APPENDIX

U. S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report: 50-498/88-34 Operating License: NPF-76
50-499/88-34 Construction Permit (CP): CPPR-129

Dockets: 50-498
50-499

CP Expiration Date: December 1989

Licensee: Houston Lighting & Power Company (HL&P)
P.O. Box 1700
Houston, Texas 77001

Facility Name: South Texas Project, Units 1 and 2 (STP)

Inspection At: STP, Matagorda County, Texas

Inspection Conducted: May 1-31, 1988

Inspectors:

J. E. Bess, Resident Inspector, Project Section D, Division of Reactor Projects — Date 7/15/88

D. L. Garrison, Resident Inspector, Project Section D, Division of Reactor Projects — Date 7/15/88

Other Assisting Personnel: J. P. Clausner, French Commissariar A L'Energie Atomique, Institute De Protection Et De Surete Nucleaire

Approved:

G. L. Constable, Project Section D, Division of Reactor Projects — Date 7/15/88

Inspection Summary

Inspection Conducted May 1-31, 1988 (Report 50-498/88-34)

Areas Inspected: Routine, unannounced inspection included loss of offsite power, bottom mounted instrumentation, observation safety verification, engineered safety feature system walkdown, surveillance observations, security observations, radiological protection observation, and security fence construction.

Results: Within the areas inspected, no violations were identified.

Inspection Conducted May 1-31, 1988 (Report 50-499/88-34)

Areas Inspected: Routine, unannounced inspection included incore thermocouples and security fence construction.

Results: Within the areas inspected, no violations were identified.

DETAILS

1. Persons Contacted

*W. P. Evans, Licensing Engineer
*W. R. Whitley, QA Specialist
*J. D. Green, Manager, Inspection and Surveillance
*S. M. Dew, Manager, Operations Support
*W. A. Randlett, Manager, NSD
*M. R. Wisenburg, Plant Superintendent Unit 1
*W. H. Kinsey, Plant Manager
*G. L. Parkey, Plant Superintendent Unit 2
*L. Giles, Plant Operations Manager Unit 2
*M. Polishak, Project Compliance
*K. M. O'Gara, Project Compliance
*M. A. McBurnette, Operations Support Licensing Manager
*S. M. Head, Supervising Licensing Engineer
*M. A. Ludwig, Manager, Operations Maintenance Division
*J. T. Westermeier, General Manager
*S. L. Rosen, General Manager, Operations Support

In addition to the above, the NRC inspectors also held discussions with various licensee, architect engineer (AE), constructor and other contractor personnel during this inspection.

*Denotes those individuals attending the exit interview conducted on June 1, 1988.

2. Plant Status

STP Unit 1 was shut down on May 2, 1988, as part of a planned outage to support thimble tube inspection and essential cooling water (ECW) fitting replacements. HL&P began the outage a day early because of operability problems with the steam generator power operated relief valves (PORVs).

On May 21, 1988, at 5:38 p.m., Unit 1 was taken critical with plans to increase power to 30 percent (reactor) and perform the Loss of Offsite Power Test (LOOP). On May 25, 1988, at approximately 11:35 p.m., a turbine trip occurred during the installation of a temporary modification for the removal of the Excess Cooldown Logic which was being implemented due to a Technical Specifications (TS) change. The trip appeared to be the result of a 24-position switch used in the testing of the logic circuit having sticking/dirty contacts.

On May 26, 1988, the LOOP testing was performed satisfactorily. Two 480VAC electrical breakers, not part of the acceptance criteria for the LOOP test, failed to reclose after the emergency diesel generator started. The primary systems functioned as designed to maintain natural circulation conditions in the reactor coolant system for 30 minutes. Also, during the performance of the LOOP test, the main feedwater (MFW) pump turbine shaft

failed. The MFW turbine was extensively damaged and the condensate system was contaminated with oil. Investigations are in process by the licensee to determine the cause of the failure. Plans are being initiated to replace the damaged Unit 1 pump and turbine with similar components from Unit 2. The secondary systems are being drained and cleaned due to the oil contamination. At the end of the inspection period the plant was in cold shutdown (Mode 5).

