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February 18, 1994

U.S. Nuclear Regulatory Commission
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Gentlemen: ULNRC-02964

DOCKET NO. 50-483
CALLAWAY PLANT
SAFETY-RELATED MOTOR-OPERATED
VALVE TESTING AND SURVEILLANCE

Reference: NRC Generic Letter No. 89-10, dated June 28, 1989

NRC Generic Letter No. 89-10 requires licensees to advise the NRC in writing when the schedule and recommendations as detailed in the generic letter have been completed. Pursuant to GL 89-10 Item M, UE has completed all the actions as required by the first paragraph of Item I. The actions taken to comply with GL 89-10 are contained in the attached closure document.

This closure document was discussed during the NRC audit of Callaway's MOV Program conducted January 1 through 10 and January 24 through 28, 1994. Please note that the attachment represents Callaway's MOV Program to date. Any future changes will be handled under the provisions of 10CFR50.59.

If you have any questions concerning this letter, please contact us.

Very truly yours,

Donald F. Schnell

Donald F. Schnell

WEK/plh
Attachment

A064

STATE OF MISSOURI)
) SS
COUNTY OF CALLAWAY)

Donald F. Schnell, of lawful age, being first duly sworn upon oath says that he is Senior Vice President-Nuclear and an officer of Union Electric Company; that he has read the foregoing document and knows the content thereof; that he has executed the same for and on behalf of said company with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By Donald F. Schnell
Donald F. Schnell
Senior Vice President
Nuclear

SUBSCRIBED and sworn to before me this 18th day of February, 1994.

Lana R. Jacobs

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Generic Letter 89-10 Close-Out

Union Electric Company
Callaway Plant
18 February 1994

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Chapter 1: Executive Summary

This document describes Callaway Plant's closure of Nuclear Regulatory Commission (NRC) Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance." This will be accomplished by defining Callaway's actions to date and describing the program implemented for on-going testing and surveillance of safety-related motor operated valves (MOV's). This program ensures MOV operability under design-basis differential pressure and flow conditions.

ISSUE

On June 9, 1985, a loss-of-feedwater event occurred at the Davis-Besse nuclear plant. During this event, plant operators were unable to electrically reopen key motor operated valves from the control room. It was later found that the MOVs failed to open because inadequate torque bypass switch set points did not bypass the torque switch for a sufficiently long time to allow the actuator to open the valve against the existing high differential pressure.[1] This significant industry event prompted the NRC to issue Bulletin 85-03 to require establishment of programs to ensure proper switch settings on certain motor operated valves. Results from Bulletin 85-03 programs and other industry events led to the NRC issuing Generic Letter 89-10 which extended the scope of required programs to all safety related position-changeable motor operated valves.

RESPONSE

Callaway MOV testing began before issuance of Bulletin 85-03. Callaway's pre-operational test program included testing of all safety related systems to assure functionality including the ability of MOV's to respond to design basis demands. For example, full flow tests were conducted to verify Residual Heat Removal System suction transfer from the Reactor Water Storage Tank to the containment sumps. Successful completion of the pre-operational test program was required to attain licensed power operation. To support power operation, maintenance requirements were established for safety related MOV's on an 18 month inspection frequency. When Bulletin 85-03 was

[1]Supplement 1 to Generic Letter 89-10: "Results of the Public Workshops," June 1990.

issued, Callaway conducted differential pressure (DP) tests using the maximum practical attainable flow on 32 of the 34 MOV's within the scope of the bulletin. This significant amount of early DP testing placed Callaway in a favorable position to address the broader scope of Generic Letter 89-10.

Union Electric has aggressively pursued resolution of Generic Letter 89-10. This effort has required significant resources from virtually every department within the nuclear division. In addition, Union Electric has been active in and supportive of industry initiatives to resolve generic issues related to MOV programs. The culmination of this effort is that Union Electric has completed all design revie[illegible] MOV's, all practical DP testing, and all switch set points have been verified correct for the required MOV's. When DP testing was not practical, other means to verify operability have been utilized as justified. The scope of the program includes 150 MOV's of which 103 could be practically DP tested.

All MOV's are being set-up with a minimum target margin[2] of 25% in excess of requirements, whenever possible. Those valves which can not be shown to have the target margin will have periodic verification done by re-DP testing whenever practical. MOV's not practical to DP test have either 25% margin or have modifications approved to achieve this margin.

Administrative programs have been firmly established and refined and personnel are trained to ensure that the program maintains the operability of Callaway Plant MOV's throughout the life of the plant.

The NRC conducted the Callaway Plant Phase II inspection for Generic Letter 89-10 in January of 1994. The results of this inspection are summarized in Chapter 8 of this document, however, only one Unresolved Issue was identified which was related to thermal binding and pressure locking of MOV's. This issue is generic to the industry and will be addressed as described in Chapter 3. No violations and no operability concerns were identified. Thus, with the program described in this document, Callaway Plant is ready for closure of the Generic Letter.

[2]Margin is defined as the difference between the required thrust (adjusted for errors and rate of loading) and the measured available thrust divided by the required thrust.

Chapter 2: The Callaway Plant MOV Program

The Callaway Plant MOV Program consists of administrative procedures, an organization to implement the program, proven advanced diagnostic test equipment, and training to establish and maintain proficiency in the implementation.

Callaway has based its Motor Operated Valve (MOV) program on actual test data whenever possible. This philosophy was adopted earlier in response to I.E. Bulletin 85-03, "Motor-Operated Valve Common Mode Failures During Plant Transients Due To Improper Switch Settings." In response to IEB 85-03, Callaway tested 32 of the 34 applicable MOV's with diagnostic equipment under maximum attainable differential pressure (DP). Using DP test data rather than abstract calculations has precluded the need to address potential incorrect switch settings resulting from formerly unknown phenomenon such as load sensitive behavior (rate of loading).

As of December 1993, all design reviews of MOV's and all practical DP testing was complete and valves which could not practically be DP tested have been set-up using alternate means. Of the 150 MOV's within the program scope, 103 could be practically DP tested. Note that at the time of the GL 89-10 Part 1 Inspection, 153 valves were in the scope of the MOV Program. Since that time, 2 additional valves have been included and 5 have been removed since they are not position changeable.

As stated previously, the objective is to ensure MOV operability under design-basis differential pressure and flow conditions. This entails several program elements to (1) determine the design basis conditions, (2) determine the physical limitations of the valve and actuator, (3) perform the requisite testing and evaluate the data to determine the appropriate limit and/or torque switch settings, and (4) ensure that operability is maintained throughout the life of the plant through on-going maintenance activities and design control measures. Figure 1 pictorially depicts the Callaway Plant MOV Program.

PROGRAM SCOPE

The scope of valves included in the MOV program includes one hundred fifty (150) motor operated valves including all position changeable MOV's in safety related piping systems. The scope is further described as :

Valve Type	Manufacturer
65 Flex Wedge Gate Valves:	17 Anchor Darling
	4 Velan
	44 Westinghouse Supplied
40 Butterfly Valves:	4 Anchor Darling
	18 Fisher
	18 Jamesbury
28 Globe Valves:	2 Anchor Darling
	1 Gimpel
	4 Masoneilan
	13 Velan
	8 Yarway
7 Solid Wedge Gate Valves:	1 Borg Warner
	4 Velan
	2 Westinghouse Supplied
5 Parallel Disk Gate Valves:	5 Anchor Darling
5 Parallel Slide Gate Valves:	5 Velan

All Callaway MOV's within the program scope utilize Limitorque operators.

PROGRAM ADMINISTRATION AND RESPONSIBILITY

Callaway's administrative program is defined by Engineering Department Procedures EDP-ZZ-01110, "Predictive Performance Program" and EDP-ZZ-01114, "Motor Operated Valve Predictive Performance Manual." Other ancillary procedures govern more specific aspects of the program such as use and calibration of test equipment and adjustment of switches. Finally, procedural interfaces exist with other programs governing routine maintenance, plant design changes/modifications, corrective action programs, and identification of non-conforming materials.

The responsibility for administering the MOV Testing and Surveillance Program lies with the Technical Support Engineering Group. Engineers trained in the operation of motor operated valves and use of the test equipment guide the day to day implementation of the program. Individual test coordinators are provided by the Quality Control (QC)

Department with work performed by trained maintenance personnel. Design support and Vendor Technical Information Program (VETIP) support is provided by the Design Control Department. Independent oversight and on-going program assessment is provided by the Quality Assurance Department.

TRAINING

Effective implementation of the MOV program requires that personnel are adequately trained and aware of program elements, diagnostic and test equipment, as well as the interfaces with other plant programs such as design control, corrective action, maintenance, quality control, etc. Additionally, personnel must maintain their proficiency and cognizance of industry events, changing technology, procedure enhancements, and the regulatory environment. This is addressed through on-going training programs at Callaway.

Initial Training:

Electricians
Must satisfactorily complete Callaway Plant MOV Testing training and be qualified in accordance with Maintenance Department procedures in order to perform MOV testing without direct supervision.

MOV Test Coordinators (MOVTC)
Must satisfactorily complete Data Acquisition and Advanced Signature Analysis classes administered by ITI MOVATS. As a prerequisite, all QC Department MOVTC's also attended a Callaway Plant MOVATS data acquisition seminar. Extensive on the job field training under the supervision of an experienced MOV Engineer is also required.

Engineer
Must satisfactorily complete Data Acquisition and Advanced Signature Analysis classes administered by ITI MOVATS. Also, Engineers receive informal training by MOV engineering on preparing work packages and Predictive Performance Reports (PPR's). Extensive on the job field training under the supervision of an experienced MOV Engineer is also required.

Retraining

Electricians
Required MOV retraining is presented, as required, during the Electricians annual training session. In 1993, 16 hours of lab intensive training was provided.

MOVTC's
Attend "lessons learned" meetings presented by MOV Engineering on an as-needed basis. Formal refresher training is required and has been administered by ITI MOVATS in the past.

Engineers
Attend in-house review sessions on preparing work packages and PPR's. In preparation for Refuel 6, MOV Engineers attended an in-house training session presented by Liberty Technologies on how to set up and operate Liberty's Packing-N-Forcer (thrust measurement device).

Training Personnel

Training is presented by Training Supervisors, MOV Test Coordinators (MOVTC's), MOV Engineers, ITI MOVATS and Liberty Technologies personnel. Training is typically presented by those individuals who are considered to be the experts for the particular course material. An example of this is the refresher training, course T67.023A.8, presented to the electricians in 1993. This course was lab intensive and simulated actual field testing. QC MOVTC's instructed this course due to their extensive involvement during actual field testing.

Training Content

MOV training is a combination of classroom instruction (approximately 25%) and hands-on lab work (approximately 75%) encompassing the following:

- Limitorque MOV designs
- Limitorque MOV operation characteristics
- Disassembly/Reassembly of various MOV's
- MOVATS testing devices and their installation
- MOVATS test data acquisition
- MOVATS test data analysis

Training Duration (by course number and/or year)

T67.0230.6, MOVATS - 40.0 hrs.

T62.0120.6, MOVATS Data Acquisition and Advanced Signature Analysis - 64.0 hrs[2]

T59.Q923.8, Limitorque Operation for QC MOVTC's - 24.0 hrs.

T67.023A.8, 1993 Refresher Training - 16 hrs.

T61.0990.6/T59.0230.6/T59.0230.6, Lessons Learned/MOVATS Analysis [3]

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[1]Required for Electricians and QC MOVTC's.
[2]Required for MOVTC's and MOV Engineers.
[3]Duration varied by individual and year. In 1993, all QC MOVTC's and all full-time MOV engineers received 24.0 hrs. of formal refresher training presented by ITI MOVATS.

Chapter 3: Design Related Topics

The Callaway MOV program is premised on two key areas. These are (1) the physical limitations of the valve and actuator based on allowable limits on subcomponents (e.g., torque limits on the actuator, thrust limits, valve component limits, etc.) and (2) the required differential pressure environment in which the valve must function. Other effects such as operation at reduced voltage and elevated temperatures, use of proper stem factors, pressure locking and thermal binding have also been considered.

