

APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 50-498/94-14
50-499/94-14

Licenses: NPF-76
NPF-80

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

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

Inspection At: Wadsworth, Matagorda County, Texas

Inspection Conducted: April 25-29, 1994

Inspector: C. J. Paulk, Reactor Inspector, Engineering Branch
Division of Reactor Safety

Approved: *A. Barnes*
for T. F. Westerman, Chief, Engineering Branch
Division of Reactor Safety

5-26-94
Date

Inspection Summary

Areas Inspected (Units 1 and 2): Routine, announced inspection of previously identified items related to motor-operated valves.

Results (Units 1 and 2):

- Fifteen of 17 previously identified inspection findings related to motor-operated valves were closed (Sections 2.1-2.17).
- The licensee had performed a thorough, objective self-assessment of the motor-operated valve program (Section 3).

Summary of Inspection Findings:

- Inspection Followup Item 498/9206-03; 499/9206-03 was closed (Section 2.1).
- Inspection Followup Item 498/9230-01; 499/9230-01 was closed (Section 2.2).

- Inspection Followup Item 498/9306-01; 499/9306-01 was closed (Section 2.3).
- Inspection Followup Item 498/9306-02; 499/9306-02 was closed (Section 2.4).
- Inspection Followup Item 498/9306-03; 499/9306-03 was closed (Section 2.5).
- Inspection Followup Item 498/9306-04; 499/9306-04 was reviewed, but remains open (Section 2.6).
- Inspection Followup Item 498/9306-05; 499/9306-05 was closed (Section 2.7).
- Inspection Followup Item 498/9306-06; 499/9306-06 was closed (Section 2.8).
- Inspection Followup Item 498/9306-07; 499/9306-07 was closed (Section 2.9).
- Inspection Followup Item 498/9306-08; 499/9306-08 was closed (Section 2.10).
- Inspection Followup Item 498/9306-09; 499/9306-09 was closed (Section 2.11).
- Inspection Followup Item 498/9306-09; 499/9306-10 was closed (Section 2.12).
- Inspection Followup Item 498/9306-11; 499/9306-11 was closed (Section 2.13).
- Inspection Followup Item 498/9306-12; 499/9306-12 was reviewed, but remains open (Section 2.14).
- Inspection Followup Item 498/9308-03; 499/9308-03 was closed (Section 2.15).
- Inspection Followup Item 498/9308-05; 499/9308-05 was closed (Section 2.16).
- Violation 498/9308-01; 499/9308-01 was closed (Section 2.17).

Attachment:

- Attachment - Persons Contacted and Exit Meeting

DETAILS

1 BACKGROUND

During previous inspections of the licensee's program developed for motor-operated valves in accordance with the guidelines of Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," and its six supplements, numerous items were identified as requiring further inspection by the NRC and further explanation by the licensee. In an effort to support the final closure of NRC Temporary Instruction 2515/109, "Inspection Requirements for Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance," this inspection was scheduled and performed.

The licensee presented the inspector with the final report of a self-assessment of the motor-operated valve program that was conducted January 8-26, 1994, to demonstrate the activities that have taken place to develop a "world-class program." The inspector reviewed the results of the self-assessment as part of the inspection to close the previously identified items.

2 CLOSURE OF PREVIOUSLY IDENTIFIED MOTOR-OPERATED VALVE ISSUES (2515/109)

2.1 (Closed) Inspection Followup Item 498/9206-03; 499/9206-03; "Motor-Operated Valve Issues"

During an inspection conducted in February 1992, three issues were identified that required additional information. The licensee provided a written response to these items on July 9, 1992, which documented discussions conducted in June 1992 between the NRC and the licensee, and the formal response for each of the concerns.

The first concern was related to the extrapolation of dynamic test results (at greater than 80 percent maximum expected differential pressure and flow) to estimate thrust and torque at 100 percent maximum expected differential pressure and flow. During this inspection, the inspector reviewed the licensee's methodology and the results of the licensee's application of the methodology to valves that had been dynamically tested. The inspector concluded, on the basis of the valves reviewed in 1992, that there were no inoperable valves. The inspector also concluded that the licensee's methodology for extrapolation of dynamic tests results at greater than 80 percent maximum expected differential pressure was acceptable.

