INSPECTION PROCEDURE 62708

MOTOR-OPERATED VALVE CAPABILITY

PROGRAM APPLICABILITY: 2515

62708-01 INSPECTION OBJECTIVE

01.01 The objective of this procedure is to independently assess the extent of condition of performance issues associated with motor operated valves (MOVs) when directed by Supplemental Inspection Procedure 95002, "Inspection For One Degraded Cornerstone or Any Three White Inputs in a Strategic Performance Area." This procedure can also be used to help assess the adequacy of the licensee's evaluation of motor operated valve performance issues, consistent with the requirements of IP 95002.

62708-02 INSPECTION REQUIREMENTS

The scope of the inspection is focused on those specific requirements listed below that are necessary to assess the adequacy of the licensee's evaluation and to independently assess the extent of condition associated with motor operated valve performance issues. The inspection plan will be consistent with the objectives of IP 95002. The inspection may involve an in-depth review of such licensee activities as MOV calculations, analyses, diagnostic test results, post-maintenance tests, corrective actions, preventive maintenance, and trending.

02.01 MOV Selection. Select a sample of risk-significant MOVs from more than one system. The selection of MOVs should also include consideration of various valve sizes, types, and manufacturers. The sample size should be appropriate for the scope of the inspection.

02.02 MOV Program Scope. Review MOV program scope changes since the completion of the GL 89-10 program reviews to determine that the appropriate safety-related MOVs are included in the program. (Appendix A provides guidance for reviewing the MOV program scope.)

02.03 Design Calculations. Review design documents and calculations for: MOV functional requirements under normal, abnormal, and accident conditions; motor and actuator sizing; methods for selecting, setting, and adjusting MOV switch settings;

and modifications to the system or valves that could affect the MOV's capability in the as-modified configuration.

02.04 Testing. Review test documents for adequacy of test procedures, test equipment, training of test personnel, acceptance criteria, and test results. If the inspection schedule permits, observe actual testing of MOVs.

02.05 MOV Trending. Review MOV trend reports, failure analyses, corrective actions, nonconformance reports, or other plant documents that may indicate that an MOV is not properly sized, has improper switch settings, or is not properly maintained.

02.06 Preventive Maintenance. Review MOV preventive maintenance to determine whether it is appropriate for the frequency of operation, working environment, and operational experience.

02.07 Corrective Actions. Determine whether the licensee is periodically reviewing data on MOV failures and the effectiveness of the corrective actions.

02.08 Post-Maintenance Testing. Review a sample of MOV maintenance packages and verify that the post-maintenance tests and results demonstrate that the MOVs are capable of performing their design functions.

02.09 Review the adequacy of licensee's processing and control of operating experience information and vendor notifications.

02.10 Review MOV periodic verification test results, both static and dynamic, and verify that information from these tests are incorporated into the design and setup calculations for safety-related MOVs.

02.11 Review changes made in programs affecting safety-related MOVs since the completion of the NRC review or inspection of the GL 89-10, GL 95-07 and GL 96-05 programs.

62708-03 INSPECTION GUIDANCE

General Guidance

In response to the identification of plant-specific MOV performance issues, and as directed by the NRC's action matrix, the NRC staff may determine that an inspection of the licensee's MOV program is appropriate using IP 62708. In planning the inspection under this procedure, the assigned regional inspector should review the identified MOV performance issues. The inspector should then prepare an inspection plan incorporating one or more of the specific inspection requirements outlined in Section 62708-02 that the inspector considers necessary to perform an independent assessment of the extent of condition associated with the MOV performance issues. The inspection plan may also include requirements for evaluating the effectiveness of the licensee's evaluation of the performance issues, as directed by IP 95002.

Based on the selected inspection requirements, the inspector should estimate the resources necessary to perform the inspection as discussed in Section 62708-04.