PHYSICAL LIMITATIONS FOR VALVES AND OPERATORS

Valve Weak Link Analysis

The physical limitations for valve components are governed by Section III of the ASME Boiler and Pressure Vessel Code (for pressure retaining items) and other manufacturer/industry standards for remaining components. These limitations ensure both the integrity of the pressure boundary and the functionality of the valve. Loads external to the valve, caused by system parameters, such as differential pressure and flow, and loads imparted to the valve by the operator, result in stresses in valve parts. These stresses must be maintained within design limits to ensure the valve will remain functional. Valve suppliers/manufacturers were contacted to supply the limiting parameters and "weak links" for their valves. Definition of the weak link allowed determination of the limiting loads which could be accommodated from the operator given that system parameters were defined. This limit also defined the threshold that, if exceeded during testing, would require corrective action such as replacement of "weak link" parts and/or refined engineering analyses to ensure that stress limits were not exceeded.

Valve Operator Limits

Similar to the "weak link" analysis for the valve, the operator's manufacturer (i.e., Limitorque) established limiting operating parameters for the operator. Situations occurred across the industry where the operator's limits would not allow attainment of the forces required to ensure the associated valve's operation under design basis conditions. Thus, several utilities combined resources to fund a study by Kalsi Engineering to justify increasing the published limits.

KALSI Engineering "Phase I and II Limitorque Overload Test Program"

In December, 1991 Union Electric became an active participant in the Limitorque Phase I and II Overload Testing Program being conducted by KALSI Engineering, Inc. The Phase I portion of this program provided the necessary testing and analysis to substantially increase the published thrust rating for Limitorque operator sizes SMB-000 through 1. The thrust rating for each size operator was increased to 162% of the published thrust rating for 2000 cycles or 200% of the published rating for 763 cycles. This report was reviewed and approved by Union Electric Nuclear Engineering for use at Callaway.[1] As a result of an MOV program audit at the Wolf Creek Nuclear Operating Corporation (WCNOC), the NRC raised several concerns with the use of the Phase I Kalsi study. These concerns were addressed jointly by the Phase I and II program participants.[2]

As an extension of the Phase I thrust overload test results, the Phase II program was initiated in March, 1992 to qualify the SMB-2 and the SB-000 through 2 operator design to larger thrust ratings. In addition, the torque carrying capabilities of the H0BC and the SMB-000 through SMB-2 operators were chosen for further study. The Phase II study is underway with a projected completion date during the third quarter of calendar year 1994. The results are anticipated to provide additional margin and extend the results of the Phase I study to a broader population of motor operated valves at Callaway.

In summary, both valve and operator limits were evaluated. The results coupled with DP test results have shown that the original design configuration was adequate for design basis conditions. Modifications are being pursued to attain target margin levels, however, no modifications are required to meet our licensing basis.

DETERMINATION OF DESIGN BASIS DIFFERENTIAL PRESSURE

Maximum DP information is required to properly set the valve's limit and torque switches. The MOV engineer determines the required thrust/torque that the valve must develop to operate against this DP.

DP's are typically determined using Bernoulli's equation. The maximum credible DP is calculated by analyzing the system configuration with the maximum credible pressure source and minimum downstream pressure. This methodology is consistent with the guidelines established by the Westinghouse Owners Group[3] and was previously used by Union Electric in response to IEB 85-03.

[1]Engineering review documented in Request for Resolution RFR-09823A.
[2]The Kalsi Phase I Study and responses to NRC Concerns are filed at Callaway under document number E-025-00004.
[3]WOG 86-168

Initially, a design bases review is performed for each valve to determine system operating parameters as well as the valve's required function. This includes a determination of when, and if, a valve is required to change position to accomplish its required function. Source documents reviewed include, but are not limited to, component specifications, design drawings, operating procedures, calculations, the Final Safety Analysis Report (FSAR) and the Safety Evaluation Report (SER). Further definition of sources of design bases may be found in Engineering Department procedure EDP-ZZ-04055, "Design Bases Control."

Other basic assumptions and considerations used to determine the maximum credible DP are described in the following.

Pressure Relieving Devices

Pressure relieving devices, such as pressure relief valves and rupture discs, are credited with maintaining system pressures below their respective relief points. Tolerances on the relief settings for relief valves are controlled by procedure.[4]

Pumps

ASME Section XI In-Service Test data for pump differential pressure is used where appropriate. The philosophy used for DP determination adds the maximum suction head with the Section XI pump DP. Final adjustments to the DP include elevation changes, i.e. static head, accordingly.

The line-ups used for Section XI testing are normally very close to the dead head of the pumps; i.e. near the top of the pump curve with minimal flow. The Section XI program also trends pump performance and would identify changes which could impact previously evaluated maximum differential pressures. Changes in pump internals which result in new baseline data require a review of any DP determination associated with that pump. This is part of the documentation for the re-baseline of Section XI pumps.

When the above methodology is not used, justification is provided with the DP determinations.

Back Leakage

Back leakage through check valves can occur from a high pressure system to a low pressure system. Credit is taken for equipment operator action to minimize pressure increases from back leakage by the identification of adverse system conditions during equipment operator rounds. Specific procedures which identify these type of conditions are ODP-ZZ-00016, "Watchstation Equipment Logs and Practices" and OOAs (operator aids) which check suction and discharge pressures of ECCS pumps. Similarly, back leakage can be identified through monitoring the temperature of piping which is also

[4]For example, Maintenance Surveillance Procedure MSM-ZZ-QV001, "Relief Valve Surveillance Test."

included in ODP-ZZ-00016. Other credit is taken for the use of OSP-BB-00009, "RCS Inventory Balance" which identifies and quantifies RCS leakage every 72 hours. Further, check valve testing per ASME Section XI assesses check valve integrity and back leakage. Where abnormal conditions are identified, appropriate corrective action is taken.

Tanks
Gravity head from levels in tanks is considered based on the tank's overflow limits.

Flow
MOVs are not considered fast acting valves that would require calculation of water hammer or momentum effects. The valve operations are sufficiently slow such that water hammer wave propagation would not be created. The speed of the operation tends to reduce flowrates gradually and not abruptly. Additionally, piping systems are designed and operated to preclude water hammer through system layout, valve closure time control and operating procedures.

Temperature Effects
Water density (62.4 lbm/ft^3) is considered constant at all temperatures. This provides conservative results for elevated line temperatures as water density decreases with elevated temperature.

Line Losses
Line losses are neglected. This provides conservative results since friction losses would decrease upstream pressure.

Flooding
FSAR Table 3.11(B)-6 provides room and area flood levels. These are used, as appropriate, to provide maximum source pressure to the valve.

Active and passive failures[5]**:**
For those systems or portions of systems that are considered short term operation; i.e. < 24 hours, only single active failures were considered. Passive failures are not assumed.

For those systems or portions of systems that are considered long term operation; i.e. > 24 hours, both passive and active failures were considered and the limiting failure used.

These assumptions are consistent with Callaway's current licensing basis.

Valve Mispositioning:
The methodology adopted by Callaway accounts for valve mispositioning, although this is still an open industry issue. Where mispositioning is included, it is not in addition to an active failure, since mispositioning is considered an active failure[6]. Those valves which have their power locked out in the control room are exempt from possible valve

[5] Active and passive failures are described in the Final Safety Analysis Report, FSAR Section 3.1.
[6] Reference ANS 58.9.

mispositioning considerations. Also, valves that provide annunciation in the control room of mispositioning[7] and those verified by equipment operators on their routine rounds are considered exempt.

Summary:

The DP determinations are developed based on these basic conservative assumptions. Where more precise determinations are required, excessive conservatism has been removed resulting in a more practical and accurate value. Where justified, credit has been taken for actual equipment performance parameters, operator actions, more accurate pressure drop consideration, etc. In all cases, DP determinations are documented in formal evaluations/calculations describing assumptions, methodology, and sources of data. Table 1 provides a summary of calculated DP's and associated evaluations.

OTHER EFFECTS

Effects Due to Reduced Voltage and Elevated Temperature

Calculations have been performed to determine the MOV terminal voltage using locked rotor current and to use the appropriate Limitorque operator factors and design thrust values in the Limitorque sizing equations to determine correct operator motor sizing.

For the AC motor operated valves, a motor control center (MCC) voltage corresponding to the minimum degraded bus voltage was used to supply the MOV feeder cables. This degraded voltage was based on load flow calculations assuming a hypothetical minimum switchyard grid voltage and accident (LOCA) bus loadings[8].

The cable voltage drop is then developed.[9] The method employed uses a constant impedance motor model for a given ambient temperature. The model was developed from the locked rotor current, nameplate voltage, and elevated temperature derating supplied by the valve operator and motor vendors. For valves located in areas where the maximum DBA temperature exceeded 40°C,[10] the derating was applied to the starting current for that valve motor at the maximum DBA temperature. The derate accounts for the resistive rise in the motor at elevated temperatures. The cable size, cable lengths, and heater element resistances were obtained for all of the listed 460V AC motor operated valves. Power factors for locked rotor torque conditions were obtained from Limitorque. The cables were derated to accident temperatures. Thus, the cable voltage drop/ motor terminal voltage was calculated for each MOV.

For the DC motor operated valves, two other voltage drop calculations exist. For the four DC controlled Modutronic valves, calculations were performed to determine the minimum

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[7]These valves are listed in FSAR Table 6.3-3.
[8]Reference calculations ZZ-62 and E-B-21.
[9]Reference calculation ZZ-214.
[10]Reference FSAR Table 3.11(B)-2.

accident input terminal voltage to the Modutronic controller.[11] For the DC MOV, calculations determined the DC locked rotor voltage that exists at the minimum battery voltage and appropriate cable voltage drops.[12]

These motor terminal voltages were then used to determine appropriate motor sizing using the Limitorque sizing equation.[13] The calculation lists the appropriate factors to input into the Limitorque sizing equation. The factors are: overall gear ratio (OAR), pullout efficiency (PE), running efficiency (RE), application factor (AF), stem factor (SF), stem load (SL), DP thrust (DPT), voltage factor for degraded voltage, and reduced torque factor for high ambient temperatures.

Stem Factor

Callaway calculations use a stem factor based on a friction coefficient of $\mu = 0.20$ or greater for all but five rising stem MOV's. A stem factor based on a friction coefficient of $\mu = 0.15$ was used based on actual measured stem factors for these five MOV's. A total of 94 different MOV's were tested using the MOVATS Torque Thrust Cell to validate our selection of friction coefficients. Friction coefficients are determined based on testing before and after stem maintenance to quantify stem factor degradation between maintenance intervals (currently every 18 months).

To summarize, the results of the calculations show that the actuators are adequately sized. All of the actuators, except for five, have shown to meet the required torque when analyzed with a coefficient of friction of 0.20. For the other five valves, the torque is adequate when analyzed with a coefficient of friction of 0.15. Justification for use of the 0.15 value is supported by actual field measurement of the stem factor for that specific valve and a resultant calculation of the existing coefficient of friction seen to be less than 0.15[14].

Thermal Binding and Pressure Locking

Callaway intends to take an aggressive approach to this issue as we have with Generic Letter 89-10. However, this is an industry issue and it is anticipated that the NRC will be issuing a separate Generic Letter in the near future identifying the need for each utility to address the pressure locking/thermal binding phenomenon and actions required.

Callaway has performed an initial evaluation of all safety-related motor operated gate valves. The initial evaluation considered the type of valve operator, Design Basis Accident temperature environment the valve may be subjected to, piping configurations,

[11]Reference calculation NG-02.
[12]Reference calculation NK-10.
[13]Reference calculation ZZ-224.
[14]This methodology has been submitted to the Commission via letter number ULNRC-2592, March 16, 1992.

system pressures, valve operation sequencing, and procedural directions given to the operators.

Since Callaway is a Westinghouse Pressurized Water Reactor plant, most of the gate valves required for the initial phase of Safety Injection are normally open and are not subject to this phenomenon. Those valves that are normally open, not required to be closed and then reopened during accidents, do not require further evaluation.[15]

Valves that are normally closed or are closed and then required to be reopened during accidents, will require further evaluation to determine that they are either not subject to the phenomenon, can overcome the additional forces that the valves may be subjected to, do not pose a significant increase in the Probabilistic Risk Assessment, or will require modification to the valve.

