

U. S. NUCLEAR REGULATORY COMMISSION  
REGION V

Report Nos: 50-275/90-16 and 50-323/90-16

Docket Nos: 50-275 and 50-323

License Nos: DPR-80 and DPR-82

Licensee: Pacific Gas and Electric Company  
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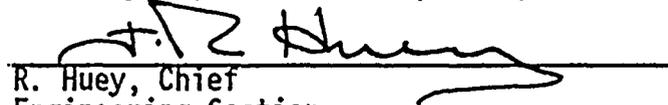
Facility Name: Diablo Canyon Units 1 and 2

Inspection at: Diablo Canyon Site, San Luis Obispo County, California

Inspection conducted: April 17, 1990 through May 25, 1990.

Inspectors: C. J. Myers, Resident Inspector, Rancho Seco

Approved By:

  
R. Huey, Chief  
Engineering Section

6/22/90  
Date Signed

Summary:

Inspection between April 17 and May 25, 1990 (Report Nos. 50-275/90-16 and 50-323/90-16)

Areas Inspected: This inspection reviewed licensee activities resulting from spring pack relaxation in Limitorque actuators for certain motor-operated valves.

During this inspection, Inspection Procedures 62702 and 30703 were used.

Results:

General Conclusions:

A significant strength was observed involving the licensee's identification of a potential generic deficiency in Limitorque actuators on certain safety related valves.

An observed weakness was identified involving inadequate prior engineering involvement in the resolution of plant problems.



Summary of Violations:

Two violations were noted. One violation dealt with a failure to follow procedures for controlling vendor supplied information. A second violation involved a failure to follow procedures for identifying, evaluating and correcting observed plant deficiencies.

Open Items Summary:

An open item regarding followup on spring pack relaxation in Limitorque actuators is described in Paragraph 2c. An unresolved item concerning MOV stroke timing is described in Paragraph 2F.



## DETAILS

### 1. Persons Contacted

#### Licensee Personnel

- ¢\*B. Giffin, Assistant Plant Manager (APM), Maintenance Services
- \*D. Miklush, APM, Operations Services
- ¢\*M. Angus, APM, Technical Services
- \*H. Phillips, Electrical Maintenance Manager
- \*T. Bennett, Mechanical Maintenance Manager
- \*+J. Hinds, Compliance Supervisor
- \*D. Bauer, Senior Engineer
- \*T. Rapp, Chairman, Onsite Review Group
- \*+D. Taggart, Quality Assurance
- \*+L. Ellis, Regulatory Compliance Engineer
- \*R. Gramins, Quality Control
- \*C. Pendleton, System Engineer
- \*J. Shoulders, Nuclear Engineering and Construction Services (NECS) Engineer
- \*M. Burgess, System Engineer
- \*R. Cupp, NECS Engineer
- \*M. Smith, Electrical Maintenance
- \*A. Young, Quality Assurance

#### NRC Personnel

- ¢\*P. Narbut, Senior Resident Inspector, Diablo Canyon

Other licensee employees contacted included technicians, mechanics and office personnel.

\*Attended the Exit Meeting on April 20, 1990.

\*+Attended the Exit Meeting on May 25, 1990.

¢ Participated in telephone exit meeting on June 19, 1990.

### 2. Spring Pack Relaxation in Limatorque Motor-Operated Valve Actuators

On March 17, 1990, with Unit 2 shutdown in a refueling outage, the licensee identified a potentially generic deficiency in certain Limatorque actuators utilized on safety-related motor operated valves (MOV's). During routine overhaul of the MOV actuators, the licensee found three consecutive instances of a loss of preload in the spring packs of Limatorque Model SMB-0 actuators. After dismantling and inspection of the spring packs, the licensee determined that the inadequate preload was due to spring pack relaxation over time. This condition reduced the previously established output thrust of the actuator, potentially causing an incomplete stroke of the valve.