To the extent applied, this inspection procedure may be implemented to assess the adequacy of calculations, analyses, switch settings, post-maintenance tests, corrective actions, preventive maintenance, and trending that are used to support MOV performance during normal, accident and abnormal conditions. Review of other areas associated with MOVs, such as surveillance testing, operations, maintenance, and quality assurance and self-assessment, are also addressed in the baseline and other supplemental procedures. However, when a weakness in any of these areas is identified, the region should consider performing additional reviews to determine whether significant weaknesses exist in the licensee's overall MOV program.

In response to generic concerns regarding MOV performance, the NRC staff issued GL 89-10 (June 28, 1989), which requested that nuclear power plant licensees and construction permit holders ensure the capability of MOVs in safety-related systems to perform their intended functions by reviewing MOV design bases, verifying MOV switch settings initially and periodically, testing MOVs under design-basis conditions where practicable, improving evaluations of MOV failures and necessary corrective actions, and trending MOV problems. Inspections were conducted to review GL 89-10 programs. Documents containing MOV design requirements, calculations, basis for switch settings, corrective actions, trending, preventive maintenance, and post-maintenance testing were reviewed and approved during the closeout inspections. Documents that are used to demonstrate that MOVs are capable of operating during normal, accident, and abnormal conditions are required to meet the requirements of 10 CFR Part 50, Appendix B, and therefore, controls are required to be in place to ensure any revisions to the licensee's GL 89-10 program are properly maintained and available for review.
On September 18, 1996, the NRC issued GL 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves," requesting that each nuclear power plant licensee establish a program, or ensure the effectiveness of its current program, to verify on a periodic basis that safety-related MOVs continue to be capable of performing their safety functions within the current licensing bases of the facility. In most instances, risk insights were used to develop MOV diagnostic static test schedules developed in response to GL 89-10 and/or GL 96-05 and these risk insights should be considered during MOV selection. MOVs may be risk ranked with respect to their relative importance to core-damage frequency and other considerations added by an expert panel. The risk-ranking process may also include the consideration of the margin between actuator capability and the thrust (or torque) required for the valve to operate during design-basis conditions. The MOV selection should include MOVs ranked as high risk and low capability margin if possible. The NRC staff completed or plans to complete its review of licensees' actions in response to GL 96-05 in a safety evaluation (SE) for each unit. Each SE describes the MOV risk-ranking methodology that was reviewed and approved by the NRC staff when closing out GL 96-05.

Several licensees did not use risk insights to rank their MOVs in the development of their GL 89-10 or GL 96-05 programs. Generic MOV risk insights for boiling water reactors (BWRs) may be obtained from BWR Owners Group (BWROG) Report NEDC-32264A (Revision 2), "Application of Probabilistic Safety Assessment to Generic Letter 89-10 Implementation." Generic MOV risk insights for Westinghouse plants may be obtained from Westinghouse Owners Group (WOG) Report V-EC-1658 (Revision 1), "Risk Ranking Approach for Motor-Operated Valves in Response to Generic Letter 96-05." These risk ranking approaches were reviewed and approved by the NRC staff in SEs dated February 27, 1997 (BWROG), and April 14, 1998 (WOG). The WOG MOV risk-ranking approach can also be used to provide insights for ranking MOVs in Combustion Engineering and Babcock & Wilcox design plants based on their safety significance, except that the generic list of high risk valves in WOG Report V-EC-1658 only apply to Westinghouse design plants.

MOV baseline inspections were conducted during the close out of GL 89-10. The results of these inspections are described in NRC inspection reports. Changes that have been made to MOV programs since the closeout of GL 89-10 should be considered during MOV selection. These changes may involve revised MOV design basis, plant modifications, power uprate, safety relief valve setpoint or tolerance changes, revised calculations, MOVs added to or removed from the MOV program, or the incorporation of new industry guidance into the MOV program.

Also in GL 89-10, the NRC staff identified pressure locking and thermal binding as potential performance concerns for safety-related MOVs. On August 17, 1995, the NRC issued GL 95-07, "Pressure Locking and Thermal Binding of Safety-related Power-Operated Gate Valves," to request that licensees perform, or confirm that they had previously performed, (1) evaluations of the operational configurations of safety-related, power-operated (including motor-, air-, and hydraulically operated) gate valves for susceptibility to pressure locking and thermal binding and (2) further analyses, and any needed corrective actions, to ensure that safety-related power-operated gate valves that are susceptible to pressure locking or thermal binding are capable of performing the safety functions within the current licensing basis of the facility. The NRC staff has completed or plans to complete its review of licensees' actions in response to GL 95-07 in an SE for each unit.