[15]The detailed evaluation is attached to internal letter (UOMNE 93-164) dated August 19, 1993, in response to NUREG 1275 and is filed in A160.0825.

Chapter 4: Test Program/Switch Setting

Given the design basis differential pressure and the physical limitations of the valve and operator, the test program characterizes the actual response of individual valves to establish the correct settings for torque and limit switches. Where practical, torque switch settings are based on actual DP testing. Certain valves cannot be practically DP tested. These are discussed later in this chapter.

OVERVIEW OF CALLAWAY MOV SETUP

Every safety related MOV that could be DP tested without adversely affecting the Callaway plant was in situ DP tested as close to design DP as practical. Of the 150 MOV's in the Generic Letter 89-10 program, 103 MOV's were DP tested with diagnostic equipment. All of the MOV's of high priority in the Probabilistic Risk Assessment (PRA) for the Individual Plant Evaluation (IPE) have been DP tested in situ at Callaway.

In order for a rising stem MOV to have been considered "DP tested" it must have been DP tested within 80% of the design DP for design DP's greater than 260 psid or within 50% of the design DP for design DP's less than 260 psid. For butterfly MOV's they must have been DP tested within 80% of the design DP for design DP's greater than 150 psid or within 50% of the design DP for design DP's less than 150 psid. 91 MOV's (56 rising stem and 35 butterfly valves) have been DP tested to the criteria[1] described above. Nine of the rising stem MOV's and three of the butterfly MOV's have been DP tested but not at a high enough pressure differential to satisfy the MOV program DP test criteria.

For the butterfly valves not DP tested, the torque requirements are based on calculations using Callaway specific information in accordance with EPRI Application Guide for Butterfly Valves in Nuclear Power Plants, NP 7501 equation 5.2.2..

For the rising stem MOV's not DP tested the primary method of determining thrust requirements has been to group similar valves that have been DP tested in situ at Callaway. When grouping is not an option the secondary method of determining thrust requirements has been the use of calculations similar to that described in EPRI Application

[1]Refer to Engineering Department Procedures EDP-ZZ-01114, Motor Operated Valve Performance Manual.

Guide for Motor Operated Valves in Nuclear Power Plants equation 5-13. The alternate methods used at Callaway to determine thrust requirements for MOV's in the Generic Letter 89-10 program are discussed in greater detail in this chapter.

METHODS OF DETERMINING DP THRUST REQUIREMENTS

In Situ DP Testing:

DP testing was done in situ using system pumps with the system aligned to produce the highest flow and DP practicable. In order to later quantify margin, non-intrusive MOV diagnostic test equipment (e.g., MOVATS Displacement Measurement Transducer (DMT)) was installed on the MOV to monitor spring pack movement during the DP test. In addition, system pressure (and flow, when available) was recorded using either existing or temporarily installed gages.

Results from the DP and static baseline tests are used together to quantify the DP effect in terms of spring pack displacement. This effect in terms of spring pack displacement is then converted to thrust using calibrations performed at static conditions. The results are then used to determine the margin[2] in the capability of the MOV to stroke against DP loads.

Using a static calibration to convert the DP effect displacement overstates the DP thrust since thrust per displacement unit under dynamic conditions is less than under static conditions. This is in part due to rate of loading (ROL). For example, during a DP test done at Callaway where the MOVATS Torque Thrust Cell was installed, the thrust required to overcome DP was measured directly as 7730 lb. The displacement required to overcome DP was also converted using static calibration[3] data to 8290 lb. The difference between the two different thrusts required to overcome DP was due to rate of loading. Callaway used the ROL-adjusted 8290 lb., added apparent Spring pack preload (APL)[4] of 1,400 lb. and extrapolated to design conditions. The resulting minimum required thrust of 10,400 lb. was used to evaluate the torque switch setting under static conditions.

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[2]Margin is defined as the difference between the measured available thrust and the adjusted required thrust (adjusted for errors and rate of loading) divided by the adjusted required thrust.
[3]Spring pack apparent preload was excluded to better illustrate accommodation of ROL.
[4]Spring pack apparent preload is the amount of force above packing loads necessary to make the spring pack compress. A limitation of this method of DP testing is the inability to monitor forces below apparent spring pack preload (APL). APL could mask some of the DP effect we are trying to determine. Since we don't know how much DP effect is being masked by APL, Callaway conservatively adds all of the APL to the previously measured DP effect.

Setup of MOV's Using DP Testing:

There is one preferred and two alternate methods to set MOV switches based on DP testing.

The Preferred Method to setup an MOV based on DP testing includes:

1. Design Basis reviews to quantify maximum allowable load and incorporation of design basis requirements into design documents for each MOV.
2. DP testing done before any maintenance is done to the MOV.
3. Baseline testing to set switches to meet design DP requirements without exceeding a maximum allowable limit. Baseline test is done after the stem on rising stem valves is cleaned and re lubricated.

Alternate Method 1 to setup an MOV based on DP testing includes:

1. Design Basis reviews to quantify maximum allowable load and incorporation of design basis requirements into design documents for each MOV.
2. Determination of DP thrust requirements for the MOV based on similar valves, or other approved methods described in EDP-ZZ-01114.
3. Baseline testing to set switches to meet design DP requirements without exceeding a maximum allowable limit.
4. DP testing.

Alternate Method 2 to setup an MOV based on DP testing of similar valves includes:

1. Design Basis reviews to quantify maximum allowable load and incorporation of design basis requirements into design documents for each MOV.
2. Determination of DP thrust requirements for the MOV based on similar valves, or calculation[5].
3. Baseline testing to set switches to meet design DP requirements without exceeding a maximum allowable limit.

[5]See RFR-08746 Rev. 1 for determinations of thrust requirements for these MOV's.

GROUPING TO DETERMINE DP THRUST REQUIREMENTS

Since Callaway DP tested safety related MOV's whenever practical, a significant amount of plant specific data has been obtained regarding how various types of MOV's respond under DP conditions. Grouping was not used as a basis for reducing the number of MOV's required to be DP tested. For those valves that cannot be DP tested, the preferred method for determining thrust requirements has been the grouping of other similar MOV's that have been DP tested at Callaway. This Callaway specific data is then used directly to demonstrate that the thrust requirements for the valves DP tested could be conservatively predicted using calculations as described below.

The valves used for grouping had to satisfy several conditions. First, the comparison valves had to be of the same manufacturer and type. Next, the comparison valves were DP tested at or above the design DP for the valve that could not be DP tested. Additionally, the similar valve(s) were the same nominal size or larger. If these conditions were not satisfied, the secondary method described below was employed.

VALVE FACTORS TO DETERMINE DP THRUST REQUIREMENTS

The secondary method used to determine thrust requirements for MOV's not DP tested is use of a modified standard industry equation[6]. Listed below is the modified industry equation being used at Callaway in both the closed and open directions.

CLOSED THRUST REQUIREMENT = ROL x ((DAxDPx VF + SAx LP)

OPEN THRUST REQUIREMENTS = ROL x (DAxDPxVF)

where:
- ROL= Rate of Loading[7] ;
- DA = Disc Area sq. inches. Based on the mean seat diameter.
- DP = Differential Pressure
- VF = Valve Factor = 0.5 to 1.0 for flex wedge gate valves, 0.4 for parallel disk/slide gate valves and 1.1 to 2.2 for globe valves.[8]
- SA = Stem Area sq. inches
- LP = Line Pressure

Note that the open thrust equation is the same as the closing thrust equation with the exception of the SAxLP term. This term, commonly referred to as the piston effect would actually be negative in the open direction thus reducing the calculated thrust requirements.

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[6]Refer to EPRI NP-6660-D, Application Guideline for Motor Operated Valves in Nuclear Power Plants equation 5-13

[7]ROL factors are set based on MOVATS Engineering Report 5.0. Ranges from 1.15 to 1.22.

[8]Other valve factors may be used based on specific DP testing.

This term is set equal to zero for conservatism. Also note that neither term includes a value for stem packing loads. This term is accounted for during field testing rather than being provided here based on generic guidelines. The calculation method above provides conservative thrust requirements for MOV's at Callaway when compared with the results of actual DP testing.[9]

Calculating Valve Factors With Callaway DP Data:

It is not possible to calculate a true *valve factor*[10] from Callaway DP test results. The transducers used during DP tests do not make it possible to isolate the valve factor from all the other factors that make up the DP effect. The following example will illustrate.

Terms used in this example:

ROL	= Rate Of Loading
DA	= Disc Area in square inches.
VF	= Valve Factor
SA	= Stem Area
LP	= Line Pressure
APL	= Apparent spring pack preload
VDF	= thrust required to overcome Valve Disk/seat Friction due to DP.
Measure DP Effect	= DP Effect measured using Callaway methodology described in preceding section.
	= (PE + VDF + APL[5]) * ROL

WHERE:

VDF	= DA * Test DP * VF
PE	= SA * LP

∴ DP Effect = (SA * LP + DA * Test DP * VF+APL) * ROL

Solving for VF, the equation becomes:

$$\therefore \quad VF = \frac{\left(\frac{DP\ \ Effect}{ROL} - PE - APL\right)}{(DA * TEST\ \ DP)}$$

[9]Refer to Request for Resolution RFR-08746I.

[10]See EQ 5-1 of EPRI Application Guide for Motor-Operated Valves in Nuclear Plants (NP-6660-D).

For a specific example, a 4" gate valve DP tested at 200 psid gave these results.

DP Effect	= 2026 lb.[11]	LP	= 200 psi
APL	= 1110 lb.	SA	= 1.225 in^2
DA	= 12.5 in^2	ROL	= unknown

ROL is unknown. However, if the ROL is set to 1, the equation becomes:

$$VF = \frac{(DP\_Effect - PE - APL)}{(DA * TEST\_DP)}$$

$$VF = \frac{(2026lbf - 245lbf - 1110lbf)}{(12.5in^2 * 200psid)} = 0.268$$

Note that this valve factor assumes (non-conservatively) that no part of the DP effect is hidden by APL. However if you assume APL is all part of the DP effect, as is done at Callaway, the equation becomes:

$$bounding\_VF = \frac{(DP\_Effect - PE)}{(DA * TEST\_DP)}$$

$$\text{bounding VF} = \frac{(2026lbf - 245lbf)}{(12.5in^2 * 200psid)} = 0.712$$

NOTE: Both valve factor (VF) values would be smaller if ROL was known and put into the calculation.

The VF was not calculated originally. Minimum Available Thrust (above packing loads) was simply set to exceed DP effect corrected for error. i.e., the close torque switch was set to assure MAT was greater than 2026 lb. corrected for error. Therefore, the DP effect is based on the bounding VF of 0.712, although it was not originally calculated.

BASELINE TEST

The static baseline tests are used to verify and reset, as necessary, MOV switch settings that affect operability.

General switch setting guidance contained in EDP-ZZ-01114 is paraphrased in the following.

[11]DP Effect converted from DP spring pack displacement using static calibration to account for ROL. DP Effect includes 1110 lb. of APL. See EDP-ZZ-01114 for further discussion.

- The CLOSE TORQUE SWITCH is set to provide thrust to overcome DP and static loads without exceeding any maximum allowable MOV limits. This includes torque limits due to reduced voltage and motor temperature effects. Close indication is controlled by a limit switch set 0-3% of full stroke from full close.

- The CLOSE LIMIT SWITCH (for those MOV's without a close torque switch in the control circuit) is set to provide positive seating without exceeding any maximum allowable MOV limits. Close indication is controlled by another contact on the switch rotor. This convention is only used on rising stem valves with SB or SBD type Limitorque operators.

- The CLOSE LIMIT SWITCH (for those MOV's with torque switch backup) is set to position the valve in the required position for sealing without exceeding any maximum allowable MOV limits. Close indication is controlled by another contact on this switch rotor. The close torque switch is set to provide thrust/torque to overcome DP and static loads.

- The OPEN LIMIT SWITCH is set to open the valve 90-92% of full valve stroke without backseating. Open indication is controlled by another contact on this switch rotor.

- The OPEN TORQUE SWITCH is set to provide the thrust/torque required to overcome DP and static loads present, when enabled, without exceeding any maximum allowable MOV limits should the valve backseat.