The licensee initiated a nonconformance report (NCR DCZ-90-EM-N014) on March 27, 1990 to address the generic aspects of the problem. As part of the NCR, the licensee prepared a Justification for Continued Operation (JCO 90-5) for the similar potentially affected valves in Unit 1, which, at that time was operating at 100% power.



The inspector examined the licensee's preliminary findings, their ongoing investigation into the problem, and their basis for the JCO for Unit 1. This review also included previous maintenance history, work observation, procedures for maintaining valve actuator performance resulting from IEB 85-03, procedures for valve performance troubleshooting and testing, and programs for incorporation of industry experience and vendor communications.

A. Background

Certain motor operated valves are actuated by Limatorque motor operators which incorporate a belleville washer spring pack in conjunction with a torque switch to limit valve stem thrust. The torque switch is adjusted to allow sufficient thrust to operate the valve under design basis conditions but limit the thrust to preclude excessive wear or damage to the valve or actuator.

The spring pack consists of an assembly of belleville washers which is preloaded in compression by the manufacturer and not normally adjusted in the field. In operation, as the actuator develops thrust, the spring pack further compresses after the preload is exceeded. The additional compression of the spring pack actuates the torque switch to interrupt the motor control circuit to stop the actuator. The total stem thrust which results during operation is determined by the combination of the initial spring pack preload and the subsequent spring pack compression during operation. Reduction of the spring pack preload over time would allow the torque switch to actuate at a lower valve stem thrust than initially established when the torque switch setting was adjusted. Under design basis maximum differential pressure conditions, this could cause the valve to "torque-out" early, resulting in incomplete valve travel.

B. Licensee Findings

During the 1990 Unit 2 refueling outage, the licensee overhauled approximately 33 of 100 Limatorque actuators (Approximately 80 are in safety-related applications).

On March 17, 1990 a loss of preload in the spring pack for valve SI-2-8802B was observed by electrical maintenance technicians during routine overhaul of the SMB-0 Limatorque actuator. The technicians found the belleville washer assembly to be loose and rattle when handled. On March 18, an identical condition was found on valve SI-2-8835. On March 21, the SMB-0 actuator for the third valve, SI-2-8802A, was found to deliver only 78% of its required thrust. In each case, there appeared to be a gross dimensional change in the free-standing stack height of the belleville washer assembly indicating that individual washers had undergone a permanent set while under long-term compression. In two cases, full adjustment of the preloading nut was unable to achieve any preload on the washer assembly.

While procuring replacement spring packs from the warehouse, the electrical maintenance foreman noticed that all three of the valves



had the same part number for the replacement spring packs. Since the problem appeared to be associated with a specific spring pack model number, Electrical Maintenance initiated a nonconformance report (NCR DC2-90-EM-N014) to evaluate the problem.

During evaluation of the NCR, the licensee determined that the problem affected only SMB-0 model Limitorque actuators with the originally installed old style spring pack (model 60-600-0017). Their conclusion was based on (1) three recent occurrences on SMB-0 actuators with 60-600-0017 spring packs, and (2) two reports on Industry Nuclear Network indicating similar problems on SMB-0 actuators at other utilities. The licensee identified nine safety-related applications of SMB-0 actuators in each unit. Corrective actions were taken to replace the spring packs in all affected valves in Unit 2 during the refueling outage. Of the nine affected valves in Unit 1, the licensee determined that four were recently load cell tested and did not require any adjustment of the torque switch setting. These four were, therefore, considered to be unaffected by the problem. Of the remaining five valves, two had required an increase in the torque switch setting, and the other three had not been load cell tested. The licensee evaluated continued operation of Unit 1 with potentially relaxed spring packs in these five valves under JCO 90-5. Continued operation was determined to be acceptable until the next refueling outage (1991) with compensatory actions established.

C. Scope of JCO

The inspector reviewed NCR DC2-90-EM-N014 and found that the licensee appeared to be taking adequate initial corrective actions for the nine SMB-0 actuators in Unit 2. This corrective action consisted of replacement of the suspect old model spring packs (Limitorque part no. 60-600-0017-1) with a newer style (replacement part no. 0501-184) which has not demonstrated the relaxation problem.

