WOLF CREEK
NUCLEAR OPERATING CORPORATION

Neil S. "Buzz" Carns
Chairman, President and
Chief Executive Officer

January 30, 1995
WM 95-0012

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station P1-137
Washington, D. C. 20555

Reference: Generic Letter 89-10, dated June 28 1989 to All Licensees from J. G. Partlow

Subject: Docket No. 50-482: Notification of Completion of Actions Associated to Generic Letter 89-10, "Safety-Related Motor-Operated Valve (MOV) Testing and Surveillance"

Gentlemen:

This letter provides notification of completion of activities at Wolf Creek Generating Station (WCGS) associated with the design basis verification and testing of safety-related motor operated valves (MOV). This submittal describes the MOV Program at the WCGS, which was established to assure the capability of MOVs to perform their safety-related functions under worst-case design-basis conditions.

If you have any questions concerning this matter, please contact me at (316)364-8831 extension 4000 or Mr. Richard D. Flannigan at extension 4500.

Very truly yours,

Neil S. Carns

NSC/jra

Attachment

cc: L. J. Callan (NRC), w/a
D. D. Chamberlain (NRC), w/a
J. F. Ringwald (NRC), w/a
J. C. Stone (NRC), w/a

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STATE OF KANSAS)
) SS
COUNTY OF COFFEY)

Neil S. Carns, of lawful age, being first duly sworn upon oath says that he is President and Chief Executive Officer of Wolf Creek Nuclear Operating Corporation; that he has read the foregoing document and knows the content thereof; that he has executed that same for and on behalf of said Corporation 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.

LINDA M. OHMIE
Notary Public - State of Kansas
My Appt. Expires 8-31-98

By Neil S. Carns
Neil S. Carns
President and
Chief Executive Officer

SUBSCRIBED and sworn to before me this 30th day of January, 1995.

Linda M Ohmie
Notary Public

Expiration Date 8-31-98

1.0 EXECUTIVE SUMMARY

Wolf Creek Nuclear Operating Corporation's (WCNOC) Motor Operated Valve (MOV) Program currently meets all commitments and requirements related to NRC Generic Letter 89-10 and its supplements. The required completion date for this Generic Letter was originally scheduled for June 28, 1994. However, after further review of the activities involved, WCNOC requested and received an extension to the completion date to December 31, 1994. This new date provided the time necessary to achieve full compliance with the Generic Letter as documented below.

WCNOC has completed activities to ensure a high level of confidence exists in the design basis capability and continued long-term performance of each MOV. The MOV Program at WCNOC is considered to be comprehensive. The design basis of each MOV has been justified, and the individual valve performance will continue to be monitored.

The approach at WCNOC has created many proactive elements related to MOVs and their issues. Many of the initiatives are "industry first" activities and are considered to be indicative of the WCNOC commitment and dedication to achieving superior performance in the MOV Program. Some of these activities include:

- Implementing reduced voltage dynamic testing;
- Creating the margin approach to determine the design basis requirements;
- Evaluating the potential for, and consequences of, mispositioning for all MOVs in the program;
- Evaluating the necessity of dynamic periodic testing;
- Adopting a team approach to ensure a well-coordinated and effective program;
- Implementing a rigorous testing sequence for set-up and dynamic testing;
- Replacing and refurbishing actuators prior to dynamic testing;

Evaluating the generic issues for the industry related to the Kalsi testing on increasing the thrust rating of MOVs;

- Reperforming pressure locking and thermal binding evaluations to the latest industry information;

- Implementing timely corrective actions to emergent industry and plant issues;
- Implementing a comprehensive performance monitoring program and;
- Increasing management oversight and awareness on broad, generic issues.

Activities related to MOVs have been incorporated into applicable training and procedures at WCNOC to help ensure long-term valve operability. This well established and successful MOV program will continue to ensure operability and maintain a high level of reliability for the MOVs.

2.0 WCNOC MOV PROGRAM

The current WCNOC MOV Program is controlled by procedure AP23D-001, "Motor Operated Valve Program." This procedure provides the scope, methodology, philosophy, and guidance used at WCNOC to ensure that the capability exists for each safety-related MOV to meet its determined design basis requirements.

3.0 DESIGN

3.1 Scope of Valves in the MOV Program

Each safety-related MOV at Wolf Creek Generating Station (WCGS) has been evaluated and complies with the MOV Program requirements. The MOV Program contains 142 motor-operated valves. The program group is comprised of 29 globe valves, 34 butterfly valves and 79 wedge-type and parallel slide gate valves. This number has been derived through evaluations performed for each MOV or family (similar valve and function). For the original set of 155 valves, a determination was made for inclusion or removal from the program. Fifteen motor-actuated valves and two motor-actuated strainers were removed from the program as documented in the applicable Engineering design document. Inclusion in the program, with the appropriate evaluations and justifications, has also been documented through the Engineering design process. Four additional valves have been included in the program as a result of conversion from solenoid-type operators to motor operators.

3.2 Grouping MOVs

MOVs were grouped or referred to as a family if they were identical in internal design and process fluid and performed similar functions; for example, opposite train or redundant valves. Industry tested valves used for comparison to WCGS valves must meet these same grouping criteria and must have been tested under sufficient flow and pressure conditions to yield accurate data.

3.3 Design Basis Requirement Determinations and Justifications

All valves within the program have minimum design basis requirements determined from one of three methods. These methods are dynamic testing, high margin approach, or use of WCNOC or other industry data.