- The OPEN TORQUE SWITCH BYPASS is set to disable the open torque switch the first 80-85% of valve travel to ensure the full capacity of the MOV is available when DP loads are present.

Torque Switch Setting Convention:

The MOVATS method of setting the close torque switch used at Callaway is based on Minimum Available Thrust at Torque Switch Trip (MAT),i.e. the force developed at torque switch trip above packing loads plus spring pack apparent preload[12]. This methodology was developed to overcome the limitations imposed by not being able to measure forces below spring pack preload. This methodology is described in more detail in EDP-ZZ-01114.

By using MAT methodology in conjunction with DP testing, factors such as RATE OF LOADING, PISTON EFFECT, VALVE FACTOR and APPARENT SPRING PACK PRELOAD (APL) are all accounted for although not necessarily individually known. The

[12]Spring pack apparent preload is the amount of force above packing loads necessary to make the spring pack compress.

apparent spring pack preload may or may not be masking DP effect measured in the DP test. Callaway assumes all the apparent spring pack preload is part of the DP effect. Assuming APL is all DP effect, adds conservatism to all resultant DP thrust requirements. The larger the APL the more conservatism is included. Extrapolation of DP results, including APL, introduces additional conservatism. Therefore, this convention works well to set switches conservatively in all cases, both in setting up a valve that is DP tested and setting up similar valves.

ACCEPTANCE CRITERIA

Static test procedures are prepared with, among other things, criteria that can be met only if the control switches are properly adjusted. Qualified MOV engineers prepare the criteria in accordance with the applicable procedure. An independent review is then performed by another MOV engineer.

The criteria used to determine the acceptability of a valve is calculated from the valve and actuator limits as well as the thrust and torque requirements needed to ensure that the valve can perform all safety functions under the specified design basis conditions. The specific criteria used depends on the type of valve being tested.

Maximum Allowed Criteria:

For both rising stem and butterfly valves, the maximum allowed criteria are based on the Actuator Thrust Rating (AThR), Actuator Torque Rating (ATqR) and Valve Thrust Rating (VTR). Calculated torque limits which are adjusted for the worst case reduced voltage are also included for both close and open strokes. These are the Allowable Reduced Voltage Running Torque (ARVRT) and Allowable Reduced Voltage Pullout Torque (ARVPT), respectively.

Butterfly valves have two additional limits which must be added to its criteria. These are Stem Allowable Torque (SAT) and Disk/Pin Allowable Torque (D/PAT).

Rising stem limit close valves must include an added term to account for line pressure piston effects. The Piston Effect Thrust (PETh) and Piston Effect Torque (PETq) are both included in various closing stroke criteria.

Minimum Required Criteria:

The minimum required criteria ensure that the valve will provide adequate thrust and torque to perform its intended safety function. As with the maximum allowed criteria, the measurements recorded depend on the type of valve being tested.

For rising stem torque close valves, there must be sufficient thrust to close against the design basis DP. This is termed the closed Differential Pressure Thrust (DPT). Similarly, sufficient thrust must exist to open the valve against Open Differential Pressure Thrust (ODPT).

For rising stem limit close valves, the same requirements exist for ODPT on the open stroke. However, the minimum required closing thrust criteria is replaced with a target seating thrust given for seating requirements.

For butterfly valves, torque, versus thrust, is the measured quantity. In the closing direction, the minimum available torque (MATq @ TST) must be sufficient to overcome BEARING DP and any torque used for seating (MATq @ LST). In the opening direction, the minimum available torque must be sufficient to overcome the DP effect torque.

MEASUREMENTS

Measurements made during a MOVATS field test are applied to the acceptance criteria provided by the MOV Engineer in each work package. Since measurement error has been incorporated into the acceptance criteria, no error need be calculated during the field test. This simplifies the field test and reduces the chance of a miscalculation.

The specific measurements recorded during the test vary depending on the type of valve tested and transducers selected. Valves at Callaway are divided into three major types. These are rising stem torque close, rising stem limit close, and butterfly. Testing of these valves is procedurally controlled by MTE-ZZ-QA003, MTE-ZZ-QA004 and MTE-ZZ-QA005, respectively.

A general list of the measurements recorded during testing are listed below:

- MATh @ TST: Minimum Available Thrust at torque switch trip. The amount of thrust above packing loads available to overcome DP loads.
- MATq @ TST: Minimum Available Torque at torque switch trip. The amount of torque above packing loads available to overcome DP loads.
- TOTAL TORQUE/THRUST (TST): Total torque/thrust, including running and inertial torque/thrust, resulting from torque switch trip.
- TOTAL TORQUE/THRUST (LST): Total torque/thrust, including running and inertial torque/thrust, resulting from limit switch trip.
- TORQUE/THRUST @ TST: Torque/thrust including running torque/thrust at torque switch trip.

- TORQUE/THRUST @ LST: Torque/thrust including running torque/thrust at limit switch trip.

- UNSEATING TORQUE: Maximum torque measured during valve unseating.

- MATq @ LST: Measured seating torque at limit switch trip. This value does not include inertial loads.

Accounting for Error:

Error may be divided into Reading Error and Full Scale Error.[13] These terms are added algebraically to give the Total Error.

$$TotalError = \pm[ReadingError + FullScaleError]$$

Applying this equation for Minimum Required Criteria produces:

$$Reading(1 - \% ReadingError) - FullScaleError > Minimum\ Required$$

or:

$$Reading > \frac{Minimum\ Required + FullScaleError}{1 - \% ReadingError}$$

Similarly, for Maximum Allowed Criteria:

$$Reading < \frac{Maximum\ Required - FullScaleError}{1 + \% ReadingError}$$

Included Errors:

To calculate error correctly, all the sources of error must first be identified. For MOVATS testing, most errors consist of test equipment error and torque switch repeatability. Which of these errors are used and how many times each must be applied depends on the specific tests. This is a list of errors included in our analysis:

Error associated with the MOVATS DATA ACQUISITION SYSTEM which includes the error due to digitization and display but does not include any error for transducers.

Error associated with LOAD CELL used.

[13] Reference Engineering Report - 5.0, "ITI MOVATS Incorporated Equipment Accuracy Summary."

Error associated with Displacement Measurement Transducer (Spring pack measurement device or DMT).

Error associated with PRESSURE GAUGES used during DP testing.

Error associated with the installation and removal of the Torque Thrust Cell (TTC on/off error).

TORQUE SWITCH REPEATABILITY which varies based on the torque switch being set to 1 and whether the resultant actuator torque is < or > 50 ft-lb.

With the exception of torque switch repeatability and pressure gauge accuracy, all error information for the equipment listed above is supplied by MOVATS. Torque switch repeatability is supplied by Limitorque.

All independent and random equipment errors are combined by the "Root Sum of the Squares" method. EDP-ZZ-01114 describes error in more detail.

INEL Test Report on MOV Test Equipment Inaccuracies:

Prior to the issuance of NRC Information Notice 92-23 "Results of Validation Testing of Motor-Operated Valve Diagnostic Equipment", Callaway established Unresolved Issue 91-10 as a method to internally track our actions in response to the preliminary results of the INEL validation testing. In our response we decided to use performance based testing to verify operability of our rising stem MOV's by measuring close thrust directly whenever possible. All previously MOVATS tested MOV's were reevaluated using the bounding criteria established in MOVATS Engineering Report 5.2 to identify those valves to be included in the Spring 1992 refueling outage test schedule.

Generic Letter 89-10, Supplement 5 "Inaccuracy of Motor-Operated Valve Diagnostic Equipment" was found to be applicable to 109 MOV's at Callaway. Validated methods have been used to verify operability of all of these valves. Of the 109 valves, 99 have been tested with a direct stem thrust measuring device (94 were tested with the MOVATS Torque Thrust Cell and 5 were tested with the MOVATS Stem Strain Ring). The remaining 10 valves have been evaluated using the criteria established in MOVATS Engineering report 5.2, where applicable. These valves are addressed below:

BGHV8109: This valve is presently not installed due to a plant modification that is in progress. However, prior to returning this valve to service it will be baseline tested with the Torque Thrust Cell(TTC). In addition, BGHV8109 performs only a passive safety function.

EGHV0062: Neither the TTC nor the Stem Strain Ring (SSR) can be used on this MOV. This valve is a parallel slide valve and a modification will be implemented in our Spring 1995 outage to bypass the close torque switch until the point that the close limit switch contacts open. This will ensure that the full capacity of the operator is available to close the valve against design differential pressure, but it will still have the torque switch in the close circuit to protect the valve in the event of limit switch failure.

EGHV0011,12,13,&14: Neither the TTC nor the Stem Strain Ring (SSR) can be used on these valves. However, these valves have no safety function to close.

EGHV0072,73,74,&75: Neither the TTC nor the SSR can be used on these valves. However, they all have been DP tested at 98% of design DP.

PERIODIC VERIFICATION OF OPERABILITY

MOV's Practicable to DP Test:

Periodic verification of operability will be done using dynamic testing whenever a rising stem MOV has less than 25% margin[14]. This sample of second round DP tests will be used in conjunction with the static tests of MOV's with more than 25% margin to re-verify operability.

A DP test will be done when maintenance performed on an MOV may affect the thrust required to close or open it against design differential pressure unless an engineering evaluation shows that it is not required. DP tests have been done in all such cases in the past.

MOV's Not Practicable to DP Test:

All MOV's with less than 25% margin have been scheduled for adjustments and modifications as required to achieve greater than 25% margin (see Table 3).

FURTHER DISCUSSION ON THE USE OF STATIC TESTING

Callaway considers the use of static tests to be adequate to verify valve operability for MOV's with greater than 25% margin for the following reasons:

The use of diagnostic test equipment during dynamic testing allows us to quantify a minimum value for the thrust margin.

[14]Table 3 in Chapter 9 defines those valves currently having less than 25% margin. Margin is defined as the difference between the measured available thrust and the adjusted required thrust (adjusted for errors and rate of loading) divided by the adjusted required thrust.

The present DP thrust values determined from dynamic testing have margin "built in" due to the fact that spring pack preload is included in the thrust values. This margin is increased when extrapolation of the DP data to design DP is necessary because any spring pack preload in the thrust value is also extrapolated.

All of the factors in the EPRI required thrust equation[15] except DP load can either be monitored statically or are constant (piston effect). All of the factors in the EPRI DP load equations[16] are known, physical parameters except disc factor. For all rising stem gate valves, the DP tests were performed after the MOV's were in service for years. Therefore any significant changes in disc factor can be assumed to have already occurred.

A DP test must be redone or an engineering evaluation made when work is done on an MOV which could effect the DP thrust required to open or close.

The use of diagnostics during static testing will monitor the material condition of the MOV. The use of the ITI-MOVATS Torque Thrust Cell during static testing enables us to monitor stem thrust and torque directly which provides for additional trending capabilities such as calculating static stem friction coefficients to monitor the effectiveness of our Preventative Maintenance program.

Butterfly valves will be periodically tested using static testing.

[15]EQ 5-1 of EPRI Application Guide for Motor-Operated Valves in Nuclear Plants (NP-6660-D).
[16]EQ 5-3a&b of EPRI Application Guide for Motor-Operated Valves in Nuclear Plants (NP-6660-D).

Controls must be established to ensure that MOV's maintain their operability throughout the life of the plant. Thus, procedures have been established to control basic design input information, control changes made to the MOV's, and continually monitor performance for signs of degradation.

CONTROL OF INFORMATION

Maintaining Accurate DP Determinations

·ges in plant systems via design changes and routine maintenance are reviewed for .t during the process of the modification and following routine maintenance. During the design process, procedure EDP-ZZ-04032, Design Input Control requires the engineer to review the change for possible impact on the existing DP determinations. This is detailed as an essential design input for the change or resolution. If the change is determined to create a change in conditions for the DP determination then that is resolved prior to the modification.

Normally, the conservatism in DP determinations reduce the cases where changes in the system have impacts on the DP determinations. Changes in the rotating element of pumps are the most likely impact to DP determinations. Procedure, APA-ZZ-00356, Section XI Pump and Valve Program requires the re-review of the DP determination when a change in a rotating element causes a base line change in the pump performance.

