review of activities which took place during times that the reactor was in various modes of operation, including power operations. Most of these activities involved modes which required the emergency containment sumps to be operable.

2 REVIEW OF THE CIRCUMSTANCES SURROUNDING THE HOLES AND GAPS IDENTIFIED IN THE EMERGENCY CORE COOLING SYSTEM SUMP ENCLOSURE (71707)

2.1 System Overview

The emergency containment sumps were designed as reservoirs to provide suction to the emergency core cooling system and containment spray system pumps during the recirculation phase following a design basis accident. There are three independent stainless steel lined sumps built into the containment floor. A typical sump configuration is shown in Attachment 2 to this report.

Following a loss of coolant accident, water spilling from the breach floods the containment floor. During the reflood phase of emergency core cooling, water from the safety injection accumulator tanks and the refueling water storage tank would be injected into the reactor vessel and spill out the break. After the water level in the refueling water storage tank reaches a minimum allowable value, the emergency core cooling systems automatically switch to the recirculation phase for long-term cooling. During this phase, water is drawn from the containment floor via the emergency sumps by the low head and high head safety injection pumps and returned to the reactor coolant system cold legs. The containment spray system also draws water via the emergency containment sump suction and directs it to the containment spray headers.

During the blow down of the reactor coolant system resulting from a system breach, it is anticipated that debris will be generated and collect in the water on the containment floor. The sources of this debris may include delamination or destruction of insulation, peeling of concrete, paint, or

equipment coatings, and maintenance debris not properly removed from containment following outage work activities. To prevent this debris from entering the sump suction piping, each sump is covered by a stainless steel framed enclosure measuring approximately 18 feet long by 5 feet wide by 3 3/4 feet high. The enclosures are provided with two vertical debris interceptors: (1) a fine inner debris screen, and (2) a coarse outer trash rack to prevent large debris from reaching the debris screen.

The Updated Safety Analysis Report, Section 6.2.2.2.3, describes the outer rack as a grating of stainless steel with a 4 inch by 1 3/16-inch spacing and the inner rack as a screen of stainless steel plate with 1/4-inch diameter perforations at 5/16 inch center-to-center spacing. This design ensures that the water entering the suction pipe at the bottom of the sump contains only a negligible amount of small particles. By design, these particles cannot clog the containment spray header nozzles that contain 3/8-inch diameter orifices. These are the smallest restrictions found in any system served by the sump. Therefore, the debris particles should not clog the coolant channel openings in the core fuel assemblies or affect the proper operation of the pumps taking suction on the emergency sump.

2.2 Background

In August 1993, the resident inspection staff determined that an internal inspection of the emergency core cooling system recirculation suction piping and sump enclosures would be necessary prior to return of the units to power. This inspection was based on industry experience with these sumps and was intended to look for debris or other causes to question the adequacy of the suction enclosures. Subsequently, on October 1, 1993, personnel at Arkansas Nuclear One, Unit 1, found several breaches in the integrity of the reactor building sump screens. This issue was added to the inspection plans of the South Texas Project residents.

In early December, the residents made arrangements to accompany the licensee on surveillance observations of the sump scheduled in early January. On January 5, 1994, during the Unit 1 sump enclosure inspection, the resident inspectors identified six holes approximately 2 x 4 inches in each sump enclosure which bypassed the sump enclosure screen. Additionally, the inspectors noted that the contact point between each sump enclosure and the containment floor was warped, such that a gap existed around the perimeter between 1/8 and 5/8 inch wide. This gap bypassed both the trash racks and the screen.

As a result of these findings, the licensee issued Station Problem Report 940022 and began reviewing the consequences of the condition. On January 6, the licensee determined that the condition potentially impacted the function of the safety injection system and the containment spray system. Control room operators reported the discovery in accordance with 10 CFR 50.72.

2.3 Review of the Sump Enclosure Design

The inspectors reviewed the design basis of the emergency containment sumps and the sump enclosures. Two systems take a suction on the emergency containment sumps during the recirculation phase following a design basis loss of coolant accident. First, the safety injection system takes a suction on the sumps and provides water to the reactor coolant system cold legs via the high head and low head safety injection pumps. Design Criteria 5N129MQ1045, "Safety Injection System," states that the containment emergency sumps shall comply with Regulatory Guide 1.82, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident." The inspectors reviewed the requirements of the regulatory guide and identified the following discrepancies:

- Section C.1.2 states "To the extent practical, the redundant sumps should be physically separated by structural barriers from each other and from high-energy piping systems to preclude damage to the sump components (e.g., racks, screens, and sump outlets) by whipping pipes or high-velocity jets of water or steam."

  The sumps themselves were physically separated by the containment floor structure. However, the sump enclosures were not separated by structural barriers. The sump enclosures were approximately 15 feet apart but were readily accessible one to another.

  Licensee engineers stated that the sump floor protected the sump outlet piping and met the criteria for physical separation to the extent practical. Additionally, although the sumps were located near each other, the curvature of the containment walls and the support wall discussed below tend to separate the sumps. The inspectors had no further questions.

- Section C.1.3 states, in part, that a curb should be provided upstream of the trash racks to prevent high-density debris from being swept along the floor into the sump.

  Licensee engineers stated that for this section the licensee had committed to the Proposed Revision 1 to Regulatory Guide 1.82. They stated that the criteria in the proposed revision only required that a curb be provided around the periphery of the screens. The engineers indicated to the inspector that a kick plate designed into the structure of the enclosure, between the trash racks and the inner screen, served the purpose of the curb.

  The inspector reviewed the proposed revision and determined that this document referred to both the trash racks and the inner screen as "the screens." Therefore, the recommendation did not vary between the proposed and the final Revision 1. The inspector concluded that the licensee did not meet this position of the regulatory guide; however,

the function of the curb was being met once the licensee installed the modification described in Section 2.9 of this report.

- Section C.1.4 states "The floor in the vicinity of the ECC sump should slope gradually downward away from the sump."