STP Unit 2 is 95 percent complete. Preoperational testing is in progress. Hot Functional testing is scheduled to begin in mid-July 1988.

3. Loss of Offsite Power Test - Unit 1 (72582B)

This inspection was conducted to determine whether the test was consistent with regulatory requirement guidance, licensee commitments, and TS.

The NRC inspectors reviewed Procedure IPEP04-ZY-0034, "Loss of Offsite Power Test," Revision 4, dated May 4, 1988. This review determined that the procedure contained the following acceptance criteria: the turbine and reactor trip and the emergency power supplies provide adequate power to maintain the plant in a stable, hot standby condition for 30 minutes following a LOOP. The procedure also required that personnel be positioned to monitor the status of emergency equipment.

The NRC inspector observed the performance of the test on May 25, 1988. A pretest briefing for all involved personnel was held by the licensee prior to the test. The electrical load transfers were accomplished, the emergency diesels started and loaded satisfactorily, steam dumps operated properly, plant pressure control, pressurizer level control and steam generator level control appeared satisfactory. Natural circulation was attained within approximately nine minutes. Data was collected for the required 30 minutes and plant recovery was in accordance with procedures.

There were a number of equipment problems encountered, particularly during the recovery phase. Two significant equipment failures occurred during the early stages of the test. Steam Generator Feed Water Pump No. 11 oversped and was destroyed. Two 480VAC electrical breakers failed to reclose on their respective busses. None of the problems or equipment failures affected the test acceptance criteria or the safe shutdown of the plant.

No violations or deviations were identified during this part of the inspection.

4. Bottom Mounted Instrumentation (BMI) Thimbles (93702)

In order to comply with a commitment as stated at the December 14, 1987, HL&P/Westinghouse/NRC meeting held in Washington, D.C.

(Letter ST-HL-AE-2458, dated January 5, 1988), the licensee shut down Unit 1 on May 2, 1988, to perform, among other activities, an eddy current (EC) inspection of the thimble tubes after 15 weeks of four pump operation.

As a result of this eddy current inspection of the thimble tube wall thicknesses on May 9, 1988, the licensee informed the NRC that 22 of the 58 thimble tubes had indications that the wall thickness had been reduced from 12 percent to 58 percent of the original wall thickness.

EC data for those 22 thimble tubes indicated that 19 have wall wear around the flow limiter areas and four include indications of wear below the lower core plate. Three other thimble tubes indicate wear below the lower core plate only.

a. System Description

BMI thimble tubes are used to remotely position miniature fission chamber detectors in retractable guide thimbles to provide flux mapping of the reactor core. The retractable thimbles, into which the miniature detectors are driven, are inserted into the reactor core through conduits which extend from the bottom of the reactor vessel down through the concrete shield area, and then to a thimble seal plate. Their distribution over the core is nearly uniform with about the same number of thimbles located in each quadrant.

Thimbles are closed at the leading ends, are dry inside, and serve as a pressure barrier between the reactor vessel and the containment atmosphere. During reactor operation, the retractable thimbles are stationary. They are extracted downward from the core during refueling to avoid interference within the core.

Unlike European plants and other Westinghouse designed reactors, STP has no isolation valves installed on the BMI tubes. Leak detection devices and a radiation alarm in the BMI area should detect any leakage from BMI tubes. A leak would require a reactor shutdown and depressurization of the primary coolant system to facilitate repairs. One charging pump is capable of maintaining pressurizer level in the event of a thimble tube rupture.