The second concern was related to the licensee's long-term plan for motor-operated valves left in a condition where total thrust may exceed 110 percent actuator rating. During this inspection, the inspector found that all actuators were in compliance with Limitorque Update 92-02. This has resulted in 23 valves with thrust greater than 110 percent rated, but less than 162 percent rated. The licensee stated that consideration was being given to

modify these valves to bring them closer to the actuator limits, if not less than the nominal limits. The inspector concluded that the licensee's actions were acceptable and that the 23 valves were operable with the as-left thrust exceeding the actuator ratings, but less than the ratings provided in Limatorque Update 92-02.

The third concern was related to the differences among the Limatorque Update, a report issued by Kalsi Engineering, Inc., and a report issued by Westinghouse Electric Company. The inspector was told that the licensee had implemented the actions described in the Limatorque Update, including torquing the actuator housing bolts. The inspector concluded that the licensee had resolved the overthrust issue in an acceptable manner.

2.2 (Closed) Inspection Followup Item 498/9230-01; 499/9230-01: "Actions for Overthrust Motor-Operated Valves"

During an inspection conducted in February 1992, an unresolved item was identified related to overthrust of motor-operated valves. This item was subsequently closed, and an inspection followup item was issued to track the completion of the licensee's actions related to Unit 2 motor-operated valves.

During this inspection, the inspector reviewed the affected Unit 2 valves and concluded that the licensee's actions (inspections, torquing the housing bolts, adjusting torque switch settings, testing, etc.) resulted in those valves being operable, within the limits of the Limatorque Update 92-02.

2.3 (Closed) Inspection Followup Item 498/9306-01; 499/9306-01: "Reevaluate Methodology for Calculating Stem Factors"

During an inspection conducted in June 1993, the NRC noted that the licensee's methodology for calculating the stem factor and the coefficient of friction was not an industry practice and may not have been appropriate. The licensee calculated the stem factor and the coefficient of friction by using the thrust at control switch trip, rather than the thrust at flow cutoff.

During this inspection, the inspector noted that the licensee had revised Procedure OPMP05-ZE-0309, "MOV Diagnostic Testing." The revision required the licensee to calculate the stem factors from direct measurements at both control switch trip and flow cutoff. The licensee would then use the more conservative value for feedback into its evaluation of the valve's performance. The inspector considered the licensee's actions to have been conservative.

2.4 (Closed) Inspection Followup Item 498/9306-02; 499/9306-02: "Valves Tested Below 80 Percent of Maximum Expected Differential Pressure"

At the time of an inspection conducted in June 1993, the licensee had not calculated the apparent valve factors for test data and compared them to the assumed values for motor-operated valves tested at less than 80 percent of the design basis maximum expected differential pressure. The licensee indicated, during that inspection, those valves tested below 80 percent of design conditions would be reevaluated to meet the requirements of Procedure OPMP05-ZE-0309.

During this inspection, the inspector reviewed the licensee's evaluation of valves tested prior to June 1993, before the current acceptance criteria were implemented. The inspector noted that all of the valves evaluated by the licensee for this item were included in the two-stage approach for determining valve capability. The licensee was in the process of performing the two-stage evaluations and had scheduled a completion date prior to June 28, 1994. The two-stage approach will be evaluated during the closure of GL 89-10.

2.5 (Closed) Inspection Followup Item 498/9306-03; 499/9306-03: "Differential Pressure Test Data for Limit-Closed Motor-Operated Valves"

During the June 1993 inspection, a deficiency in the acceptance criteria to evaluate the torque levels measured during differential pressure tests was identified. The licensee did not adequately translate a particular requirement into acceptance criteria. The requirement was that the calculated degraded voltage torque for limit-closed, rising-stem valves should be greater than the measured torque at seat contact, extrapolated to the design basis differential pressure. The licensee was to review the diagnostic test data for limit-closed motor-operated valves to determine if any torque-related problems were missed by the use of non-conservative acceptance criteria.