  During the initial inspections of the sump and sump area, the inspectors could not verify that the floor sloped in the appropriate directions. This slope was recommended to ensure that routine containment drainage would collect in the normal containment sump prior to entering the emergency sumps. However, during the inspections, the inspectors and licensee personnel identified a significant buildup of boric acid crystals on the floor of Emergency Containment Sump B in Unit 1. This indicated that drainage had been collecting in this sump as opposed to being directed to the normal sump.

  Licensee engineers stated that the design of the containment floor was to slope away from the emergency sumps. Floor Plan Drawing-3C01-1-C-1561, "Reactor Containment Building Internal - Floor Drain Plan at Elevation -11.3," indicated that the floor grading did slope away from the sumps. This slope was very slight and, as expected, Sump B had the least drainage. The inspectors verified that this item was properly met.

- Appendix A, Table A-4, "Additional Guidelines Related to Sump Size and Placement," states, in part, that the clearance between the trash rack and any wall or obstruction should be at least 4 feet. A solid wall or large object may form the boundary of the sump on one side only, (i.e., the sump must have three sides open to the approach flow).

  The inspectors determined by direct measurement that Emergency Containment Sump B did not meet this criteria. All three sumps were located in the vicinity of the containment wall, such that one of the 18 foot sides of the enclosure was within 2 feet of the wall. The licensee stated that, according to their design, this wall was considered a boundary of the sump as allowed by the criteria. However, in the case of Sump B, a support wall was located 2 feet 10 inches from the side opposite the containment wall. Therefore, this installation did not meet the criteria of Regulatory Guide 1.82.

  Licensee engineers concurred that the specific criteria of the regulatory guide had not been met. Regulatory Guide 1.82 states that these criteria were required to be met to ensure that experimental test boundaries for air ingestion are noted. This criterion was based on the boundary conditions of tests performed and published in NUREG/CR-2761, "Results of Vortex Suppressor Tests, Single Outlet Sump Tests, and Miscellaneous Sensitivity Tests." The licensee engineers stated that Calculation MC-6126, "Emergency Sump Vortex Breaker Safety Evaluation," demonstrated that there would be negligible air ingestion into the sumps

during a loss of coolant accident. This calculation was substantiated by the experiments published in NUREG/CR-2761. Therefore, the use of this experimental data was inappropriately applied to the emergency containment sumps because, as stated above, the boundary conditions were not met.

The inspectors discussed this discrepancy with NRC technical reviewers responsible for containment and reactor systems design. The reviewers stated that, based on the robust design of the South Texas Project sumps, the failure to meet the regulatory guide recommendations should not affect the operability of the emergency containment sumps. However, the licensee should evaluate this nonconforming condition adverse to quality in accordance with the guidelines of Generic Letter 91-18, prior to restart of Unit 1, and determine the overall operability of the emergency containment sumps.

* Section C.1.3 states, in part, that the sump outlets should be protected by at least two vertical debris interceptors: (1) a fine inner debris screen and (2) a coarse outer trash rack.

  Although according to the design and design drawings the sump enclosure met this criteria, as discussed in Section 2.4 of this inspection report, the as-installed configuration did not meet this criteria.

The licensing manager committed to review these deviations from the proposed Revision 1 to Regulatory Guide 1.82 and evaluate any nonconformances in accordance with the guidelines of Generic Letter 91-18. Additionally, the licensing basis requires revision to reflect the as-installed design of the containment sump enclosures.

The second system that takes a suction on the emergency containment sumps was the containment spray system. This system supplies water from the sumps to the containment spray headers. The inspector reviewed Design Criteria 5N109MQ1024, "Containment Spray System." Section 3.1.H stated that the containment spray system shall be designed in accordance with Regulatory Guide 1.82 to prevent debris larger than 1/4 inch in diameter from entering the recirculation piping that would impair the performance of the containment spray pumps, valves, eductors, or spray nozzles.

Compliance of the emergency containment sumps with Regulatory Guide 1.82 was addressed above. The inspectors reviewed the design with respect to meeting the debris limitation. The inspectors concluded that, as designed, the containment sump enclosures met this requirement. However, the design criteria was not met, considering the design installation deficiencies discussed in Section 2.4 of this inspection report.

2.4 Review of the Initial Installation

As discussed in Section 2.2 of this report, the inspectors identified holes in the emergency containment sump enclosures that bypassed the trash racks, kick plate, and/or inner screens. The inspectors reviewed the initial installation documents for the emergency containment sumps. Pittsburgh-Des Moines Work Package PDM 16706, "Normal and Emergency Sumps," was written to control the installation of the sump liner and sump enclosures. This document instructed the craftsmen to install the sump in accordance with Drawing E5/A and to install the cover and gasket.

The emergency containment sump covers were prefabricated offsite under Pittsburgh-Des Moines Work Package PDM 21258. The inspectors reviewed Drawing 312, "Sump Cover Sub-assembly." This drawing did not provide sufficient detail to prohibit the construction of the six holes which bypassed the sump enclosure screen as discussed in Section 2.2 of this report. These holes appeared to have been made to simplify construction by allowing the screen to fit around the structural angle iron.

10 CFR Part 50, Appendix B, Criterion III, states, in part, that measures shall be established to ensure that applicable regulatory requirements and the design basis, as defined in 10 CFR 50.2 and as specified in the license application for those structures, systems, and components to which this appendix applies, are correctly translated into specifications, drawings, procedures, and instructions. The failure to provide adequate work instructions and drawings to properly control the design basis of the emergency containment sumps was the first example of a violation of 10 CFR Part 50, Appendix B, Criterion III (498;499/94007-01).

The inspector reviewed the circumstances surrounding the gaps between the sump enclosure and the containment floor. It was unclear when these gaps were created. The excessive gaps existed in the Unit 1 sumps only. The licensee stated that the gaps were most likely created during attempts to lift the sump enclosures during the installation of the vortex breakers as discussed in Section 2.5 of this report. However these gaps were created, the existence of the gaps was outside of the design basis for the sumps. The inspectors noted that the design drawings did not clearly identify the specific requirements for these surfaces. Therefore, this deficiency was considered to represent a failure to properly control the design basis of the emergency containment sumps and was considered the second example of Violation 498;499/94007-01.