3.3.1 Dynamic Testing at WCGS

Dynamic testing was performed on 44 gate and globe valves of which 41 valves provided practicable and meaningful data. These valves were ranked among the highest in safety significance to the plant. For the three valve tests that failed to produce meaningful data, the design basis thrust requirements for the respective valve families were evaluated as described in Sections 3.3.2 or 3.3.3. The goal during testing was to subject the MOV to differential pressure and flows as close as possible to the maximum expected differential pressure (MEDP) while maintaining the plant in a safe condition. Specific temporary test procedures were written for each MOV or MOV family. After completion of dynamic tests, an immediate operability review was performed. Thrust settings were immediately increased, if necessary, to provide margin over design basis required thrusts. The data obtained from the testing was then incorporated into the design process. The dynamic testing validated the assumptions made from the theoretical approach used to set-up the MOVs. The finalized minimum required design basis values have been adjusted for degradation and long term reliability. [Reference 9.2.2, 9.6.6]

3.3.1.1 Use of Dynamic Test Data Varying from Design Conditions

A. Differential Pressure Effects and Extrapolation/Interpolation

1) Gate Valves

Prior to dynamic testing, the minimum required design basis thrust values were calculated based on an assumed disc/seat coefficient of friction (COF) of 0.5. Torque limitations were converted to thrust limits assuming a stem to stem nut COF of 0.2. Dynamic tests were performed as close as possible to the MEDP to validate these assumptions. A preliminary evaluation of these assumptions was made immediately following completion of the differential pressure test. This evaluation used straight-line extrapolation of the thrust to overcome differential pressure multiplied by the ratio of design basis differential pressure to the test differential pressure. The measured differential pressure thrust and average running load were corrected for diagnostic system accuracy prior to extrapolation or interpolation of the results. The reliability of this type of linear extrapolation down to as low as 25% of MEDP conditions has been confirmed through the Electric Power Research Institute (EPRI) Performance Prediction Test Program. This approach is considered conservative since the EPRI data concluded that in most cases, the COF decreased slightly at higher differential pressures.

2) Globe Valves

For globe valves, disc/seat COF are not dependent upon differential pressure. Guide loading and other effects specific to globe valves were expected to be dependent on differential pressure. However, the dynamic testing did not produce the expected differences in design basis requirements. The required loads under differential pressure were determined to be enveloped by the original calculated values.

B. Fluid Temperature Effects on Seat Friction Coefficients

The dynamic tests were performed as near to the design basis accident conditions as safely achievable. The design basis fluid temperature was not reached in most cases. The test results gathered under these test conditions are considered to be more conservative than design basis temperatures. This is based upon EPRI MOV testing results that have indicated that the valve factor is higher at lower temperatures than those recorded at elevated (design basis) operating temperatures. The amount of conservatism is not quantifiable due to the number of variables (i.e., type of valve, test temperature inconsistency, medium, valve condition and material) and the absence of specific information in the industry concerning this subject. Therefore, based on the general trend observed in the industry that indicates the temperature effect to be negligible or conservative, adjusting the data to account for higher design temperature conditions was not considered necessary.

C. Flow Effects

Industry data related to the effects of flow on the seating and unseating of the disc has indicated consistent results, not only in flex-wedge gate valves, but also in parallel-slide gate valves. Two documented, independent tests performed in the past have produced similar results.

One set of test data, was a result of an IE Bulletin. It was produced by Westinghouse and Pacific Pumps in the early 1980's. This extensive data was reviewed by WCNOC in 1992 during an audit at Westinghouse. The results of the testing provided significant information that remains relevant today because of the parameters and information obtained. For the flow issue in particular, the data proved to be consistent in supporting a relation of flow to stem loading effects. Westinghouse valves were tested at consistent differential pressures and varying flows (flows varying by a magnitude of ten). The resultant data indicated that the change in stem thrust in all cases was considered negligible in comparison to the change in flow. The higher flow would produce consistently higher stem thrusts, but the change was no greater than a single digit percentage.

A second set of data was produced from testing at the Sizewell 'B' Nuclear Plant in England. The information obtained during this testing was presented at the Second NRC/ASME Symposium on Pump and Valve Testing in Washington, D.C., in 1992. Results on different valve seats with different types of valve actuating devices also indicated that flow effects were not substantial. The presence or absence of fluid flow did not vary the measured disc/seat COF.

The conclusions of these two independent tests provide justification that flow effects do not significantly alter the required stem thrusts under differential loading conditions. The majority of valves dynamically tested at WCGS are Westinghouse supplied. Similar industry results have been identified during testing on other valve and actuator designs. WCNOC has determined that testing at conditions which produce less than design temperatures will provide a compensatory effect to testing at less-than-design flow conditions.

D. Reduced Voltage Effects

Of the valves dynamically tested, 37 valves were tested under reduced voltage conditions. During dynamic testing of these 37 MOVs, the voltage was reduced at the Motor Control Center (MCC) to the design basis minimum value. This subjected the motors to the design basis voltage value which includes the ambient temperature effects as specified in the Limitorque Technical Update 93-03. The motors in these 37 tests were of various sizes and characteristics. Based on this sample, WCNOC concluded that the calculated motor capabilities adequately represent, with margin, the minimum values that can be expected for each MOV. These plant testing results provide sufficient justification to support the accuracy of WCNOC's approach in determining the minimum motor capabilities. [Reference 9.6.4]

3.3.1.2 Feedback of Dynamic Data to Design Basis Values

After dynamic testing was complete, the required thrusts theoretically derived from the calculations (using actual COFs) were compared to the interpolated/extrapolated values for all valves dynamically tested. The results of this comparison led WCNOC to use the interpolated/extrapolated method. Review of data for valves tested near the MEDP did not reveal a consistent trend. The calculated minimum thrust requirements did not vary consistently in value or direction from the extrapolated/interpolated thrust requirements. There was not a relationship between the calculated and the extrapolated values.