During this inspection, the inspector verified that the licensee had properly included this requirement in the procedures and had implemented the procedure correctly. The inspector also verified that the licensee had reviewed the data for 65 limit-closed valves. The inspector noted that the licensee had retested 37 of the valves; evaluated 17 valves that had been tested at less than 50 percent maximum expected differential pressure using Procedure OPMP05-ZE-0309, Revision 8, Addendum 44; and evaluated 11 valves that had been tested at greater than 50 percent maximum expected differential pressure. The inspector did not identify any inoperable valves on the basis of this review.

2.6 (Open) Inspection Followup Item 498/9306-04; 499/9306-04: "Torque Extrapolation Method"

During the June 1993 inspection, the licensee did not have sufficient justification for the straight-line extrapolation method used to estimate the thrust and torque necessary to overcome differential pressure effects at design basis conditions when tests were performed at less than maximum expected differential pressure.

The licensee used an extrapolation method based on the standard industry equations for gate valve stem force prediction. The licensee extrapolated the stem thrust/torque required to overcome differential pressure to design basis conditions by multiplying the test obtained torque/thrust by the ratio of maximum expected differential pressure to test differential pressure.

The licensee has performed multi-point differential pressure tests on several valves, covering a wide range of differential pressures up to, and exceeding, maximum expected differential pressure. The results of the licensee's data analysis indicated that thrust and torque were linear with respect to differential pressure. The licensee's analysis also showed that variation of stem factor due to increasing differential pressure was insignificant.

The inspector reviewed the licensee's data and analysis and found that the extrapolation method used by the licensee could indicate that negative torque and thrust would be present at zero differential pressures. Therefore, this item will remain open pending further NRC evaluation.

2.7 (Closed) Inspection Followup Item 498/9306-05; 499/9306-05:
"Differential Tests Less Than 80% Maximum Expected Differential Pressure"

During the June 1993 inspection, the licensee had not included an extrapolation of measured torque or thrust in the analysis of test data when the tests were conducted at less than 80 percent maximum differential pressure.

As discussed in Section 2.4, the licensee does not extrapolate results from tests conducted at less than 80 percent maximum differential pressure for determining actuator capability. Those valves were included in the two-stage approach to determine capability and extrapolation was used to determine any anomalies. The two-stage approach will be evaluated during the closure of GL 89-10.

2.8 (Closed) Inspection Followup Item 498/9306-06; 499/9306-06: "Opening
Differential Pressure Trace of Motor-Operated Valve AISIMOV0008A"

During the June 1993 inspection, an error in the open differential pressure test was identified for Valve AISIMOV0008A, high head safety injection pump to reactor coolant system hot leg. The licensee had determined that the highest thrust in the opening direction (in this case the pullout thrust) was 61.64 kN (13,857 lbf). Based on review of the diagnostic trace, the inspectors determined that the measured pullout force was approximately 81.85 kN (18,400 lbf). The licensee agreed that an error had been made in the analysis of this trace and that a reevaluation would be performed.

During this inspection, the inspector reviewed the licensee's actions and concluded that the added requirement for a second qualified individual review of the traces was adequate to resolve this issue.

2.9 (Closed) Inspection Followup Item 498/9306-07; 499/9306-07: "Valve Factor for Motor-Operated Valve B2RCMOV0001B"

During the June 1993 inspection, a concern with the setpoints for the power-operated relief valve block valves was identified. At control switch trip (limit), the output thrust was slightly lower than required by the design basis calculation, and total thrust was slightly greater than the actuator limit.

During this inspection, the inspector found that the South Texas licensee had reviewed the test data from another South Texas licensee with the same model valve. The licensee had initially assumed a valve factor of 0.45 in the calculation for thrust requirements, but revised the valve factor to 0.55 after review of the data obtained from another licensee. The inspector reviewed the results of the licensee's calculations using the test derived valve factor of 0.55 and concluded that the subject valves were operable.