During the first refueling of Unit 1 and prior to initial fuel load of Unit 2, the licensee will install remotely operated isolation valves on the BMI tubes.

b. Background

Incore thimble tube leakage and wall thinning problems were found on Westinghouse reactors with 14-foot cores operating in Europe. The cause of the wear on the thimble tubes is believed to be flow induced vibrations of the thimble tubes that causes wear where tubes contact reactor core compounds.

Based on test results performed in France, it was found that the mass flow around the thimbles is the cause of thimble vibrations. In order to reduce the flow energy around the thimbles, different guides with reduced clearance and larger guidance lengths were designed. One particular model comparable to the one installed at STP, but using a spring instead of a bellows, showed a high efficiency to reduce the thimble excitation. However, because of questions regarding the long-term spring reliability, a simple long guide without any spring was tested. This guide, used with thicker wall thimble tubes, was found to have an efficiency adequate to obtain an acceptable vibration level. They were installed on several plants where they initially showed satisfactory operation. Leakage through a thimble tube wall was detected at the end of March 1985 in Paluel Unit 1 (French). The investigations revealed that all the thimble tubes that exhibited relatively significant wear were located in the discontinuity zones where the thimble tubes passed through the lower core vessel components.

In response to requests for additional information from the NRC regarding the Paluel problem (Final Safety Analysis Report (FSAR) Question Nos. 492.6N, 492.7N, and 492.8N) the licensee (Letter ST-HL-AE-1339, dated February 3, 1986) stated that the failure of the Paluel thimble tubes was not attributed to the 14-foot core but to the use of a more flexible thimble and other changes to thimble guide tube configuration.

Over the last year, it has come to the NRC's attention that several licensees in the United Sates had detected thinning of the incore instrumentation thimble tubes as a result of flow-induced vibrations. On September 16, 1987, the NRC issued an Information Notice (IEN) 87-44 to alert licensees that Westinghouse reactors had a potential for problems from thimble tube thinning.

On October 27, 1987, the NRC was informed that leakage had occurred through a BMI thimble tube at the Belgian plant Tihange 3 after approximately 16 weeks of operation. Since the BMI column gap, BMI thimble and flow limiting devices are essentially identical in configuration to that of the STP, the NRC requested that the licensee implement a program to monitor the potential problem. The NRC met with several European representatives to gather information on the French and Belgian plants.

The flow limiting devices had been installed at STP prior to the first fuel load and on the Belgian plants (Tihange 3 and Doel 4) during their latest refueling. The purpose of the devices is to reduce the flow energy around the thimble tubes by providing reduced clearances and longer length for guidance between the lower core plate and the bottom of the fuel assembly.

Prior to the installation at Tihange 3, a modification to the flow limiters was performed due to interfering fillet welds used to secure

the thimble guide to the lower support plate. After this modification, the limiters were installed with a long handled tool and the mechanical fit was verified by camera inspection under water.

It was thought that this difference between Tihange 3 and STP, Unit 1, could have led to the thimble tube wear at Tihange.

The licensee committed to perform a baseline eddy current inspection at STP, Unit 1, prior to initial criticality. This inspection was conducted on December 18-24, 1987, after approximately four weeks of low temperature reactor coolant pump operation. No indications of thimble tube degradation were apparent.

On April 27, 1988, the licensee informed the NRC that the Belgian plant Doel 4, which is a sister unit to Tihange 3, had recently experienced two thimble tube leaks. The Belgian licensee conducted an eddy current inspection in April 1988 during the refueling outage and found that all thimble tubes except one exhibited wear.

Based on these results and the Tihange 3 experience a decision was made to remove the flow limiters from those plants.

c. Second Eddy Current Inspection Results On STP May 4-5, 1988

The licensee shut down Unit 1 on May 2, 1988, to perform an eddy current inspection of the thimble tubes after 11 additional weeks of four pump operation at RCS normal operating temperature (i.e. above 560°F and pressure at 2235 psig).