In November 1988, the licensee engineers determined that vortex breakers would be necessary to fully comply with the requirements of Regulatory Guide 1.82. The engineers then developed Engineering Change Notice Package 88-C-0037 to enhance the installation of the vortex breakers in the emergency containment sumps. The original notice suggested that additional holes be cut through the sump covers at the location of the sump manway. This suggestion was deleted from the final version of the change notice.

Following implementation of the modifications discussed in Sections 2.9 and 2.10 of this report, the inspectors observed the sump enclosure access manways and determined that the manways were not in accordance with Design Drawing 3C26-9-S-1516, "Structural Reactor Containment Building S. ST. Liner and Normal & Emergency Sumps." This drawing indicated that the manways were perfectly round; however, the as installed manways on Unit 1 had slot-type extensions cut into them. These slots were of the right dimensions to have been installed to facilitate the vortex breaker installation. The inspectors determined that the slots were cut because of a failure to provide proper instructions to control the design of the sump enclosures. This failure to properly control the design of the sumps was considered the third example of Violation 498;499/94007-01.

In addition to the existence of the slots in the manways, the inspectors determined that the manway covers were free to move within the manways. This condition allowed the outside edge of the slots to be uncovered on the Unit 1 sump enclosures. The resultant holes in the sump covers were greater than 1/4 inch. Therefore, this condition was also outside of the design basis of the sump enclosure. This failure to properly control the design basis of the sumps was considered a fourth example of Violation 498;499/94007-01.

The inspectors determined that a 1/8-inch rubber gasket was not installed in Unit 2. This gasket was designed to be installed between the bottom of the sump enclosures and the containment floor. The inspectors determined that Section F-F and Detail 9 of Design Drawing 3C26-9-S-1525, "Structural Reactor Containment Building S. ST. Liner - Section and Details," appeared to be in conflict and did not provide appropriate guidance to ensure the installation of the 1/8-inch gasket. This failure to properly control and implement the design of the emergency containment sumps was considered the fifth example of Violation 498;499/94007-01.

2.5 Review of the Modification History

A review of the emergency containment sump histories revealed that two modifications had been installed. Although neither modification appeared to have contributed to the problems found during this inspection, both represented an opportunity for licensee personnel to discover the sump enclosure deficiencies.

In December 1986, Nonconformance Report M-03121 was written to document that the threaded studs used to secure the sump enclosures were bent and the threads had been damaged on the Unit 1 sumps. As corrective action, Field Change Request DC01999 was issued to abandon the studs, nuts, bolts, and gaskets on the Unit 1 sumps and weld the cover to the baseplate at the location of each original anchor stud. The field change called for the sump covers to be attached to the floor by 6 to 8 inch weld beads at irregular intervals around the base of the sump cover.

The inspectors noted that the Updated Safety Analysis Report, Section 6.2.2.2.3, stated, in part, "The sump assemblies are protected by a

removable stainless steel cover. The screen and stainless steel cover are bolted to the floor over the sump." The Updated Safety Analysis Report had not been revised to reflect the modification. The licensing manager subsequently committed to update this section.

A second modification was installed in December 1988. At that time, design engineers discovered that the vortex breakers called for in the original design, as recommended by Regulatory Guide 1.82, had not been installed in the sumps of either unit. The modifications were performed by inserting all necessary materials through the manway covers and completing fabrication of the vortex breakers inside the sump enclosures. The original work package called for removing the sump enclosures to install the vortex breakers, but the piping above the enclosures prevented their removal. The modification package was revised accordingly via Engineering Change Notice Package 88-C-0037 as described in Section 2.4 of this report.

In either case, the opportunity to discover the sump enclosure deficiencies during the installation of these modifications presented itself. Neither modification design contributed to the problems identified during this inspection.

2.6 Review of the Surveillance and Maintenance History

Since 1987, the Unit 1 emergency containment sumps have been inspected 12 times and Unit 2 sumps have been inspected 4 times, including the inspections conducted on January 5 and 6, 1994. The inspections were conducted in accordance with Plant Surveillance Procedure OPSP04-XC-0001, "Inspection of Containment Emergency Sumps," written to satisfy the Technical Specification 4.5.2.d surveillance requirement that the sumps be inspected at least once per 18 months by a visual inspection of the containment sump and verifying that the subsystem suction inlets were not restricted by debris and that sump components (trash racks, screens, etc.) showed no evidence of structural distress or abnormal corrosion. It was noted that, during some performances of this inspection, no personnel entries were made into the sumps. Therefore, the inspection was performed from the top of the sump enclosure. The dates and results of the sump inspections, and whether personnel entered the sumps during these inspections for Unit 1, are listed below:

DATE	ENTRY MADE	RESULTS	TIME SINCE LAST INSPECTION/SUMP ENTRY
10/87	NO	ACCEPTABLE	FIRST INSPECTION
12/87	NO	ACCEPTABLE	2 MONTHS/2 MONTHS
1/88	NO	ACCEPTABLE	1 MONTH/3 MONTHS
9/88	NO	ACCEPTABLE	8 MONTHS/11 MONTHS
12/88	YES	ACCEPTABLE*	3 MONTHS/14 MONTHS

10/89	NO	ACCEPTABLE	10 MONTHS/10 MONTHS
5/90	NO	ACCEPTABLE	7 MONTHS/17 MONTHS
3/91	YES	UNACCEPTABLE	10 MONTHS/27 MONTHS
3/91	YES	ACCEPTABLE**	0 MONTHS/0 MONTHS
12/92	NO	ACCEPTABLE	21 MONTHS/21 MONTHS
8/93	NO	ACCEPTABLE	8 MONTHS/29 MONTHS
1/94	YES	UNACCEPTABLE	4 MONTHS/33 MONTHS

* This inspection was conducted following installation of the vortex breakers.

** This inspection was conducted following corrective maintenance performed as a result of the previous inspection.

The inspectors noted that the inspections that included sump entries provided the licensee personnel with additional opportunities to identify that the sump enclosure deficiencies existed.

