UNITED STATES
NUCLEAR REGULATORY COMMISSION
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101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

Report No. 50-416/92-01

Licensee: System Energy Resources, Inc.

Docket No. 50-416 License No. NPF-29

Facility Name: Grand Gulf

Inspection Conducted: January 6-10, 1992

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SUMMARY

Scope:

This special, announced inspection examined the program developed in response to NRC Generic Generic Letter (GL) 89-10, "Safety-Related Motor Operated Valve Testing and Surveillance." The inspection was the first of two or more that will be conducted for each nuclear plant in accordance with NRC Temporary Instruction 2515/109, issued January 14, 1991.

Results:

In the areas inspected, violations or deviations were not identified.

The inspectors determined that the GL 89-10 MOV program was satisfactory at the current stage of implementation. Concerns were identified in some of the MOV program areas. The MOV program was also found to contain strengths.

The concerns identified involved licensee assumptions and methods whose adequacy will require further review. In addition concerns similar to these are largely the result of technological uncertainties regarding the predictability of MOV operation. These uncertainties should be resolved as MOV tests and analyses recommended by GL 89-10 are completed and the associated data is disseminated throughout the industry. The concerns and strengths identified for the Grand Gulf MOV program are listed below:

Concerns

(1) The NRC requested (NRC LTRS. dated September 20, 1990, December 4, 1990) that the licensee identify those MOVs for which testing in-situ under design basis condition is practicable. The licensee should also note those MOVs that will be tested under such conditions. The licensee has not identified the MOVs at the current stage of MOV program development. (paragraph 3.d)

(2) The licensee is planning to group identical/similar MOVs and test only a portions of each group. The inspectors cautioned that grouping of MOVs should not replace in-situ testing of MOVs that are practicable to test. The NRC should be promptly informed if testing is discontinued and the basis. (paragraph 3.d)

(3) The licensee program methodology for identifying and grouping MOVs is under development. The inspectors discussed criteria for grouping MOVs and indicated that the licensee should be prepared to address and provide the basis for: (a) The number of MOVs tested per group should be more than two to allow a more accurate characterization of the group; (b) The criteria to be used to compare the results from tests of MOVs in the same group should be carefully considered; (c) Assess the effects of differences in the performance of Motor Actuators on the grouping of MOVs; (d) The internals of a sample of MOVs should be considered for inspection to verify its capability to predict the onset of damage; (e) The effects of fluid conditions (ie flow and temperature) on MOV grouping should be adequately considered. (paragraph 3 d)

(4) The effects of high ambient accident temperatures on motor torque, if any had not been accounted for in the licensee calculations. The licensee indicated an evaluation and the need for correction to calculations would be made when the results of a study by Limitorque are issued. (paragraph 3.b)

(5) Static tests are planned during periodic testing to demonstrate MOV capability to perform under design basis conditions. It is not clear that static test can demonstrate design basis capability because of the uncertainties between the performance of MOVs under static and design conditions. The licensee will need to justify the present periodic test methodology. (paragraph 3.e)

(6) The licensee is using a 0.3 valve factor for flex wedge gate valves. Employing a 0.3 valve factor may not provide adequate conservatism in

torque switch setting calculations. The licensee 0.3 valve factor assumptions will need to be verified using applicable means, such as testing where practicable. (paragraph 3.c)

(7) The methodology (procedure 17-S-03-26) for determining the thrust window (minimum and maximum values) does not clearly define the criteria to use a 0.3 valve factor instead of a 0.5 valve factor. (paragraph 3.c)

(8) The design basis review had not considered worst case flowrate or temperature as recommended by GL 89-10, Supplement 1 question 16. In addition E.O.Ps had not been reviewed to ensure that identified differential pressures bound system conditions presented by E.O.Ps. (paragraph 3.b)

(9) The MOV Users Group validation committee is preparing to issue a report on diagnostic system accuracies. The licensee should address these new accuracy values and the effects on torque switch setting calculations promptly. (paragraph 3.1)

(10) The licensee has not incorporated into the MOV program the thrust values provided by INEL tests concerning GL 89-10 Supplement 3 MOVs. (paragraph 3.c)

(11) The MOV program does not specify the review/evaluation of test results to the extent necessary to ensure MOV operability has been addressed prior to returning MOV/system to operation. (paragraph 3.d)

(12) The licensee has not established design controls which ensure that limit switch settings once determined are changed only on authorization of Nuclear Plant Engineering. (paragraph 3.i)

The following strengths were noted in the licensee MOV program:

Strengths

(1) Thrust verification program efforts

(2) The licensee's trending program has evaluated a large data base of information. The results have lead to additional MOV inspections and maintenance.

