APPENDIX B

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 50-498/93-35
50-499/93-35

Licenses: NPF-76
NPF-80

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

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

Inspection At: STP, Wadsworth, Matagorda County, Texas

Inspection Conducted: November 15-19, 1993

Inspectors: L. E. Ellershaw, Reactor Inspector, Maintenance Section
Division of Reactor Safety

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Approved: Samuel Collins 12/16/93
Dr. Dale A. Powers, Chief, Maintenance Section Date
for Division of Reactor Safety

Inspection Summary

Areas Inspected (Units 1 and 2): Routine, announced inspection of onsite followup of previous inspection findings and followup of licensee event reports.

Results (Units 1 and 2):

- Based on the results of this inspection, it was concluded that significant progress has been made concerning Restart Issue 14, "Adequacy of the Licensee's Resolution of the Reliability of the Feedwater Isolation Bypass Valves." However, this restart issue will remain open pending completion of the open findings specified in the report.

- Management was proactive by ensuring a more aggressive troubleshooting plan be developed to identify the cause of the erratic refueling machine behavior. Once the plan was developed, the licensee identified the root cause and took appropriate corrective action.

Summary of Inspection Findings:

- Inspection Followup Item 498/9324-01; 499/9324-01 was reviewed, but not closed (Section 2.1).
- Licensee Event Report 498/93-020 was reviewed, but not closed (Section 2.2).
- Licensee Event Report 499/93-008 was reviewed, but not closed (Section 2.3).
- Unresolved Item 498/9319-01; 499/9319-01 was closed (Section 3.1).
- Unresolved Item 498/9319-02; 499/9319-02 was closed (Section 3.2).
- Unresolved Item 498/9319-03; 499/9319-03 was closed (Section 3.3).
- A noncited violation was identified (Section 3.3).
- Inspection Followup Item 498/9335-01; 499/9335-01 was opened (Section 3.3).
- Unresolved Item 498/9319-04; 499/9319-04 was closed (Section 3.4).
- Violation 498/9335-02; 499/9335-02 was opened and closed (Section 3.4).
- Inspection Followup Item 498/9319-05; 499/9319-05 was closed (Section 3.5).
- Unresolved Item 498/9319-06; 499/9319-06 was closed (Section 3.6).
- Unresolved Item 499/9319-07 was closed (Section 3.7).
- Violation 499/9335-03 was opened and closed (Section 3.7).
- Inspection Followup Item 498/9330-01 was closed (Section 3.8).
- Licensee Event Report 498/93-017 was closed (Section 3.9).

Attachment:

- Attachment - Persons Contacted and Exit Meeting

DETAILS

1 PLANT STATUS

Unit 1, which had been in a defueled condition, entered Mode 6 on November 18, 1993, and Unit 2 was defueled and in no mode during this inspection period.

2 STATUSING OF ITEMS RELATED TO RESTART ISSUES (92701)

The following items related to Restart Issues were statused concerning the manner in which the licensee had resolved the issue.

2.1 (Open) Inspection Followup Item (498/9324-01; 499/9324-01): Inadequate Feedwater Isolation Bypass Valve Spring Design

On August 13, 1993, during plant heatup to normal operating pressure and temperature, Steam Generator 1D water level was noted to have decreased abnormally. Investigation determined that Feedwater Isolation Bypass Valve FV-7145A was approximately 10-15 percent open. The valve was manually closed and a followup investigation was initiated and documented in Station Problem Report (SPR) 93-2462. The investigation determined that Feedwater Check Valve FW-0249 leaked by the seat allowing full steam generator pressure to be applied to the downstream side of valve FV-7145A. This pressure was sufficient to lift the valve disk against the closing spring pressure. It was determined, in conjunction with the valve manufacturer, that the closing spring strength would keep the valve closed against a maximum of 847 psi. It was recognized that identical springs were used in the other three bypass valves in Unit 1 and all four bypass valves in Unit 2, thus making them susceptible to the same failure mechanism.

Technical Specification 3.0.3 requires initiation of action within one hour to place the unit in a specified mode when a limiting condition for operation is not met. Technical Specification 3.7.1.7 requires each feedwater isolation valve to be operable, and since the bypass valves for all four feedwater isolation valves were inoperable, a plant cooldown was commenced.

The SPR identified the root cause of the failure as being "less than adequate design specification for the feedwater isolation bypass valve." The specification did not describe the safety function of the valve or describe all conditions under which the safety function was required to be performed. The SPR addressed the degradation of containment integrity, therefore a generic implications review was performed with respect to similar type operating characteristics where a valve could be pressurized from the direction opposite to its normal flow. The review culminated in the identification of the main steam isolation bypass valves and the steam generator preheater bypass valves as being susceptible to backflow conditions under certain operational/accident scenarios.