Control of Switch Settings

Torque and limit switch settings are controlled procedurally. Engineering Department Procedure EDP-ZZ-01114 details the philosophy of all MOV switch settings. Specific limit switch settings are controlled through the Callaway Equipment List (CEL). CEL is a computer database that is controlled through the RFR Process. Torque switch settings are controlled in Maintenance Mechanical Procedure MTM-ZZ-QA006 "Limitorque Actuator Limit Switch And Torque Switch Adjustment."

VALVE RETEST MANUAL

The Valve Retest Manual (VRM) provides guidelines for the retests to be performed following maintenance on applicable valves/actuators. This document is used primarily by Callaway's Planning Department to schedule required retests to valve/actuator work requests. The VRM does not identify all of the required retests, but only those associated with Local Leak Rate Testing, Inservice Testing, MOV diagnostic testing, and QC retest requirements regarding valves. Control of the VRM is the responsibility of the Systems Engineering Department. Any revisions to the manual require a review by a "Qualified Reviewer".[1]

Section 3 of the VRM is the "Procedure" section which provides instructions on how to use the manual. Attachment 1 of the VRM is a table which includes actuator type, valve type, applicable retests, retest procedure, plant mode required for the retest, and other information. Attachment 2 of the manual lists examples of valve/actuator maintenance items which require a retest. Attachment 3 of the manual lists specific continuity tests which provide methods to verify the proper operation of valve interlocks which use limit switch contacts on one or more different valves following actuator maintenance.

TRENDING PROGRAMS

All MOV's at Callaway are set up on 18 month Preventative Maintenance (PM) frequency. These 18 month PM's are performed in accordance with procedure, MPM-ZZ-QA0001, Limitorque Operator Inspection and Lubrication. If a MOVATS baseline test is scheduled as a retest following the PM on a rising stem valve, the valve stem lubrication portion of the PM is deferred to the time of the retest so that stem friction data can be taken before and after lubricating the stem.

A baseline MOVATS test is performed on all GL 89-10 valves every 4.5 years (or less depending on valve/actuator maintenance performed). In addition, for those valves with an active safety function that have less than 25% thrust margin above the required DP thrust, a MOVATS trend test is performed every 18 months. These trend tests monitor spring pack displacement, motor current, limit switch settings, torque switch settings, and stem factor, when applicable. The procedures used for both baseline and trend testing are MTE-ZZ-QA003 (for rising stem valves with a torque switch in the close circuit), MTE-ZZ-QA004 (for rising stem valves without a torque switch in the close circuit), MTE-ZZ-QA005 (for butterfly valves).

Prior to testing, an MOV engineer reviews the work package to specify the test equipment to be used and provides all operability criteria for the valve to be tested. The test is performed by an MOV test coordinator working with two electricians. The MOV test coordinator is either an MOV engineer or a QC inspector trained on MOVATS data acquisition and signature analysis. The data taken during the test is compared with the criteria specified by engineering and any adjustments, if necessary, are made at that time. If the operability criteria is met and no significant degradation or test anomalies are found, the valve is returned to service. Otherwise, corrective actions are identified and implemented.

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[1] A Qualified Reviewer is a trained and qualified engineer meeting requirements specific to the task. Such qualification is documented and maintained in the engineer's training file.

Within two months after the test has been completed, an MOV engineer performs a "trending review" of the test data and prepares a Predictive Performance Report (PPR) for the valve. In this review the engineer compares the present test data with previous data to identify any adverse trends. For baseline tests on rising stem valves, the static stem friction coefficient is calculated at close control switch trip both before and after stem lubrication, when available. The MOV engineer then initiates work requests for maintenance on the MOV, if necessary, based on the results of the trending review.

SOS SYSTEM

The Suggestion, Occurrence, Solution (SOS) system is the administrative program used to document, resolve, track and trend concerns which fall within the scope of Callaway's Corrective Action Program.[1]

Once a concern is identified, an SOS must be generated within a time limit consistent with its potential safety implications as defined in section 2.15 of procedure APA-ZZ-00500. Any immediate actions taken must also be documented. The SOS is then sent to the Licensing and Fuels/Site Licensing department (LFSL) where it is reviewed for reportability and assigned to the appropriate departments for resolution.

During resolution of the SOS it may be necessary to initiate other documents, such as a request to perform an engineering or operability evaluation. These documents are then referenced in the SOS and tracked through closure.

The resolution of an SOS contains a determination of cause (for occurrence only) as well as the corrective actions necessary to prevent future problems. The corrective actions may take the form of document revisions, training or even a modification.

Other related procedures include:

FDP-ZZ-05401, "Administration of Suggestion, Occurrence, Solution (SOS) Corrective Action Program."

GDP-ZZ-01610, "Quality Assurance Corrective Action Procedure."

[1]Plant Administrative Procedure APA-ZZ-00500, "Corrective Action Program."

RFR PROGRAM

The Request For Resolution (RFR) program[2] has been in existence at Callaway since 1984. It has recently underwent an extensive enhancement to integrate it into Callaway's Nuclear Information System (NIS)[3]. In the current paperless configuration an RFR is initiated, approved and dispositioned completely on-line. RFR's are used to request engineering and operability evaluations, design changes, clarification's on drawings and part numbers, and material equivalencies.

The MOV program takes full advantage of the RFR program and has used all facets of the system. However, the major uses of the program are to formally document evaluations and to request modifications.

Evaluations are divided into two major categories; engineering and operability. Although the methods of evaluation are similar, the operability evaluation only deals with concerns on operability as defined in the Technical Specifications. All operability evaluations are reviewed by the Onsite Review Committee (ORC).

CALLAWAY MODIFICATIONS TO IMPROVE MARGIN

The following is a list of approved modifications which improve the performance and increase the margin of MOV's at Callaway. All modifications are currently scheduled to be complete by the end of Callaway's Spring 1995 refuel outage.

CMP 87-1029 Implementation completed 11/20/87
Description: Rewire limit switches on Limitorque valve operators. Relocate the bypass limit switch on valves AL-HV-30, 31, 32, 33, 34, 35, 36 and FC-HV-312 to ensure the valve will open under load.

CMP 88-1020 Implementation completed 11/16/90
Description: Isolate the bypass limit switch in the Limitorque operators for 78 valves. This will allow the bypass limit switch to be adjusted to ensure the valve will not trip on high opening torque.

CMP 88-1021 Implementation completed 7/17/91
Description: Isolate the bypass limit switch in the Limitorque operators for 21 valves. This will allow the bypass limit switch to be adjusted to ensure the valve will not trip on high opening torque.

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[2]APA-ZZ-00604, Requests for Resolution, EDP-ZZ-04015, Evaluating and Processing Requests for Resolution.

[3]The Callaway Nuclear Information System is a mainframe computer system comprised of several individual applications.

CMP 88-1023 Implementation completed 5/24/91
Description: Revise the Limitorque valve breaker instantaneous breaker set points on 74 valves to avoid tripping on valve reversal.

CMP 89-1015 Implementation completed 5/3/91
Description: Change the control circuitry for valves EG-HV-72,73,74,75 to close on torque not limit and KC-HV-253 to close on limit rather than torque.

CMP 89-1019 Implementation completed 8/7/92
Description: Install a heavier spring pack on EJHV8716A/B to increase thrust capability and add additional margin to ensure valve will close against design DP.

CMP 89-1028 Implementation completed 3/24/92
Description: Replace solenoid operated BG-HV-8357A&B with motor operated high pressure drop valves and use manual gate valves on stop check valves upstream to facilitate maintenance.

CMP 91-1004 Implementation completed 11/10/93
Description: Replace penetration valves EFHV0031, 32, 33, 34, 45, 46, 47, 48, 49 & 50 with stainless steel valves that will provide additional isolation capability. Also, increase torque capability on EFHV0047 & 48, install heavier spring packs and replace the 2 ft-lb. motors with 5 ft-lb. motors.

CMP 92-1003 Implementation completed 5/8/92
Description: Install larger actuators on MOV's EG-HV-0062, EM-HV-8807 A&B, and EM-HV-8923 A&B. Also, install power lockout on EM-HV-8924.

CMP 92-1006 Implemented retirement 5/92. Remainder of implementation scheduled for completion before the end of 1995 spring refuel outage.
Description: Retire and remove MOV's KJHV0001, KJHV0002, KJHV0101 and KJHV0102.

CMP 92-1011 Implementation completed 5/8/92
Description: Install a heavier spring pack on EGHV0060 to increase thrust capability and add additional margin to ensure valve will close against design DP.

CMP 92-1053 Implementation scheduled for completion before the end of 1995 spring refuel outage.
Description: Retirement of spray additive tank, TEN01. This will retire MOV's ENHV0015 and ENHV0016.

CMP 93-1058 Implementation scheduled for completion before the end of 1995 spring refuel outage.
Description: Change in control wiring. EJHV8716A and EJHV8716B will be changed to close on limit. EGHV0062, a Velan parallel slide valve, will be rewired to allow the close torque switch to be bypassed until the valve is in the full close position.

CMP 94-1006 Implementation scheduled for completion before the end of 1995 spring refuel outage.
Description: Change in gear ratios on MOV's BBPV8702A, BBPV8702B, EJHV8701A and EJHV8701B in order to increase the actuator torque rating.

CMP 94-1011 Implementation scheduled for completion before the end of 1995 spring refuel outage.
Description: Modification to ALHV0034, ALHV0035, BBHV8000A, BBHV8000B, BGLCV0112C, ENHV0006, ENHV0012 and FCHV0312 in order to increase their reduced voltage output torque. Changes of motors, gearing, stems and overload heaters is included in this modification.

Chapter 7: Industry Involvement and Information

Union Electric recognizes that certain generic issues require consistent and uniform approaches from the industry for resolution. Thus, Union Electric continues to be an active particiapnt in industry initiatives through the Electric Power Research Institute (EPRI), the Nuclear Utility Management Resources Council (NUMARC), and other collaborative efforts. Examples of our involvement are:

Active Membership In:

- MOV USER GROUP (MUG)
- Region III, Midwest Nuclear Engineering Managers Forum, MOV Subcommittee
- NMAC/EPRI including participating as a member of the MOV Predictive Performance Program TAG Subcommittee

Participation in KALSI Engineering's Limitorque Thrust/Torque Rating Increase Qualification Program. Refer to the previous discussion of KALSI testing in Chapter 3 for additional information.

Developmental Support of MOV NMAC/EPRI Guides
(attended meetings, helped write and review guides, provided test equipment)

- LUBRICATION GUIDE (TR-102135)
- APPLICATION GUIDE (NP-6660-D)
- TECH REPAIR GUIDES (TR-100539) (NP-6229) (NP-7214)
- FRICTION SEPARATE EFFECTS (TR-103119)
- GLOBE VALVE MODULE ENG MODEL REPORT (MPR-1420)

Vendor Information:

Awareness of vendor information such as technical bulletins, maintenance instructions, good practices, etc., is controlled through the Vendor Equipment Technical Information Review Program (VETIP). Such information received by Union Electric is reviewed and assessed in accordance with the governing procedures.

EDP-ZZ-06000, "Vendor Equipment Technical Information Review Program" establishes the program to control vendor updates, 10CFR21's, and issues with CATS to track

APA-ZZ-00006, "Licensing and Fuels Organization and Responsibility" establishes the Licensing and Fuels Organization which is responsible to distribute Generic Letters and Bulletins to the appropriate Supervisor for review

INTERNAL AUDITS:

The Callaway Plant Quality Assurance (QA) Department has conducted several audits and independent assessments of the MOV testing program. These internal audits[1] have been useful in identifying program strengths/weaknesses as well as suggesting program enhancements. QA personnel involved with these audits have independently reviewed the program elements from design basis differential pressure determinations through final review of the test data. Any corrective action required as a result are followed through completion to ensure that concerns are adequately addressed.

The most recent audit[2] evaluated MOV: design basis reviews, sizing and switch settings, testing, periodic testing to ensure continued capability, corrective actions and trending, program schedule, and industry issues. This audit was previously scheduled for late in the first quarter of 1994. At the request of Nuclear Engineering, the audit was completed prior to the phase II inspection in January of 1994. The audit assessed Union Electric's preparations for the NRC Phase II inspection. No major concerns were identified by the audit and only one open issue related to pressure locking/thermal binding (industry issue without a published NRC position). In summary, the audit determined that the Callaway program "effectively ensures MOV operability under design basis and differential pressure and flow conditions."