2.10 (Closed) Inspection Followup Item 498/9306-08; 499/9306-08: "Causes of Behavior of Unit 1 Valve"

During the June 1993 inspection, a review of the test package for Valve C1CVMOV8348, "Centrifugal Charging Pump Seal Water Injection Flow Control Bypass," indicated that this valve exhibited a 38 percent load-sensitive behavior effect despite a very minimal dynamic effect on the valve during the closing stroke. The licensee agreed to review the test results for this valve to determine the validity of the differential pressure test and to determine the cause of the unusual load-sensitive behavior. The licensee stated that the same valve in Unit 2 was scheduled to be tested and that this test could provide additional information regarding the causes of the behavior of the Unit 1 valve.

During this inspection, the inspector reviewed the licensee's actions related to Valve C1CVMOV8348. The inspector noted that the licensee was capable of obtaining the design flow rate on Unit 2 because of a change in the procedure for providing the flow path. The licensee reviewed the Unit 1 dynamic test results and found the actual thrust values were higher than originally recorded. This resulted in an actual load-sensitive behavior of 10 percent. The inspector noted that the rate of loading results of the Unit 2 tests were consistent with the reevaluated results of the Unit 1 valve and this issue can be closed.

2.11 (Closed) Inspection Followup Item 498/9306-09; 499/9306-09: "Retesting of Motor-Operated Valves"

During the June 1993 inspection, a review of the dynamic traces for Valve B1RHMOV0066B, "Residual Heat Removal Pump B To Chemical and Volume Control Letdown," and C1CVMOV8348 revealed that the dynamic traces were similar to static traces. A concern was identified related to the validity of the measured differential pressure. The licensee identified that there may

have been a large pressure drop caused by a heat exchanger located upstream of Valve B1RHMOV00668.

During this inspection, the inspector found that the licensee had retested both valves, but was unable to obtain greater than 40 percent maximum expected flow. As a result, the licensee placed these valves into the two-stage approach for determining the capability of the valves. The two-stage approach will be evaluated during the closure of GL 89-10.

2.12 (Closed) Inspection Followup Item 498/9306-10; 499/9306-10: "Method for Zeroing Thrust and Torque Traces Not Consistent"

During the June 1993 inspection, inconsistencies were identified in the zeroing method for thrust and torque. This was especially evident for differential pressure traces, which rarely exhibited the classic "plateau" areas, indicating the transition region between tension and compression.

During this inspection, the inspector verified that Procedure OPMP05-ZE-0309, Revision 8, Addendum 24, had been revised and provided guidance for the consistent identification and marking of the zero points during diagnostic trace review and analysis. The inspector also noted that the licensee had reviewed all data analyzed prior to the procedural revision to determine if any anomalies existed. The licensee identified some traces that were not marked in accordance with the revised procedure; however, the incorrect zeroes did not adversely affect the previous analyses.

2.13 (Closed) Inspection Followup Item 498/9306-11; 499/9306-11: "Evaluation of Motor-Operated Valve Failure for Potential Reportability Under 10 CFR Part 21"

During an internal inspection of Valve B1SIMOV0031B, "Residual Heat Removal Train and Low Head Safety Injection Pumps Isolation," the licensee discovered a broken worm shaft clutch. The licensee had informed Limitorque of the failure so that an evaluation for 10 CFR Part 21 applicability could be made.

During this inspection, the inspector reviewed Station Problem Reports 931506 and 931816. The licensee had initiated these documents to evaluate the failure of the particular part, as well as the generic implications of the failure. The licensee was informed by Limitorque that the failed worm shaft clutch failed due to improper heat treatment during the manufacturing process. Limitorque determined that this was an isolated failure and concluded that the guidance of 10 CFR Part 21 was not applicable. The licensee also sent five additional samples to Limitorque for analysis and evaluation. The conclusion was the failure was an isolated case with no generic implications. The inspector concluded that the licensee and the vendor had adequately evaluated the failure.

2.14 (Open) Inspection Followup Item 498/9306-12; 499/9306-12: "Pressure Locking and Thermal Binding of Gate Valves"

During the June 1993 inspection, a review of the licensee's evaluation of the potential for pressure locking and thermal binding of gate valves was performed. The licensee had developed a matrix for 218 safety-related gate valves. A concern was raised with respect to normally open valves.