The licensee established corrective actions, some of which had not been implemented. Design engineering was drafting a written policy that all purchase orders for globe style air operated valves must specify the necessary information for the valve manufacturer to be sensitized to reverse flow conditions. Design engineering was preparing a procurement-related requirement for an engineering design report, including spring calculations, which must receive a detailed review by design engineering prior to the valve being shipped from the manufacturer.

At the time of this inspection, the following actions had been developed and were planned on being implemented prior to startup of each unit. For the main steam isolation bypass valves, the actuator springs will be replaced. For the feedwater isolation bypass valves, the valve stroke will be decreased in order to pre-load the existing closing spring and increase the actuator thrust. The existing valve adjusting screw will be replaced and the valve plug will be modified to accommodate the decreased stroke requirement. In addition, the unbalanced valve trim will be replaced with a pressure-balanced trim, thereby reducing the thrust required to close the valve. Regarding the feedwater preheater isolation bypass valves, the valve stroke will be decreased and the existing valve adjusting screw and valve plug will be replaced.

This inspection followup item will remain open pending completion of the currently planned actions.

2.2 (Open) Licensee Event Report 498/93-020: Entry Into Technical Specification 3.0.3 Due to the Feedwater Isolation Bypass Valves Being Determined to be Inoperable

Based on the discussion in Section 2.1, this licensee event report will remain open, pending completion of the currently planned corrective actions.

2.3 (Open) Licensee Event Report 499/93-008: Failure to Maintain Environmental Qualification of a Residual Heat Removal Motor Operated Valve

Based on the discussion in Section 3.7, this licensee event report will remain open pending completion of the training program enhancements

3 CLOSED ITEMS RELATED TO RESTART ISSUES (92701)

The inspectors determined that the licensee's actions to address the following issues were adequate. These items were considered closed.

3.1 (Closed) Unresolved Item (498/9319-01; 499/9319-01): Unauthorized Independent Verification Activity Performed by an Instrumentation and Controls Technician

Further review of this item revealed that the technician, prior to performing the verification activity, had been granted permission by the Unit Supervisor

to stroke the valve locally to complete the service request he was working on. By granting permission to locally stroke the valve, operations reliquished control of the valve to the craftsmen, thereby allowing them to open or close the valve at will. Step 3.01.01 of the service request required adjustment of the valve position indicator to reflect actual valve position. In order to determine actual valve position, the technician loosened the stem clamp bolts and tried to rotate the valve stem. This verification activity was used to assure full closure prior to valve stroking. In addition, Step 7.3.3 in Procedure OPMP08-ZI-0025 required that the final element be seated in the closed position prior to valve stroke verification. However, the vendor's technical manual (Valtek) stated "To avoid possible stem and/or seat galling, do not allow the plug to turn on the seat." The manual went on to provide the proper methodology for seating the valve.

The licensee recognized the potential for error, and established Nuclear Training Department Lesson Plan ICT 980.01.LP, "Control Valves," dated August 16, 1993. The lesson plan is a 72-hour course which was initiated to provide valve stroke verification, calibration and adjustment methods, bench set, positioner calibration, position indication, troubleshooting techniques, and consistent guidance for valve seating in accordance with vendor requirements. Lesson Plan ICT 980.01.LP is now used in the certification of Instrumentation & Controls technicians for calibration of control valves. The inspectors verified that the current 10 Instrumentation & Controls Technicians have all been certified to the requirements of ICT 980.01.LP.

3.2 (Closed) Unresolved Item (498/9319-02; 499/9319-02): Failure to Calibrate Valve Remote Position Indicators as Required by the Inservice Test Program

The inspectors determined that a station problem report, SPR 930762, had previously identified the conflict between the wording used in the STP Pump and Valve Test Plan (calibrate) and Section XI IWV-3300 of the ASME Code (observe to verify accurate indication) regarding remote valve position indicators. The station problem report identified the concern regarding the use of the word "calibrate" on March 10, 1993. The engineering evaluation dated March 11, 1993, concluded that the word "calibrate" was used in error and the STP Pump and Valve Test Plan would be corrected with next revision.

The inspectors verified that the next revision of the STP Pump and Valve Test Plan for both units had been revised to correct the wording. The version of the STP Pump and Valve Test Plan containing the correction was Revision 6 for Unit 1 and Revision 4 for Unit 2.

The inspectors also noted that the terminology used in Procedure OPG03-ZE-0021, "Inservice Testing Program for Valves," Revision 6, and Procedure OPGP03-ZG0002, "Valve Remote Position Indicator Verification Test (Cold Shutdown)," Revision 0, was consistent with the terminology used in Section XI IWV-3300 of the ASME Code. In addition, the inspectors verified that the valve remote position indicator verification tests had been performed within the past two years and were documented as satisfactory.