Due to this inconsistency, it was determined that the extrapolated values were more accurate and better represented the actual loads on the valve. Through testing there were fewer unknown parameters not accounted for, especially near 100% MEDP or greater. The theoretical approach, using a known disc/seat COF, did not account for any other effects such as guide loads or other valve specific loads above the disc in the bonnet area. For these reasons, WCNOC has determined that the more accurate approach for feeding back dynamic test results into the design calculations is through an extrapolation/ interpolation method as discussed above. For the 37 valves dynamically tested under reduced voltage conditions and other grouped/family valves, this was the method used.

3.3.2 High Margin Approach

The high margin approach involves a theoretical design method using conservative parameters to envelope the required design basis values. This approach does not require dynamic testing to validate the assumptions made in the theoretically determined design basis values. This method is based on three criteria. First, it is based on the amount of margin available after optimizing the actuators. Second, it depends on adjusting the thrust output for each MOV as high as possible in its analytically calculated window. And third, it assesses the availability of industry and plant data for similar MOVs. Concluding that this methodology conservatively bounds the design requirements is based on information and data obtained from WCNOC experience in dynamic testing and other industry testing. This approach is mainly used for MOVs with low MEDPs and/or valves originally designed with conservatively sized actuators. Each MOV or family is evaluated on a case-by-case basis for this approach based on the appropriate data and Engineering judgment.

The conservatism used in this approach with ample margin ensures a high confidence factor in MOV performance capability. These ample margins in both opening and closing directions provide for degradation effects such as stem lubrication degradation, unknown flow and temperature effects, seat/disc COF degradation, and/or any other types of unforeseen/unknown degradation. The net result of this approach is an MOV with maximum capability and the reliability to exceed its design requirements while fulfilling its design basis function under the worst operational conditions and scenarios.

When evaluating butterfly valves, the required torque was determined using the equivalent resistance method in conjunction with the single line model to envelope the bounding MEDP torque requirements. This methodology is considered conservative, because it assumes a constant system pressure, no line losses, no elevation

head differences and a valve shutoff pressure equal to pump shut off head. Bearing coefficients were used which bound industry data. Other values, such as seat torque coefficients and packing coefficients, were chosen based on vendor information and plant specific data. For the safety-related function of opening and closing, the capability to achieve the calculated bounding design basis value is more than adequately met without reliance on the vast margin of capability above conservative minimum requirements. The calculated minimum values also provide for effects such as lubrication degradation, unknown temperature effects, bearing COF degradation, and/or any other types of unforeseen/unknown degradation.

3.3.3 Utilization of WCNOC or Other Industry Data

Other data was used to determine the design basis requirements for some MOVs. Test data obtained from other plants and industry testing, such as that performed in the EPRI Performance Prediction Test Program, was used to provide justification for the design basis values. Most often, this data was used to obtain the thrust or torque requirements for the MEDP of the WCGS MOVs through extrapolation or interpolation as discussed previously. Appropriate margins were included for unknowns and degradation, as applicable.

In every case, operability reviews were performed for past and continued operation of MOVs. These reviews included dynamic test results as well as the data obtained from the industry.

3.4 Use of Limitorque and Kalsi Information For Increasing Thrust and Torque

Increased thrust ratings for Limitorque actuators are used only as needed. Thrust increases up to the values specified in the Limitorque Technical Update 92-01 are utilized as required. In some cases, values as high as that considered acceptable by Kalsi (62% over the original rating for the appropriate size of actuator) were used for long term design or for overthrust conditions. For these valves, the need for this actuator thrust increase would only be required for the design basis condition or short term overthrusts. This would be for limit opening and closing cases in which the static (non-design basis) loads are relatively low. In any case, the thrust increases for the actuators are used as required and not as the standard.

Torque increases generally follow Limitorque guidelines. However, torque increases at WCGS have been needed less than thrust increases. Any actuators that could have possibly been overtorqued above the 10% inertial overtorque value allowed by Limitorque, have had the torque-related components inspected or replaced. Since WCNOC is a participant in the Kalsi actuator rating increase program, published data will continue to be evaluated.

3.5 Motor Performance Factors

To determine the motor performance characteristics and capability, WCNOC complied with the standard Limitorque design guidelines. The rated starting motor torque and application factor (changed in Limitorque Technical Update 93-03), with the appropriate duration due to temperature effects, were included in the motor capability value. For the associated gear ratio and RPM, the run efficiency was used in the closed direction and pullout efficiency in the open direction as specified in the Limitorque design guidelines.

The power factor of AC motors during starting was based on Limitorque guidance. The highest value in the given range for each particular frame size was used. For those power factors based on a sample of only one motor however, a correction factor of +10% was used to account for variances in motors of the same design. For frame sizes not provided by Limitorque, a power factor of 0.9 was conservatively assumed unless justification could be provided for a lesser value.

Motor temperature effects related to the Limitorque 10 CFR Part 21 notification were evaluated for all MOVs in the program. Using the torque reduction factors contained in the Part 21 notification (reference Limitorque Technical Update 93-03) and the worst case ambient temperature profile for the location of the actuator, a percent torque loss for the actuator was calculated. When combined with the occurrence of reduced voltage conditions, an additional reduction of the motor capability resulted. These changes have been incorporated into the minimum motor capability values as depicted in the associated calculations.