The inspector reviewed JCO-90-5 for Unit 1 and found that the licensee appeared to adequately evaluate the interim operability of the nine SMB-0 valves until their spring packs would be replaced in 1991. In each case, sufficient time was available to take compensatory actions should the valve fail to completely perform its design basis function. The inspector reviewed the compensatory actions established by the licensee and found them to be adequate.

The inspector observed, however, that the scope of the JCO did not include all applications of Limitorque actuators with Belleville washer spring packs. The inspector noted that the JCO stated, "There is no indication or experience that this type of relaxation with any other spring pack supplied by Limitorque."

In contrast to the licensee determination, the inspector found the following indications of potential spring pack relaxation affecting Limitorque actuators other than the model SMB-0:



1. In one of the Nuclear Network reports (Duke Power, 8/87) cited by the licensee in the JCO, spring pack relaxation was reported in a model SMB-1 actuator.
2. In Limatorque Maintenance Update dated 8/88, the vendor referenced having received reports of spring pack relaxation on different size SMB actuators. Limatorque recommended attention be paid to valves left in the full closed position or backseated.
3. In review of 49 licensee work orders replacing spring packs at DCPD, the inspector found four cases on SMB-00 model actuators in which the spring packs had been observed to have been collapsed.
4. In review of 239 reports of Limatorque spring problems entered in the Nuclear Plant Reliability Data System (NPRDS), the inspector found seven SMB-0, seven SMB-00, eight SMB-000, two SMB-1, one SMB-2, two SMB-3 and one SMB-4 actuators described as exhibiting potential spring pack relaxation.

Accordingly, the inspector considered that the licensee did not appear to have identified an adequate technical basis for limiting the scope of the problem to just nine valves in each Unit. While the majority of reported problems identified by the licensee and industry focused suspicion on the SMB-0 model actuator used on these valves, the inspector found that instances of spring pack relaxation had been reported on other model actuators, as well. No compensatory attention was identified in the JCO for other model actuators in either Unit.

Furthermore, four of the nine SMB-0 actuators in Unit 1 with the suspect spring packs were not covered within the scope of the JCO based on the licensee's determination that they did not exhibit evidence of spring pack relaxation. However, no compensatory attention was identified for these actuators.

A review conducted by the licensee of the maintenance records for a 10% sample of other MOVs with non-SMB-0 Limatorque actuators was inconclusive in determining if the problem was evidenced in the maintenance history of other style operators. The criteria which the licensee used as evidence of spring pack relaxation was a substantial increase in the torque switch setting to achieve the required valve stem thrust. Since as-found load cell/current signatures were not taken during preventative or corrective maintenance, the maintenance history did not contain sufficient reliable data to determine if spring pack relaxation had been experienced.

The licensee committed to review the scope of the JCO and the need for interim enhanced surveillance until the root cause is determined. The licensee has contacted the vendor (Limatorque) regarding the problem, and Limatorque is pursuing additional review and testing to determine Part 21 applicability. In addition,



licensee in-house engineering examination of relaxed spring packs will supplement the vendor review in determining root cause. Based on prior NRC awareness of the problem (Inspection Report 99900100/87-01, dated 8/12/87), the licensee did not consider the problem to be Part 21 reportable. The licensee committed to submit a voluntary licensee event report (LER) to inform industry of their findings.

The licensee's corrective actions for the spring pack relaxation will be followed up during further review of actions accomplished in resolution of NCR-DC2-90-EM-N014. (Open Item: 50-275/90-16-01).

After the inspection period, the vendor issued Limatorque Maintenance Update 90-1, dated May 1990, which addressed spring pack relaxation. The Maintenance Update recommended that personnel be advised that spring pack relaxation has occurred on actuator sizes 000 through 3 with type SMB, SB and SBD actuators.