3.3 (Closed) Unresolved Item (498/9319-03; 499/9319-03): This Item Dealt With the Licensee's Reclassification of the Feedwater Isolation Bypass Valve Positioners from a Safety-Related to a Nonsafety-Related Status

The design of the feedwater isolation bypass valve and its positioner was such that upon receipt of an engineered safety features actuation signal, the positioner was required to vent air from the valve in order to assure valve closure. As a result of an architect-engineer memorandum dated September 10, 1986, which stated that the pneumatic positioners are "non-safety," the licensee inappropriately reclassified the positioners (in late 1986) from a safety-related to a nonsafety-related status. Since the positioners had been reclassified, actions had not been established or performed to ensure their ability to function as required.

During the licensee's review of the problems associated with out-of-calibration positioners identified in SPR 931818, dated May 21, 1993, it became known that the positioners had been reclassified as nonsafety-related, when in fact, they performed a safety-related function. The licensee established that the positioners had been procured as safety-related equipment and had been properly qualified. Subsequent calculations demonstrated that the positioners remained within their qualified life at all times despite the fact that they had been inappropriately reclassified. The licensee further analyzed the consequences of failed feedwater isolation bypass valves and determined the failure to be bounded by the current analyses. Therefore, the failure of all feedwater isolation bypass valves to close under design basis accident conditions has no safety significance. However, the licensee, as an enhancement to the system, determined that rerouting the air supply to the positioners would provide the benefit of preventing valve packing failures from causing positioner failures (as had happened previously), and, at the same time, resolve the positioner classification concern. During May 1993, the Unit 1 feedwater isolation bypass valve positioner's air supply was rerouted in accordance with engineering change notice package ECNP 89-J-0164. The Unit 2 modification is scheduled for implementation during the first quarter of 1994 (prior to Unit 2 startup).

The licensee's incorrect reclassification of the positioners was a violation of Criterion III in Appendix B to 10 CFR Part 50, which requires that licensees assure that the applicable design basis for components that prevent or mitigate the consequences of postulated accidents are correctly translated into specifications, procedures, and instructions. This violation will not be subject to enforcement action because the licensee's efforts in identifying and correcting the violation met the criteria specified in Section VII.B.2 of Appendix C to 10 CFR Part 2.

The licensee also performed an evaluation to ensure there was no generic equipment qualification concern with safety classification downgrades. The evaluation reviewed 643 Technical Evaluations that had been used to reclassify active components from safety-related to nonsafety-related. Each Technical Evaluation was associated with a specific part or component. The review identified 10 parts that required reclassification to a safety-related

designation. The scope of the evaluation was expanded to include an additional 196 Technical Evaluations. This resulted in the identification of 11 more parts requiring reclassification.

The licensee initiated and had completed plant impact assessments on 20 of the 21 parts. It was determined that none had any negative impact regarding plant operability. The due date for completion of the last plant impact assessment was established as December 31, 1993.

An Engineering Training Bulletin was issued and the licensee conducted training of design engineering personnel regarding equipment qualification issues and design verification activities based on lessons learned from this event. The training was documented as having been provided on July 8 and 9, 1993.

While the unresolved item has been closed, the inspectors considered an evaluation of the licensee's completed impact assessments on plant operability to be warranted. Therefore, the inspectors identified this as an inspection followup item (498/9335-01; 499/9335-01).

3.4 (Closed) Unresolved Item (498/9319-04; 499/9319-04): Prompt Corrective Action was not Initiated Upon Identification of Conditions Adverse to Quality

On June 12, 1989, the licensee initiated engineering change notice packages (ECNP 89-J-0164 for Unit 1 and ECNP 89-J-0165 for Unit 2) which identified that the feedwater isolation bypass valves were subject to failure due to the nonsafety-related positioners being required to perform a safety-related function. The suggested change noted on the ECNPs was to, "Redesign as required to ensure valve closure on actuation of the safety solenoids, independent of the positioner." At the same time, the ECNPs referenced SPR 890335 which identified failures of feedwater isolation bypass valve packing, which, in turn, had caused failures of the associated positioner. As a result, the SPR corrective action focused on improving valve packing performance, which included re-routing the positioner instrument air piping. The modification would also resolve the positioner classification concern by eliminating the positioner's safety function, thereby allowing the positioners to remain classified as nonsafety-related and eliminating their equipment qualification requirements. Since the primary emphasis was directed towards improvement of valve packing performance, the assigned priority was relatively low.

Implementation of these ECNPs was not initiated until the licensee identified that the qualified life of the positioners was thought to have expired. On February 1993, the design change associated with ECNP 89-J-0164 (Unit 1) was implemented on a modification work order authorized by Service Request 16874. The same design change associated with ECNP-89-J-0165 (Unit 2) has been scheduled for implementation during the first quarter of 1994 (prior to Unit 2 startup).