(3) Project personnel and engineers responsible for MOV programs were found to be very knowledgeable regarding on going issues and state of the art.

(4) The licensee has recognized the effects of "rate of loading: and has properly incorporated into the thrust calculations.

(5) The licensee's MOV program requires the refurbishment of MOVs to establish the best obtainable conditions prior to baseline testing.

TABLE OF CONTENTS

REPORT DETAILS

NRC Inspection of the Program Developed in Response to Generic Letter 89-10 at the Grand Gulf Nuclear Station (GGNS)

1. Background

On June 28, 1989, the NRC staff issued Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," which requested licensees and construction permit holders to establish a program to ensure that switch settings for safety-related motor-operated valves (MOVs) and certain other MOVs in safety-related systems are selected, set and maintained properly. The staff held public workshops to discuss the generic letter and to answer questions regarding its implementation. On June 13, 1990, the staff issued Supplement 1 to GL 89-10 to provide the results of those public workshops. In Supplement 2 to GL 89-10 (August 3, 1990), the staff stated that inspections of programs developed in response to GL 89-10 would not begin until January 1, 1991. In response to concerns raised by the results of NRC-sponsored MOV tests, the staff issued Supplement 3, to GL 89-10 on October 25, 1990, which requested that boiling water reactor (BWR) licensees evaluate the capability of MOVs used for containment isolation in several systems. In Supplement 3, the staff indicated that all licensees and construction permit holders should consider the applicability of the information obtained from the NRC-sponsored tests to other MOVs within the scope of GL 89-10 and should consider this information in the development of priorities for implementing the generic letter program.

The GL 89-10 requested licensees to submit a response by December 28, 1989. Entergy Operations, Inc. submitted responses to the generic letter for its Grand Gulf Nuclear Station on December 21, 1989. In those responses, Entergy Operations stated that it planned to meet the recommendations of the generic letter and would deviate only in the area of schedule. Grand Gulf plans to complete required sections within 6-years, spanning 4 refueling outages. The NRC staff agreed in a letter dated December 4, 1990 to extend the generic letter scheduled to includes four refueling outages, June 30, 1995.

GL 89-10, Supplement 3 indicated that INEL MOV test program results may suggest that deficiencies exist in the RCIC, HPCI, RWCU and isolation condenser system at BWR facilities. Systems applicable to Grand Gulf because it is a Mark III, BWR 6 design are the RCIC and RWCU systems. The licensee responded to GL 89-10 Supplement 3 in letters dated December 4, 1990, March 8, 1991 and August 7, 1991. As requested by Supplement 3 safety assessments for the motor operated isolation valves in the aforemention systems were conducted. The results indicated that specified MOVs had thrust capacity exceeding that which was predicted using INEL data. In addition the evaluations recommended that torque switch adjustments be made for the inboard RCIC steam supply isolation valve (E51F063) and the outboard RWCU post-pump mode supply isolation valve

(G33F251). Torque switch adjustments are scheduled during refueling outage 5 (April 1992).

2. Inspection Plan

The NRC inspectors followed Temporary Instruction (TI) 2515/109 (January 14, 1991), "Inspection Requirements for Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance," in performing this inspection. The inspection focused on Part 1 of the TI which involves a review of the program being established by the licensee in response to GL 89-10. Part 2 of the TI, which involves a detailed review of program implementation, was not performed. Implementation was examined only where this aided in evaluating the program.

3. Program Areas Inspected and Findings

a. Scope of the Generic Letter Program

The scope of GL 89-10 includes all safety-related MOVs and other MOVs that are position-changeable in safety-related piping systems. GL 89-10 Supplement 1 defined "position-changeable" as any MOV in a safety-related piping system that can be inadvertently operated as a result of an action in the control room.