During this inspection, the inspector was presented an assessment that was developed to identify conditions that could lead to pressure locking or thermal binding of a gate valve. The inspector noted that this assessment was performed for each motor-operated valve in the GL 89-10 program.

Although the licensee has evaluated the motor-operated gate valves in the GL 89-10 program, this item will remain open pending resolution of the generic concerns related to pressure locking and thermal binding.

2.15 (Closed) Inspection Followup Item 498/9308-03; 499/9308-03: "Adequacy of the Licensee's Lubrication Program"

During an inspection conducted in February 1993, concerns were identified with the licensee's lubrication program for motor-operated valves.

During this inspection, the inspector reviewed the licensee's program for lubricating motor-operated valves and controlling the lubricants. The inspector found that the licensee had identified problems related to the control of lubricants for safety-related components. As a result, in August 1993, the licensee revised the requirements for commercial-grade lubricants used in safety-related equipment to be dedicated for safety-related applications. The inspector also reviewed the frequency of lubrication preventive maintenance activities and concluded that the licensee was complying with the vendor recommendations and the requirements of the environmental qualification program.

2.16 (Closed) Inspection Followup Item 498/9308-05; 499/9308-05: "Overtorque of Unit 1 Residual Heat Removal Suction Valves"

During the inspection in February 1993, four areas were identified where degradation, over time, could affect valve operability. The four areas were stem factor, degraded voltage, underthrusting, and excessive packing loads.

In order to address the degradation concerns, the licensee modified the residual heat removal suction valves on both units to change the gear ratio. The new gear ratio increased the torque capability of the actuator and resolved the four concerns identified in the February 1993 inspection, as discussed below.

The inspector found that the increased torque capability increased the ability of the actuator to accommodate the effects of stem factor degradation. Additionally, the valve was limit controlled, therefore, all available torque

would be applied to attain the desired position. The inspector noted that there was adequate capability at degraded voltage as a result of the lower maximum expected differential pressure. The issue of underthrusting was resolved by the modifications made to the valves. This resulted in the application of all available thrust and torque to the valve. The concern with packing load degradation was also addressed by the increased torque capability.

2.17 (Closed) Violation 498/9308-01; 499/9308-01: "Failure to Take Corrective Actions for Failed Motor-Operated Valve"

During the February 1993 inspection, an apparent violation was identified for the operation of the plant for an entire fuel cycle with Valve A2SIMOV0031A, "Residual Heat Removal and Low Head Safety Injection Pumps Isolation," inoperable. This violation was issued as Violation I.B. of Civil Penalty EA 93-047. The licensee responded to the civil penalty by letter dated May 19, 1993. The licensee concurred that the violation occurred as cited.

During this inspection, the inspector verified that the licensee had provided the training that had been committed to in the response and had made the described changes in the process for determining operability. The inspector considered the licensee's actions to have been adequate to prevent recurrence.

3 LICENSEE SELF-ASSESSMENT

On January 8, 1994, the licensee initiated a self-assessment of the motor-operated valve program because of recent concerns and problems. The objective of this assessment was to evaluate the implementation and overall effectiveness of the motor-operated valve program, in accordance with the requirements of GL 89-10. The self-assessment concluded on January 26, 1994, and the final report was issued on March 30, 1994.

The licensee's focus was to assess the status of the program from the standpoint of motor-operated valve operability and readiness for power ascension. The licensee also focused on the ability to meet their commitments to comply with GL 89-10 requirements by June 28, 1994, and an assessment of the effectiveness and efficiency of the overall motor-operated valve program. The scope of the assessment was limited to activities performed on motor-operated valves since February 1993, at the start of the Unit 1 forced outage.

The licensee reviewed a statistical sample of work packages to assess previous field activities with the success criteria based on identification of issues affecting motor-operated valve operability. A total population of 907 work documents was identified, for which a sample of 56 field-work-complete work documents were reviewed. The licensee's team was comprised of 5 persons with maintenance package review, quality control inspection and/or quality assurance experience, and 12 persons to review the sample for operability/return to service testing.