The licensee's failure to promptly correct identified conditions adverse to quality constitutes a violation of Criterion XVI of Appendix B to 10 CFR Part 50 requirements (498/9335-02; 499/9335-02).

Since 1991, there have been several enhancements made to the corrective action program to improve deficiency identification, root cause determinations, and corrective action implementation. These changes included the formation of the Operations Work Control Group, which is responsible for screening and prioritizing work requests. The group has been staffed with senior reactor operators and supporting engineering personnel.

Discussion with licensee personnel led the inspectors to conclude that the significant factor in allowing this condition was the assignment of a low priority in 1989. The inspectors concluded that had this condition occurred while under the control of the current corrective action program, the condition would have been more likely to be promptly corrected.

3.5 (Closed) Inspection Followup Item (498/9319-05; 499/9319-05): Deactivation of Preventive Maintenance Activities on Feedwater Isolation Bypass Valves Without Sufficient Bases

In late 1988, the licensee had initiated deactivation of preventive maintenance (PM) for equipment which had been classified as low priority levels, including the feedwater isolation bypass valves. The deactivation was to be "a short-term effort to more effectively utilize manpower on Units 1 and 2 corrective maintenance and finalize PM development" for equipment with a higher priority level.

The inspectors' review of PMs associated with the feedwater isolation bypass valves revealed that none had been performed after July 1989, and further, one of the valves had never received PM.

The inspectors were provided with a copy of SPR 931759 dated May 18, 1993, which documented the lack of PM being performed on the feedwater isolation bypass valves and positioners.

Subsequent investigation regarding SPR 931759 determined that there were no active PMs for these valves and the deactivated PMs dealt with valve inspection and testing, operator seal replacement, and bypass valve refurbishment. The PMs to inspect and test the bypass valves were deactivated because valve operation was verified during valve surveillance testing. The PMs to replace the operator seals were deactivated because of high maintenance costs and the limited consequences of a feedwater isolation bypass valve failure. The PMs for valve refurbishment were deactivated because the qualified life of the valves and ancillary equipment had been extended to 40 years. The licensee determined that while the valve PMs were deactivated, valve performance degradation would have been identified during ongoing surveillance testing; therefore, it was concluded that the valve PMs were unnecessary.

Based on revised qualified life calculations, the licensee initiated 24 PMs to: periodically replace those feedwater isolation bypass valve components with limited qualified lives, periodically replace the solenoid valves and coils consistent with their calculated qualified lives, calibrate the feedwater isolation bypass valves' flow controllers, and inspect the valves' components for general condition. Further, the eight safety-related solenoid valves associated with the four Unit 1 feedwater isolation bypass valves were replaced during June 1993, while the corresponding Unit 2 solenoid valves are scheduled to be replaced during the first quarter of 1994 (prior to Unit 2 startup).

The licensee also provided equipment qualification training to all design engineering personnel during July 8 and 9, 1993.

3.6 (Closed) Unresolved Item (498/9319-06; 499/9319-06): Equipment Qualification of Solenoid Valves

This item dealt with the failure to maintain the environmental qualification of electrical equipment. Specifically, the licensee extended the qualified life of safety-related solenoid valves of the feedwater isolation bypass valves from 4 years to 40 years. The inspectors reviewed the computation sheet for the solenoids, which stated that for solenoid valves installed in a normally de-energized configuration, thermal aging is not a limiting condition since heat rise due to an energized coil is not a factor. Therefore, the licensee concluded that the solenoid valves had a thermal qualified life of 40 years, as documented in the Environmental Qualification (EQ) calculation package. The inspectors noted during review of the valve manufacturer's (Valtek) seismic/environmental qualification report, that the "Statement of Qualified Life" also pertained to ASCO solenoid valves associated with the feedwater isolation bypass valves. The "Statement of Qualified Life" addressed the need for replacement of the solenoid coils and elastomeric components every 4 years, and that this must be performed in order to achieve a 40-year life.

In response to the conflict, the licensee initiated SPR 931881 on May 28, 1993, which stated that the feedwater isolation bypass valve solenoids had exceeded their qualified life. The inspectors reviewed the Feedwater Isolation Bypass Valve Logic Diagram 5S-13-9-Z-40121, No. 1/No. 2, Revision 5, dated May 25, 1988, and noted that the safety-related solenoid valves were normally energized. Based on Valtek's design report and the start of qualification life (Unit 1, June 6, 1987; and Unit 2, December 9, 1988), the qualifications of the safety-related solenoids expired in June 6, 1991, and December 9, 1992, respectively.

The inspectors reviewed the licensee response to this issue. The licensee performed calculations to determine the actual qualified thermal life of the solenoid coil, based on their actual application. The calculations determined that the actual qualified thermal life was 2.5 years for the solenoid valve coils.