3.6 Valve Structural Capacities

The original valve structural thrust and torque limitations for each valve in the program have been revalidated with the vendor or recalculated when vendor data was unavailable or inadequate. This includes each component in the load path for both seismic and non-seismic conditions. From this, the component having the lowest load capacity, based on its capability to withstand all postulated loading conditions, was considered to be the weak link. This weak link value was determined to be the maximum load parameter for the valve.[Reference 9.6.5]

3.7 Load Sensitive Behavior

The characteristic of load sensitive behavior (otherwise known as rate-of-loading) has been determined for all valves that have been dynamically tested and the resultant values have been incorporated into the design basis requirements. Those MOVs following the margin approach have ample margin to accommodate any load sensitive effects as well as other needs for margin. The minimum design basis requirements for MOVs that used non-WCNOC data also addressed load sensitive behavior on a case-by-case basis.[Reference 9.12.1]

3.8 Stem Friction Coefficient

For the purposes of design, unless the actual stem coefficient of friction is known, a value of 0.2 is used in determining the motor capability for all rising stem valves. Historical data and maintenance practices were used to determine a generally enveloping value of 0.2. During diagnostic testing, the actual value was ascertained and then compared to the 0.2 value to ensure conformance with the design basis requirements. For valves with actual COFs of 0.18 or greater, a margin for degradation of 0.03 was added for conservatism.

3.9 Mispositioning

Each MOV at WCGS has been evaluated for concerns of inadvertent actuation and restoration from inadvertent actuation. If the valve is not blocked (prevented from being inadvertently actuated from the control room), it is considered to be position changeable unless otherwise justified. The results of this evaluation were reviewed to determine if these functions would create bounding MEDPs. If so, the design basis requirements will reflect values associated to these functions.[Reference 9.6.3]

3.10 Pressure Locking and Thermal Binding

During NRC Inspection 50-482/93-02 in May of 1993, (Phase 2 MOV inspection), the need to address pressure locking and thermal binding of normally open valves was identified as a Follow-up Item. Since this phenomenon occurs when the valves are closed, the original evaluation performed by WCNOC limited the scope to normally closed valves. Past industry events related to pressure locking and thermal binding due to maintenance, surveillance, or testing activities that precluded the restoration of valves for a long period of time, have also created the need to evaluate normally open valves. Therefore, WCNOC is currently evaluating the normally open valves and re-evaluating normally closed valves considering industry and methodology changes during the past few years.

The evaluation of pressure locking and thermal binding for MOVs is currently being completed to address future efforts related to the current draft NRC Generic Letter on this issue. WCNOC considers this an ongoing evaluation of more general scope than covered by Generic Letter 89-10. [Reference 9.12.6]

3.11 Degradation

Margin has been included in the design basis requirements for each MOV. An additional 10% (for all MOVs except those under the high margin approach) was added to compensate for additional potential effects (such as stem lubrication degradation, any slight variances in the disc/seat COF or other unknown effects that have not been previously included in the theoretical calculations or detected by the industry).

3.12 Spring Pack Relaxation

Spring pack relaxation has been evaluated and adequately addressed in response to Limitorque Technical Update 93-02. From this review, it was determined that spring pack relaxation was inherently bounded by normal valve characteristics. A review of the dynamic testing performed during the sixth refueling outage established that the inertial effect for all torque closed MOVs tested, provided adequate margin for spring pack relaxation. Therefore, no additional margin is included in the design basis requirements for this phenomenon.

3.13 Configuration Control

The main source of configuration control for MOVs is design document E-025-00007, "MOV Design Configuration Document." Each MOV is represented in this document in detail describing the actuator, motor, valve, system, limit switch characteristics, diagnostic test windows and inputs and other related information. Other design documents such as electrical schematics and vendor-supplied valve drawings also provide design information.

4.0 TESTING

4.1 Sequence of Testing

The general sequence of diagnostic tests for those valves with marginal capability consists of an as-found test, set-up test, dynamic test, baseline test, as-left test, and periodic test. MOVs with excess margin capability do not require the dynamic test and the set-up test is considered the baseline test. Except for the as-found and as-left tests, torque is monitored during the tests. Since the Valve Operation Test and Evaluation System (VOTES) Torque Cartridge is intrusive to the actuator, a true as-found test mandates thrust measurements only. The as-left test provides verification that the actuator has been restored to the correct configuration after removing the VOTES Torque Cartridge.

4.2 Diagnostic Equipment and Test Equipment Inaccuracy

WCNOC uses Liberty Technologies VOTES system for diagnostic testing of MOVs. The overall system thrust accuracy is based on the valve stem geometry, material, calibration location and other factors according to vendor recommendations. The torque inaccuracy is 10% when using the VOTES Torque Cartridge. During testing activities, the theoretical upper and lower thrust/torque limits are adjusted (lowered and raised, respectively) depending on the specific current calibration and stem properties.[Reference 9.14.1, 9.14.2]

4.3 Torque Switch Repeatability

Torque switch repeatability is also included when evaluating the diagnostic results compared to the minimum and maximum design requirements and limitations for torque closed valves. Limitorque's standard percentages for repeatability are used based on the torque switch setting and the amount of torque being produced. Limit closed valves are not evaluated for the parameter.

5.0 PERFORMANCE MONITORING

Procedure I-ENG-001, "Motor Operated Valve Tracking and Trending," provides the guidelines for performance monitoring of each MOV in the program. These guidelines include directions for collecting and maintaining specific key parameters used to trend performance, enhance reliability and schedule optimum preventive maintenance frequencies by analyzing and anticipating potential degradation.[Reference 9.6.7, 9.6.8, 9.7.2]

5.1 Baseline Tests

Baseline tests are static diagnostic tests performed following a modification or refurbishment of the MCV that has the potential to change the thrust, torque, current, or stroke time characteristics of the MOV. The base line test serves as a basis or reference point to trend future test data.

5.2 Periodic Testing

The periodic test is considered an as-found static test performed at determined intervals to evaluate the immediate status, performance, and available margin. Currently, the frequency for periodic testing is based on the industry standard of not exceeding three (3) fuel cycles or five (5) years. Monitoring the performance of each valve will provide the information necessary to establish the optimum frequency for periodic testing.

5.3 Justification for Static Periodic Testing

Static versus dynamic periodic testing is only questionable for the MOVs that did not follow the margin approach. This is because the margin approach MOVs have excessive margin to accommodate unknowns, degradation or any other type loading not accounted for in the calculation methodology.