During the self-assessment, the licensee initiated the following 10 Station Problem Reports:

- SPR 940067 "LLRT incorrectly signed off as complete in work package";
- SPR 940098 "Use of fire proof file cabinets for storage of QA records";
- SPR 940103 "Use of non-safety grade lubricants";
- SPR 940134 "Record retention of conditional release authorizations";
- SPR 940135 "Vendor procedures for performing on-site maintenance work are not being screened under 10 CFR 50.59 prior to use";
- SPR 940137 "Configuration management concern of heater wire termination points";
- SPR 940210 "Lack of programmatic requirements to verify ERFDADS input and ESF status lights";
- SPR 940201 "Completion of operability testing forms per OPGP03-ZM-0025";
- SPR 940213 "Tracking and trending of motor-operated valve data per OPEP07-ZE-0007 and the identification of all motor-operated valves to operations that have adverse trends which may require contingency actions and/or revised operating policy and practices"; and
- SPR 940219 "Work packages were not effectively controlled, revised and implemented. Scope and schedule control was lost due to duplicate work documents. Planning of work packages and field implementation was not effectively monitored."

The licensee identified what it considered significant key strengths. These included the motor-operated valve program plan, the expertise and commitment of the staff, the level of detail in the testing procedure, and the limit switch compartment inspections. Other significant improvements in process included a dedicated motor-operated valve program manager, a staff supplemented with contractors with motor-operated valve-related plant experience, and implementation of tracking the assessment results and day-to-day work.

The licensee also identified key areas for improvement. These included resource planning and allocation, licensee ownership and program oversight, training, scope control, and the overtightening/overthrusting of motor-operated valves. The licensee's team provided recommendations for achieving "world class status." Those recommendations were directed toward the areas of ownership, program management, quality, work processes, long-term program

maintenance, meeting the GL 89-10 requirements, engineering support, and general areas. The licensee's team noted that completion of the scope of work required to comply with the June 28, 1994, GL 89-10 commitments would require extensive planning and management attention.

The inspector noted that the South Texas Project management team support of the assessment team members and the overall cooperation shown by all individuals in support of the assessment was an improvement over previous activities undertaken for the motor-operated valve program.

The inspector reviewed the assessment report and 30 of the 78 station problem reports discussed in the report. The inspector found that the licensee had taken a thorough, objective look at their performance in the motor-operated valve area. The number of problem reports, identified and reviewed, indicated that the licensee's personnel were identifying problems. The responses to the problem reports indicated that the issues were being adequately addressed.

ATTACHMENT

PERSONS CONTACTED AT EXIT MEETING

1 PERSONS CONTACTED

1.1 Licensee Personnel

M. Bagale, Motor-Operated Valve Project Manager
T. Cloninger, Vice President, Nuclear Engineering
W. Cottle, Vice President, Nuclear
R. Fast, Unit 1 Maintenance Manager
J. Groth, Vice President, Generation
S. Head, Senior Compliance Engineer
T. Jordan, Manager, Systems Engineering
M. Meier, Assistant to the Vice President, Nuclear Engineering
A. Mikus, Supervisor, Engineering
L. Myers, Plant Manager
G. Parkey, Plant Manager
P. Parrish, Senior Licensing Specialist
H. Pate, Staff Licensing Engineering Specialist
S. Rosen, Vice President, Industry Relations
J. Sheppard, General Manager, Nuclear
C. Stephenson, Licensing Engineer
S. Thomas, Manager, Design Engineering Department
L. Walker, Licensing Engineer
D. Wohleber, Department Manager

1.2 NRC Personnel

D. Loveless, Senior Resident Inspector
P. Qualls, Reactor Inspector, Plant Systems Branch

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

2 EXIT MEETING

An exit meeting was conducted on April 29, 1994. During this meeting, the inspector summarized the scope and findings of the report. The licensee acknowledged the inspection findings identified in this report without expressing an opinion on the findings. The licensee did not identify as proprietary any information provided to, or reviewed by, the inspector.