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ACCESSION NBR:8804200521 DOC.DATE: 88/04/14 NOTARIZED: NO DOCKET #
FACIL:50-275 Diablo Canyon Nuclear Power Plant, Unit 1, Pacific Ga 05000275
50-323 Diablo Canyon Nuclear Power Plant, Unit 2, Pacific Ga 05000323
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SUBJECT: Forwards addl info to suppl util response to IE Bulletin 85-003 re motor operated valve common mode failures.

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James D. Shiffer
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April 14, 1988

PG&E Letter No. DCL-88-087

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Re: Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Additional Information for IE Bulletin 85-03

Gentlemen:

As requested by the NRC Staff in its March 15, 1988, letter, enclosed is the additional information which supplements PG&E's previous responses to IE Bulletin 85-03, "Motor-Operated Valve Common Mode Failures During Plant Transients Due to Improper Switch Settings."

Kindly acknowledge receipt of this material on the enclosed copy of this letter and return it in the enclosed addressed envelope.

Sincerely,

W. B. Kaefer /for

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Enclosure

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ENCLOSURE

ADDITIONAL INFORMATION FOR IE BULLETIN NO. 85-03

NRC Item 1

Has water hammer due to valve closure been considered in the determination of pressure differentials? If not, explain.

PG&E Response

PG&E's selection of maximum pressure differentials presented in the responses to IEB 85-03 relied upon pump discharge capabilities and piping relief valve settings in accordance with a generic study performed by the Westinghouse Owners Group, (WOG-86-168). Water hammer due to valve closure was not considered in the determination of the pressure differentials. The normal closure or opening of a motor-operated valve (MOV) would not result in significant water hammer because their closure/opening times are orders of magnitudes longer than the sonic transit times of the system's lines.

As noted in Revision 1 of NUREG-0993, elimination of water hammer events is not feasible due to design and operational considerations. However, as noted in the NUREG, the most common cause of water hammer is due to line voiding.

PG&E identified the following conditions that minimize the possibility of line voiding in the plant systems examined in response to the Bulletin:

- Fluid system temperature is less than 200°F, and
- The piping is filled - no voids.

In addition to line voiding, PG&E has noted the dynamic action associated with the MOV stroke as an additional cause of water hammer in an isolated flowpath. To address dynamic action PG&E has reviewed MOV closures to ensure a closure would not result in complete isolation of a pump suction or discharge flow path.

As described above, water hammer is considered credible if any one of the following conditions is satisfied: (1) MOV closure would result in complete isolation of a pump suction or discharge flow path, (2) Fluid system temperature is greater than 200°F, or (3) Piping is not filled. The following evaluation explains why the auxiliary feedwater (AFW) system and emergency core cooling system (ECCS) valve closures would not result in a water hammer event at DCPP.

The AFW and ECCS can be grouped into the following seven flow paths:

(1) High Head Injection Suction (ECCS)
(2) High Head Injection Discharge (ECCS)
(3) Medium Head Injection Suction (ECCS)
(4) Medium Head Injection Discharge (ECCS)
(5) Auxiliary Feedwater Pump Suction (AFW)
(6) Auxiliary Feedwater Pump Discharge (AFW)
(7) Turbine Driven Auxiliary Feedwater Pump Steam Supply (AFW)

These seven flow paths are evaluated below using the three conditions for which a water hammer occurrence is considered credible. In summary a water hammer occurrence for the seven flow paths noted above is not likely.

1. Water Hammer in High Head Injection Suction Flow path

Water hammer due to closure of MOVs in the centrifugal charging pump suction from the refueling water storage tank (RWST) is not likely because the RWST suction valves (8805A and 8805B) are in parallel. Therefore, a single valve closing would not isolate the suction flow.

The series MOVs on the charging pump suction (LCV 112B and LCV 112C) from the volume control tank are interlocked so that they will not close unless the RWST suction valves are in the full open condition. Thus, closure of valves LCV 112B or LCV 112C would not result in an isolation of pump suction flow.