Specific Guidance

03.01 MOV Selection. MOV risk insights and performance should be considered during MOV selection. For example, review of MOV trend reports, nonconformance reports, licensee event reports, maintenance history or other plant documents may indicate that an MOV is not properly sized or has improper switch settings. The inspector should focus on MOVs that are categorized as high risk and low capability margin. The selection of MOVs should include the consideration of various valve sizes, types, and manufacturers. Additional guidance on MOV selection is provided in the general guidance discussion above.

03.02 MOV Program Scope. Since the completion of inspections of GL 89-10, some licensees have modified the scope of their MOV programs. The licensees are expected to justify any changes in the scope of their MOV program. For example, the staff evaluated a proposed change in the scope of the GL 89-10 program at the Hatch nuclear power plant. The results of the staff review is provided in an SE forwarded to J. T. Beckham, Jr., Georgia Power Company, by K. N. Jabbour, NRR Division of Reactor Projects I/II, on October 16, 1995.

Where a licensee has modified the scope of its MOV program since the previous inspection, the inspector should determine whether the licensee has adequately justified the removal of any MOVs from its MOV program. The inspector should also review any modifications involving MOVs and verify that the MOVs were properly incorporated into the licensee's MOV program. Considerations for the review of the licensee's scope of its GL 89-10 program are provided in Appendix A.

03.03 Design Calculations. Review the methods used for selecting, setting, and adjusting switches. Motor sizing calculations must consider degraded voltage and elevated ambient temperature conditions. For example, the inspector should ensure that the lowest motor terminal voltage commensurate with the design-basis conditions has been factored into the MOV program. Use of appropriate actuator efficiency and the proper application factor must be justified. Adequate bases must exist for stem factors, valve factors, load sensitive behavior and other assumed parameters that are used in calculations used to size actuators.

In Technical Update 93-03, Limitorque Corporation provided guidance on determining the effect of increased motor temperature on ac-powered actuator capability. In Technical Update 98-01 and its Supplement 1, Limitorque Corporation provided updated guidance for predicting the torque output of its ac-powered motor actuators. Commonwealth Edison developed a method for determining capability for ac-powered motor actuators that is based on a comprehensive motor and actuator test program. The NRC staff has reviewed and accepted the Commonwealth Edison methodology for estimating MOV motor-actuator output capability, based on test data obtained by the licensee in plant-specific GL 96-05 SEs. In its letter dated July 17, 1998, forwarding Technical Update 98-01, Limitorque indicates that a future technical update will be issued to address the application of dc-powered MOVs.

The Electric Power Research Institute (EPRI)developed the MOV Performance Prediction Methodology (PPM) to define a bounding thrust (or torque) required to operate a gate, globe, or butterfly valve within the scope of the EPRI MOV PPM (EPRI TR-103237-R2, dated April 1997). The NRC staff concluded that the EPRI MOV PPM constituted an acceptable methodology to predict thrust and torque requirements following the conditions and limitations in an SE dated March 15, 1996, and an SE supplement dated February 20, 1997.

The following is a list of some issues to be addressed and assumptions to be justified as applicable:

a. Valve factor (including area assumption).

b. Stem friction coefficient.

c. Load sensitive behavior (rate of loading).

d. Margins for stem lubrication degradation and springpack relaxation.

e. Motor performance factors:
   1. motor rating
   2. efficiencies used in open and close directions
   3. application factor
   4. power factor used in degraded voltage calculations
   5. ambient temperature

f. Basis for extrapolation method of partial differential pressure thrust measurements.

g. Torque switch repeatability.

h. Use of Limitorque, Kalsi, or other sources for increasing thrust and torque allowable limits.

i. Equipment error.

j. Degradation assumptions.

k. Justification for grouping of MOVs for application of test data, performance characteristics, structural operating limits, and common-cause failure analyses.