#### D. Engineering Involvement

The inspector found that previous occurrences of spring pack relaxation had been encountered by the licensee. In four cases in 11/88 (A/R 012573, 0126109, 0126108, 0126110), spring packs had been replaced following observations by maintenance personnel that the spring packs appeared to be loose or that the belleville washers appeared to be collapsed. In another case in 11/88 (Work Order C0038771), potential cracks in belleville washers were observed. In each case, the condition had been considered to involve degradation resulting from normal wear and, as a result, replacement of the component was performed as a routine maintenance activity. Apparently, Engineering was not made aware of the situations and corrective actions.

The inspector found that there had been no quality evaluation or quality evaluation report initiated to evaluate the degradation observed in any of these previous instances.

Licensee procedure NPAP C-12, Rev.19, Identification and Resolution of Problems and Non-Conformances, required a quality evaluation be performed for situations in which there is a question regarding whether an item will perform its intended safety function.

This is an apparent violation (50-275/90-16-02).

In discussions with cognizant licensee quality control personnel, the inspector found that a quality evaluation was not deemed necessary because the condition was not considered to affect the operability of the valve to perform its safety function based on load cell testing. This determination was, apparently, based on an incomplete and inaccurate technical understanding of the load cell testing which had been performed. The load cell testing had been performed at the time of the last overhaul of the actuator. No as-found condition was tested to support the operability evaluation. As a result, the technical review of this situation was inadequate.



The inspector found that the licensee did not adequately evaluate the effect of the degradation on the design bases operability of the component. Loss of preload due to spring pack relaxation could cause the valve to fail to perform its intended safety function. The inspector found that inadequate engineering involvement appeared to have resulted in the failure to recognize the potential consequences of the previous cases of spring pack relaxation.

An engineering representative (NECS) stated to the inspector that they were not aware of the extent of previous instances of spring pack relaxation which plant maintenance had been dealing with on a routine basis. This admission indicates a need to improve the day-to-day communication and involvement between NECS engineering and plant maintenance.

In discussion with licensee engineering representatives regarding the recent Unit 2 cases, the inspector found that the licensee had not evaluated the effect of the loss of preload due to spring pack relaxation on the design basis operability of the valves. Due to the lack of any as-found testing, there had been no quantitative determination as to whether the actuator would be able to meet design performance requirements.

The licensee committed to evaluate the observed spring pack degradation in Unit 2 to determine if sufficient margin existed to enable the valves to meet their design basis performance requirements.

The licensee had recently established an engineering project to upgrade their program for MOV actuators in response to Generic Letter 89-10. These enhancements are to include use of state-of-the-art diagnostic signature analysis and trending techniques in addition to a new predictive maintenance approach.

#### E. Vendor Information

The inspector found that the licensee had been unaware of a Limitorque Maintenance Update, dated August, 1988, which alerted the industry to the potential for spring pack relaxation. When the bulletin was brought to their attention by the NRC Resident, the licensee contacted the vendor and obtained a copy of the information.

According to the licensee, they had no record of having received the vendor bulletin. However, after the inspection period ended, the licensee determined that the 8/88 Maintenance Update had been received by individuals in the plant.

The inspector reviewed the vendor interface program which the licensee had established to control vendor information.

IEB 85-03, Action Item d, required the licensee to consider applicable industry recommendations in their preparation of procedures to maintain correct switch settings throughout the life



of the plant. The inspector found that the licensee's two part program consisted of a vendor manual update project and an ongoing program for processing unsolicited vendor information.

The vendor manual review program (ICE-6, Rev. 0; 1/19/90) consisted of a major review effort underway to update all vendor technical manuals for equipment in safety related applications by 1991. The inspector found that this program incorporated direct solicitation of information from the vendors to update technical manuals.