Dynamic testing on a periodic basis is useful solely for the purpose of determining, on a valve specific basis, if the disc/seat is susceptible to degradation over time. Almost all other factors of significance that influence the design basis minimum required values have been accounted for by including additional margin and can be monitored statically.

Disc/seat coefficient changes are considered to be dependent on disc/seat geometry, tilting effects under loading conditions, and the actual load present during the stroke. The amount of degradation would then be related to the stroke frequency under a significant load. Unless excessive disc tilting is occurring, static stroking would not present the conditions necessary for significant degradation of the disc/seat. The worst case evaluation would consider excessive disc tilting and its effects.

The EPRI Performance Prediction Test Program provides two key results related to the disc/seat edges and dynamic loading. The edge chamfer on the disc/seat was found to be a significant contributor to valve thrust requirements. A sharp edge resulted in degradation to the disc/seat at moderate to high dynamic loads. At low disc loads, the sharp edge performed well. Additionally, sharp edges were able to provide good performance, even under severe loading conditions, if the valve was previously stroked under a less severe loading level. This effect is due to material removal from the sharp edges that produced slight chamfering that allows degradation to plateau. Therefore, unless every stroke of the valve was under high loading, the valve would essentially improve its resistance to gouging or damage due to a self-chamfering process.

The analysis performed by Kalsi Engineering in the Gate Valve Design Effects Testing Results (EPRI TR-103255), and BATTELLE in the Friction Separate Effects Test Report (EPRI TR-103119), in support of the EPRI program, corroborates this philosophy and provides results that reflect this performance characteristic. The various tests performed on Stellite (the exclusive material used in

WCGS gate valves in the program) indicated that the manufactured sharp edges gradually became more dull. Whether the interacting contact surfaces were edge-on-edge or edge-on-flat, the first stroke always exhibited the highest friction effects and the most damage or degradation. Once the disc/seat is placed under high load, chamfering would occur. Subsequent strokes would not be as damaging with the edge being less sharp. These effects are considered a break-in consequence and in theory, would be expected as validated from the tests performed. Even though the testing in both cases is limited, it appears to be consistent and representative of gate valves. WCNOC concurs with the analysis performed which provides a strong basis for static periodic testing.

The concern of disc/seat degradation would not be applicable for globe valves since sliding disc and seat interactions do not occur during the stroke. Other types of degradation in globe valves have been accounted for or are considered insignificant.

Twenty-eight gate MOVs were dynamically tested at WCGS and were reviewed for the potential for disc/seat degradation based on the above and using the worst-case assumption that every gate valve disc tilts under load. Six additional gate valves were also evaluated for the potential degradation phenomenon.

The criteria used in determining the susceptibility to disc/seat degradation consisted of reviewing the stroke frequency for each MOV under a dynamic load. If frequent strokes are performed under significant dynamic loading conditions, the valve would be considered susceptible to disc/seat degradation. Again, this assumes that the clearances in the valve internals are sufficient to create a tilting effect that would cause gouging under higher dynamic loading.

Of the 34 gate valves in the scope of this review, only 20 are stroked under a dynamic load. The 14 valves not regularly stroked under a dynamic load are not considered susceptible to degradation. For those valves regularly stroked under a dynamic load, the number of dynamic strokes at the MEDP or less than the MEDP are less than ten per plant cycle in comparison to the number of static strokes, which in every case is more than double that amount. One family of small valves could see as many as ten dynamic strokes per cycle, but at low pressure loads ($\leq$ 80 psid). Over the past few years of plant operation, the most damaging strokes have already occurred if tilting is considered. Therefore, at the time the actual dynamic test data was gathered for Generic Letter 89-10, the disc/seat coefficients would remain the same or be decreasing at this point rather than increasing. The calculated design basis values for these valves should bound future deviations due to stroking under dynamic loading. The break-in effect has most likely already occurred and any sharp edges contacting under the dynamic loads have been self-corrected and, or enhanced.

In summary, from a valve specific standpoint, dynamic periodic tests are not warranted at WCGS. If disc/seat tilting is occurring, the results obtained during dynamic testing provided the worst case design basis data. Future static periodic tests will monitor and trend the other variables that significantly affect the design basis requirements for each MOV.

5.4 Lubrication and Grease Inspection

Lubrication and grease inspection frequencies follow the Limitorque recommendations of 18 months for stem and gear case and 36 months for geared limit switch compartments as a rule. Exceptions to the rule are based on stroke frequency, performance monitoring, specific environmental conditions, and other data such as EPRI's Lubrication Program.

5.5 Post-Maintenance or Modification Testing

Prior to maintenance activities that may affect the thrust capability (i.e., packing adjustments), an as-found diagnostic test should be performed if more than six months have passed since the previous VOTES test, unless otherwise evaluated and justified. Depending on the scope of maintenance or modifications performed, Engineering will determine the type of post-maintenance testing necessary to ensure that the design basis requirements are met. This could range from full dynamic testing with the appropriate diagnostic tests to a simple stroke test of the MOV. (Currently at WCGS, packing adjustments require follow-up diagnostic testing.) System design changes, valve replacements, and/or other design or maintenance activities (such as, valve disc replacements/rework, significant increase in system pressure or flow, bonnet gasket replacements, or other internal valve activities) that potentially impact the internal seat condition or alignment to the extent that the existing dynamic test or capability margin is in question or no longer acceptable, shall require a new dynamic test or additional justification.[Reference 9.6.7]

5.6 Trending of Industry and WCNOC MOV Problems

Industry issues and concerns are identified at WCNOC through various sources. The most common channels are through the Nuclear Network, vendor submittals, and/or NRC correspondence such as Information Notices. Issues are then transferred into the Industry Technical Information Program (ITIP) and evaluated. WCNOC specific concerns are documented and resolved in the WCGS corrective action program either by a Corrective Work Request (WR) or a Performance Improvement Request (PIR).