The licensee also contacted the solenoid valve vendor (ASCO) with regards to potential failure of the solenoid coils. The vendor stated that while de-energized, if the coil fails, the valve would remain closed. If the coil fails while energized, the valve would change state and return to a closed position. The vendor stated that failure of the solenoid coil would not prevent the valve from performing its safety function. Based on this information, the licensee concluded that failure of the coil would not prevent the feedwater isolation bypass valves from performing their safety function (fail close and remain closed).

Since the licensee was assured that failure of the coil was not detrimental to safe operation, calculations were performed on the elastomers, which were determined to be the next most limiting component. Based on actual application usage, calculations showed that the elastomers have an actual qualified thermal life of approximately 30.55 years. The licensee concluded that the equipment qualification life condition which would affect the safety function of the solenoid valve is the elastomer, and not the coil. The licensee determined, through this re-evaluation, that the feedwater isolation bypass valves had not exceeded their qualified life since a coil failure would not prevent the valve from performing its safety function.

As discussed in Section 3.5, the licensee established PMs for replacement of the solenoid valve coils and elastomers. The replacement intervals were based on the actual qualified thermal life calculations, and were established for the solenoid coil and elastomer as 2.5 and 30.55 years, respectively. However, at the 30.55 year interval, the entire valve will be replaced. To eliminate any confusion as to when the equipment qualification "clock" life started, the licensee replaced the Unit 1 solenoid valves in June 1993, and the Unit 2 solenoid valves are scheduled for replacement during the first quarter of 1994.

Since the normal state of the safety-related valves is energized and not de-energized, as originally thought by the licensee, the licensee initiated required training for all engineering personnel. The training was developed to address the lessons learned surrounding the circumstances in which the incorrect state of the solenoid valves had been assumed. Engineering was also sensitized to the need for attention to detail, with respect to environmental qualifications and verifying assumptions.

Based on the actions taken by the licensee and review of supporting documentation, the inspectors concluded that the licensee had properly responded to this issue.

3.7 (Closed) Unresolved Item (499/9319-07): Failure to Maintain the Motor Operator for the Unit 2 Residual Heat Removal B Train Suction Valve in a Configuration Supported by Test Results

The inspectors reviewed the licensee's final evaluation of the cause of the event reported in Licensee Event Report 93-08, Revision 1, and related corrective actions pertaining to the licensee's discovery on May 5, 1993, that

the replacement motor for the Unit 2 Residual Heat Removal Train B pump suction isolation valve was missing the two T-drains. At the time of the discovery, Unit 2 was defueled. The valve motor, Equipment Tag Number B2RH-MOV-0060B, was identified in the updated equipment qualification checklist package for motor operated valves, Document EQCP-Limitorque, Revision 0, with Document Change Notice EQ-193, as requiring two T-drains based on equipment location and safety function.

The installation of the replacement motor without the required T-drains was documented in Work Request (WR) PM-88059. The work request clearly annotated that the T-drains were not installed on the motor housing when the motor was replaced in November 1990. Another work request, WR-RH-70405, issued on November 27, 1990, stated that T-drains needed for installation on motor B2RH-MOV-0060B were not available. The motor installation work request, PM-88059, was closed based on the issuance of WR-RH-70405, and the residual heat removal valve was declared operable. A notation was subsequently made on WR-RH-70405 that T-drains were to be installed by Service Request RH-2-88227. That work order documented that the T-drains were installed on the residual heat removal valve motor in April 1993.

The licensee stated in the licensee event report that the NRC Diagnostic Evaluation Team had identified a potential deficiency existed concerning the T-drains. The licensee performed an evaluation of the event and determined that the absence of the T-drains rendered the environmentally qualified electrical motor for Valve RHR-0060B technically inoperable in a "harsh environment" following a postulated design basis accident. The apparent cause of this event was specified as lack of knowledge regarding the requirement to maintain the environmental qualification of motor operated valves located in harsh environments. The replacement equipment for environmentally qualified electrical equipment must be qualified in accordance with the provisions of 10 CFR 50.49. Technical Specification 3.5.6 requires three independent residual heat removal loops to be operable in Modes 1, 2, and 3. The action statement of the Technical Specification stated that with one residual heat removal loop inoperable, restore the required loop to operable status within 72 hours or be in at least hot standby within the next 6 hours and in hot shutdown within the following 6 hours. The licensee stated in the licensee event report that because Unit 2 has operated in Modes 1, 2, and 3, since November 29, 1990, with Valve RH-0060B inoperable, Technical Specification 3.5.6 was violated. Therefore, the replacement of environmentally qualified electrical equipment with unqualified equipment and operating in Modes 1, 2 and 3 with one residual heat removal loop inoperable beyond the requirements of the action statement is a violation of 10 CFR 50.49 and Technical Specification 3.5.6 (499/9335-03).