Only one of the inspections resulted in unacceptable results. That inspection was conducted on March 20, 1991, and resulted in Work Requests SI 105727 and SI 105728 being issued on the Unit 1 sumps. Problems found included missing nuts and bolts, galled nuts, evidence of structural distress in Sump 1B, debris, and water. The service requests were completed on March 22, 1991. All nuts and bolts were replaced and tightened, debris and water was removed, and the structural distress was evaluated and determined to be nondetrimental to the sump structural strength or function. The sump was reinspected and accepted. The inspectors noted that the performance of these maintenance activities provided maintenance personnel with an additional opportunity to identify that the sump enclosure deficiencies existed.

The inspectors reviewed Procedure OPSP04-XC-0001, Revision 4. This procedure did not specifically require personnel entry into the sump. The procedure did require the inspection of the suction inlet to ensure that it was not restricted by debris. The procedure also stated that the use of a mirror on a pole may be required. This statement appeared to be based on the need to view the inlet piping through the vortex breakers. Licensee personnel stated that this procedure was never designed to be performed from outside the sump enclosure.

As noted above, a number of surveillance inspections on Unit 1 were performed using a mirror and a flashlight through the manway on top of the sump enclosure. The NRC inspectors attempted to use this method to see if the requirements of the Technical Specifications could be met. Because of the design of the vortex breakers, the inspectors determined that the intent of the Technical Specifications to verify that the suction inlets were not

restricted by debris could not be met without entering the sumps. Additionally, the vertical portion of the vortex breaker could not be observed from outside the sump enclosure.

As noted in the above table, the March 22, 1991, reinspection of the Unit 1 sumps was the last time that the sump was entered for inspection prior to January 5, 1994. Technical Specification 4.5.2.d requires that this inspection be performed every 18 months. Additionally, Technical Specification 4.0.2 allows a 25 percent extension of this time for scheduling purposes. Including the allowable extension, the maximum allowable surveillance interval would be 22 1/2 months.

Technical Specification 4.0.1 requires that "Surveillance requirements shall be met during the operational modes or other conditions specified for individual limiting conditions for operations unless otherwise stated in an individual surveillance requirement." In August 1993, Unit 1 was placed into Mode 3, which was an applicable mode for Technical Specification 3.5.2, "ECCS Subsystems." At that time, it had been 29 months since an adequate inspection of the emergency containment sumps had been performed as delineated in Technical Specification 4.5.2.d. Therefore, in accordance with Technical Specification 4.0.1, Limiting Condition for Operation 3.5.2 was not met. This was identified as Violation 498/94007-02.

The inspectors determined that the failure to maintain an adequate surveillance procedure for the implementation of Surveillance Requirement 4.5.2.d was the cause of this violation.

Three inspections had been conducted in the Unit 2 emergency sumps prior to the January 6 inspection. All inspections involved entry into the sumps. The sumps were found to be acceptable. None of the previous inspections noted any problems with integrity of the sump screens. Neither the 2- by 4-inch holes at the top of the sump enclosures nor the 5/8-inch gaps between the bottom of the Unit 1 sump enclosures and the floor were identified during the inspections.

2.7 Review of the Historical Sump Problems

Two station problem reports were identified that directly related to the emergency containment sumps. One was Station Problem Report 88-0477 that was written upon discovery that the vortex breakers were missing from the sumps as described in Section 2.5 of this report. Station Problem Report 94-0022 was issued as a result of the NRC inspection activities described in Section 2.2 of this report. No other problems had been identified with these sumps.

2.8 Review of the Licensee's Industry Operational Experience Program

The inspectors reviewed the licensee's response to industry operational experience related to emergency containment sumps. The following documents were reviewed:

2.8.1 Generic Letter 85-22, "Potential for Loss of Post-LOCA Recirculation Capability due to Insulation Debris Blockage"

This generic letter required the licensee to perform a plant-specific evaluation of the debris blockage potential for the design of their emergency sumps. This letter addressed plant insulation surveys and methods for estimating debris generation and transport. Although this information could affect the significance of the breaches identified in the sump screens, the letter would not have driven the licensee to identify the sump enclosure deficiencies.

2.8.2 Information Notice 88-28, "Potential for Loss of Post-LOCA Recirculation Capability due to Insulation Debris Blockage"

This information notice addressed the delamination of aluminum foil coating on the surface of fiberglass insulation. This condition was reported to potentially compromise the net positive suction head margin for the emergency core cooling system pumps because of blockage of the strainers. Again, this notice did not reference degradation or holes in the suction screens; therefore, it did not cause the licensee to identify the sump screen deficiencies.

2.8.3 Information Notice 89-77, "Debris in Containment Emergency Sumps and Incorrect Screen Configurations"

On November 21, 1989, the NRC issued this information notice to alert licensee's of debris problems and incorrect screen configurations in emergency containment sumps identified at other plants. The notice stated that several plants had identified debris in the containment sumps larger than the size of the sump screen holes. The notice specifically discussed gaps in the sump screens, missing screens, and damaged screens. Additionally, the notice discussed a plant that had errors in the sump screen arrangement on the design drawing and that the sump screens were not configured in accordance with drawings in the Final Safety Analysis Report.

The licensee's design engineering organization reviewed this notice and determined that a review of Plant Surveillance Procedure OPSPO-XC-0001 was necessary to ensure that the procedure included adequate instructions to ensure that, among other things, the sump installation was adequate. Additionally, a review was requested to determine if the sump manway design was adequate. Plant engineering department personnel reviewed the procedure and determined that it was adequate for ensuring proper inspections.

During additional reviews, the system engineer determined that the procedure should be revised to require an additional evaluation if surveillance activities identified debris inside the sump enclosure. An engineer in the plant engineering department disagreed with this review. It was determined that modification reviews should not be part of surveillance procedures and that the design would be reviewed based on the failure of the surveillance test without a procedure revision because of routine plant practices.

A physical inspection of the sump enclosures was not performed to determine if they had been properly installed. Additionally, on March 20, 1991, the results of observations performed in accordance with Procedure OPSP04-XC-0001 were found to be unacceptable because of excessive levels of debris in the emergency containment sump. However, this was not evaluated by engineering personnel to consider the proper design and installation of the sump enclosure.

The inspector concluded that this notice was not adequately addressed in accordance with the licensee's operational experience review program and that, had it been properly reviewed and dispositioned, the licensee could have identified deficiencies in the sump installation at that time.