In addition to audits, QA has also performed surveillances[3] of the MOV program against the requirements of Generic Letter 89-10. The surveillances focus directly on the MOV program to assess its effectiveness.

The specific findings of the above activities can be found in the referenced reports, however, QA has generally found the Callaway MOV Program to be effective and in compliance with regulatory requirements. QA has provided several suggestions on program improvements which have been addressed by the responsible parties. No major program revisions were required as a result of QA audits or independent assessments.

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[1]Reference Audit Reports AP90-018, AP91-022 and AP92-016 for additional information.

[2]Reference Audit Report AP93-021.

[3]Reference Surveillance Reports SP90-067, "Independent Assessment of Motor-Operated Valve Testing Program," SP91-082, "Assessment of Motor-Operated Valve Test Program," and SP-92-031, "Motor-Operated Valve Testing Conducted During Refuel V" for additional information.

EXTERNAL AUDITS

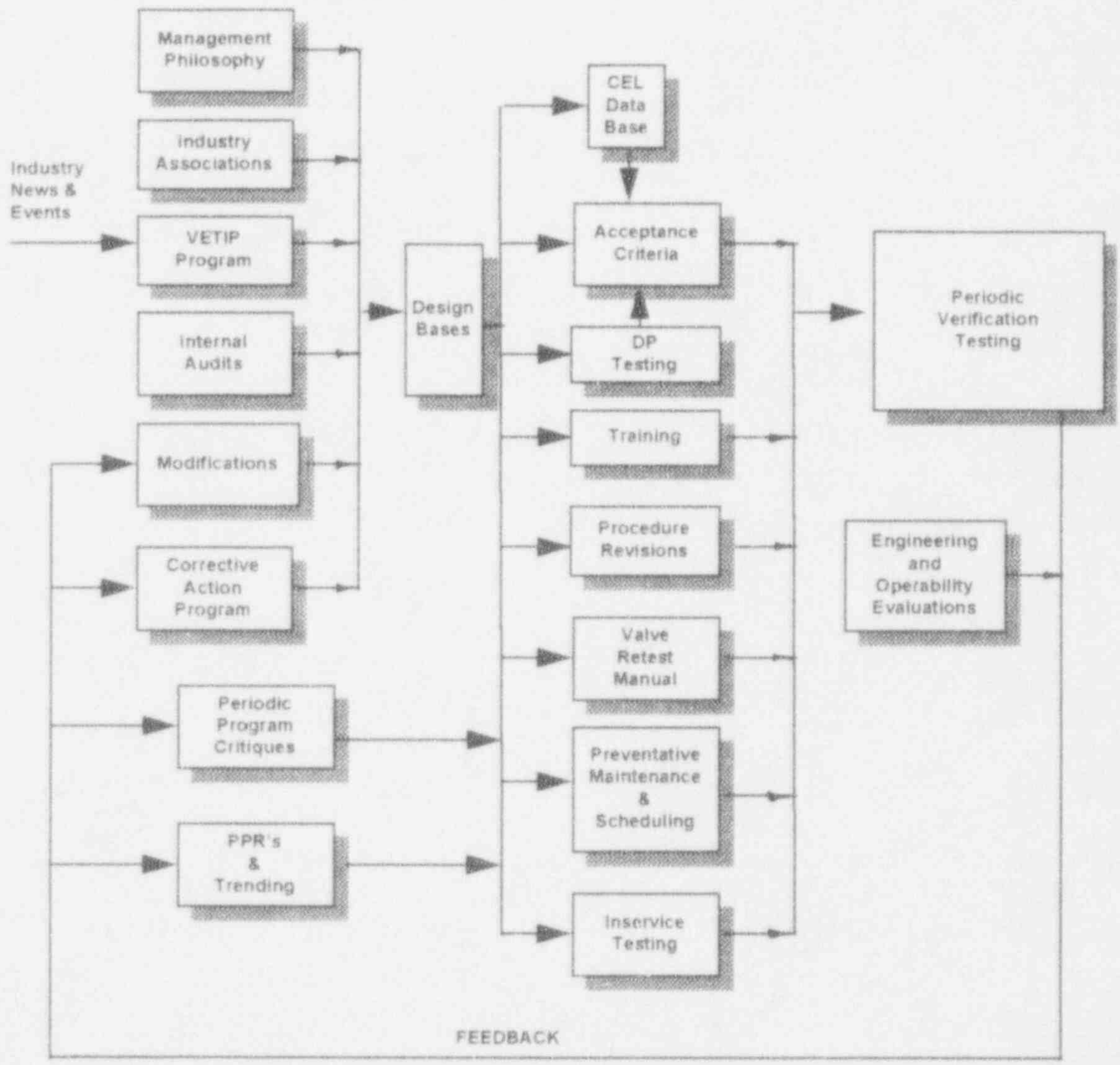
In May of 1990, Callaway Plant received an inspection of maintenance and inservice testing.[4] The conclusion of the inspection related to MOV testing stated that Callaway had "addressed all of the significant aspects" of Bulletin 85-03.

In January of 1992, Callaway Plant received an announced special team inspection[5] to assess response to Generic Letter 89-10. The inspection focused on Part I of Temporary Instruction (TI) 2515/109, "Inspection Requirements for Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance," which involved a review of the program established. No violations of NRC requirements and one open item were identified. The open item concerned the need to confirm the use of the proper MOV motor power factor in the calculation of degraded voltage performance. This has been addressed[6] and is discussed in Chapter 3. This open item was closed during the phase II inspection. Strengths were identified as partial testing on MOV's every 18 months for the purpose of trending and performance of full-flow differential pressure testing on MOV's in both the opening and closing directions.

In January of 1994, Callaway Plant received the Generic Letter 89-10 Phase II Inspection. No violations and no operability concerns were identified. The inspectors noted that Callaway had made excellent progress towards meeting the intent of the Generic Letter. The inspectors also assessed Callaway's MOV testing as a strength in that it was comprehensive enough to identify lubrication degradation. Further, they felt that the program is structured such that new information can be evaluated in a timely manner, and the effect on MOV's is immediately apparent. Only one Unresolved Item (UI) was identified regarding pressure locking and thermal binding. As noted previously, this is an industry open item and further guidance from the staff is anticipated in the near future.

[4]USNRC Inspection Report 50-843/90010(DRS).
[5]USNRC Inspection Report No. 50-483/91020(DRS).
[6]Reference letter ULNRC-2592, March 16, 1992, on file in file number A160.0761.

CALLAWAY MOV PROGRAM



PPR = Predictive Performance Report
VETIP = Vendor Equipment Technical Information Program
CEL = Callaway Equuipment List

Figure 1

System	Style	Number	OPEN	CLOSE	RFR	Rev.
AL	HV	5	1725	1725	5353	X
AL	HV	7	1725	1725	5353	X
AL	HV	9	1725	1725	5353	X
AL	HV	11	1725	1725	5353	X
AL	HV	30	140	140	5353	X
AL	HV	31	140	140	5353	X
AL	HV	32	140	140	5353	X
AL	HV	33	141	141	5353	X
AL	HV	34	25	135	8746	D
AL	HV	35	25	135	8746	D
AL	HV	36	25	135	8746	D
BB	HV	13	145	2335	5353	X
BB	HV	14	156	2335	5353	X
BB	HV	15	145	2335	5353	X
BB	HV	16	145	2335	5353	X
BB	HV	8000A	2485	2335	5353	X
BB	HV	8000B	2485	2335	5353	X
BB	HV	8037A	104	104	5353	X
BB	HV	8037B	104	104	5353	X
BB	HV	8351A	0	0	5353	X
BB	HV	8351B	0	0	5353	X
BB	HV	8351C	0	0	5353	X
BB	HV	8351D	0	0	5353	X
BB	PV	8702A	380	464	14612	A
BB	PV	8702B	380	464	14612	A
BG	HV	8100	155	155	5353	X
BG	HV	8104	125	125	5353	X
BG	HV	8105	2750	2750	5353	X
BG	HV	8106	2750	2750	5353	X
BG	HV	8109	94	2818	5353	X
BG	HV	8110	2750	2750	5353	X
BG	HV	8111	2750	2750	5353	X
BG	HV	8112	155	155	5353	X
BG	LCV	112B	100	100	5353	X
BG	LCV	112C	100	100	5353	X
BG	HV	8357A	2722	2722	***	***
BG	HV	8357B	2722	2722	***	***
BN	HV	3	32	32	5353	X
BN	HV	4	32	32	5353	X
BN	HV	8813	1552	1552	5353	X
BN	LCV	112D	92	242	5353	X
BN	LCV	112E	92	242	5353	X

Table 1: Calculated Differential Pressures (psid)

Table 1 (cont.)

System	Style	Number	OPEN	CLOSE	RFR	Rev.
BN	HV	8806A	50	241	5353	X
BN	HV	8806B	50	241	5353	X
BN	HV	8812A	33	33	5353	X
BN	HV	8812B	33	33	5353	X
EC	HV	11	119	119	5353	X
EC	HV	12	119	119	5353	X
EF	PDV	19	134	134	5353	X
EF	PDV	20	134	134	5353	X
EF	HV	23	81	81	14572	A
EF	HV	24	81	81	14572	A
EF	HV	25	81	81	14572	A
EF	HV	26	81	81	14572	A
EF	HV	31	134	134	5353	X
EF	HV	32	134	134	5353	X
EF	HV	33	131	131	5353	X
EF	HV	34	131	131	5353	X
EF	HV	37	144	144	5353	X
EF	HV	38	144	144	5353	X
EF	HV	39	146	81	14572	A
EF	HV	40	146	81	14572	A
EF	HV	41	146	81	14572	A
EF	HV	42	146	81	14572	A
EF	HV	45	131	131	5353	X
EF	HV	46	131	131	5353	X
EF	HV	47	0	50	13506	A
EF	HV	48	0	50	13506	A
EF	HV	49	10	50	13506	A
EF	HV	50	10	50	13506	A
EF	HV	51	123	123	5353	X
EF	HV	52	123	123	5353	X
EF	HV	59	60	60	5353	Z
EF	HV	60	60	60	5353	Z
EF	HV	65	20	20	13324	A
EF	HV	66	20	20	13324	A
EF	HV	97	125	125	5353	X
EF	HV	98	125	125	5353	X
EG	HV	11	123	123	5353	X
EG	HV	12	122	122	5353	X
EG	HV	13	123	123	5353	X
EG	HV	14	122	122	5353	X
EG	HV	15	109	109	5353	X
EG	HV	16	109	109	5353	X

Table 1 (cont.)

Table 1 (cont.)

System	Style	Number	OPEN	CLOSE	RFR	Rev.
EG	HV	53	109	109	5353	X
EG	HV	54	108	108	5353	X
EG	HV	58	112	112	5353	X
EG	HV	59	112	112	5353	X
EG	HV	60	112	112	5353	X
EG	HV	61	112	112	5353	X
EG	HV	62	112	2335	5353	X
EG	HV	71	0	0	9861	C
EG	HV	72	105	105	5353	X
EG	HV	73	105	105	5353	X
EG	HV	74	105	105	5353	X
EG	HV	75	105	105	5353	X
EG	HV	101	104	104	5353	X
EG	HV	102	109	109	5353	X
EG	HV	126	0	0	9861	C
EG	HV	127	0	0	9861	C
EG	HV	130	0	0	9861	C
EG	HV	131	0	0	9861	C
EG	HV	132	0	0	9861	C
EG	HV	133	0	0	9861	C
EJ	FCV	610	200	200	5353	X
EJ	FCV	611	200	200	5353	X
EJ	HV	8840	228	228	5353	X
EJ	HV	8701A	380	464	14612	A
EJ	HV	8701B	380	464	14612	A
EJ	HV	8716A	228	228	5353	X
EJ	HV	8716B	228	228	5353	X
EJ	HV	8804A	251	251	5353	X
EJ	HV	8804B	251	251	5353	X
EJ	HV	8809A	228	228	5353	X
EJ	HV	8809B	228	228	5353	X
EJ	HV	8811A	53	53	5353	X
EJ	HV	8811B	53	53	5353	X
EM	HV	8835	0	249	5353	X
EM	HV	8801A	2713	2169	5353	X
EM	HV	8801B	2713	2169	5353	X
EM	HV	8802A	250	250	5353	X
EM	HV	8802B	250	250	5353	X
EM	HV	8803A	2724	2180	5353	X
EM	HV	8803B	2724	2180	5353	X
EM	HV	8807A	0	0	5353	X
EM	HV	8807B	0	0	5353	X

Table 1 (cont.)