The full flow duration was 77 days (cumulative period) including 31 days of consecutive operation. This represents about 15 weeks of full flow operation, including approximately 4 weeks of low temperature reactor coolant pump operation since the first eddy current inspection on December 18-24, 1987.

This duration can be compared with the 16 weeks of operation at the Belgian plant Tihange 3 when leakage through a thimble tube wall occurred in October 1987.

On May 4, 1988, the licensee proceeded to inspect the Unit 1 thimble tubes. This second eddy current inspection was conducted during 2 days by Westinghouse personnel.

On May 4, 1988, the licensee completed the data acquisition which was conducted on 15 thimble tubes and a first analysis showed no indication of significant wear. Only three minor indications, close to the minimum detectable limit (about 10 perc[illegible]) were found.

On May 5, 1988, the licensee completed the da[illegible] on the 58 thimble tubes. This same day the NRC me[illegible]

representatives to obtain additional technical information relative to the eddy current method used to detect potential wall thinning on thimble tubes.

This EC method utilized three different frequencies (60, 140, and 300 KHz). Each of these three frequencies was analyzed separately. The three frequencies were mixed together to cancel potential false signals from core components and leaving only those signals induced by wear (wall thinning). On May 9, 1988, the licensee informed the NRC that the results from data analysis revealed that a total of 22 thimble tubes exhibited wear indications from 12 to 58 percent of wall thickness.

Nineteen of those 22 thimble tubes indicated wall thinning in locations around the flow limiter areas. Four thimble tubes indicated wear below the lower core plate. Three other thimble tubes indicated wall thinning only below the lower core plate.

The wear observed by eddy current inspection on the 19 thimble tubes around the flow limiter areas was as follows:

- 5 thimble tubes at 12 percent reduction in wall thickness
- 2 thimble tubes at 15 percent reduction in wall thickness
- 1 thimble tube at 16 percent reduction in wall thickness
- 5 thimble tubes at 20 percent reduction in wall thickness
- 1 thimble tube at 25 percent reduction in wall thickness
- 1 thimble tube at 28 percent reduction in wall thickness
- 1 thimble tube at 36 percent reduction in wall thickness
- 2 thimble tubes at 40 percent reduction in wall thickness
- 1 thimble tube at 58 percent reduction in wall thickness

STP, Unit 1, has found no indications of wall thinning on the upper part of the thimble tubes.

d. Assessment

Based on the results above, it is possible to compare STP, Unit 1, and Tihange 3. Doel 4 which is equipped with thicker wall thimble tubes, hence less flexible, showed that a different wear rate had occurred.

Neither at STP nor at Tihange 3 was it possible to determine any preferential wear zones. The thimble tube wear locations were randomly spread throughout the core.

The licensee indicated that at STP the kinetics of the phenomenon differ from those at Tihange 3 where leaks indicative of thimble tube failures occurred after a 16-week operating period.

During flux map performances in the European reactors, miniature probes occasionally became jammed in some thimble tubes. This was

caused by circular stricture due to primary pressure on thimble tubes thinned by external wear. This should be considered at STP which is still in startup testing phase during which numerous flux maps are taken.

e. Licensee Commitments

On May 17, 1988, the NRC met with the licensee and Westinghouse in Washington D.C. During this meeting, the licensee gave a detailed presentation and explained the different recommendations taken into account to restart and operate the plant.

Based on the given information, the NRC authorized the licensee to operate STP, Unit 1, for an additional 16 weeks of four reactor coolant pump operation. Further, the NRC will require the licensee to perform an eddy current inspection if, after a minimum of 8 weeks of full operation, the licensee shuts the plant down for a period long enough to perform this inspection.

The licensee will also investigate the advantages of installation of thicker walled thimble tubes in Unit 1. If thicker walled thimble tubes resolve the wear problem, they will be installed during the first refueling on STP, Unit 1, and if proven successful they will also be installed on STP, Unit 2.

No violations or deviations were identified.

5. Operational Safety Verification - Unit 1 (71707)

The objectives of this inspection by the NRC inspectors were to conduct reviews and observe selected activities to verify that plant operations were performed in accordance with the requirements established under 10 CFR Part 50 administrative procedures and the TS. The NRC inspectors observed the activities in the control room on a daily basis to verify the following:

- The control room was free from distractions such as nonwork-related reading materials.
- Operability of reactor protective systems and engineered safety components.
- Maintenance work requests (MWR) were written for equipment/components out of service.
- Operators were adhering to approved procedures for ongoing activities.
- Proper control room staff is maintained.
- Operations behavior is commensurate with control room operations.

No violations or deviations were identified.

6. Engineered Safety Feature (ESF) System Walkdown - Unit 1 (71710)

The NRC inspectors conducted a walkdown of the accessible portions of Train "A" of the Component Cooling Water (CCW) System to independently verify the operability of the system. A review was performed to confirm that the licensee's system operating procedure matched plant drawings and the as-built configuration. Equipment condition, valve and breaker positions, housekeeping, labeling, permanent instrument indication and calibration, and operability of support systems essential to actuation of the ESF system were all noted as appropriate.

The NRC inspector identified the following items to licensee management:

- There was no permanent ID tag on Valve CC-0009.
- Small oil leak under the hand wheel of Valve CC-MOV-0235.
- The label on Breaker E1A1E2 indicated that this breaker supplies power to CCW charging pumps supply motor operated valve (MOV). The CCW Electrical Lineup stated that this breaker supplies power to charging pump coolers.
- The label on Breaker E1A2B2 indicated that this breaker supplies power to Cooling Fan 10A. CCW Electrical Lineup indicated that the referenced breaker should supply power to Cooling Fan 11A.
- The name plate for Seal Water Heat Exchange 1A is inscribed by the alpha-numeric identifier 2R171NHX104A. Piping and Instrumentation Diagram (P&ID) 5R209F05020, Revision 9 identifies the heat exchange by alphanumeric identifier 4R171NHX104A.

Following the discussion of these concerns with licensee management, aggressive actions were implemented to identify other discrepancies of this kind including the resolution of the specific concerns identified in this report.

No violations or deviations were identified.

7. Surveillance Observations - Unit 1 (61726)

The NRC inspectors observed selected portions of surveillance testing and reviewed completed data packages to verify if TS requirements are being met for safety-related systems and components. The following surveillance tests were observed:

- 1PSP03-SI-0013, Revision 1, "Accumulator Isolation Valve Verification"

- 1PSP03-SI-0014, Revision 1, "Emergency Core Cooling System Valve Checklist"
- 1PSP03-SI-0017, Revision 0, "Containment Spray Valve Checklist"

The NRC inspector verified the following items during the inspection:

- The testing was performed by qualified personnel using approved procedures.
- Removal and restoration of the affected systems were accomplished.
- The surveillance testing was completed at the required frequency per TS requirements.
- Test data was accurate and complete.

No violations or deviations were identified.

8. Security Observations - Unit 1 (71881)

The NRC inspector verified that selected physical security activities were being implemented by direct observations of the following items:

- The security monitors (guards) in the secondary (SAS) and central (CAS) alarm stations were properly carrying out their duties.
- No breaches or weakness of vital area barriers were identified.
- The protected area (PA) was well maintained and was not compromised by objects that could be used to scale the barrier.
- Personnel within the PA displayed their identification badges.
- Persons and packages were observed to be properly cleared and checked before entry into the PA.
- Compensatory measures were observed to be employed when equipment failure or impairments made them necessary.

No violations or deviations were identified.

9. Radiological Protection Observation - Unit 1 (71709)

The NRC inspector verified that selected activities of the licensee's radiological protection programs were implemented in conformance with regulatory requirements. The activities listed below were observed:

- Radiation work permits contained the appropriate information to ensure that work was performed in a safe and controlled manner.