The MOV Program coordinator reviews and evaluates each concern or issue as it is identified. This individual remains cognizant of these concerns. Due to increased industry cognizance, many of the major MOV problems and deficiencies have now been identified and resolved. The number of unexpected failures should decrease as a result of this increased knowledge and awareness. For concerns that have been identified, the appropriate corrective action has been performed or corrective action documentation initiated for resolution. All safety-related MOVs at WCGS included in the program have now been design verified and optimized and will continue to be monitored in the performance monitoring program. Through the ITIP, WR and PIR programs at WCNOC, trending of issues in these programs can be performed. Repetitive industry problems are most generally raised to a higher level of attention through Information Notices or 10 CFR Part 21 reports. Repetitive WCNOC problems are documented on PIRs and resolved accordingly.

5.7 Root Cause and Corrective Actions

Root cause evaluations and corrective actions are performed on plant specific issues and concerns as required by Engineering and Maintenance procedures. Industry issues and concerns are evaluated and corrective actions implemented as necessary. In every case, the corrective action program ensures that the appropriate actions and attention are placed on each problem. Those items considered significant are reviewed later to ensure that the corrective actions were adequate. Almost all past MOV program-related PIRs were classified as "significant." These significant PIRs required an Effectiveness Follow-up Review be performed to ensure the corrective action was appropriate and effective for the given problem.[Reference 9.2.3]

The corrective action program at WCNOC ensures that the appropriate root cause and corrective actions are taken for all plant concerns and issues including MOVs. This program will continue to be used in the future for effective root cause analysis and corrective actions for MOVs.

6.0 ADMINISTRATIVE

Since the inception of the formal MOV Program at WCNOC, various administrative changes and enhancements have been made to the MOV staff. Both initial training and subsequent training have been and will continue to be provided for MOV engineering and maintenance personnel in order to remain cognizant of standard practices, diagnostic testing software changes, and other industry issues. Self-assessments performed during the past three years have found the program to be correctly focused and comprehensive. Periodic Quality Assurance surveillances and audits are performed to assure program compliance and performance are adequate. Recommendations are made for enhancements and for problems encountered.

WCNOC will continue to follow industry actions and initiatives such as EPRI activities, Kalsi Engineering testing, and MOV Users Group (MUG). In addition, WCNOC will use Nuclear Network and the Nuclear Plant Reliability Data System data base to review industry events and issues.

7.0 REMAINING AND ONGOING ACTIVITIES

There are no remaining requirements or commitments outstanding related to MOVs as part of the Generic Letter 89-10 program. There are many ongoing activities and currently planned projects that will further enhance MOVs and the overall program at WCNOC.

Ongoing activities include, but are not limited to:

- Increasing the existing margins for specified valves above the minimum design basis requirements by increasing switch settings;

- Determining the optimum frequencies for testing and inspections;

- Performing design changes to limit close MOVs where appropriate to increase margin, eliminate unknowns and torque close concerns, decrease stresses to valve and actuator components and improve repeatability and;

- Continuing the evaluation and modifications necessary to eliminate all pressure locking and thermal binding concerns.

Currently Planned Projects include, but are not limited to:

- Refurbishment of the remaining high-margin valve actuators;

- Enhancing the diagnostic testing procedures and equipment;

- Further enhancing MOV parts availability, specifications, design information and other processes;

- Enhancing butterfly diagnostic testing capabilities and;

- Increasing the use of the motor power monitor for determining more specific motor performance characteristics.

8.0 SUMMARY

The MOV Program at WCNOC has grown into a comprehensive program for establishing the minimum design basis requirements (including the appropriate verification), ensuring that the appropriate capabilities exist, and assuring current and long-term reliable performance is achieved for each MOV. This program has become a model for other nuclear facilities. All requirements and commitments related to the Generic Letter 89-10 program have been completed. Future activities and enhancements will continue to strengthen this program to an optimal level.

9.0 REFERENCES AND PREVIOUS COMMITMENTS

The list of references provided here were either used in the preparation of this submittal or have been referenced in the body of this document. The associated commitments made in these references have all been satisfied.

9.1 Letter, 89-01429, dated June 28, 1989, to All Operating License Holders, from J.G. Partlow, USNRC, Subject: Safety-related Motor-Operated Valve Testing and Surveillance (G.L. 89-10) - 10 CFR 50.54(f).

9.1.1 The licensee will have completed the design bases reviews, analysis, verifications, tests and inspections of all safety-related & position changeable MOVs (WCNOC commitment number 89-192).

9.1.2 The licensee will advise the NRC within 30 days of the completion of G.L. 89-10. (Letter 89-01429) (WCNOC commitment number 89-193).

9.2 Letter, 91-02292, dated November 22, 1991, to B.D. Withers, WCNOC, from A.B. Beach, USNRC, Subject: NRC Inspection Report No. 50-482/91-034.

9.2.1 Deviation 91-034-01: Failure to consider parameters other than differential pressure in the design basis evaluation, failure to establish a method for determining proper size and switch settings, & failure to develop procedures for design basis testing.

9.2.2 Unresolved Item 91-034-03: Design basis testing/operability evaluations of problem valves.

9.2.3 Violation 91-034-02: Inadequate corrective actions for significant conditions adverse to quality.

9.3 Letter, NO 91-0337, dated December 2, 1991, to USNRC from J.A. Bailey, WCNOC, Subject: LER 91-024-00 (superseded by Letter NO 92-0002).

9.4 Letter, 92-00358, dated February 20,1992, to B.D. Withers, WCNOC, from R.D. Martin, Subject: Notice of Violation and Proposed Imposition of Civil Penalty--$150,000 (NRC Inspection Report 50-482/91-34).