The Idaho National Environmental and Engineering Laboratory developed a computer program to assist inspectors in assessing the capability of MOV gate and globe valves powered by Limitorque operators. The Mechanical and Civil Engineering Branch of NRR or the regional MOV valve inspector may be contacted for further information regarding use of the computer program.

Following the initial verification of MOV capability under design-basis conditions, the MOV switch settings will need to be re-verified if the MOV is replaced (which would constitute the need for a complete demonstration of design-basis capability), modified, or overhauled to the extent that the licensee considers that the existing test results are not representative of the MOV in its modified configuration. Because of the interrelationship of various operating parameters, the performance of the MOV can be affected by routine maintenance work, such as valve packing adjustments.

03.04 Testing. The following should be considered during the review of MOV test programs:

a. The licensee should use the best available MOV test data when sizing and setting its MOVs.

b. The licensee should consider industry test data.

c. The licensee should have justification for its assumption for each parameter in its MOV calculations.

d. The licensee should assume a reasonable value based on industry test data for a parameter where it does not have plant-specific justification for the parameter.

e. Where the licensee assumes realistic values based on test data for all parameters, the licensee should take action where the calculation predicts MOV capability problems.

f. The licensee should undertake prompt evaluation of test results to determine capability under design-basis conditions prior to declaring the MOV operable and returning it to service.

g. The licensee should have justification for the accuracy of its MOV diagnostic equipment.

h. The licensee should monitor test data to affirm assumptions.

i. The licensee should have justification for applying test data to valve groups.

Where a licensee follows a different approach than outlined above, the licensee should justify its approach.

When observing MOV testing, the inspector should: (1) witness licensee testing of MOVs, (2) verify test equipment is setup and calibrated in accordance with vendor recommendations, (3) verify qualification of test personnel, (4) determine test equipment inaccuracies and test data accuracy, and (5) verify test results are adequately reviewed prior to declaring MOVs operable.

Where a licensee uses diagnostic equipment during MOV testing, the inspector should verify that the licensee has justified the accuracy of that equipment. The inspector should also verify that the licensee has an adequate training program for personnel operating MOV diagnostic equipment and analyzing the information obtained. As part of that training, the licensee should ensure that plant personnel understand the inherent sensitivities and limitations of the diagnostic equipment.

03.05 MOV Trending. The MOV data on failures and corrective actions should be periodically reviewed by the licensee as part of a monitoring and feedback effort to establish trends of MOV performance. In addition to plant specific data, the monitoring and feedback effort should include industry-wide MOV data. Examples of MOV parameters that may be trended include valve factor, stem factor (as-found and as-left), rate of loading/load sensitive behavior, actuator torque output, bearing coefficients, running load, motor current and voltage, torque switch settings, capability margin, and thrust and torque at control switch trip.

03.06 Preventive Maintenance. The inspector should verify that the licensee has implemented periodic MOV preventive maintenance based on MOV frequency of operation, working environment and

operational experience. Examples of the licensee's preventive maintenance activities may include the following items:

a. Checking for indications of grease or oil leakage from the various sealed joints and shaft protrusions.

b. Checking the mounting flange and valve yoke for cracks or damage.

c. Checking fasteners for tightness.

d. Lubrication of valve stem, main gear case, and limit switches.

e. Checking valve stem and stem nut threads for damage.

f. Checking that the ball in the grease relief valve, if installed, is free to move.

g. Sampling and analysis of the grease in main gear case.

h. Checking spring pack for hardened grease.

i. Checking that T-drains, if installed, are clear.

j. Check limit switch compartment for cleanliness and general integrity of gears and wire terminals.