Systematic Motor Actuator Reliability Testing (SMART) project, MOV Program Plan dated October 1, 1990 section 6 described the criteria to be used to exclude MOVs. The inspector found that program scope and exclusion criteria were in agreement with GL 89-10 and Supplement 1 recommendations.

The licensee identified 294 MOVs to be within the scope of the GL 89-10 and Supplement 1. Mechanical Standard MS-25.0, Motor Operated Torque and Limit Switches, Revision 6 dated November 26, 1991 document the MOVs in Appendix A. 36 MOVs were excluded from the program. The inspectors reviewed the licensees documented justification for the exclusion and identified no concerns.

The inspectors reviewed system diagrams for three systems to assess the completeness of the MOV list, Appendix A to MS-25. Systems selected for review were the high pressure core spray, reactor water cleanup and reactor core isolation cooling. MOVs for these systems were determined to be included in the MOV program or appropriate justification for removal.

b. Design-Basis Reviews

Recommended action a of GL 89-10, requests the review and documentation of the design basis for the operation of each MOV within the generic letter program to determine the maximum differential pressure and flow (and other factors) expected for both normal operations and abnormal conditions.

Accordingly, the inspectors examined the GGNS GL 89-10 Program Description documents ("Project SMART Program Plan, GGNS Program to Respond to Generic Letter 89-10," Rev. 1, dated October 1, 1990 and Site Directive G4.401, "GGNS Generic Letter 89-10 Motor Operated Valve Program," Draft #3), GGNS-GES-06, "General Engineering Standard for the Evaluation of Motor Operated Valves," Rev. 0, dated December 27, 1991, and a sample of design-basis review calculations, (MC-Q1E51-90140, "Calculation of the Maximum Expected Differential Pressure of Valves in the Reactor Core Isolation Cooling System," dated August 20, 1990 and MC-Q1G33-90100, Calculation of the Maximum Expected Differential Pressure for Valves in the Reactor Water Cleanup System," dated July 23, 1990) to determine that the review methodology and criteria were consistent with the recommendations of GL 89-10 and Supplement 1.

Section 5.0 of the General Engineering Standard,GGNS-GES-06 described the methodology for performing the design-basis review for the MOVs. The method consisted of performing a calculation to determine the maximum expected differential pressure for each MOV during opening and closing for both normal and abnormal events and including valve mispositioning conditions. The reactor was assumed to be at either the safety relief valve setpoint or the reactor trip setpoint, whichever was applicable based on the required function of the valve. Downstream pressure was typically assumed to be at zero psig.

GGNS had completed design basis reviews for 277 of 294 MOVs in their GL 89-10 program. The remaining reviews concerned butterfly valves and were in the process of being revised. GGNS was not able to provided a schedule for the completion of these remaining MOVs because the valve vendor was responsible for the torque calculations.

The inspectors noted that GGNS' analyses had determined only differential pressure and did not consider design flow effects and other factors discussed in the staff response to Question 16 of Supplement 1 to GL 89-10. To determine the conditions under which the MOV must perform its safety function, the generic letter recommends that licensees consider all relevant factors that may affect the capability of the MOV to perform its function. GGNS' MOV design basis test program intends to account for flow by establishing MOV test conditions using existing system pumps to achieve the maximum flowrate attainable. However, the inspectors noted that 17-S-03-16, "P&SE Engineering Instruction, Safety Related MOV Program," Rev. 2, dated December 27, 1991, did not specify that system flow be recorded during differential pressure testing. Fluid temperatures would be recorded as part of the test. Test procedures should be modified to ensure that worst case flow conditions during valve strokes are recorded on the appropriate data sheets, where instrumentation is available. The licensee's consideration of flow will be reviewed during future inspections.