Temperatures in this portion of the system are normally below 120°F since the RWST temperature is near ambient outside temperature and the volume control tank will activate a control room annunciator upon reaching a temperature of 116°F.

The centrifugal charging pump suction from the volume control tank is in service during normal operation and thus would not be voided. Automatic realignment of the system to the RWST suction is accomplished with the centrifugal charging pumps in operation, thus water hammer due to voids in the piping is not likely.

2. Water Hammer in High Head Injection Discharge Flow path

The discharge of the centrifugal charging pumps is normally directed to three flow paths:

(1) The regenerative heat exchanger (Valves 8107 and 8108) - Normal charging
(2) The reactor coolant pumps seal injection,
(3) Centrifugal charging pump recirculation flow (Valves 8105 and 8106)

The automatic realignment of the centrifugal charging pump discharge is accomplished upon receipt of the safeguards actuation signal. In

the coolant injection phase of post-LOCA ECCS operation, the centrifugal charging pump discharge is directed to two flow paths:

(1) Discharge through the boron injection tank (Valves 8801A, 8801B, 8803A, and 8803B)
(2) Centrifugal charging pump recirculation flow (Valves 8105 and 8106)

Water hammer is not expected during this automatic realignment. Diablo Canyon Power Plant (DCPP) has experienced safeguards actuations with no water hammer. The recirculation flow path is available throughout the automatic transfer.

Throughout the remaining post-accident scenario, none of the boron injection tank or normal charging MOVs (8801A, 8801B, 8803A, 8803B, 8107, 8108) are repositioned.

The temperature of the centrifugal charging pump discharge is slightly greater than the suction temperature which is well below 200°F, as previously explained.

To assure there are no ECCS piping voids, Technical Specification Surveillance Requirement 4.5.2.b.1 requires that the ECCS piping be verified full of water by venting the ECCS pump casings and accessible discharge piping high points once per month.

3. Water Hammer in Medium Head Injection Suction Flow path

The safety injection (medium head) suction flow path is normally aligned to the RWST. The common suction valve (8976) is de-energized in its open position and verified open once per 12 hours per Technical Specification Surveillance Requirement 4.5.2.a.

The pump suction isolation valves (8923A and 8923B) are normally open. These valves are verified open once each shift. In addition, monthly ECCS pump testing and operations practices ensure proper suction valve alignment. The suction valve is not manipulated with the medium head pump in operation.

The fluid temperature of the medium head suction piping is equal to the RWST temperature, which is near ambient outside temperature.

The suction piping is verified full of water monthly per Technical Specification Surveillance Requirement 4.5.2.b. Therefore, water hammer is not likely.

4. Water Hammer in Medium Head Injection Discharge Flow path

The safety injection pumps recirculation valves (8974 A and 8974 B) are maintained open throughout the post-LOCA injection phase. These valves have series contactor switches to prevent inadvertant operation. Technical Specification Surveillance Requirement 4.5.2.a

requires the valves be verified in the open position with power to the operators removed once per 12 hours. Closing any of the following MOVs: 8821A, 8821B, and 8835 would isolate the pump injection flow path. However, the recirculation flow path would remain, ensuring that a discharge flow path is always available. Therefore, water hammer is not likely.

The fluid temperature in the safety injection portion of the ECCS is equal to the RWST temperature which is near ambient outside temperature.

The discharge piping is verified full of water once per month per Technical Specification Surveillance Requirement 4.5.2.b.

5. Water Hammer in Auxiliary Feedwater Suction Flow Path

The auxiliary feedwater pump suction flow path is manually aligned to the condensate storage tank. No MOVs are used in this piping section. The alignment is verified monthly per Technical Specification Surveillance Requirement 4.7.1.2.1.a.3.

The condensate storage tank water temperature is near ambient outside temperature, which is considerably less than 200°F.

The pumps are tested monthly per Technical Specification Surveillance Requirement 4.7.1.2.1.a. This test verifies the suction line is filled with water. Therefore, water hammer is not likely.