The ongoing program for processing unsolicited vendor information received by the licensee (NPAP-E-14/NPG-5.13, R. 2, 10/6/88) established the licensee's controls over the receipt, distribution, review and documentation of technical communications received from vendors. The inspector found that this procedure did not provide for periodic contact with vendors to verify that licensee documents contained all pertinent information issued by the vendor. In addition, the inspector found that while the procedure identified a single-point contact to initiate the processing of vendor information, it did not establish that individual as the appropriate addressee to formally receive information from vendors. Rather, according to the licensee, vendor information was personally addressed to individuals within the plant who would subsequently forward the information to the designated contact for processing. The inspector considered that without periodic contact with vendors and the lack of a clear identification of the appropriate addressee for vendor information, a situation could result in vendor information being received in the plant but not processed within the licensee program.

As an example, the inspector found that vendor instructions supplied with a replacement Limatorque actuator spring pack were incorporated into the licensee's procedures to adjust the preload of the spring pack. The inspector found that these instructions differed from the technical manual instructions. However, the replacement instructions were considered by the maintenance personnel to be authorized supplemental information without the benefit of formal engineering technical evaluation and approval. The inspector also found that the instruction had not been processed as vendor information under the licensee's program.

In discussions with licensee electrical maintenance personnel, the inspector found that two of the vendor maintenance updates (88-2 and 89-1) had been received by plant personnel and forwarded to electrical maintenance. However, the inspector found that no Limatorque Maintenance Updates had been controlled under the licensee's established program.

This failure to follow procedures is an apparent violation (50-275/90-16-03).

The inspector found that the lack of positive feedback was a weakness within the licensee's programs for the control of vendor information. The program did not contain provisions to periodically



contact the vendor to confirm the receipt of all applicable information sent by the vendor or assure adequate technical evaluation of the information.

F. MOV Stroke Timing

The inspector reviewed licensee procedure STP-V3M4 which the licensee established to perform ASME Section XI testing of valves. The inspector found that the licensee performed stroke timing of all power operated valves by using a switch-to-light technique (i.e., the interval of time measured from control switch actuation to light indication of valve position). The inspector observed that the licensee's technique did not account for the inaccurate closed position light indication which occurs on Limitorque actuators using a common limit switch for both closed light position indication and torque switch bypass control. As a result of this dual function design feature, the valve is still open by as much as 15% when the closed position is indicated by the position lights. The valve continues to travel closed until the torque switch actuates to complete the cycle.

The inspector found that the licensee's technique for stroke timing did not measure the full stroke time of the valve. The inspector reviewed the acceptance criteria in the licensee procedure and found that it did not account for the difference between the measured stroke time and the required full stroke time.

Inaccurate valve position indication has been highlighted in NRC Information Notice (IN 86-29), Effects of Changing Valve Motor-Operator Switch Settings, dated April 25, 1986, and INPO Significant Operating Experience Report, SOER 86-2, "Inaccurate Closed Position Indication on Motor Operated Valves." In the event cited, an excessive cooldown resulted when a MOV showing closed indication was actually greater than ten percent open. Licensee Engineering had reviewed the subject notices on January 12, 1988 and had concluded that existing surveillance testing was adequate.

The licensee acknowledged the deficiency in their procedure and committed to review all affected valve stroke times to insure compliance with Technical Specification and Code requirements.

This item will remain unresolved pending completion of the licensee review (50-275/90-16-04).

G. Maintenance of MOV Switch Settings

IE Bulletin 85-03, Motor Operated Valve Common Mode Failures During Plant Transients Due to Improper Switch Settings, Action Item d., required the licensee to establish procedures to ensure that correct switch settings are determined and maintained throughout the life of the plant. These procedures should include provisions to monitor valve performance to ensure the switch settings are correct. The inspector found that the licensee's program consisted of periodic (18 mo.) preventative maintenance (MPE-53.10A) and (4 1/2 yr.)



overhaul of safety related valve actuators (MPE-53.10K, typical). The inspector reviewed the licensee's program and identified the following weaknesses.