9.5 Letter, WM 92-0040, dated March 20, 1992, to USNRC from B.D. Withers, WCNOC, Subject: Docket No. 50-482: Reply to Notice of Violation (EA 91-161).

9.5.1 The team will remain in place until all issues have been resolved and integrated into normal operations, at which time the MOV program elements will return to the appropriate line organizations (WCNOC commitment number 92-065).

9.6 Letter, WM 92-0043, dated March 20,1992, to USNRC from B.D. Withers, WCNOC, Subject : Docket No. 50-482: Response to Notice of Deviation.

9.6.1 These open actions items have been subsequently incorporated into a formal MOV scope document which will guide the preparation of the remaining program and procedural work (WCNOC commitment number 92-054).

9.6.2 A new program document defining implementation of the provisions of Generic Letter 89-10 will be issued (WCNOC commitment number 92-055).

9.6.3 Procedure will be revised to address other instances of credible mispositioning (WCNOC commitment number 92-056).

9.6.4 Procedures will be revised to incorporate methods to reconcile the diagnostic test voltage with the design basis voltage so that diagnostic tests confirm the ability of the MOV to perform under design basis conditions (WCNOC commitment number 92-057).

9.6.5 Procedures will also be revised to address the weak link analysis and criteria for when this analysis is required and methods used for the analysis (WCNOC commitment number 92-058).

9.6.6 A procedure for overall dynamic testing will be written to identify purpose, objectives, design basis input parameters to be monitored, acceptance criteria and feedback mechanisms (WCNOC commitment number 92-059).

9.6.7 The MOV program will be revised and procedures written to address post maintenance testing, these procedure will also identify criteria for when periodic testing is required to verify operability (WCNOC commitment number 92-060).

9.6.8 A tracking program will be formalized within the overall MOV program to accommodate valve failures, corrective actions and provide data to enhance and provide for improved MOV preventive maintenance and periodic verification (WCNOC commitment number 92-061).

9.6.9 Necessary implementing procedures will be revised to require timely evaluation of calculation and test results and documentation of discrepancies on appropriate corrective action documents, and in accordance with existing WCNOC procedures (WCNOC commitment number 92-062).

9.6.10 EA 91-161 Violation I.a : Failure to take prompt corrective actions, February 1991, when a work request identified five MOVs that might not be capable of performing their safety functions based on minimum voltage assumptions.

9.6.11 EA 91-161 Violation I.b: Failure to take prompt corrective actions in response to a contractor-performed audit that identified significant deficiencies in the MOV testing and surveillance program.

9.6.12 EA 91-161: Violation II.a.: Failure to take corrective action in October, 1991, after valve BBHV8000B had been subjected to several times its maximum calculated thrust.

9.6.13 EA 91-161: Violation II.b: Failure to take corrective actions in November, 1991, to determine the cause of an apparent failure of a safety-related MOV to close completely when remotely operated.

9.7 Letter, NO 92-0002, dated March 27, 1992, to USNRC from J.A. Bailey, WCNOC, Subject: Docket No. 50-482: Licensee Event Report 91-024-01 (supersedes LER 91-024-00).

9.7.1 WCNOC will continue to maintain responsibility for the design basis torque and thrust calculations, ensuring that the appropriate conservative and latest available methodologies are applied (WCNOC commitment number 92-133).

9.7.2 WCNOC is developing a tracking and trending program to ensure valve field performance is optimized (WCNOC commitment number 92-134).

9.7.3 Design documentation for all G.L. 89-10 MOVs will be modified to clearly show proper open and closed configurations (WCNOC commitment number 92-135).

9.7.4 As a result of the G.L. 89-10 program, WCNOC has taken ownership of the design basis and will periodically test the Westinghouse valves to ensure continued operability under the program requirements (WCNOC commitment number 92-136).

9.8 Letter, ET 92-0077, dated May 22, 1992, to USNRC from F.T. Rhodes, WCNOC, Subject: Docket No. 50-482: Schedule Extension to Complete Initial Test Program Pursuant to Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance".

9.8.1 A schedule extension to the end of 1994 (12/31/94) will encompass WCNOC's seventh refueling outage and thereby provide an additional refueling outage in which to perform all design basis testing and other activities related to the MOV program (WCNOC commitment number 92-099).

9.8.2 Based on prioritization, a plan has been developed to fully implement the requirements of G.L. 89-10 for approximately two thirds of the safety-related MOVs by the original June 1994 date. Testing of the remaining MOVs will be completed by 12/31/94 (WCNOC commitment number 92-100).

9.9 Letter, 92-01260, dated June 22, 1992, to B.D. Withers, WCNOC, from W.D. Reckley, USNRC, Subject: WCGS - Schedule Extension to Complete Motor-Operated Valve Testing and Surveillance (TAC No. M75739).

9.10 Letter, WM 92-0204, dated December 29, 1992, to USNRC from B.D. Withers, WCNOC, Subject: Docket No. 50-482: Response to Questions Concerning Study by Kalsi Engineering.

9.10.1 "Additionally, WCNOC intends to refurbish/replace actuators on all valves in the WCNOC MOV program to the completion of NRC Generic Letter 89-10" (WCNOC commitment number 94-171).

9.11 Letter, WM 93-0032, dated February 25, 1993, to USNRC from B. D. Withers, WCNOC, Subject: Docket No. 50-482: Response to Request for Additional Information on Kalsi Engineering Report.

9.11.1 WCNOC will inspect or replace all stem nuts during refurbishment/replacement of actuators on all valves in the WCNOC MOV program prior to the completion of NRC Generic Letter 89-10" (WCNOC commitment number 94-172).