The inspectors reviewed the status of the licensee's corrective actions that were taken to address the event reported in Licensee Event Report 93-08, Revision 1, and discussed above. The T-drains missing from the motor of Valve RH-0060B have been replaced as documented in Work Order SR RH-2-88227. The licensee performed a 100 percent walkdown of motor operated valves located in Units 1 and 2 harsh environments and identified

three additional valve motors in Unit 2 with missing T-drains, which were subsequently installed. The evaluation of the impact of these discrepancies was discussed in SPR 931524. The missing T-drains on these other valve motors were evaluated as not impacting the intended function of the valves. In addition to the walkdown, the licensee performed a review of open service requests. The NRC followup regarding walkdowns and review of open work requests was documented in NRC Report 498/93-19; 499/93-19.

The inspectors also reviewed the corrective actions regarding improvements pertaining to procedures and training specified in the licensee event report. The inspectors verified that a step was added to Procedure OPMP05-ZE-0300, "Limitorque MOV Motor Inspection and Lube," Revision 13, by Field Change 93-0984, which required an inspection of motor and limit switch housings for T-drains with a task completed signoff. The inspectors verified that the training initiatives specified in the licensee event report were complete for the following: (1) System Engineer training on environmental qualification program requirements and implementation; (2) Maintenance Department issued Training Bulletin MTB-93-007 to emphasize environmental qualification requirements; and (3) Briefing Papers regarding lessons learned from this event were provided to operations, plant engineering, design engineering, and quality control. Another program enhancement specified in Licensee Event Report 93-008 pertained to the revision of initial and continuing training provided to system engineers, senior reactor operators, quality control inspectors, maintenance planners, and craft. The scheduled completion date for revising the training program was established as December 15, 1993. The licensee event report, as discussed above in Section 2.3, will remain open pending completion of the training program enhancements.

3.8 (Closed) Inspection Followup Item (498/9330-01): Refueling Machine Failures

During off-loading of fuel assemblies from Unit 1 in August 1993, numerous refueling machine problems were experienced and SPR 932530 was initiated to document and correct the problems. Subsequently, the licensee was able to complete the off-load of the core.

The inspectors conducted a review of the August 1993 failures, previously identified problems, licensee corrective actions, and operating history of both units refueling machines.

On August 22, 1993, the Unit 1 refueling machine exhibited some erratic behavior when operators latched onto the first assembly in an attempt to remove it from the core. Tension was slowly increased on the hoist cable and the dillon cell indicated a reading of approximately 2000 pounds. The dillon cell indicator then suddenly reduced to a reading of approximately 60 pounds. All fuel movement activities were stopped while the fuel assembly was inspected using binoculars. The inspection indicated that the fuel assembly had not moved.

The Core Load Supervisor (CLS) unlatched the assembly from the hoist for troubleshooting, and an attempt was made to raise the hoist, but the hoist did not respond. The electrical hoist brake was deactivated and the hoist was manually cranked up approximately two feet. A second attempt was made to electrically raise the hoist. This time the hoist rose approximately five feet. Operators re-engaged the electric brake in another attempt to raise the hoist. This time the hoist moved in the downward direction at a high rate of speed. The downward movement stopped when the operator released the switch that was sending the up signal to the hoist. Several other attempts were made to raise the hoist, all with similar results, until the hoist rested atop the fuel assembly with the slack cable alarm lit. At this point, operators manually cranked the hoist up.

The CLS suspended all fuel movements until the refueling machine problem could be analyzed and repaired. While moving the refueling machine to the In Containment Storage Area (ICSA) operators noticed that the trolley and bridge would only operate in the reverse direction at fast speed, regardless of the speed and direction specified. Since the trolley, bridge, and hoist controls were now completely lost, the refueling machine was manually cranked to the ICSA.

During troubleshooting, instrumentation & controls technicians verified a shorted pin on the power supply. After the pin was straightened, the refueling machine successfully passed all postmaintenance tests.

Once operable, core movements were recommenced on August 22, 1993. The refueling machine experienced another reverse movement failure. This was the second of four failures that occurred during the course of core off-load. The corrective action for the second, third and fourth failures involved replacing accelerate/decelerate (ACC/DEC) and/or silicon controlled rectifier (SCR) driver cards from the refueling machine for troubleshooting. After each incident, technicians verified failures in the cards.

On August 29, 1993, after the corrective action for the fourth failure had been implemented, fuel movements were halted, and a meeting involving personnel from Instrumentation & Controls, Operations, and Engineering was held with the plant manager. A more aggressive troubleshooting plan was developed. The licensee installed recorders on the refueling machine to monitor selected test points. The refueling machine was then operated with a dummy assembly until the failure recurred. While monitoring the test points, technicians verified that the output of the ACC/DEC card (control firing logic) was being distorted before reaching the SCR driver card. The only interface between these two cards was a connector. The control firing logic determined the hoist (up-down), trolley (E-W), and bridge (N-S) direction of the refueling machine. The connector was removed and the technicians noticed that a ground pin on the connector was making intermittent contact. The pin was reseated and the machine appeared to operate properly. It was determined that when contact was not being made, there was no reference ground for the refueling machine's control circuitry. Due to the design of the control

circuitry, this resulted in negative inputs being sent to the SCR driver card which caused the reverse movements.