Table 1 (cont.)

System	Style	Number	OPEN	CLOSE	RFR	Rev.
EM	HV	8814A	1552	1552	5353	X
EM	HV	8814B	1552	1552	5353	X
EM	HV	8821A	1552	1734	5353	X
EM	HV	8821B	1552	1734	5353	X
EM	HV	8923A	50	215	9861	B
EM	HV	8923B	50	215	9861	B
EN	HV	1	54	54	5353	X
EN	HV	6	244	0	5353	S
EN	HV	7	54	54	5353	X
EN	HV	12	244	0	5353	S
EN	HV	15	18	18	5353	X
EN	HV	16	18	18	5353	X
EP	HV	8808A	0	0	5353	X
EP	HV	8808B	0	0	5353	X
EP	HV	8808C	0	0	5353	X
EP	HV	8808D	0	0	5353	X
FC	HV	312	1220	1220	5353	X
GS	HV	20	3	48.1	5353	X
GS	HV	21	3	48.1	5353	X
KA	HV	30	148.5	148.5	5353	R
KC	HV	253	189	189	5353	X
LF	HV	95	10	58	5353	X
LF	HV	105	18	18	5353	X
LF	HV	106	18	18	5353	X

Notes: ***: These valves were evaluated in Callaway Modifcation Package CMP 89-1028 revision A.

Numbers under the "OPEN" column reflect the maximum calculated differential pressure (psid) for opening. Similarly, numbers under the "CLOSE" column reflect the maximum calculated differential pressure for closing.

Reference to "Document" and "Rev." corresponds to the Engineering Request for Resolution where the determination of maximum differential pressure is documented (e.g., RFR-05353 revision X).

VALVE ID	NOUN NAME	TEST DATES					
		DP TEST	INITIAL BASELINE	ADDITIONAL TESTING			
ALHV0005	MDAFP B TO S/G D HV	04/87	04/87	03/88	01/89	03/91	7/92 (F) TTC
ALHV0007	MDAFP B TO S/G A HV	04/87	04/87	03/88	02/89	03/91	7/92 (F) TTC
ALHV0009	MDAFP B TO S/G B HV	05/87	05/87	02/89	10/91	02/91	9/93 (F) TTC
ALHV0011	MDAFP B TO S/G C HV	04/87	04/87	03/88	03/89	02/91	3/93 (F) TTC
ALHV0030	ESW TO MD AFP B HV	04/87	03/91	04/87 02/93	02/89	05/89	01/90
ALHV0031	ESW TO MD AFP A HV	05/87	04/92	05/87 05/91	02/89 4/92 (F)	12/89	11/90
ALHV0032	ESW TO TD AFP HV	10/87	04/92	10/87 4/92 (F)	05/89	03/90	10/91
ALHV0033	ESW TO TD AFP HV	04/87	04/91	04/87 09/92	01/89	05/89	05/91
ALHV0034	CST TO MD AFP B HV	04/87	04/87	01/89	4/92 TTC		
ALHV0035	CST TO MD AFP A HV	04/87	04/87	02/89	05/91	4/92 TTC	10/92
ALHV0036	CST TO TD AFP HV	04/87	04/87	01/89	04/91	4/92 TTC	09/92
BBHV0013	RCP A THRM BAR COOL COIL COOL WTR OUT HV	04/92	4/92 TTC	10/93			
BBHV0014	RCP B THRM BAR COOL COIL COOL WTR OUT HV	04/92	4/92 TTC	10/93			
BBHV0015	RCP C THRM BAR COOL COIL COOL WTR OUT HV	04/92	4/92 TTC	10/93			
BBHV0016	RCP D THRM BAR COOL COIL COOL WTR OUT HV	04/92	4/92 TTC	11/93 TTC			
BBHV8000A	RCS PZR OUT PWR OPER RLF HV		10/90	3/92 TTC			
BBHV8000B	RCS PZR OUT PWR OPER RLF HV		10/90	4/92 (F) TTC			
BBHV8037A	RCS PRT OUT TO CTMT NORM SMP ISO HV		3/92 TTC	11/93 TTC			
BBHV8037B	RCS PRT OUT TO CTMT NORM SMP ISO HV		3/92 TTC	10/93 TTC			
BBHV8351A	RCP A SEAL WTR SPLY ISO HV		10/90	4/92 TTC			
BBHV8351B	RCP B SEAL WTR SPLY ISO HV		10/90	4/92 TTC			
BBHV8351C	RCP C SEAL WTR SPLY ISO HV		10/90	4/92 TTC			
BBHV8351D	RCP D SEAL WTR SPLY ISO HV		10/90	4/92 TTC			
BBPV8702A	RCS LOOP 1 HOT LEG TO RHR PMPS PCV ISO		04/89	10/90	04/92	10/93 TTC	

TTC = Torque/Thrust Cell
(F) = Baseline MOVATS Testing
SSR = Stem Strain Ring

Table 2 Valve ID's, Names, and Test Dates

VALVE ID	NOUN NAME	TEST DATES					
		DP TEST	INITIAL BASELINE	ADDITIONAL TESTING			
BBPV8702B	RCS LOOP 4 HOT LEG TO RHR PMPS PCV ISO		04/89	10/90	04/92	10/93 TTC	
BGHV8100	SEAL WTR RTN OUTER CTMT ISO		04/92 TTC	10/93			
BGHV8104	EMERG BORATE TO CCP A & B HDR ISO HV	10/93	03/91	11/92 (F) TTC			
BGHV8105	CVCS CHARGING HDR TO REGEN HX OUTER CTMT ISO VLV	09/87	10/87	04/89	10/90	4/92 TTC	
BGHV8106	CVCS CHARGING HDR TO REGEN HX OUTER CTMT ISO VLV	09/87	10/87	04/89	10/90	4/92 (F) TTC	
BGHV8109	CVCS PDP RECIRC TO VCT HV		02/92				
BGHV8110	A CCP DISCH MINIFLOW TO SEAL WTR HX ISO	09/87	01/88	11/89	03/91	10/92 (F) TTC	
BGHV8111	CCP B DISCH MINIFLOW ISO VLV	10/87	01/88	11/89	01/91	11/92 (F) TTC	
BGHV8112	SEAL WTR RTN INNER CTMT ISO HV		09/90	04/87	01/89	4/92 TTC	10/93
BGHV8357A	CVCS CCP A DISCH TO RCP SEALS THROT VLV	04/92	04/92 TTC	10/92	10/93		
BGHV8357B	CVCS CCP B DISCH TO RCP SEALS THROT VLV	04/92	04/92 TTC	11/92			
BGLCV112B	CVCS VCT OUT UPSTRM ISO		09/87	04/89	10/90	4/92 TTC	10/93
BGLCV112C	CVCS VCT OUT DNSTRM ISO		09/87	04/90	10/90	4/92 TTC	10/93
BNHV0003	RWST TO CTMT SPRY PMP B HV		08/91	4/92 (F) TTC	7/93 TTC		
BNHV0004	RWST TO CTMT SPRY PMP A HV		05/91	3/92 (F) TTC			
BNHV8806A	SI PMP A SUCT FROM RWST ISO	10/87	12/87	11/89	6/91 (F)	1/93 TTC	
BNHV8806B	SI PUMPS SUCT FROM RWST ISO	10/87	01/88	11/89	04/90	07/91	2/93 TTC
BNHV8812A	RWST TO RHR PMP [illegible]CT ISO VLV		07/91	6/93 TTC			
BNHV8812B	RWST TO RHR PMP [illegible]CT ISO VLV		05/91	10/92 TTC			
BNHV8813	SI PMPS MINIFLOW TO RWST ISO VLV(3.0.3)	10/87	09/87	04/89	10/90	4/92 (F) TTC	10/93
BNLCV112D	CCP A SUCT FROM RWST ISO VLV	10/87	10/87	04/89	10/90	4/92 TTC	10/93
BNLCV112E	CCP B SUCT FROM RWST ISO VLV	10/87	10/87	04/89	10/90	4/92 TTC	
ECHV0011	FUEL POOL HX A SHELL SIDE CCW OUT ISO	01/92	01/92				
ECHV0012	FUEL POOL HX B SHELL SIDE CCW OUT ISO	02/92	03/92				
EFHV0023	SERV WTR/ESW TRN A XCON HV	07/92	05/91	03/93	11/93		
EFHV0024	SERV WTR ESW TRN B XCON HV	10/92	09/91	11/92			

TTC = Torque/Thrust Cell

(F) = Baseline MOVATS Testing

SSR = Stem Strain Ring

Table 2: Valve ID's, Names, and Test Dates

VALVE ID	NOUN NAME	TEST DATES					
		DP TEST	INITIAL BASELINE	ADDITIONAL TESTING			
EFHV0025	SERV WTR ESW TRN A XCON HV	11/93	05/91	03/93	10/93 (F)	11/93	
EFHV0026	SERV WTR/ESW TRN B XCON HV	10/92	09/91	03/93	10/93		
EFHV0031	ESW TRN A TO CTMT AIR CLRS OUTER CTMT HV	10/93	10/93				
EFHV0032	ESW TRN B TO CTMT AIR CLRS OUTER CTMT HV	10/93	11/93				
EFHV0033	ESW TRN A TO CTMT AIR CLRS INNER CTMT HV	10/93	10/93	10/93			
EFHV0034	ESW TRN B TO CTMT AIR CLRS INNER CTMT HV	10/93	11/93				
EFHV0037	ESW TRN A TO UHS HV	11/93	08/91	1/93 (F)	10/93 (F)		
EFHV0038	ESW TRN B TO UHS HV	12/93	12/91	5/92 (F)	10/93 (F)		
EFHV0039	ESW TRN A TO SERV WTR UPSTRM HV	07/92	05/91				
EFHV0040	ESW TRN B TO SERV WTR UPSTRM HV	10/92	09/91				
EFHV0041	ESW TRN A TO SERV WTR DNSTRM HV	07/92	05/91				
EFHV0042	ESW TRN B TO SERV WTR DNSTRM HV	12/93	09/91	11/93 (F)			
EFHV0045	ESW TRN A FROM CTMT AIR CLRS INNER CTMT HV	10/93	11/93				
EFHV0046	ESW TRN B FROM CTMT AIR CLRS INNER CTMT HV	11/93	10/93				
EFHV0047	ESW TRN A FROM CTMT AIR CLRS BYP ISO HV	10/92	10/93				
EFHV0048	ESW TRN B FROM CTMT AIR CLRS BYP ISO HV	11/93	10/93				
EFHV0049	ESW TRN A FROM CTMT AIR CLRS OUTER CTMT HV	10/93	10/93				
EFHV0050	ESW TRN B FROM CTMT AIR CLRS OUTER CTMT HV	11/93	10/93				
EFHV0051	ESW TRN A TO CCW HX A HV	10/91	10/91				
EFHV0052	ESW TRN B TO CCW HX B HV	10/92	01/92				
EFHV0059	ESW TRN A FROM CCW HX A HV	10/91	10/91	8/92 (F)			
EFHV0060	ESW TRN B FROM CCW HX B HV	01/92	01/92				
EFHV0065	ESW UHS COOL-TWR TRN A BYP HV	08/91	08/91	4/92 (F)	01/93		
EFHV0066	ESW UHS COOL-TWR TRN B BYP HV	06/91	06/91	12/91	4/92 (F)	11/92	
EFHV0097	ESW PMP A DISCH RECIRC HV	03/90	03/90	08/91	1/93 TTC		
EFHV0098	ESW PMP B DISCH RECIRC HV	03/90	06/90	06/91	10/92 TTC		
EFPDV0019	ESW S-C STR A DRN DP CTRL VLV		05/92 TTC				
EFPDV0020	ESW S-C STR B DRN DP CTRL VLV		12/91	10/92 TTC			