03.07 Corrective Actions. The inspector should verify that the licensee's administrative procedures require that MOV failures/malfunctions/deficiencies be promptly identified and corrected. The inspector should verify the adequacy of the licensee's analysis of MOV failures, justification of corrective actions, and trending of failures and corrective actions for the selected MOVs. The inspector should review recent MOV failures and the resulting corrective actions. The licensee's failure analysis should include the results and history of each as-found deteriorated condition, malfunction, test, inspection, analysis, repair, or alteration. For example, a torque switch adjustment may be made to overcome an increased actuator load instead of identifying and correcting the cause of the increased actuator load. The application of a greater actuator torque allows the MOV to be returned to service but could lead to a repetitive or more serious failure. The inspector should also verify that the licensee performed the appropriate level of root cause analysis based on the significance of the MOV failure/malfunction/deficiency.

03.08 Post-Maintenance Testing. The inspector should verify that the licensee's procedures require that MOVs be properly tested prior to return to service following maintenance. The inspector should review selected MOV maintenance packages and verify that the post-maintenance tests demonstrate that the MOV is capable of performing its design function. For example, MOVs are set up to deliver thrust or torque values determined by calculations based on design-basis conditions. Stroking a valve following maintenance that could have adversely affected the capability of the MOV to

provide the required thrust or torque does not demonstrate that the MOV is capable of operating during design-basis conditions. Since post-maintenance testing under design-basis conditions is not always feasible, the licensee must use other methods to ensure the maintenance performed has not rendered the MOV incapable of performing its intended function.
If the licensee chooses not to test an MOV following maintenance, the licensee should be able to justify that a test was not necessary to demonstrate the capability of the MOV to perform its safety function. For example, valve packing adjustment can affect MOV operation since the adjustment of packing could increase the torque required to open or close the MOV. In some instances, it may be difficult to test an MOV following the adjustment of packing during plant operation because plant conditions prohibit the cycling of the MOV. The inspector should verify that the licensee has an adequate basis for not testing the MOV following the adjustment of the packing. For example, test data previously obtained could be used to demonstrate that the MOV's thrust or torque capability is not adversely affected at specific packing adjustment settings.

The NRC staff provided guidance on pre-lubrication of valves prior to inservice testing in a memorandum dated July 2, 1996, from F. J. Hebdon, NRR, to Jon R. Johnson, Region II. In the attachment to the memorandum, the staff states that the performance of maintenance on a component to ensure its proper operation prior to conducting a test negates the validity of the test in assessing the operational readiness of the component. In American Society of Mechanical Engineers (ASME) Code Case OMN-1, "Alternative Rules for Preservice and Inservice Testing of Certain Electric Motor Operated Valve Assemblies in LWR Power Plants," the ASME states that certain maintenance activities, such as stem lubrication, shall not be conducted if they might invalidate the as-found condition for inservice testing. The inspector should consider this guidance in evaluating the licensee MOV programs.

03.09 No guidance provided.

03.10 No guidance provided.

03.11 No guidance provided.

62708-04 RESOURCES

This inspection procedure provides guidance that could be used to assess the entire MOV program. However, since the scope of the inspection is focused on an independent extent of condition review and oversight of licensee self-assessment and may be limited to specific inspection requirements identified in Section 62708-02, it is estimated that it may take an inspector a minimum of 8 hours to accomplish. If the nature of the problems prompting the inspection are extensive requiring a more broad review, then more time will be required to accomplish the inspection. On average, it took two inspectors knowledgeable of MOVs and GL 89-10 recommendations approximately 70 hours of onsite inspection, and 80 hours of

offsite preparation to complete the GL 89-10 closeout inspection at each site.
Other factors that affect the amount of time required to complete the inspection are the knowledge and experience of the inspector(s) and the number of safety-related MOVs in each unit. It is recommended that inspector(s) knowledgeable of GL 89-10 and GL 96-05 recommendations and MOV mechanical and electrical characteristics perform the inspection. Some early-vintage units may have fewer than 30 safety-related MOVs, while later-vintage units may have more than 150 MOVs. The number of safety-related MOVs should be considered when determining the amount of time needed to accomplish the inspection.