- Radiation and contaminated areas were properly posted and controlled based on the activity levels within the area.

- Personnel frisked themselves properly prior to exiting radiation protected areas (RPA).

- Personnel in the RPA were wearing proper monitoring equipment (ME) and the ME was properly located on the individuals.

No violations or deviations were identified.

10. Incore Thermocouples - Unit 2 (52053)

An inspection of the incore thermocouple system was performed to verify conformance to the drawings and specifications. The incore thermocouple system consists of 50 chromel-alumel sheathed thermocouples. Wiring extends from the incore housing through the vessel head and proceeds to the thermocouple junction boxes at elevation +44'. Twenty-five thermocouples (1-25) are included in Train "A" and 25 (26-50) in Train "C." These are placed symmetrically to Westinghouse design Drawing 20-322-03, Revision 1.

The NRC inspector had previously inspected these items as they were installed on the vessel head cover. This inspection included the installation from the refueling bridge to reference boxes A211TB002 and C211B003. The items were inspected for correct radius, indication of damage, and proper termination. The routing and design is shown on Drawing 5E20-9E-2516, Revision 5; the terminations were in accordance to the Specification 5E530E51035, and Standard Site Procedure (SSP) 26, Revision 2. The thermocouple wiring from the reference boxes A2IITB002 and C2IIB003 are then routed through conduit and cable trays to the instrument penetrations in the containment wall per Drawing 5E50-9E-59508, Revision 1. The workmanship meets the requirements of the drawings and procedures.

The NRC inspector reviewed the startup test procedure "scheme verification" SG-E-03, Revision 8, for inclusion of design attributes during checkout and testing. The thermocouples require a continuity check and will be calibrated to ambient temperature in the reactor containment building. This testing had not been performed; however, the procedure appeared adequate to perform the test and record the test results.

No violations or deviations were noted during the inspection.

11. Security Fence Construction - Unit 2 (35060)

An inspection of the construction of the Unit 2 protected area security fencing was conducted by the NRC inspector in order to compare the construction practices with the specification requirements. The fence barrier is classed as a nonsafety-related item, although it is important to plant physical security.

The fence was inspected to the requirements of Specification 9Y280YS1006, Revision 4, Field Change Request HXBC-03924 of May 9, 1988, and Drawings 9Y28-0Y-36066, Revision 11; 9Y28-0Y-36067, Revision 6; 9Y38-0Y-36068, Revision 5; and 9Y28-0Y-36069, Revision 8.

The NRC inspector found that the fence meets the general requirements of 10 CFR Part 73, "Physical Protection of Plants and Materials." However, some of the construction details of the specification were not adhered to. The following are the items found to be deficient:

- Fence structural poles - These poles are required to meet the requirements of American Society for Testing and Materials (ASTM) A120; however, the vendor marking indicates they were manufactured to ASTM 53, which is a similar specification. It was noted that the Unit 1 poles were marked ASTM A120/A53.

- Post foundation not crowned - The specification requires that the posts be set and the concrete foundation be raised and crowned to shed water and prevent deterioration at the ground line. It was found that most of the posts were not crowned but topped off at ground level.

- Keys in extension arms - On top of the fabric fence, extension arms are attached to the poles. These are set at a 45 degree angle and three strands of barbed wire are affixed in slots; the wire in the slots is required to be fastened with steel wire keys. The vendor supplied extension arms with slotted holes that do not provide for positive locking.

These three concerns are considered to be an Open Item (499/8834-01) and will be further reviewed by the Region IV security section.

All other attributes, as described in the design documents, were found to be satisfactory.

12. Exit Meeting (30703)

The NRC inspector met with licensee representatives (denoted in paragraph 1) on June 1, 1988, and summarized the scope and findings of the inspection. Other meetings between NRC inspectors and licensee management were held periodically during the inspection to discuss identified concerns.