2.8.4 Information Notice 89-77, Supplement 1

On December 3, 1993, the NRC issued Supplement 1 to Information Notice 89-77. This supplement specifically addressed breaches identified in the integrity of the containment sump enclosure at another facility. The notice stated that failure to ensure that the physical configuration of the screens and the screening of any penetrations that communicate with the sump could allow bypass of the filtering function and lead to the loss of the emergency core cooling system function.

On December 13, 1993, the licensee's operational experience review coordinator determined that flow paths that bypass the sump screens was a potential concern that had not been noted previously. However, this issue was not determined to require resolution prior to unit restart. The notice was given a due date of February 6, 1994, for development of a plan of action.

The inspector reviewed the licensee's system acceptance package for the safety injection system. This package was developed under the system certification program as documented in NRC Inspection Report 50-498/93-45; 50-499/93-45. This supplement had not been identified as a portion of the system certification reviews. The certification program coordinator stated that the sump enclosures and suction piping had not been included in the system certification review because they did not carry the "SI" designator. As such, the supplement did not receive a documented restart evaluation as a component required for the function of the emergency core cooling system. The coordinator stated that they had evaluated all plant open items, as documented in a computerized database, for system applicability; however, Supplement 1 was not treated as a separate document from the original notice. Therefore, the licensee's data base did not emphasize that the notice addressed a potential failure mechanism for the emergency core cooling system.

During the performance of the surveillance procedure addressed in Section 2.2 of this report, engineering representatives were present and inspected the sump enclosure. At the time that the inspector identified the holes in the enclosure, one individual had already completed his inspection and the other was performing his final observation of the sump suction piping after thoroughly walking down the enclosure screens.

Based on the failure of the licensee to identify this notice as a restart restraint, and to schedule the development of an action plan prior to scheduled plant restart, the inspector determined that it was unclear that the licensee would have identified the sump enclosure deficiencies prior to plant restart. It should be noted that, after plant restart, the sump enclosures could not have been entered to perform this inspection until the next outage.

2.8.5 Information Notice 90-07, "New Information Regarding Insulation Material Performance and Debris Blockage of PWR Containment Sumps"

This notice was issued to alert licensees to the potential of increased sump blockage following an accident based on the degradation of insulation in an alkaline environment. This notice did not address concerns related to the identified sump enclosure deficiencies.

2.8.6 Information Notice 92-71, "Partial Plugging of Suppression Pool Strainers at a Foreign BWR"

This notice was written to document the partial plugging of emergency core cooling system strainers caused by the transporting of mineral wool insulation material into the suppression pool. This notice, also, did not address concerns related to the identified sump enclosure deficiencies.

2.8.7 NRC Bulletin 93-02, "Debris Plugging of Emergency Core Cooling Suction Strainers"

This bulletin required licensees to identify all fibrous air filters or other temporary sources of fibrous material not designed to withstand a postaccident environment that were installed or stored in primary containment. Although the types and amount of fibrous materials in containment were applicable to evaluating the significance of the deficiencies identified in the containment sump enclosures, this bulletin did not specifically address concerns related to enclosure design and installation.

2.8.8 Information Notice 93-34, "Potential for Loss of Emergency Cooling Function due to a Combination of Operational and Post-LOCA Debris in Containment"

This notice alerted the licensees to additional sources of debris in containment that could impact the operability of the emergency core cooling system. Although additional sources of debris in containment were applicable to evaluating the significance of the deficiencies identified in the containment sump enclosures, this bulletin did not specifically address concerns related to sump enclosure design and installation.

2.8.9 Conclusions

The inspector determined that the licensee had the opportunity to identify and correct the sump enclosure deficiencies prior to the recent inspection. This opportunity involved the proper review and disposition of Information

Notice 89-77. In this case, licensee personnel failed to implement their proposed action plan. Additionally, it was unclear whether the licensee would have identified these deficiencies prior to plant restart based on their review of Supplement 1 to Information Notice 89-77.

2.9 Review of the Licensee's Corrective Actions

Following the discovery of the 2- by 4-inch holes at the top of the emergency containment sump enclosure screens and the gap around the base of the screens, the licensee developed a plan of action for resolution of the emergency containment sump issue. The plan of action called for an in-depth review of all historical documentation involving the emergency sumps. Corrective actions included development of Plant Change Form 314415-A, which was issued on January 7, 1994. The plant change form called for installing plates to cover the 2 by 4 inch holes and welding stainless steel rod around the base of the sump where gaps greater than 1/8 inch existed.

To insure that future inspections meet the requirements of the Technical Specifications, Procedure OPSP04-XC-0001, "Inspection of Containment Emergency Sumps," was revised to state that entry into the sumps was required to adequately perform the surveillance. Also, a description of how to perform the inspection and what the workman should look for was included.

2.10 Observation of the Modifications

On January 18, 1994, the NRC inspector entered Emergency Containment Sump 1A and found that the modification had been performed in accordance with Plant Change Form 314415-A. The sumps had been cleaned and all debris found during the first inspection had been removed. Sumps 1B and 1C were also inspected and the modifications were found to be satisfactorily installed.

The inspector identified that the sump manway covers were free to move within the manway. This condition allowed the outside edge of the slots to be uncovered as described in Section 2.4 of this report. The inspectors noted that Plant Change Form 314415-A did not address or correct these gaps. The slots had been cut to allow material for the vortex breaker installation to be taken into the sumps. If the covers on the manways were not perfectly centered, a gap greater than 1/4 by 4 inches was created.

On January 22, Plant Change Form 204633-A was issued to modify the sump manway covers. The modification was considered sufficient to preclude the covers from slipping to the side, thus the gap could not be created. The modifications to the sump covers and clean up of the sumps appeared to be adequate.

2.11 Safety Significance

The inspectors reviewed the licensee's preliminary assessment of the safety significance of the identified deficiencies in the emergency containment sump enclosures. The assessment concluded that there was no safety significance,

although the inspector determined that, at face value, the assessment supported at least minor safety significance.