62708-05 REFERENCES

GL 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance"

GL 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves"

GL 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves"

BWR Owners Group (BWROG) Report NEDC-32264A (Revision 2), "Application of Probabilistic Safety Assessment to Generic Letter 89-10 Implementation"

Westinghouse Owners Group (WOG) Report V-EC-1658 (Revision 1), "Risk Ranking Approach for Motor-Operated Valves in Response to Generic Letter 96-05"

ASME Code Case OMN-1, "Alternative Rules for Preservice and Inservice Testing of Certain Electric Motor Operated Valve Assemblies in LWR Power Plants"

END

Appendix
A. Considerations In Reviewing The Scope of Licensee MOV Program

APPENDIX A

CONSIDERATIONS IN REVIEWING THE SCOPE OF LICENSEE MOV PROGRAM

1. The scope of the MOV program extends to safety-related MOVs as defined in the NRC regulations. In GL 89-10, the staff requests licensees to determine the design basis for the operation of each safety-related MOV including the maximum differential pressure expected during both the opening and closing of the MOV for both normal operations and abnormal events, to the extent that these MOV operations and events are included in the existing approved design basis.

2. In Supplement 1 to GL 89-10, the staff stated that safety-related MOVs that are always in their safety position, or would have no affect on the operation of the safety train if placed in the nonsafety position, could be removed from the GL 89-10 program. However, containment isolation valves will always have a safety function to close regardless of their system performance requirements.

3. Section 3.1.2 of NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants," issued by GL 89-04 (Supplement 1), "Guidance on Developing Acceptable Inservice Testing Programs," dated April 4, 1995, discusses the capability of plant components and surveillance testing. In this regard, safety-related MOVs that are placed in a position that prevents the safety-related system (or train) from performing its safety function must be capable of returning to their safety position, or the system (or train) must be declared inoperable and the appropriate plant technical specifications followed.

4. In the second footnote in GL 89-10, the staff states that design-basis events are defined as conditions of normal operation, including anticipated operational occurrences, design-basis accidents, external events, and natural phenomena for which the plant must be designed to ensure the function delineated as "safety-related" can be performed. The staff further states in the footnote that the design bases for each plant are those documented in pertinent licensee submittals, such as the final safety analysis report. In Bulletin 85-03, the staff requested BWR plants to ensure that MOVs in the Reactor Core Isolation Cooling system can perform their safety function.

5. The consideration of pipe breaks in conjunction with the ability of MOVs to close should be consistent with the staff's licensing review for the individual facility (i.e., in accordance with Standard Review Plan (SRP) Section 3.6.2).

6. Supplements 4 and 7 to GL 89-10 removed the recommendation that licensees of BWR and pressurized water reactor nuclear plants, respectively, consider inadvertent mispositioning of MOVs as part of their GL 89-10 programs.

7. The consideration of long-term passive failures in piping should be consistent with the staff's licensing review for the individual facility and should be in accordance with SRP 3.6.1. Further, the licensee's evaluation of passive failures must consider valve and pump seal failures as discussed in SECY 77-439.

8. Licensees may rely on analysis results for each design-basis event and each system's required capability to satisfy event acceptance limits provided in the updated final safety analysis report (FSAR) where the licensee can demonstrate that the information in the updated FSAR is consistent with the licensing basis of the facility.

9. Licensees are required to meet the single failure criterion in the NRC regulations. Other criteria may also apply at the same time (e.g., loss of offsite power). Further, safety systems are required to meet the redundancy provisions of Appendix A to 10 CFR Part 50. The consideration of the single failure criterion as applied to anticipated operational transients should be consistent with the staff's licensing review for the individual facility.

10. The safe shutdown licensing basis for each facility is defined in licensing documents. Valves that are operated during conditions below the safe shutdown licensing basis are not required to be in the scope of the MOV program provided that the licensee does not have any other commitments that the MOV must operate during certain conditions. For example, if the safe shutdown licensing basis is Hot Shutdown, valves that are operated during conditions below Hot Shutdown are not in the scope of the MOV program. However, the MOV would be included in the MOV program scope if the licensee has an Appendix R commitment that requires the MOV to operate during certain conditions.

END