Subsequent to the repair of the connector, the licensee conducted an extensive search of the warehouse and located a new Group 4 SCR driver card. The Group 4 card was an updated version of the original SCR driver card (Group 1) installed in the machine. On August 30, 1993, technicians replaced the original SCR Driver card with the updated Group 4 version.

Since the licensee did not have additional ACC/DEC cards, the original card vendor (Sundstrand) was contacted for additional cards. The vendor no longer manufactured the cards, but agreed to provide the licensee with the circuit components and board etch patterns required to make replacement cards. The licensee secured a vendor, and three additional spare ACC/DEC cards were manufactured. The licensee also had two additional Group 3 SCR driver cards updated to the latest Group 4 configuration.

The core off-load of 166 fuel assemblies for Unit 1 was completed on September 6, 1993, using an original ACC/DEC and a Group 4 SCR driver card installed in the refueling machine. These movements were completed with no additional reverse movement failures. The Unit 2 refueling machine currently has a new ACC/DEC card and an original SCR driver card installed.

The licensee identified the root cause of the failure and implemented an appropriate corrective action. This is supported by the fact that 166 fuel assemblies were off-loaded without any additional reverse movement failures.

The inspectors reviewed the operating histories of both refueling machines. The first Unit 1 refueling outage (August-October 1989) was completed with the refueling machine being operated in the semi-automatic mode. Operation in the semi-automatic mode allowed operators to dial in a position and the refueling machine would respond by traversing to that position. During the first refueling outage for Unit 2 (September-December 1990), the refueling machine would not operate in this mode and was operated in the manual mode. Operators had to maneuver a selector switch to hoist, trolley, or bridge, and concurrently operated the speed control and jog control to maneuver the refueling machine to the desired location. Operations in the semi-automatic mode were never successfully repeated for either unit and the machine has since been operated in the manual mode only. The licensee had also adopted the practice of removing the ACC/DEC and SCR driver cards at the completion of an outage. This practice was to ensure that spare cards were on hand as backups to support the other refueling machine in the event of a failure.

During the inspectors' review, it was noted that numerous failures of limit switches and the underwater cameras had occurred for both machines. The licensee stated that the cameras were of poor quality and susceptible to failure. The limit switches were mounted on the west side of the machine and were frequently bumped, which could cause position indication changes leading to failure. The licensee had a modification planned that will upgrade the camera system. To accomplish a permanent resolution to the limit switch

issue, two modifications were under consideration. The first modification would provide improved limit switch protection by installing covers on the switches. The other consideration is a new design which would completely eliminate the need for the limit switches. The selected modification was scheduled to be implemented prior to the completion of each unit's next scheduled refueling outage.

The inspectors noted that there have been two previous service requests which documented erratic machine behavior. Service Request 112593 dated October 10, 1990, stated that the refueling machine for Unit 2 traveled opposite to the requested direction. Corrective action involved replacing and troubleshooting the ACC/DEC card. Troubleshooting revealed that an integrated circuit was not properly seated; however, once reseated, the card passed all further testing. The card was given to the system engineer for storage as a backup card to support the next outage.

Service Request 134195 dated January 3, 1991, documented a problem with the Unit 1 refueling machine, regarding the bridge motor running erratically. While traveling in one direction, the machine would reverse on its own and continue in the other direction. This service request was voided and the problem was investigated under Service Request 118293. The corrective action was to replace and test the ACC/DEC and the SCR driver cards. Once replaced, the machine operated correctly. Testing of the ACC/DEC card was performed and two integrated circuits were found to be inoperable. The failure mechanism for both circuits appeared to be different from the failure mechanism which subsequently occurred in August 1993.

The inspectors also reviewed the training and qualifications of the fuel handling operators. Fuel movement activities during the events of August 1993, were conducted by contract personnel from ABB Combustion Engineering, Inc., and Master-Lee Energy Services. All ABB Combustion Engineering operators were trained, qualified, and certified in accordance with their procedure (RFS-TRNG-001, Rev. 01, Refueling Services Personnel Qualification Program). Master-Lee personnel were certified in accordance with their procedure (ML-TRN-001, Fueling Operations Personnel Qualification). Master-Lee procedures had been audited by ABB Combustion Engineering, and their personnel met the ABB Combustion Engineering qualification standards. The inspectors reviewed the qualification matrix supplied by ABB Combustion Engineering for all contract operators. The inspectors determined that the refueling machine operators had received the proper training required for fuel movement activities.