9.12 Letter, 93-00859, dated June 4, 1993, to B.D. Withers, WCNOC, from S.J. Collins, USNRC, Subject: NRC Inspection Report 50-482/93-02.

9.12.1 Inspection Follow-up Item 93-002-01: i) Justification for the exclusion of a rate-of-loading margin for torque-closed MOVs ii) with positive bounding rate-of-loading assumption revisit operability of BBHV00013 iii) staff plans discussions with WCNOC to review rate-of-loading test results.

9.12.2 Inspection Follow-up Item 93-002-02: Trend analysis program now in place will evaluate for the effects of stem lubrication degradation and that appropriate margins will be established if they were indicated by the trending.

9.12.3 Inspection Follow-up Item 93-002-03: Review of diagnostic traces identified several discrepancies. The licensee indicated that additional training in the use of the Votes 2.3 software would be conducted. Other traces would be reviewed to identify other similar problems.

9.12.4 Inspection Follow-up Item 93-002-04: Anomalies identified in the post-test analysis process. Traces from periodic verification of valve performance would be compared to the previous trace. This may be restricted to static traces since the current plan was to conduct only static testing.

9.12.5 Inspection Follow-up Item 93-002-05: An inspection to close out TI 2515/109 Part 2 will be conducted to review the disposition of valves that can be tested only under static conditions or at low differential pressures.

9.12.6 Inspection Follow-up Item 93-002-06: Concerning pressure locking for normally open valves. The evaluation of normally open valves and the deferral of valve modifications will be reviewed during a future inspection.

9.12.7 Inspection Follow-up Item 93-002-07: The licensee will need to provide additional justification for the use of static periodic tests.

9.13 Letter, 93-00860, dated June 4, 1993, to B.D. Withers, WCNOC, from A.B. Beach, Subject: NRC Inspection Report 50-482/93-08 (Notice of Violation)

9.13.1 Complete a review of safety-related motor-operated valves by 8/31/93 and identify these valves which require complete reassembly and a flow test to ensure maintenance was performed correctly (WCNOC commitment number 93-143).

9.14 Letter, 93-00981, dated June 28, 1993, to B.D. Withers, WCNOC, from J.G. Partlow, USNRC, Subject: G. L. 89-10, Supplement 5, "Inaccuracy of Motor Operated Valve Diagnostic Equipment."

9.14.1 Notify the NRC staff of the diagnostic equipment used to confirm the proper size, or to establish settings, for MOVs within the scope of GL 89-10 (WCNOC commitment number 93-167).

9.14.2 Report whether they have taken actions or plan to take actions (including schedule and summary of actions taken of planned) to address the information on the accuracy of MOV diagnostic equipment (WCNOC commitment number 93-168).

9.15 Letter, 93-01403, dated September 16, 1993, to B.D. Withers, WCNOC, from B.K. Grimes, USNRC, Subject: NRC Information Notice 93-74: High Temperatures Reduce Limitorque AC Motor Operator Torque.

9.16 Letter, ET 93-0111, dated September 29, 1993, to USNRC from F.T. Rhodes, WCNOC, Subject: Docket No. 50-482, Response to NRC Generic Letter 89-10, Supplement 5.

9.16.1 All valves with an overthrust and/or overtorque beyond the Limitorque and Kalsi engineering extended thrust ratings will be inspected in accordance with Limitorque recommendations prior to replacement in any other application (WCNOC commitment number 93-241).

9.17 Letter, 93-01738, dated November 12, 1993, to N.S. Carns, WCNOC, from W.D. Reckley, USNRC, Subject: Summary of Meeting Held on October 15, 1993 to Discuss Motor Operated Valves and Completion of Actions Related to G.L. 89-10 at Wolf Creek Generating Station.

9.18 Letter, 94-00347, dated March 8, 1994, to N.S. Carns, WCNOC, from L.A. Reyes, USNRC, Subject: Generic Letter 89-10, Supplement 6, "Information on Schedule and Grouping, and Staff Responses to Additional Public Questions."

9.19 Letter, ET 94-0030, dated May 13, 1994, from F. T. Rhodes, WCNOC, to USNRC, Subject: Docket No. 50-482: Change to Commitment Associated to Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance."

9.19.1 MOVs with higher design differential pressures (approximately greater than 300 psid) will be refurbished and/or replaced prior to the completion date (WCNOC commitment number 94-163).

9.19.2 Each actuator will be optimized in order to provide the maximum capability to increase margin window (WCNOC commitment number 94-164).

9.19.3 WCNOC will continue to maintain a sound basis for operability (WCNOC commitment number 94-165).

9.19.4 WCNOC will continue to test where feasible and meaningful or practical (WCNOC commitment number 94-166).

9.19.5 WCNOC will continue to group MOV's that are practicable and not meaningful or practical to test in a manner that provides adequate confidence in the capability to perform the design basis function (WCNOC commitment number 94-167).

9.19.6 WCNOC will continue to static test each MOV and adjusting it within conservative windows (WCNOC commitment number 94-168).

9.19.7 WCNOC will continue to justify alternate approaches to dynamic testing where sufficient information exists to demonstrate the validity of its approach (WCNOC commitment number 94-169).

9.19.8 Based on evaluation, MOV's not providing a high confidence margin will be differential pressure tested, if practicable and meaningful or practical, following the original methodology and process. In either case, the same confidence level will exist in the ability of the MOV to perform its design basis function (WCNOC commitment number 94-170).

9.19.9 The period of time before refurbishment/ replacement will be directly proportional to the amount of degradation margin that exists for each MOV (WCNOC commitment number 94-173).

9.19.10 The minimum required stem thrust will be based upon conservative disc and seat coefficients of friction as determined from WCNOC specific data, EPRI testing, other industry testing and/or any other applicable sources of information (WCNOC commitment number 94-174).