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Table 2: Valve ID's, Names, and Test Dates

VALVE ID	NOUN NAME	TEST DATES					
		DP TEST	INITIAL BASELINE	ADDITIONAL TESTING			
EGHV0011	ESW TO CCW TRN A UPSTRM HV		04/92				
EGHV0012	ESW TO CCW TRN B UPSTRM HV		02/91	04/92			
EGHV0013	ESW TO CCW TRN A DNSTRM HV		05/92				
EGHV0014	ESW TO CCW TRN B DNSTRM HV		02/91	04/92			
EGHV0015	CCW TRN A SPLY/RTN ISO HV	04/92	04/92	11/93			
EGHV0016	CCW TRN B SPLY/RTN ISO HV	04/92	05/92				
EGHV0053	CCW TRN A SPLY ISO HV	04/92	04/92				
EGHV0054	CCW TRN B SPLY ISO HV	04/92	05/92	05/92	11/93		
EGHV0058	CCW TO CTMT OUTER ISO HV	05/89	05/89	09/90	3/92 TTC	10/93 TTC	
EGHV0059	CCW FROM CTMT OUTER ISO VLV	05/89	05/89	09/90	3/92 TTC	10/93 TTC	
EGHV0060	CCW FROM RCS IN CTMT ISO HV	05/92	05/89	09/90	5/92 (F) TTC	10/93	
EGHV0061	CCW FROM RCP THRM BAR OUTER CTMT ISO	10/90	09/89	09/90	3/92 TTC	10/93 TTC	
EGHV0062	CCW FROM RCS IN CTMT ISO HV		09/90	04/92	10/93		
EGHV0071	CCW TO CTMT OUTER ISO VLV	05/89	04/89	10/90	3/92 TTC	10/93	
EGHV0072	CCW TO PASS UPSTRM ISO HV	05/91	05/91	09/92			
EGHV0073	CCW TO PASS DNSTRM ISO HV	05/91	05/91	09/92			
EGHV0074	CCW FROM PASS UPSTRM ISO HV	05/91	05/91	09/92			
EGHV0075	CCW FROM PASS DNSTRM ISO HV	05/91	05/91	09/92			
EGHV0101	CCW TO RHR HX A ISO	01/92	01/92				
EGHV0102	CCW TO RHR HX B ISO	02/92	02/91	09/92			
EGHV0126	CCW TO CTMT BYP VLV	05/89	05/89	09/90	3/92 TTC		
EGHV0127	CCW TO CTMT BYP ISO VLV	05/89	05/89	10/90	3/92 TTC		
EGHV0130	CCW FROM RCS CTMT EGHV0060 BYP ISO HV	05/89	05/89	10/90	10/90 (F)	3/92 TTC	
EGHV0131	CCW FROM CTMT EGHV0059 BYP ISO	05/89	09/90	3/92 (F) TTC			
EGHV0132	CCW FROM RCS CTMT EGHV0062 BYP ISO HV		09/90	3/92 (F) TTC			
EGHV0133	CCW FROM RCP THRM BAR EGHV0061 BYP ISO	10/90	09/90	09/89	3/92 TTC	10/93 TTC	
EJFCV0610	A RHR PMP MINIFLOW RECIRC FLOW CTRL VLV	04/92	04/92	10/93 TTC			
EJFCV0611	RHR PUMP B MINIMUM FLOW CTRL VLV	04/92	04/92	3/93 TTC	10/93 TTC		

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Table 2: Valve ID's, Names, and Test Dates

VALVE ID	NOUN NAME	TEST DATES					
		DP TEST	INITIAL BASELINE	ADDITIONAL TESTING			
EJHV8701A	RHR PUMP A SUCT ISO		04/89	10/90	04/92	10/93 TTC	
EJHV8701B	RHR PUMP B SUCT ISO		05/89	10/90	04/92	10/93 TTC	
EJHV8716A	RHR TRN A SI SYS HOT LEG RECIRC ISO (3.0.3)	09/90	05/89	09/90 10/93	4/92 TTC	4/92 (F) TTC	04/93
EJHV8716B	RHR TRN B SI SYS HOT LEG RECIRC ISO (3.0.3)	09/90	04/89	09/90	4/92 (F) TTC	10/93	
EJHV8804A	RHR TRN A CHARGING PUMPS SPLY ISO	09/90	10/90	09/90	4/92 TTC		
EJHV8804B	RHR TRN B SI PUMPS SPLY ISO	10/93	10/90	4/92 TTC			
EJHV8809A	RHR TRN A ACC INJ SPLY ISO (3.0.3)	09/90	05/89	10/90	4/92 SSR	10/93 TTC	
EJHV8809B	RHR TRN B ACC INJ SPLY ISO (3.0.3)	09/90	04/89	10/90	4/92 SSR	10/93 TTC	
EJHV8811A	CTMT RECIRC SUMP A TO RHR PUMP A SUCT ISO		10/90	4/92 TTC	10/93		
EJHV8811B	CTMT RECIRC SUMP B TO RHR PUMP B SUCT ISO		10/90	4/92 TTC	10/93 TTC		
EJHV8840	RHR TRN A & B SI SYS HOT LEG RECIRC ISO (3.0.3)	10/90	04/89	10/90 (F)	4/92 SSR	10/93 TTC	
EMHV8801A	BIT OUT TO COLD LEGS ISO A	09/87	04/88	05/89	10/90 (F)	4/92 (F) TTC	
EMHV8801B	BIT OUT TO COLD LEGS ISO B	09/87	04/88	05/89	10/90 (F)	3/92 TTC	
EMHV8802A	SI PMP A DISCH TO HOT LEG INJ ISO (3.0.3)	09/90	10/90	3/92 (F) TTC			
EMHV8802B	SI PMP B DISCH TO HOT LEG INJ ISO (3.0.3)	08/90	10/90	3/92 TTC			
EMHV8803A	BIT SPLY FROM CCP A ISO	09/87	01/88	12/87	11/89	03/91	10/92 (F) TTC
EMHV8803B	BIT SPLY FROM CCP B ISO	10/87	01/88	11/89	1/91 (F)	11/92 TTC	11/93 TTC
EMHV8807A	RHR HX A TO SI PMPS SUCT DNSTRM ISO VLV A		06/91	4/92 (F) TTC			
EMHV8807B	RHR HX A TO SI PMPS SUCT DNSTRM ISO VLV B		07/91	4/92 (F) TTC			
EMHV8814A	SI PMP A RECIRC TO RWST ISO	10/87	01/88	11/89	06/91	8/92 (F) TTC	
EMHV8814B	SI PMP B RECIRC TO RWST ISO	10/87	01/88	11/89	01/91	8/92 (F) TTC	
EMHV8821A	SI PMP A DISCH TO COLD LEG INJ ISO	10/87	12/87	11/89	03/91	8/92 (F) TTC	
EMHV8821B	SI PMP B DISCH TO COLD LEG INJ ISO	10/87	01/88	04/89 11/93 TTC	11/89	07/91	2/93 TTC
EMHV8835	SI PMPS DISCH TO COLD LEG INJ ISO (3.0.3)	10/87	10/87	04/89	10/90 (F)	4/92 TTC	
EMHV8923A	RWST TO SI PMP A SUCT ISO HV (3.0.3)	10/87	10/87	04/89	10/90	4/92 (F) TTC	
EMHV8923B	RWST TO SI PMP B SUCT ISO HV	10/87	10/87	05/89	07/90	4/92 (F) TTC	

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Table 2: Valve ID's, Names, and Test Dates

VALVE ID	NOUN NAME	TEST DATES					
		DP TEST	INITIAL BASELINE	ADDITIONAL TESTING			
ENHV0001	CTMT RECIRC SMP TO CTMT SPRY PMP A HV		10/90	4/92 (F) TTC			
ENHV0006	CTMT SPRY PMP A DISCH HV		05/91	3/92 TTC	9/92 TTC	11/93 TTC	
ENHV0007	CTMT RECIRC SMP TO CTMT SPRY PMP B HV		04/89	10/90	4/92 SSR	11/93 SSR	
ENHV0012	CTMT SPRY PMP B DISCH HV		08/91	3/92 TTC	7/92 TTC	11/93 TTC	
ENHV0015	CTMT SPRY A ADD SPLY HV		10/91	9/92 TTC			
ENHV0016	CTMT SPRY B ADD SPLY HV		11/91	1/93 (F) TTC			
EPHV8808A	SI ACC TK A OUT ISO		04/92	10/93 P.E.			
EPHV8808B	SI ACC TK B OUT ISO		04/92	10/93 P.E.			
EPHV8808C	SI ACC TK C OUT ISO		04/92	10/93 P.E.			
EPHV8808D	SI ACC TK D OUT ISO		04/92	10/93 P.E.			
FCHV0312	AFP TURB MECH TRIP/THROT HV	11/87	01/88	11/87	11/89	05/90	10/91
				05/92	08/93	10/93 (F)	
GSHV0020	H2 PURGE IN CTMT ISO HV		11/93	04/92			
GSHV0021	H2 PURGE OUTER CTMT ISO HV		11/93	08/91			
KAHV0030	H2 CTRL SYS M/U AIR HV		05/92 TTC				
KCHV0253	F-PROT LOOP TO RX BLD OUTER CTMT DNSTRM ISO		05/92 TTC				
LFFV0095	CTMT NORM SMP PMPS DISCH HDR CTMT FV	05/92	04/89	10/90	5/92 TTC		
LFHV0105	DRW SMPS DISCH HDR DNSTRM HV	06/91	06/91	1/93 TTC			
LFHV0106	DRW SMPS DISCH HDR UPSTRM HV	06/91	06/91	1/93 TTC			

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Table 2: Valve ID's, Names, and Test Dates

RISING STEM MOV'S WITH LESS THAN 25% MARGIN

VALVE	ACTION DOCUMENT(S)	PRESENT SCHEDULE	TEST ACTIONS	MODIFICATIONS OR PART REPLACEMENTS	DP TESTED?
ALHV0007	WR163007	PRIOR TO '95 OUTAGE	ADJUST TORQUE SWITCH	NA	Y
ALHV0009	WR163008	PRIOR TO '95 OUTAGE	ADJUST TORQUE SWITCH	NA	Y
ALHV0011	WR163009	PRIOR TO '95 OUTAGE	ADJUST TORQUE SWITCH	NA	Y
BBHV0013	WR163011 & RFR14743	SPRING '95 OUTAGE	ADJUST TORQUE SWITCH	CHANGE LIMITER PLATE	
BBHV0014	WR163012 & RFR14743	SPRING '95 OUTAGE	ADJUST TORQUE SWITCH	CHANGE LIMITER PLATE	
BBHV0016	WR163014 & RFR14743	SPRING '95 OUTAGE	ADJUST TORQUE SWITCH	CHANGE LIMITER PLATE	
BBPV8702B(N1)	CMP 94-1006	PRIOR TO '95 OUTAGE	ADJUST TORQUE SWITCH	MODIFY GEARING	
BGHV8100	WR163015	SPRING '95 OUTAGE	ADJUST TORQUE SWITCH	NA	
BGHV8112	WR163019	SPRING '95 OUTAGE	ADJUST TORQUE SWITCH	NA	
BGLCV0112C(N2)	WR163018 & RFR14743	SPRING '95 OUTAGE	ADJUST TORQUE SWITCH	CHANGE LIMITER PLATE	
EGHV0058	WR163016	SPRING '95 OUTAGE	ADJUST TORQUE SWITCH	NA	Y
EGHV0060	WR163006	SPRING '95 OUTAGE	DP TEST	REPLACE WEDGE	Y
EGHV0062 (N3)	CMP 93-1058	SPRING '95 OUTAGE	NA	LIMIT CLOSE	
EGHV0071	WR163017 & RFR14743	SPRING '95 OUTAGE	ADJUST TORQUE SWITCH	CHANGE LIMITER PLATE	Y
EJHV8716A(N4)	CMP 93-1058	SPRING '95 OUTAGE	DP TEST	LIMIT CLOSE	Y
ENHV0015	CMP 92-1053	SPRING '95 OUTAGE	NA	RETIRE/REMOVE MOV	

TABLE 3: