ENCLOSURE

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 50-275/95-01
50-323/95-01

Licenses: DPR-80
DPR-82

Licensee: Pacific Gas and Electric Company
77 Beale Street, Room 1451
P.O. Box 770000
San Francisco, California

Facility Name: Diablo Canyon Nuclear Power Plant, Units 1 and 2

Inspection At: Diablo Canyon site, San Luis Obispo County, California

Inspection Conducted: January 13-17 and 23-27, 1995

Inspectors: C. Myers, Reactor Inspector, Engineering Branch
Division of Reactor Safety

M. Runyan, Reactor Inspector, Engineering Branch
Division of Reactor Safety

Accompanying
Personnel: H. Rathbun, Office of Nuclear Reactor Regulation

Approved: _____ 2-22-95
T. Westerman, Chief, Engineering Branch Date
Division of Reactor Safety

Inspection Summary

Areas Inspected (Units 1 and 2): Special, announced inspection of safety-related motor-operated valve testing and surveillance and followup of engineering issues.

Results (Units 1 and 2):

- The inspectors verified completion of the licensee's commitments to Generic Letter 89-10, contingent on submittal within 60 days of the date of this report, a letter to the NRC documenting additional justification related to periodic verification and the capability of untested motor-operated valves (Section 1.1).

- The inspectors concluded that the licensee had adequately established the design basis capability of motor-operated valves that had not been tested at or near design basis conditions. Some additional effort was needed to confirm generic assumptions used in support of untested motor-operated valves and to address certain valves using the Electric Power Research Institute valve factor evaluation process (Section 1.5).

- The licensee's motor-operated valve program included consideration of valve mispositioning (Section 1.2).

- The licensee's analysis and corrective actions taken for potential pressure locking and thermal binding concerns were thorough and timely. Modifications of susceptible valves had been completed. (Section 1.3).

- The inspectors found that the licensee had incorporated all appropriate vendor information regarding diagnostic system measurement accuracy. Additional sources of error had been identified (Section 1.4).

- Grouping of valves for comparison of test results was utilized to justify the capability of untested valves. Additional information was requested regarding implementation of the grouping guidelines of Generic Letter 89-10, Supplement 6 (Section 1.5).

- Limited differential pressure testing was included as part of the licensee's plans for periodic verification. The licensee was requested to provide additional information regarding several issues related to periodic verification (Section 1.6).

- Detailed maintenance fitup of valve internals and performance trending had been implemented and were considered strengths in the licensee's ongoing program (Section 1.6.2 and 1.7.2).

- Continuing strong quality assurance oversight of the motor-operated valve program was evident. The technical depth of the audits was considered a strength. Some recent audit findings had not been resolved at the time of the inspection (Section 1.8).

Summary of Inspection Findings:

- Inspection Followup Item 275;323/9319-02 remains open pending issuance of a planned NRC generic communication on the issue of pressure locking and thermal binding (Section 1.9.1).

- Inspection Followup Item 275;323/9139-02 was reviewed but left open (Section 1.9.2).

- Additional information was requested to clarify ongoing program commitments as identified in Attachment 2.

Attachments:

- Attachment 1 - Persons Contacted and Exit Meeting
- Attachment 2 - Additional Information Requested to Clarify Ongoing Program Commitments

DETAILS

1 GENERIC LETTER 89-10, "SAFETY-RELATED MOTOR-OPERATED VALVE TESTING AND SURVEILLANCE" (2515/109)

On June 28, 1989, the NRC issued Generic Letter 89-10, which requested licensees and construction permit holders to establish a program to ensure that switch settings for safety-related motor-operated valves were selected, set, and maintained properly. Subsequently, six supplements to the generic letter have been issued. NRC inspections of licensee actions implementing commitments to Generic Letter 89-10 and its supplements have been conducted based on guidance provided in Temporary Instruction 2515/109, "Inspection Requirements for Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance," Revision 1. Temporary Instruction 2515/109 was divided into two parts: Part 1, "Program Review;" and, Part 2, "Verification of Program Implementation." The Temporary Instruction 2515/109, Part 1, program review inspection was conducted at Diablo Canyon during October 1991 and was documented in NRC Inspection Report 50-275/91-39; 50-323/91-39. The Temporary Instruction 2515/109, Part 2, implementation review inspection was conducted at Diablo Canyon during July 1993 and was documented in NRC Inspection Report 50-275/93-19; 50-323/93-19. A followup Part 2 inspection was conducted during June 1994 and was documented in NRC Inspection Report 50-275/94-17; 50-323/94-17. The licensee notified the NRC in a letter dated November 28, 1994, that Diablo Canyon's commitments to Generic Letter 89-10 had been completed.

The principal focus of this inspection was to evaluate the licensee's process for qualifying the design basis capability of each of the motor-operated valves in the Generic Letter 89-10 program. Though most valves were tested under conditions applying a high percentage of the design basis differential pressure, some were tested only under static or low differential pressure conditions. As discussed in Generic Letter 89-10, these were considered to be valves for which a two-stage approach should be utilized. The first stage was to set up the valve using the best available information. The second stage required a more precise methodology, which could include comparison to a similar valve, prototype testing, use of the Electric Power Research Institute (EPRI) testing results, or other methods.

1.1 Summary Status of Generic Letter 89-10 Motor-Operated Valves

At the time of the inspection, 155 motor-operated valves were included in the Generic Letter 89-10 program. Approximately 68 percent of the motor-operated valves had been tested under differential pressure conditions. The remainder of the motor-operated valves were tested only under static conditions.

Based on the documents reviewed during this inspection and discussions with cognizant licensee personnel, the inspectors verified completion of the licensee's commitments to Generic Letter 89-10, contingent on submittal of additional justification and information related to several areas of ongoing program activities as described in this report, and subsequent NRC review.

1.1.1 Generic Implications Report

The inspectors reviewed Procedure ICE-12, "I&C Engineering Procedure for Preparation of Motor Operated Valve Sizing and Switch Setpoint Calculations," Revision 10. This procedure was developed and implemented to ensure that motor-operated valves were properly sized and setup prior to differential pressure testing. In addition, Procedure ICE-12 provides guidance on evaluating the results of differential pressure testing.

As required by Procedure ICE-12, the licensee developed a "Report on Generic Implications of 89-10 Testing" following completion of the differential pressure testing recommendations of Generic Letter 89-10. The inspectors reviewed the licensee's report dated December 9, 1994. This document summarized the methods and assumptions used to qualify each valve in the program as being capable of performing its safety function under design basis conditions. The report discussed the results of differential pressure testing for each valve type and included an evaluation of assumed valve factors, rate of loading, and stem friction coefficient. Test valve factors and rates of loading were compared to design assumptions. In cases where test results indicated marginal motor-operated valve capacity, the licensee provided an engineering evaluation to support design basis capability.

The inspectors reviewed the available margin identified by the licensee for each of the motor-operated valves at the conclusion of their program. Generally, the inspectors found that the licensee had adequately demonstrated the existing design basis capability for each of the valves consistent with their program plan commitments.

1.1.2 Actions Taken for Valve Factor Exceeding Assumptions

Valve factor is a measure of the condition of the valve internals affecting valve operation. Valve factor is defined as the ratio of the actuator thrust to the differential pressure force. The actuator thrust setpoint range was established using the design valve factor.

The existing margin based on as-left switch settings was termed the "ICE-12 margin," after Procedure ICE-12, which defines the motor-operated valve testing program. A positive ICE-12 margin was required for motor-operated valve operability.

The licensee did not routinely revise the design valve factor for a motor-operated valve group to account for measured valve factors that exceeded the original assumption. This feedback of test information was a common method to validate design basis capability of the entire allowable range of thrust

settings. Rather, long-term maintenance of acceptable valve settings was controlled by using what was termed the "effective margin." The effective margin was based on the lowest permissible thrust setting within the setpoint window. The fact that some motor-operated valves had positive effective margins even though the measured valve factor exceeded the design valve factor was attributable to conservatisms in estimating packing and ejection loads and rates of loading. Some motor-operated valves, however, had negative effective margins (meaning that, if the valve were set at the low end of the setpoint window, it may not have adequate capability). The licensee had implemented administrative controls to prevent changing the switch setting for these motor-operated valves until the setpoint window has been appropriately adjusted.

The inspectors found the licensee's actions to be adequate.

1.1.3 Rate-of-Loading Assumption Validated

The generic implications report summarized an evaluation of the assumptions made for rates-of-loading. The rate-of-loading assumption was important for the evaluation of static-only motor-operated valves and for other valves for which a accurate rate-of-loading was not obtained. Rate-of-loading is the percentage change in the thrust at control switch trip from the static to the dynamic test, expressed as a positive number when the static control switch trip thrust is greater than the dynamic thrust. The licensee had established a margin of 15 percent to account for rate-of-loading. Six gate valves and four globe valves had rates-of-loading calculated to be greater than 15 percent, with the highest gate valve being 24.65 percent and the highest globe valve being 30.30 percent. The average rate-of-loading for gate valves was a positive 2.39 percent. For globe valves, the average was a positive 7.27 percent. The licensee evaluated each instance where the measured rate-of-loading exceeded the design value. Two patterns were noted; one in which high rates of loading were associated with low test differential pressures, and one in which high rates of loading were associated with low measured valve factors. The inspectors reviewed this information and concluded that the use of a design value of 15 percent rate-of-loading was justified.

1.1.4 Limited Validation of Stem Lubrication Assumption

The generic implications report also addressed the consistency between the measured and assumed values for stem friction coefficient. The design assumption for stem friction coefficient was 0.2. Since the licensee's diagnostic system did not regularly measure torque, only five tests performed with a Teledyne stem mounted thrust and torque strain gage gave results from which a stem friction coefficient could be calculated. The highest measured values for stem friction coefficient were 0.12 in the closing direction and 0.18 in the opening direction. Based on these tests and industry experience, the inspectors considered the design assumption of 0.2 to be acceptable.

The licensee identified that for one motor-operated valve, 1-9001B, a stem friction coefficient assumption of 0.15 was used in lieu of 0.2 because the use of 0.2 would have yielded a negative capability margin in the opening evaluation. This motor-operated valve was on a special 3-month inspection and lubrication schedule.

The inspectors noted that the licensee also included a 7 percent margin for stem lubrication degradation in their determination of motor-operated valve capability.

The inspector found the licensee's actions to be adequate.

1.1.5 Inadvertent Use of Neolube on Valve Internals

The licensee observed unexpectedly low pullout thrust requirements during initial static testing of several motor-operated valves immediately following valve internal maintenance. The licensee discovered that maintenance personnel had applied the graphite base lubricant "Neolube" to the internal guides, disks and seats of 14 Generic Letter 89-10 motor-operated valves during valve reassembly prior to differential pressure testing. The maintenance practice had been implemented by procedure to assist in fitup reassembly of the valve. Engineering was unaware of this practice at the time of the differential pressure testing and became concerned that this practice may have affected the validity of differential pressure test results. The licensee conducted various static tests to determine the effects of neolube on valve performance. The licensee's testing found that motor-operated valve performance was not affected by the use of neolube. In addition, the licensee concluded that neolube was rapidly removed by water from the valve internals after a few valve strokes. The licensee considered that all valves had been stroked at least ten times prior to differential pressure testing. The licensee concluded that valve performance during differential pressure testing was not affected by the use of neolube.

The inspectors found that the licensee's static testing and evaluation focused on disk pullout performance and did not address valve factor performance under differential pressure conditions. The inspectors found no test-basis for the licensee's conclusion regarding the effect of neolube on valve factor performance. The inspectors were concerned that lubrication of the valve internals may have resulted in nonconservative determinations of actual valve factors from testing soon after reassembly. The inspectors noted that the licensee had generically assumed that actual valve factor did not change, and no margin had been specifically identified to accommodate valve factor degradation.

The inspectors reviewed the test results for the 14 affected motor-operated valves and found that all valve factors were consistent with the results of other valves in their group. None of the valves exhibited a low valve factor.

In response to the inspectors' concern, the licensee identified that one of the neolubed valves had been selected for differential pressure testing during periodic verification. According to the licensee, changes in valve factor performance attributable to the previous use of neolube will be evaluated at that time to confirm their opinion. The licensee is being requested to provide additional detail of their use of periodic testing to validate their assumptions regarding the use of neolube in response to this inspection report.

1.2 Mispositioning

The inspectors reviewed the licensee's motor-operated valve program to determine the licensee's current treatment of valves subject to mispositioning. As recommended in Generic Letter 89-10, the scope of licensee motor-operated valve programs was to include motor-operated valves which were not prevented from inadvertent mispositioning from the control room.

The inspectors found that the licensee's program continued to include motor-operated valves which were not prevented from inadvertent mispositioning. The licensee had not changed their consideration of mispositioning in establishing the scope of their program.

The inspectors found the licensee's position regarding the consideration of mispositioning within their Generic Letter 89-10 program to be adequate.

1.3 Pressure Locking and Thermal Binding

During the first Part 2 inspection, the inspectors reviewed the licensee's program to address pressure locking and thermal binding, which was documented in Nuclear Engineering and Construction Services memorandum to Nuclear Operations Support, "Pressure Locking of Gate Valves," dated October 6, 1992. As of the date of this inspection, no additional program documentation had been issued on this subject.

The licensee had identified 26 motor-operated valves in each unit which met their review screening criteria for valves susceptible to pressure locking and thermal binding. As a result of their evaluation, the licensee identified six valves considered susceptible for pressure locking: 1/2-8703, 2-8801A/B, and 2-8803A/B. No valves were considered susceptible to thermal binding.

The licensee review recommended three options as corrective actions for each of the valves:

(1) Drill a hole in the high pressure side of the disk,
(2) Install a bonnet leakoff line and block valve, or
(3) Install a bonnet relief line and discharge line.

During this inspection, the inspectors reviewed closed Action Request A0316042, which identified that modifications to the six identified valves had been completed in Refueling Outages 1R6 and 2R6. In addition to

these modifications, the licensee stated that, based on information obtained from industry sources, modifications (drilled upstream valve disks) were performed on the six power-operated relief valve block valves, 1-8000A/B/C and 2-8000A/B/C.

The inspectors concluded that the licensee had taken sufficient steps to have met its commitments associated with pressure locking and thermal binding for Generic Letter 89-10 closure. The inspection followup item (275;323/9319-02) tracking this issue will remain open pending issuance and subsequent reviews of a planned NRC generic communication.

1.4 Actions in Response to Generic Letter 89-10 Supplement 5

The inspectors reviewed the licensee's actions in response to Supplement 5 of Generic Letter 89-10. Supplement 5 had requested information regarding the diagnostic systems being used by the licensee during their Generic Letter 89-10 program.

The inspectors found that the licensee had responded to Supplement 5 and identified that the VOTES diagnostic test system was used for diagnostic testing during their Generic Letter 89-10 program. The licensee uses either the VOTES thrust transducer (yoke-mounted) or the Teledyne quick stem sensor transducer (stem mounted). Several unexpected sources of error were identified by the licensee during their testing, as described below.

The inspectors found that the licensee had incorporated all appropriate vendor information regarding measurement accuracy using the VOTES system.

The inspectors found the licensee's actions to be adequate.

1.4.1 Transition Zone with Split Stem Design

The licensee identified two incidents of gross calibration errors using the yoke-mounted, VOTES thrust sensor on valves with split-stem designs. The discrepant measurements were observed on Auxiliary Feedwater Globe Valves 1-LCV-107 and 2-LCV-106. The stem design for Valves LCV-106 and -107 consisted of a coupled assembly of a threaded portion and an unthreaded portion. The coupling also served as the torque restraint. For purposes of calibrating the VOTES thrust sensor mounted on the valve yoke, the licensee had treated this configuration as a solid stem geometry change and applied vendor recommendations to avoid locating the "mini-c" calibrator in the transition zone. Later confirmatory thrust measurements used a strain gage transducer (quick stem sensor) mounted directly on the unthreaded portion of the valve stem and analytically calibrated, indicated only half of the previously measured thrust.

After extensive investigation of the cause of the observed discrepancy including communications with the vendor (Liberty), the licensee concluded that transition zone effects for split-stem valve designs extended much farther beyond the range identified by the vendor, introducing an error in the

output of the mini-c calibrator. Due to space limitations in the area between the valve yoke and the stem, the mini-c clamp was required to be placed in an orientation that caused a three-point contact with the stem. The licensee concluded that having the mini-c clamp in three-point contact with the stem contributed to the observed diagnostic testing errors.

The licensee concluded that VOTES mini-c calibrator could not be used to calibrate the VOTES thrust transducer or the quick stem sensor. The licensee had changed their practice to use an analytic calibration of the quick stem sensor supplied by the manufacturer for LCV-106 and -107. No other valves incorporated the split-stem design.

The inspectors reviewed the licensee's root cause evaluation and found the licensee's actions to be adequate.

The licensee determined that the observed problem was not reportable under Part 21. The licensee planned to formally notify the VOTES diagnostic equipment vendor (Liberty) of their observations and conclusions.

1.4.2 Translating Torque Restraint Effect

The inspectors reviewed Action Request A0354065 which documented that during the recent 2R6 refueling outage, the licensee had performed a hydrostatic test of Residual Heat Removal Suction Isolation Valve 2-8702 to demonstrate design basis capability. The diagnostic trace indicated a unexpectedly large thrust required for disk pullout during opening of the valve. The other three identical valves in this valve group did not display this anomaly. The licensee's initial root cause investigation determined the cause of the anomaly to be a pressure locking condition existing during the test.

Motor-Operated Valve 2-8702 was one of two pressure isolation valves off the reactor coolant system to the suction of the residual heat removal pumps. These pressure isolation valves were normally locked closed with electric power removed during operation. The licensee identified a closing safety function to isolate residual heat removal pipe break during cooldown operation and opening safety function to initiate cooldown for Appendix R shutdown.

The inspectors observed that the test data for Motor-Operated Valve 2-8702 indicated that only marginal capability existed. The inspectors reviewed the thrust signature analysis for this valve and found that the licensee had discounted the excessive opening thrust requirement as a test anomaly in their analysis of the capability of the motor-operated valve. According to the licensee, the valve had experienced pressure locking due to a valve alignment unique to the testing which was not possible during normal valve alignment. The bonnet vent valve to prevent pressure locking had been closed during testing.

The inspectors were concerned that the capability of the motor-operated valve could not be demonstrated based on the measured data without discrediting the anomalous portion of the opening thrust. While the licensee's hypothesis of

the occurrence of pressure locking appeared reasonable to explain the observed excessive opening thrust requirement, the inspectors found that the licensee had no confirmatory evidence (such as measured bonnet pressure) to validate the pressure locking occurrence. Furthermore, the valve had not been disassembled for internal inspection. The inspectors did not consider the quality of the test to be an adequate demonstration of design basis capability and requested additional justification.

On further review, in response to the inspectors' concern, the licensee identified a calibration error affecting the accuracy of the opening thrust measured during the test of these valves. The licensee determined that the error was due to a yoke-torque effect during initial valve opening which was not present during calibration of the yoke-mounted VOTES thrust sensor. The licensee had calibrated the yoke-mounted VOTES thrust sensor by backseating the valve to produce stem tension. The design of the valve incorporated a stem-mounted torque restraint which translated along the stationary yoke during valve stroking. This design feature subjected varying portions of the yoke to torque depending on the location of the torque restraint. During valve stroking the torque restraint translated past the fixed location of the VOTES sensor on the yoke. As a result, the yoke in the location of the VOTES sensor was not subjected to torque during backseating. However during initial disk pullout, the yoke in the location of the VOTES sensor was subject to torque. The licensee concluded that a backseating technique could not be used for open calibration purposes for valves with the translating torque restraint design.

The licensee reanalyzed the test data for Motor-Operated Valve 2-8702 using the close calibration data obtained from the same test and determined that additional margin was available to justify design basis capability based on the actual test data irrespective of the potential pressure locking occurrence. The licensee reviewed all other uses of the backseating calibration technique and found no other valves which would be similarly affected.

The licensee committed to formally notify the VOTES diagnostic equipment vendor (Liberty) of their observations and conclusions.

The inspectors found that the licensee had appropriately selected the VOTES sensor location based on vendor recommended practice. The inspectors found that the vendor information did not address the use of backseat calibration techniques. The inspectors reviewed the licensee's evaluation and found the licensee's actions to be adequate.

1.5 Grouping

The inspectors reviewed the licensee's justification for the design basis capability of motor-operated valves which were not tested under dynamic conditions.

Approximately 68 percent of the motor-operated valves in the licensee's program were tested under differential pressure conditions, and valve factors were determined based on results of the individual valve tests. For motor-operated valves which were not considered practicable or meaningful to test under differential pressure conditions, the licensee determined design basis capability by analysis with an assumed valve factor for each motor-operated valve. The inspectors noted that the assumed valve factors in the licensee's capability analysis were not validated by comparison with the test results of similar valves, nor were they validated by industry testing of identical valves. Rather, the licensee selected valve factors which were considered to be adequately conservative based on engineering judgement and the best generic test data available at the time.

Although not defined within their program as grouping, the licensee used a grouping methodology to validate assumptions made for valve factors. Nineteen valve groups were established, generally defined by a specific manufacturer, size, and pressure class. Some groups contained valves with more than one size or pressure class. The inspectors considered the groups to represent an acceptable division of valves for the purpose of evaluating valve factors.

The licensee utilized groups of motor-operated valves for the purpose of establishing the best available data for evaluating similar performance.

The inspectors were specifically concerned with eight untested feedwater isolation valves, 1/2-FCV-438,-439,-440,-441. The licensee identified zero existing margin for these Anchor Darling 16-inch flex wedge gate valves with an assumed 0.6 valve factor. The inspectors considered that the use of 0.6 for valve factor was adequate as the best available data for Stage I qualification of the valve. But the inspectors were concerned that the generic valve factor of 0.6 may not be sufficiently conservative to bound or have a high statistical confidence in representing expected valve performance. Industry test results of some similar valves have shown valve factors as high as 0.8. Although a 0.6 valve factor has recently been considered generally conservative, several of the licensee's tests of flex-wedge gate valves have indicated valve factors greater than 0.6. The inspectors considered that additional valve specific justification was required for the use of generic valve factors to demonstrate the design basis capability of untested valves.

The inspectors noted that the licensee had changed their approach to justifying Stage II motor-operated valves and had decided not to utilize the EPRI performance prediction methodology to more precisely estimate the valve factors for the feedwater isolation valves and other valves lacking specific test validation of valve factor assumptions. During previous NRC inspections, the licensee's program had intended to use the EPRI performance prediction methodology for justification of untested motor-operated valves.

In response to the inspectors' concern, the licensee reviewed their approach to justifying untested valves and stated that they planned to utilize the EPRI performance prediction methodology for the eight main feedwater isolation valves and the six power operated relief block valves. Further, the licensee stated they would consider the EPRI performance prediction methodology or other justifiable sources of data as part of the justification for the remainder of the untested valves in their program.

The licensee stated they would review their grouping method in view of the guidelines presented in Supplement 6 of Generic Letter 89-10. In general, the inspectors found the licensee's method consistent with the guidance of Supplement 6. Exceptions were noted regarding the use of the highest individual valve factor as the group valve factor.

The licensee is being requested to submit additional detail of their program enhancements in a written response to this inspection report.

The inspectors concluded that the licensee had adequately established the design basis capability of motor-operated valves that had not been tested at or near design basis conditions. Some additional effort was expected on the licensee's part to obtain applicable data to confirm generic assumptions used in support of untested motor-operated valves.

1.6 Periodic Verification and Post-Maintenance Testing

1.6.1 Periodic Verification

The inspectors reviewed the method utilized by the licensee for periodic verification of design basis capability. The licensee had previously committed to conduct periodic static testing only for each motor-operated valve every 2 to 6 refueling outages depending upon probablistic risk analysis risk significance, performance history, margin, and control logic utilized. The licensee considered that static testing provided adequate periodic performance monitoring assuming that observed valve factors remain constant. Prior to this inspection, the licensee also committed to conduct additional testing under differential pressure conditions to validate their calculation assumptions relating to valve factors. The licensee planned to test nine motor-operated valves (seven gates, one butterfly, and one globe) over the next three refueling outages. Two differential pressure tests would be conducted during the 1R7 outage, three during 1R8, one at power between 1R8 and 2R7, and three during 2R7. After that time, the need for further differential pressure testing would be evaluated. The licensee issued Action Request A0362274 to track their commitment.

The licensee is being requested to provide additional details following the inspection regarding their programmatic enhancements regarding the use of differential pressure testing in their periodic verification program or other justifiable sources of data.

The inspectors found that the licensee had not included any specific margin for valve factor degradation in their determination of motor-operated valve capability. However, based on a review of the available margin for all motor-operated valves, the inspector considered that of the licensee's motor-operated valves had adequate margin to accommodate some degree of valve factor degradation until confirmatory differential pressure testing could be performed during periodic testing. Some valves, however, had very small margins that my not be sufficient to account for short-term degradation. Accordingly, the licensee is being requested to identify the existing margin for valve factor degradation in all motor-operated valves in their program as part of their written response to this inspection report. The previous Inspection Followup Item 9139-02 concerning periodic verification remains open.