1. The inspector found that there was no specific monitoring of valve performance to ensure the switch settings remained correct. As-found stem thrust was not determined prior to preventative maintenance or overhaul. There was no meaningful data trended for actuator performance. Current signatures were not compared with previous traces. There was no acceptance criteria, procedures or training for current signature analysis. The load cell was simply used to initially adjust the closed torque switch setting to achieve a valve stem thrust within a specified window. Load cell data was not trended to determine degradation. There appeared to be a programmatic weakness in monitoring valve performance to ensure switch settings are correct.
2. The licensee's technique of using a load cell to set the closed torque switch causes maximum closing thrust to be developed at mid-stroke of the valve rather than at the end of stroke. Degraded stem thread conditions resulting from normal closing action may reduce the actual stem thrust developed. This is not accounted for, nor detected, using the licensee's technique.
3. There was no diagnostic use of the load cell/current signatures in troubleshooting equipment failures.
4. The inspector found a conflict between the licensee maintenance procedure and the Limatorque technical manual regarding spring pack preloading. Electrical Maintenance Procedure, MP-E-53.10K, R. 1, Valve Operator Maintenance and Disassembly, Paragraph 7.4.21, specified setting the preload by adjusting the gap between a thrust washer and torque limiter sleeve in the spring pack assembly to that existing before disassembly. The Limatorque technical manual specified preloading the spring pack by reassembling the stop nut with the same number of turns as were used to remove it. The inspector found that, while the two techniques were technically equivalent, there appeared to be no formal control of the technical reference material for the licensee's procedure.
5. The inspector reviewed the differential pressure (dP) testing performed by the licensee in response to IEB 85-03 and found that only limited dP testing had been performed. Of the 54 valves identified by the licensee within the scope of IEB 85-03, only 22 (41%) valves had been tested at approximately maximum dP conditions, 18 (33%) had been tested at reduced dP conditions ranging from 40% to 90% maximum dP, and 14 (26%) had no dP testing. The inspector found no extrapolation to maximum dP conditions. The inspector found no degraded voltage condition testing. Testing was performed only with the actuator in an overhauled condition, i.e., no as-found



condition testing was performed or margin evaluated for wear or aging effects.

6. The inspector noted that the as-left torque switch settings reported in the licensee response to IEB 85-03 for 50% of the valve actuators were less than that currently specified as the minimum in licensee procedure MPE-53.10B. Licensee maintenance engineering personnel indicated that the required torque switch settings have been increased since the IEB 85-03 testing to more conservatively account for valve packing friction. They further indicated that the as-left torque switch settings reported for IEB 85-03 were actually minimum design values and not actual as-left measurements. The inspector noted that in some cases, the required torque switch setting had been increased by as much as 64% from the as-left condition following IEB 85-03 testing. Licensee maintenance engineering agreed to review the adjustments performed on the IEB 85-03 valves to insure they meet the current minimum required settings.
7. The programmatic use of a 10% torque bypass switch setting appeared to be only marginally adequate without confirmatory diagnostics and maximum differential pressure signatures (20-25% is more typical of industry experience). Furthermore, the switch setting was specified based on observed valve stem travel or handwheel turns after backlash takeup. It was not based on actual valve disc movement.

The inspector discussed his concerns with licensee management regarding the apparent weaknesses in the licensee's program. The licensee committed to address the inspectors concerns within the scope of their on-going program upgrade in response to Generic Letter 89-10.

### 3. Exit Meeting (30703)

The inspector met with licensee representatives (noted in paragraph 1) at various times during the report period and formally on April 20 and May 25, 1990. The scope and findings of the inspection activities described in this report were summarized at the meeting. Licensee representatives acknowledged the inspector's findings at that time.

At the exit meeting, the inspector expressed his concerns regarding the weaknesses identified in the licensee's programs and encouraged the timely enhancements which were in progress in response to Generic Letter 89-10. Licensee management acknowledged the inspector's concerns and agreed to address the programmatic weaknesses within the scope of their on-going program upgrade. Subsequent licensee actions will be reviewed as part of the followup to the Generic Letter 89-10.

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