6. Water Hammer in Auxiliary Feedwater Pump Discharge Flow path

The auxiliary feedwater pump recirculation flow path is manually aligned to return to the condensate storage tank. No MOVs are used in this piping section. The alignment is verified monthly as part of Technical Specification Surveillance Requirement 4.7.1.2.1.a.3.

The turbine driven auxiliary feedwater pump discharge to the steam generators valves (LCV 106, 107, 108, and 109) is normally full open. The four MOVs are in parallel, so closing of any one MOV will not isolate discharge flow to the remaining steam generators. In addition, the recirculation flow path is available.

The fluid system temperature is normally equal to the temperature of the condensate storage tank. However, the discharge fluid temperature could exceed 200°F if back leakage from the main feedlines occurred. To mitigate this, DCPP has an auxiliary feedwater back leakage detector system. This system annunciates in the control room should any discharge piping temperature detector reading reach 200°F. In addition, there is auxiliary feedwater pump annunciation should pump casing temperature reach 200°F. This information assures that corrective action can be taken when the discharge fluid temperature reaches 200°F.

The auxiliary feedwater pumps are tested monthly per Technical Specification Surveillance Requirement 4.7.1.2.1.a. Part of this testing establishes flow to the steam generators which assures that the discharge piping is not voided.

7. Water Hammer in Turbine-Driven Auxiliary Feedwater Pump Steam Supply

The steam supply valves from the individual steam generators to the turbine-driven auxiliary feedwater (TDAFW) pump turbine (FCV 37 and FCV 38) are normally open. If either of these MOVs are closed, the TDAFW pump annunciator will activate in the control room.

The steam admission valve (FCV 95) is normally closed and opens to start the TDAFW pump.

DCPP has experienced water hammer events with this steam supply piping. The principal cause was determined to be improper steam trap alignment. Following these events, PG&E established an engineering task force to address the problem and provide corrective actions to optimize the piping system. These corrective actions included modification of piping supports, steam trap relocation, and improvement in operating practices concerning verification of steam trap valve alignment. These actions have adequately addressed the water hammer concerns.

NRC Item 2

Unlisted MOVs FCV-436 and FCV-437 are shown normally closed in suction lines from the essential service water system to the AFW pumps, in the lower left corner of Drawing 102003, Revision 31. Similar valves HV 30 and HV 33 are identified on Page 27 of the WOG Report of March 1986. Revise the response of 09-02-86 to include these valves, or justify their exclusion. As required by Action Item a of the bulletin, assume inadvertent equipment operations.

PG&E Response

FCV 436 and FCV 437 were evaluated by PG&E and were not included in PG&E's September 2, 1986 response for the reasons noted below.

FCV 436 is the raw water supply isolation to turbine driven auxiliary feedwater pump No. 1. FCV 437 is the raw water supply isolation to motor driven auxiliary feedwater pumps No. 2 and No. 3. These valves are 8 inch Fisher butterfly valves. The valves are equipped with Rotork model 6A/1RP operators.

Electrical maintenance procedure (MP) E-53.11B addresses Rotork limit and torque switch setting and adjustments. The Rotork operator open and close torque switches are adjusted to "max" position. This is common practice for butterfly valves, as the valve opening and closing are controlled by limit switches. Thus, improper torque switch setting is not a concern. Electrical MP E-53.11B and post-maintenance testing require electrical stroke testing of the valve as part of the verification of valve operability. The concerns of the Bulletin are therefore not applicable to FCV 436 and FCV 437.

NRC Item 3

The proposed program for action items b, c and d of the bulletin is incomplete. Provide the following details as a minimum:

(a) commitment to a training program for setting switches and maintaining valve operators,

(b) commitment to justify continued operation of (SIC) a valve determined to be inoperable, and

(c) consideration of applicable industry recommendations in the preparation of procedures to ensure maintenance of switch settings.

PG&E Response

(a) Training Program for Switch Settings

NPAP B-750, "Maintenance Personnel Training", defines the maintenance training program and delineates the requirements by which the program is administered and conducted. A brief description of the program is presented:

(1) Initial Training Program - The goal of this program is to ensure that maintenance department personnel possess the physical attributes, knowledge and skills necessary to perform assigned duties in a manner that promotes safe and reliable plant operations. The content of the program was determined by analyzing the various maintenance jobs in order to identify the various tasks performed.

The initial mechanical maintenance training program includes segments on motor operated valve operators. The initial electrical training program includes segments on Limitorque Type SMB, SMC, and HBC motor operators, electric motors, and troubleshooting electrical equipment.

(2) Qualification - A qualified mechanical or electrical journeyman is present at all work. Qualification of these personnel is based on successful completion and demonstrated competence in performance of the related job tasks. The related job tasks for electrical maintenance of Limitorque operators, for example, include adjustment of settings, inspection and cleaning, testing, replacement of torque switches, inspection and cleaning of limit switches, lubrication, and limit switch replacement. These job tasks are listed on a qualification record. Qualification is obtained by certification that the journeyman can perform the related job tasks. The certification involves approval

by a foreman and final qualification approval by the General Foreman.

(3) Continuing Training Program - The goal of continuing training is to assure that maintenance department personnel are knowledgeable on applicable plant physical and procedural modifications, changes to regulatory requirements, and lessons learned from industry and in-house operating experience. The principle forum for this continuing training is the quarterly seminar. These seminars disseminate information to maintenance department personnel in a manner that is conducive to open discussion and interaction. A partial listing of the type of information covered includes: industry experiences (INPO SOERs, NRC Bulletins and Notices, LERs), procedure changes, maintenance information notices, vendor recommendations and goals of the maintenance department.

DCPP has a training program in place that provides for setting Limitorque torque and limit switches and maintenance of valve operators. No further action is required.

(b) Justification for Continued Operation if a Valve is Determined to be Inoperable

Motor Operated Valves included in the scope of the Bulletin response are included in the DCPP Technical Specifications. Therefore, an inoperable MOV will result in entrance to the applicable DCPP Technical Specification Action Statement. The MOV will either be returned to operable status within the allowed time or the Technical Specification Action Statement will be followed. Thus, a Justification for Continued Operation for an inoperable MOV are consistent with that allowed by the DCPP Technical Specifications.

(c) Consideration of Industry Recommendations in the Preparation of Switch Setting Procedures

As a result of Bulletin 85-03, the methods for selecting all switch settings (i.e., torque, torque bypass, position, overload) were reevaluated and the associated maintenance procedures were upgraded. Since the initiation of this work, several other industry events have occurred involving problems with MOV switch setting. These have prompted additional examinations of the existing program and associated procedures.

NRC Information Notice 86-29, "Effects of Changing Valve Motor-Operator Switch Settings," and INPO significant operating experience report 86-2, "Inaccurate Closed Position Indication on MOVs," discuss an event caused by inaccurate valve position indication resulting from changing of switch settings. In response to these notices, PG&E reexamined DCPP's MOV switch setting program

and associated post maintenance testing requirements and determined that no changes were necessary. Another event, documented in INPO Significant Event Report (SER) 38-82, dated December 21, 1987, concerned MOV inoperability due to unbalanced Limitorque torque switches. The applicability of this event was investigated and the appropriate maintenance procedure revised.

PG&E's existing operating experience review program, which provides for the receipt, review, dissemination, disposition, tracking and retention of operating experience data, ensures that the latest industry events are factored into DCPP's MOV operating and maintenance practices. In addition, PG&E's vendor update program ensures information received directly from suppliers of plant equipment is properly incorporated into plant procedures and programs. Together these programs ensure that applicable industry recommendations are continually considered in the preparation/ revision of maintenance procedures for switch setting. Documentation reguarding specific implementation of industry recommendations are available in PG&E files.