Prior to beginning fuel movement activities, operators were required to attend a pre-job briefing. The brief covered topics such as industry events associated with fuel movement activities, reactivity management, health physics, foreign material exclusion, and contingency actions should problems occur. The specific requirements of the pre-job brief were outlined in Procedure OPOP08-FH-0009, "Core Refueling," Revision 8 (General) dated September 23, 1992, which is the controlling document for fuel movement

activities. The refueling machine was operated in accordance with Procedure OPOP08-FH-0001, "Refueling Machine Operating Instruction," Revision 1 (General) dated June 16, 1993.

The core refueling procedure and all fuel movement activities were implemented and controlled by the CLS, who was a licensed senior reactor operator. Senior reactor operators receive CLS training during their requalification process.

The inspectors also evaluated the potential for generic ramifications during this review. The refueling machines were supplied to the South Texas Project by Westinghouse and are one of a kind. The refueling machines were manufactured by Stearns-Rodgers, while the control circuitry was designed and supplied by Sundstrand. The South Texas Project is the only known site that utilizes the Sundstrand designed control circuitry.

The licensee entered the event into the Nuclear Network on September 3, 1993, but had not received any feedback with regard to plants having similar experiences. Several utilities have contacted the licensee and requested additional information.

The inspectors determined that since the control circuitry for the refueling machines is unique to the South Texas Project, there are no generic implications.

The inspectors accompanied the refueling machine operators on the refueling machine at the beginning of the Unit 1 core reload on November 19, 1993. Initially, operators appeared apprehensive in conducting fuel movements based on the prior failures. The inspectors verified that the operators had received a pre-job briefing prior to any fuel movement. The inspectors verified that all fuel movements were in accordance with the licensee's fuel movement procedure, and it was noted that fuel movement activities were conducted without any anomalies.

3.9 (Closed) Licensee Event Report 498/93-017: Extension of Feedwater Isolation Bypass Valve Positioner and Solenoid Equipment Beyond Qualification Life

This licensee event report was initially reported as Revision 0 on June 25, 1993. Subsequent licensee evaluation of the equipment qualification life and operability of the feedwater isolation bypass valves' positioners and solenoid equipment resulted in the determination that the qualified lives had not been exceeded. Therefore, the event described in Revision 0 to the licensee event report was not considered reportable per 10 CFR Part 50.73, and as such, the licensee changed the report to a voluntary status and issued Revision 1, dated July 20, 1993, to document the change.

The inspectors performed a thorough review of this subject and concurred with the licensee's evaluation. The bases for the inspectors' concurrence is documented throughout Section 3, above.

ATTACHMENT

1 PERSONS CONTACTED

1.1 Licensee Personnel

*R. Balcom, Director Nuclear Security
*M. Berg, Manager, Engineering Support
*H. Bergendahl, Manager, Technical Services
*D. Bize, Licensing Engineer
*J. Calloway, Staff Consultant
*T. Cloninger, Vice President, Nuclear Engineering
*J. Conly, Licensing Engineer
*W. Cottle, Group Vice President, Nuclear
*M. Coughlin, Senior Licensing Engineer
*P. Dahl, Licensing Engineer
*R. Fellingham, Staff Specialist
*M. Grim, Licensing Engineer
*J. Groth, Vice President, Nuclear Generation
G. Hales, Instrumentation and Controls Design Engineer
*A. Harrison, Supervising Engineer, Nuclear Licensing
*C. Harvey, Staff Specialist, Corrective Action Group
*J. Johnson, Supervisor, Quality Assurance
*T. Jordan, General Manager, Nuclear Engineering
*M. Kanavos, Manager, Mechanical and Nuclear Engineering
*D. Keating, Director, Independent Safety Review Group
*D. Leazar, Manager, Plant Engineering
*M. Ludwig, Manager, Nuclear Training
*L. Martin, General Manager, Nuclear Assurance
*L. Myers, Plant Manager, Unit 1
*M. Pacy, Manager, Design Engineering
*P. Parrish, Senior Specialist, Licensing
*J. Sheppard, General Manager, Nuclear Licensing
*M. Smith, Senior Consultant
*L. Taylor, Senior Consultant
*C. Walker, Manager, Public Information

1.2 NRC Personnel

*D. Garcia, Resident Inspector
*W. Johnson, Chief, Project Section A, Division of Reactor Projects
*J. Keeton, Resident Inspector
*T. Westerman, Chief, Engineering Section, Division of Reactor Safety

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

* Denotes those personnel that attended the exit meeting.

2 EXIT MEETING

Exit meeting was conducted on November 19, 1993. During this meeting, the inspectors reviewed the scope and findings of the report. The licensee did not identify as proprietary any information provided to, or reviewed by, the inspectors. At the exit meeting, the licensee acknowledged the findings and did not express disagreement.