Input for GGNS' design basis review was taken from existing plant documentation such as the FSAR, plant drawings, system descriptions, and plant operating procedures. Contrary to the direction given in Section 5.2.1 of GGNS-GES-06, GGNS engineering personnel indicated that the emergency operating procedures were not reviewed as part of the differential pressure determinations. The licensee needs to correct this deviation to ensure that the highest differential pressures had been determined for the MOVs within its GL 89-10 program. Emergency procedures within GGNS' design basis should be included in this review. [concern (8)]

GGNS had included a review of the original valve seismic and stress calculations for MOV in their GL 89-10 program. The intent of this review is to ensure that any increased thrust requirements would not overstress any of the valve components under accident conditions. The licensee's consideration of seismic effects will be reviewed during future inspections.

The method used for calculating the capability of the MOV actuator under degraded voltage conditions was given in Appendix C to mechanical standard GGNS-MS-25.0. Numerical values of motor terminal voltage used in Appendix G were obtained from calculation EC-Q111-G0016, Voltage Drop Study for AC Motor Operated Valves, Revision 8. The inspectors reviewed this calculation and verified that the degraded voltage relay setpoints, for Division 1, 2, and 3, 4160 Volt Bus undervoltage was consistent with values specified in TS table 3.3.3.-2. The voltage drop calculations used to determine minimum motor terminal voltage assumed rated load at a power factor of 0.9 for the load centers and MCCs coincident with a degraded voltage condition. The MOV feeder voltage drop was calculated using the motor full load current. Additionally, the voltage drop calculation did not include the voltage drop caused by the TOL Heater since the circuit model did not include this element.

The inspectors expressed concern at Licensee Management's failure to (1) calculate the motor feeder voltage drop using the motor locked rotor current and (2) include the TOL heater in the circuit model for calculating minimum motor terminal voltage. In response to the inspector's concern Licensee management performed a voltage drop calculation using actual loads under LOCA conditions for the MCC having the lowest bus voltage as documented in calculation EC-Q1111-90028. The voltage drop was calculated using locked rotor current for the MOV, fed from this MCC, having the longest feeder cable run. The results demonstrated that the calculated worst case full load running condition voltage of 390 volts pounds the value of 408.5 volts that was determined by using locked rotor current under accident conditions with degraded voltage. Licensee management also performed a calculation which demonstrated that the voltage drop caused by TOL heater is negligible under locked rotor conditions and 0.4 power factor.The inspectors concluded that values of minimum motor terminal voltage documented in calculation EC-Q1111-90016 were

conservative and bounded the values that would be obtained during a DBA coincident with degraded voltage condition.

In demonstrating D.C. powered MOV capability the Licensee relied on the torque output of D.C. motors at degraded voltage conditions. Calculations EC-OIL21-90032, Sizing of 125 VDC Division Battery and Chargers, and EC-OIL-90033, Division 1, 125V D.C. Class IE Voltage Drop Study, were reviewed by the inspectors in connection with this determination. The inspectors concluded that the Licensee's analysis of D.C. powered MOVs under degraded voltage conditions was technically adequate and demonstrated that adequate margin was available for motor developed torque under these conditions. It was not clear, however, that the effects of degraded voltage on the MOV stroke time had been evaluated by the licensee. This issue will be evaluated during additional NRC inspections.

The inspectors requested information concerning whether the licensee had evaluated the effects of high ambient temperature, caused by DBA, upon motor developed torque. Actions taken by the licensee in response to the 10 CFR Part 21 Notification issued by Limitorque Corp concerning the effects of high temperature on DC motor developed torque were evaluated by the inspectors. The corrective actions documented on MNCR No. 0223-88 were determined to have been technically adequate. The licensee also stated that the effects of high ambient temperature on motor torque for AC motors was presently being studied by the valve operator vendor. Upon completion of this study an evaluation of the temperature effects on motor performance will be performed by GGNS. Additional inspections of this area will be performed by the NRC to determine the results of Licensee's evaluation. [Concern (4)]

The inspectors determined from review of general engineering standard GGNS-GES-06, paragraph 5.5.1.2, that the present practice at GGNS, for most MOVs was to bypass the TOL relay except during testing operations. This practice is in accordance with the requirements of Regulatory Guide 1.106. A small number of MOVs have their TOL in the circuit but are bypassed upon receipt of certain ESF signals. Additionally, other MOVs are configured such that the TOL relay may manually be bypassed while others have TOL that are not bypassed under any circumstances. Sizing of TOL were performed in accordance with the guidelines of Report No. 11-0200-004, Guide for Application of Thermal Overload Relays for Motors at Grand Gulf Nuclear Station. Discussions with Licensee's engineering personnel revealed that the methodology delineated in this report is consistent with the guidelines in IEEE 741-1990.