The inspector noted that the assessment was based primarily on engineering judgment. In addition, a number of assumptions appeared to be nonconservative. The following discusses these assumptions:

- The engineers assumed that the containment was clean and free of foreign material that could migrate to the emergency sumps.

  This assumption was based on the performance of Plant Surveillance Procedure OPSP03-XC-0002, "Containment Inspection." However, industry experience has shown that, although useful, containment close-out inspections were not perfect. Therefore, the impact of maintenance debris left in containment should have been included in the assessment.

- The assessment stated that NUKON brand insulation will not deteriorate or lose its mechanical integrity during a loss of coolant accident.

  This statement was based on the Final Staff Evaluation of Topical Report OCF-1, "Nuclear Containment Insulation System," dated December 8, 1978. This report described the design and testing of NUKON brand insulation. The topical report clearly states that the potential for jacketed insulation, in the vicinity of a postulated pipe break, to be stripped from piping and components was beyond the scope of the report. The tests did, however, evaluate the potential of NUKON brand insulation to interfere with the operation of the containment spray system following a loss of coolant accident. These tests used a wire rack to support intact and torn blankets to simulate the containment sump strainers. Because the licensee's evaluation was of degraded strainers, the tests did not appear to be applicable or clearly support the licensee's conclusion.

- The assessment stated that the holes at the top of the sump enclosure do not challenge the integrity of the screen because of the normal flow configuration.

  The inspectors noted that the lower edge of a 4- by 4-inch structural angle was located in front of the holes in the screen. This angle was located at the same elevation as the lower edge of the holes in the screen. However, it was approximately 6 inches from the screen. Based on the configuration and the low flow rates at the sump enclosure screens, the inspectors did not consider this to be a tortuous path that would take the place of the screen.

- Licensee engineers reviewed the potential for particles greater than the 1/4-inch design criteria to enter sump. The assessment stated that little impact was probable, based on the nature of the particulate and design flow velocities.

This statement did not consider the effects of the blowdown following an accident and any sweeping action of water making its way to the sump. The statement was based on a steady state 0.2 feet per second flow rate through the screens. Also, it did not address the fact that the gaps bypassed the trash racks, the kick plate, and the screens.

- The assessment stated that larger particles would be heavier; therefore, they would settle to the bottom of the sumps.

  This statement did not take into account the higher flow rates near the suction piping. In the assessment, engineers assumed that heavy particles would settle to the bottom of the sump during the injection phase following a design basis accident. The design flow velocity of 0.2 feet per second was used to support that this material would not be drawn into the pump suction piping. However, this flow rate was the design velocity through the screens. The flow rate at the suction piping would be considerably higher. With the suction piping located within 1 foot of the bottom of the sump, some agitation of the debris on the bottom would be expected.

- The assessment states that, given the location and geometry of the immediate area around the sumps, it was highly unlikely that remote debris would propagate to the emergency sumps.

  Again, this statement ignored the turbulence in containment during the blowdown following an accident. Also, the floors above the sumps are grated and designed to direct the containment spray flow back to the sumps. This flow rate should be substantially higher than that of the water on the containment floor.

- The assessment stated that pump performance tests substantiate that there would be no adverse impact on the emergency core cooling system and containment spray system pumps from the sump enclosure deficiencies.

  These pumps were designed to pass 1/4-inch particles. The performance tests addressed in the assessment did not test larger particles because the screens were designed to prevent entry of larger debris. Therefore, these tests were invalid for use in evaluating the effect on pump performance of larger particles via the sump enclosure deficiencies.

- The assessment stated that the potential for core cooling to be affected by miscellaneous debris migrating to the core channel was remote.

  This statement was based only on engineering judgment considering the pathway through the vessel and an evaluation of Westinghouse Analysis Calculation 2N129MC5647, "Analysis of Transport of Paint Chips to ECCS Sumps- Reactor Cavity Coating." This calculation stated that paint chips 0.04 inches and larger would not be transported to the core. However, this statement was based on the protection of the screens.

Westinghouse Analysis Conclusion 5 states that the larger particles will be stopped by the curb. This curb was bypassed by the gaps between the sump enclosure and the containment floor. Therefore, the use of the calculation to assess the impact of the sump enclosure deficiencies was invalid.

The inspector concluded that the licensee's preliminary assessment of the safety significance of deficiencies identified in the emergency containment sump enclosures was insufficient to determine the safety impact of these deficiencies on the operation of South Texas Project. Nonconservative engineering judgment and use of calculations which were invalid for the application precluded any meaningful safety significance assessment conclusions. The NRC staff will evaluate the licensee's written safety analysis, which is to be submitted with the licensee event report. The safety significance of the deficiencies appears to be small based on the nature of the deficiencies and the South Texas Project three-train, three-sump design.

2.12 Conclusions

Based on the review of the emergency containment sumps' design basis, the inspectors identified five examples of installation deficiencies that caused the sump enclosures' configuration to be outside of the design. Additionally, the licensee's commitments concerning sump design were not met in three cases. Licensee personnel took prompt corrective action for the specific deficiencies to ensure that each sump was returned to an operable condition and that design discrepancies were resolved. However, following installation of the plant modifications, the inspectors identified an additional deficiency which did not meet the design basis of the sump enclosures.

The inspectors concluded that the licensee had numerous opportunities to identify these deficiencies. These included maintenance and surveillance activities, two modifications that were installed on the sumps, and industry operational experience reviews. An NRC information notice published in 1989 was not adequately addressed by the licensee, and the recommended actions by licensee engineers were not implemented in the plant. Additionally, it was unclear that the review of a recent supplement to that notice would have resulted in the identification of the deficiencies in the sump enclosures prior to restart of Unit 1.

The inspectors identified that the Technical Specification surveillance requirement for inspection of the sumps and sump components was not met in all cases. The plant surveillance procedure was determined to be inadequate to ensure that these inspections were performed properly.

The inspectors concluded that the licensee's preliminary assessment of the safety significance of deficiencies identified in the emergency containment sump enclosures was insufficient to determine the safety impact of these deficiencies on the operation of South Texas Project. Nonconservatisms were identified in the engineering judgment used in the assessment. Additionally, in two cases, previous design calculations used in support of the assessment

were not applicable because the assumptions required the sump enclosures to meet the design basis. The safety significance of the deficiencies appears to be small based on the nature of the deficiencies and the South Texas Project three-train, three-sump design.