1.6.2 Post-Maintenance Testing

The inspectors reviewed licensee Procedure AD13.ID4, "Post-Maintenance Testing," Revision 1. The inspectors reviewed the licensee's post-maintenance test matrix which identified maintenance activities requiring subsequent diagnostic testing to assure that design basis capability is maintained. The inspectors found that the matrix required appropriate diagnostic testing following motor-operated valve maintenance; dynamic testing was identified generally for valve modifications which could negatively affect efficiency or valve factor. However, no specific maintenance activities were identified.

The inspectors considered the lack of prescribed differential pressure testing following valve maintenance (e.g., valve disc replacement or reversal, dimensional rework of valve internals, etc.) to be a weakness. In response to the inspectors' concern, the licensee identified detailed maintenance and modification activities which would require differential pressure testing. The licensee stated that the detailed post-maintenance testing requirements would be added to the post-maintenance test procedure. The inspectors reviewed selected maintenance records and found that appropriate testing had been performed. The inspectors considered the licensee actions to be adequate.

The inspectors reviewed Maintenance Procedure MP M-51.38, "Inspection and Maintenance of Wedge Gate Valve Internal Components," Revision 0. The inspectors found that the licensee procedure required a detailed inspection and fitup procedure for all wedge and parallel disk valves. The procedure incorporated the lessons learned from industry experience for good maintenance practices and critical areas of emphasis for long-term control of valve performance. The licensee considered the detailed inspection information to be critical in their determination of required differential pressure testing for post-maintenance testing. The inspectors found the implementation of the detailed maintenance procedure to be a noteworthy strength in the licensee's program.

1.7 Failure Analysis and Trending

1.7.1 Failure Analysis

The inspectors reviewed the licensee's actions in response to recent operational problems encountered during testing of motor-operated valves. According to the licensee, one operational failure to perform on demand had been experienced subsequent to differential pressure testing. The failure occurred on LCV-109. The failure was considered an isolated incident, and the root cause involved auxiliary contacts in the motor contacter in the motor control center. The licensee's failure analysis was addressed during a previous NRC inspection.

Based on a review of all action requests for the past two years regarding motor-operated valve problems, the inspectors found that the licensee documented problems in detail, thoroughly analyzed motor-operated valve failures, and evaluated design basis capability as a condition of return to service of the motor-operated valve. Several noteworthy examples of licensee failure analysis are described below.

1.7.1.1 Valve 1-8923A

The inspectors reviewed the licensee documented results of differential pressure testing for Valve 1-8923A. This Aloyco 6"-150#, split-wedge, gate valve displayed a high closing force requirement as compared to other identical valves in its group. The licensee disassembled and inspected the valve and found wear and damage in the valve internals. The licensee attributed the high closing force to an inability of the valve disks to rotate when wedging due to a wear ridge on the ball of the ball-and-socket joint which coupled the disks. The licensee concluded that the sharp corner of the socket did not allow the valve disks to rotate to achieve its intended wedging action. The licensee's corrective action involved chamfering the shoulder on the socket and blending out the wear ridge on the ball. In addition, the licensee has included two similar valves in the periodic verification program to monitor for this wear mechanism.

1.7.1.2 Directional Valve Factors

The inspectors found that the licensee had identified a significant flow direction effect on the valve factor performance of Aloyco, spit-wedge, gate valves with a ball-and-socket joint design. Although considered to be bi-directional valves, the valve factor for flow in one direction was consistently observed to be twice the valve factor observed in the opposite flow direction. The licensee analyzed the capability of the motor-operated valve based on the worst valve factor displayed. Furthermore, specific procedural requirements were established in Maintenance Procedure MP M-51.38 to assure the orientation of the disk was controlled to prevent reversal of the disk assembly.

The licensee stated they will notify the industry of the observed directional effects on Aloyco valves via the nuclear news network. Furthermore, the licensee plans to notify the valve vendor of their observation and conclusions.

The inspectors found the licensee actions to be adequate.

1.7.2 Trending

The inspectors reviewed the licensee's motor-operated valve tracking and trending program. The licensee had established and was implementing a computer based program for trending motor-operated valve data. The inspectors found the licensee's program to be effectively implemented and capable of providing meaningful performance indicators. The inspectors considered the licensee's trending activities to be a strength in their ongoing program to maintain design basis capability.

1.8 Quality Assurance

The inspectors reviewed "Site Quality Assurance 2R6 Technical Support Outage Assessment." The licensee performed this follow-up assessment of items identified in their Generic Letter 89-10 Management Prerogative Audit (Audit 94016I), the 89-10 High Impact Team's activities during the 2R6 outage, and the Stage 2 qualification of the main feedwater isolation valves.

The inspectors found that the licensee's self-assessment efforts were comprehensive and indicated a strong commitment to ensuring the design basis capability of motor-operated valves. The inspectors reviewed reports summarizing the activities discussed above and noted that the findings and observations were substantive. As a result of the licensee's self-assessments, several action requests were initiated.

Action Request A0354168, "Qualification of Stage 2 Motor-Operated Valves (Generic Letter 89-10 Program)," was among the action requests generated by the quality assurance self assessment. This recent action request identified a need to prepare adequate justification for the change in commitments to the NRC regarding the basis for the Stage 2 qualifications of the main feedwater isolation valves. This action had not been completed prior to the NRC closure inspection. The licensee was requested to address closure of all outstanding quality assurance findings in a written response to this inspection report.

The inspectors found the strong quality assurance involvement in the licensee's closure activities to be a performance strength.

1.9 Open Items

1.9.1 (Open) Inspection Followup Item 93-19-02: Pressure Locking and Thermal Binding

This issue is discussed in Section 1.3 of this report. This item will remain open pending issuance of a planned NRC generic communication addressing pressure locking and thermal binding.

1.9.2 (Open) Inspection Followup Item 91-39-02: Periodic Verification

This item is discussed in Section 1.6 of this report. This item will remain open pending the licensees submittal of additional information and NRC review.

ATTACHMENT 1

1 PERSONS CONTACTED

1.1 Licensee Personnel

*M. Angus, Manager, Regulatory and Design Services
*M. Baker, Engineer, Electrical Maintenance
*W. Crockett, Manager, Engineering Services
*M. Frauenheim, Engineer, Electrical Maintenance
W. Fujimoto, Vice President, Nuclear Power Generation
*R. Goel, Engineer, Nuclear Engineering Services
*T. Grebel, Director, Regulatory Compliance
*K. Hubbard, Engineer, Regulatory Compliance
*C. Lewis, Engineer, Nuclear Quality Services
*J. Molden, Manager, Maintenance Services
*H. Philips, Director, Technical Maintenance
L. Pulley, Engineer, Nuclear Engineering Services
K. Riches, Engineer, Regulatory Compliance
*A. Toy, Engineer, Predictive Maintenance
*L. Womack, Vice President, Nuclear Technical Services
*M. Williamson, Engineer, Onsite Nuclear Engineering Services
*J. Young, Director, Nuclear Quality Services

1.2 NRC Personnel

*T. Westerman, Engineering Branch Chief, Division of Reactor Safety, RIV

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

*Denotes personnel that attended the exit meeting.

2 EXIT MEETING

An exit meeting was conducted on January 27, 1994. During this meeting, the inspectors reviewed the scope and findings of the report. The licensee acknowledged the inspection findings documented in this report. The licensee did not identify as proprietary any information provided to, or reviewed by, the inspectors.

ATTACHMENT 2

Information Requested to Clarify Certain Program Commitments
Regarding Generic Letter 89-10

1. Clarify intended use of the Electric Power Research Institute Performance Prediction Methodology or other justified sources for confirming the design basis capability of motor-operated valves which have not been tested under differential pressure conditions in the Diablo Canyon Generic Letter 89-10 program. Specifically address the main feedwater isolation valves and the block valves for power operated relief valves (Section 1.5).

2. Provide the results of the Pacific Gas & Electric's review of the grouping of untested motor- operated valves consistent with the guidance of Supplement 6 to Generic Letter 89-10. In particular justify any exceptions to the use of the highest individual valve factor as the group valve factor (Section 1.5).

3. Provide additional detail of the intended use of periodic verification testing to validate assumptions regarding the effect of neolube on valve factors (Section 1.1.5).

4. Provide additional detail of the use of differential pressure testing as periodic verification (Section 1.6.1).

5. Identify the margin for valve factor degradation existing in all motor-operated valves in your Generic Letter 89-10 program (Section 1.6.1).

6. Identify the status of any outstanding quality assurance audit findings related to motor-operated valve program closure (Section 1.8).