ATTACHMENT 1

1 PERSONS CONTACTED

1.1 Licensee Personnel

T. Asbury, NSSS System Engineering
J. Cook, NSSS Section Supervisor
T. Cloninger, Vice President, Nuclear Engineering
R. Engen, Structural Engineer
D. Gore, Supervising Engineer
J. Groth, Vice President, Nuclear Generation
A. Harrison, Supervising Engineer
R. Hernandez, Manager, Mechanical Maintenance
C. Johnson, Manager, South Texas Project Activities
J. Johnson, Acting Quality Assurance Director
T. Jordan, Manager, Systems Engineering Department
W. Jump, Director, Regulatory Activities Support
M. Kanavos, Manager, Mechanical/Civil Engineering
D. Keating, Director, Independent Safety Engineering Group
Mangan, General Manager, Plant Services
L. Martin, General Manager, Nuclear Assurance
G. Parkey, Unit 2 Plant Manager
P. Parrish, Senior Engineering Specialist
J. Pinzon, Senior Engineer
J. Sheppard, General Manager, Nuclear Licensing
S. Thomas, Manager, Design Engineering Department
C. Walker, Manager, Public Information
L. Walker, Licensing Consultant

1.2 NRC Personnel

W. Johnson, Chief, Project Section A

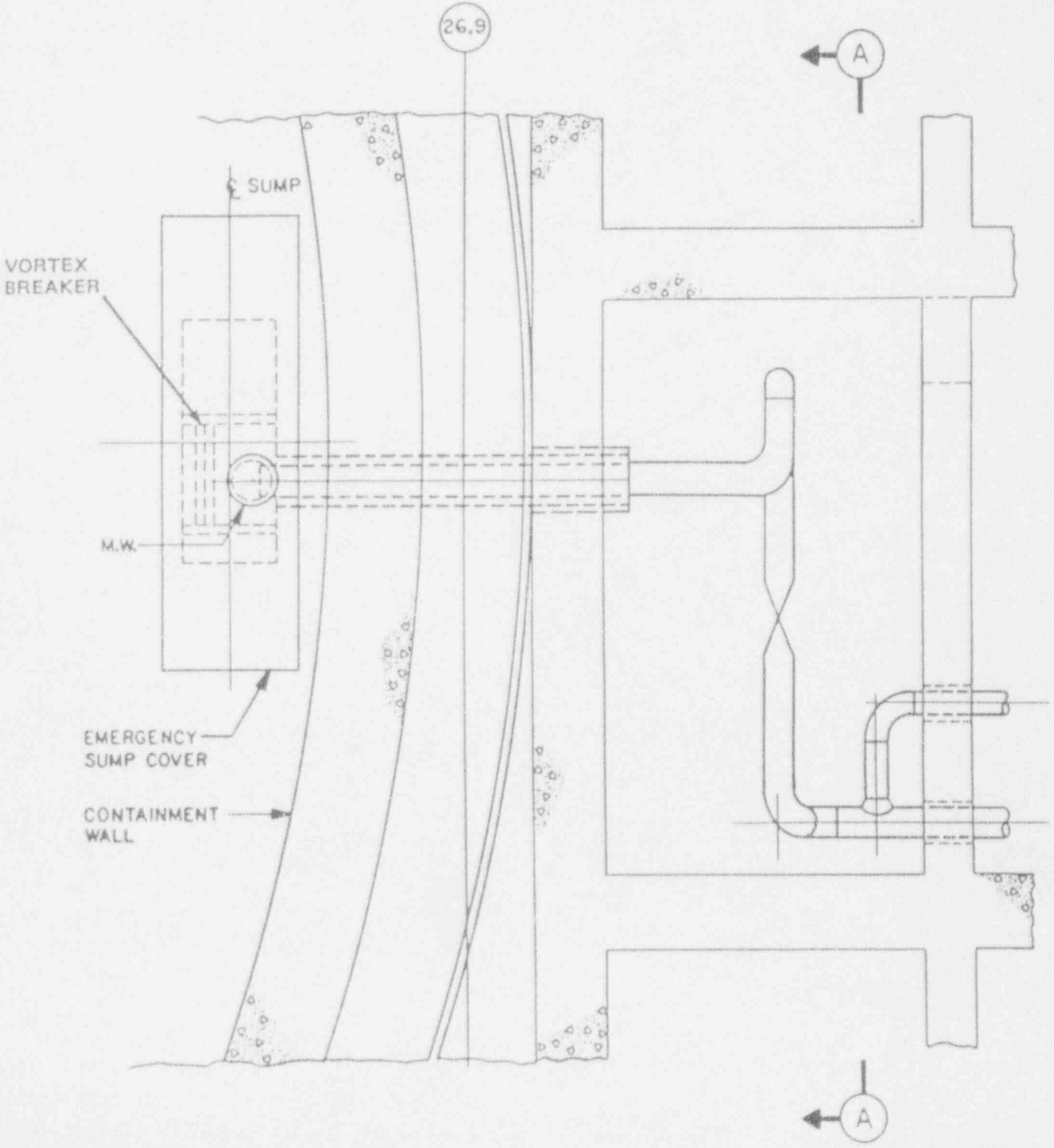
The personnel listed above attended the exit meeting. In addition to the personnel listed above, the inspectors contacted other personnel during this inspection period.

2 EXIT MEETING

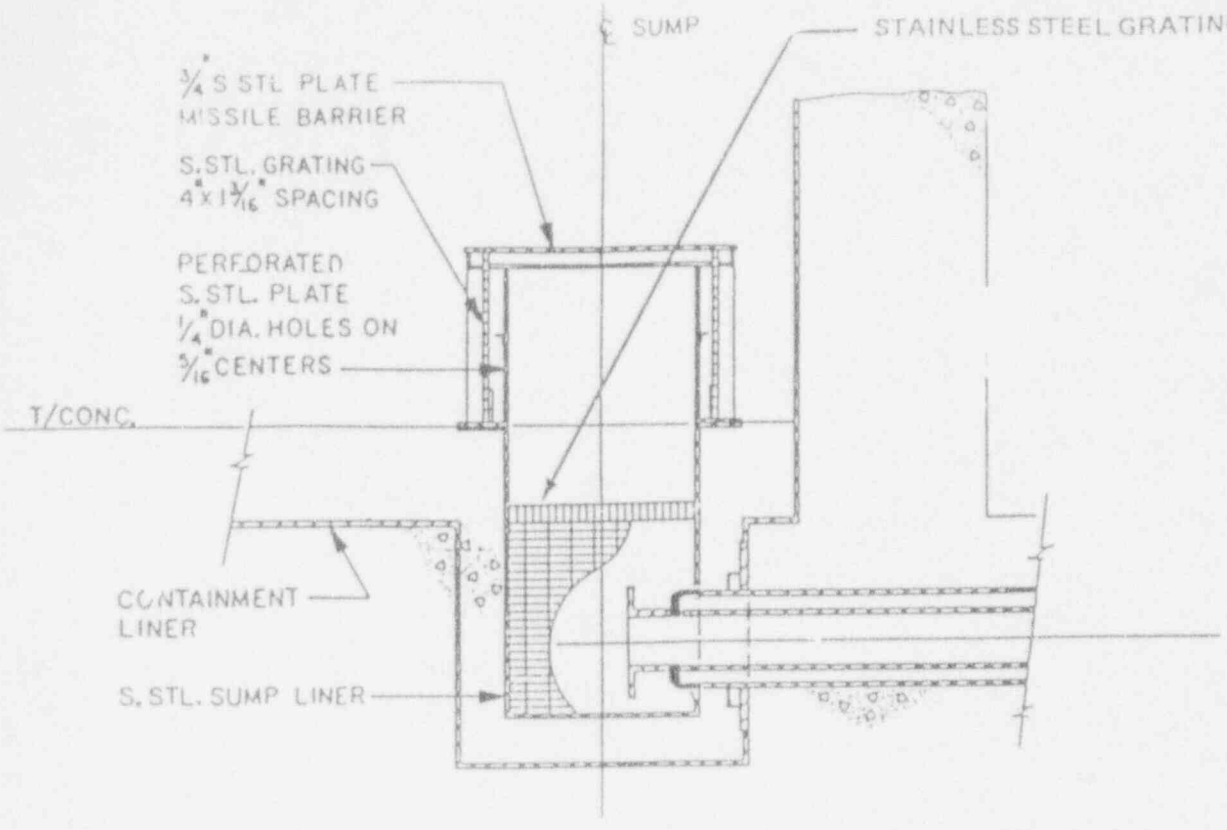
An exit meeting was conducted on January 20, 1994. During this meeting, the inspectors reviewed the scope and findings of the report. The inspectors addressed the significance of the failures of the surveillance inspections and the operational experience reviews to identify the sump enclosure deficiencies. Additionally, the inspectors expressed concern over the poor quality of the licensee's safety analysis. The licensee acknowledged the information presented at the exit meeting. The Vice President, Nuclear Generation agreed to evaluate the discrepancy between the sump arrangement and Regulatory Guide 1.82 prior to Unit 1 restart to ensure operability. In addition, the Licensing Manager committed to correct the Updated Safety Analysis Report discrepancies in the description of the emergency containment sumps. The licensee identified several Westinghouse calculations and reports

provided to and reviewed by the inspectors as proprietary. However, no proprietary information was included in this inspection report.

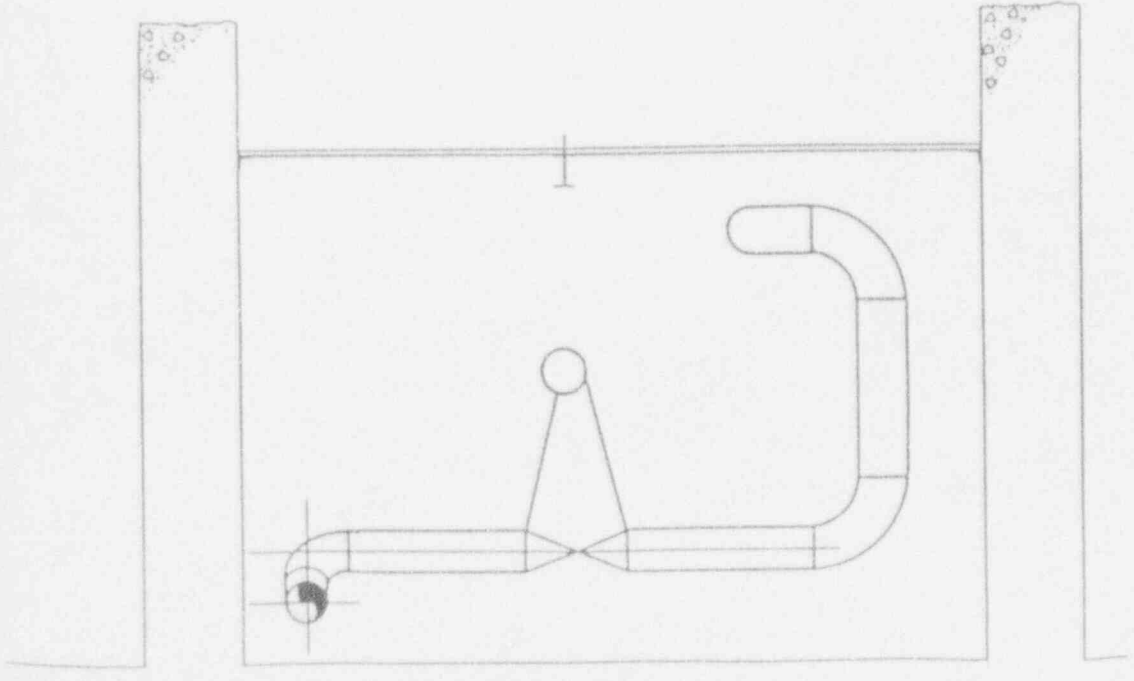
ATTACHMENT 2



PLAN



ENLARGED SECTION THRU SUMP



SECTION A-A