c. MOV Switch Settings

Recommended action b of Generic Letter 89-10 requests licensees to review, and to revise as necessary, the methods for selecting and setting all MOV switches. (i.e., torque, torque bypass, limit, thermal overload)

The inspectors reviewed the licensee's GGNS GL 89-10 Program Description documents ("Project SMART Program Plan, GGNS Program to Respond to Generic Letter 89-10," Rev. 1, dated October 1, 1990 and Site Directive G4.401, "GGNS Generic Letter 89-10 Motor Operated Valve Program," Draft #3), GGNS-GES-06, "General Engineering Standard for the Evaluation of Motor Operated Valves," Rev. 0, dated December 27, 1991, and GGNS-MS-25.0, "Mechanical Standard for Motor Operated Valve Torque and Limit Switches," Rev. 6, dated November 26, 1991, and a sample of MOV thrust calculations (MC-Q1111-91132, "Minimum Stem Thrust Required for Motor Operated Gate and Globe Valves," Rev. 1, dated November 15, 1991 and MC-Q1111-91133, "Degraded Voltage Actuator Capability Torque of Gate and Globe Motor Operated Valves," Rev. 1, dated November 14, 1991). The inspectors also discussed the process for sizing MOVs and setting their switches with GGNS personnel.

As stated in report Section 3.b above, GGNS had completed sizing and switch setting calculations for approximately 277 gate and globe valves. A standard industry equation was used for determining the required minimum thrust for gate and globe valves. The worst case differential pressures identified in each MOV's design-basis calculation were applied in sizing and setting the MOVs for opening and closing capability. The valve factor assumed had recently been revised from 0.30 to 0.50 for gate valves and the licensee used mean seat diameter to determine the disk area term. Thrust calculations for globe valves were observed to utilize a valve factor of 1.1, as recommended by Limitorque.

MOV thrust requirements were calculated using both the 0.50 and 0.30 valve factor. The initial MOV torque switch window determination used the thrust requirement based on 0.50 valve factor. If GGNS personnel were unable to create an adequate window for torque switch setup, a window was determined using the thrust requirements based on the 0.30 valve factor and an Engineering Evaluation Report (EER) was generated to prompt an evaluation by Nuclear Plant Engineering (NPE). NPE will consider MOV modification to provide thrust margin as part of these evaluations. The inspectors noted that the program documentation should include criteria to be used to determine when modifications would be performed.

Thrust requirements based on a 0.30 valve factor for flex wedge gate valves have been shown to yield non-conservative results in some analytical thrust determinations. The inspectors indicated that, if implemented, the use of low valve factors places a heavy emphasis on the performance of design basis testing of MOVs in situ in order to verify the licensee's methodology for sizing MOVs and their switches.

Where it is not practicable to test an MOV under worst case differential pressure and flow conditions, GGNS will need to develop specific justification. The licensee will need to be prepared to evaluate its methodology, including appropriate consideration of MOV operability, when results of design basis testing are obtained. The licensee's use of a 0.30 valve factor will be reviewed during future inspections. [Concern (6)]

The inspectors noted that 17-S-03-26, "Performance and System Engineering Instruction, MOV Torque Switch Setpoint Methodology," Rev. 0, dated December 31, 1991, did not specify the criteria that would be used to decide when to implement a 0.30 valve factor in lieu of a 0.50 valve factor. GGNS personnel were relied upon to make a judgement call when a torque switch setup window is large enough for proper MOV setup without utilizing a 0.30 valve factor. GGNS should provide program guidance on when to use a 0.30 valve factor. [Concern (7)]

The inspectors noted that Appendix D of GGNS-MS-25.0, "Mechanical Standard for Motor Operated Valve Torque and Limit Switches," specified the use of 0.20 disk factor of parallel disk gate valves. GGNS personnel indicated that 0.50 or 0.30 will be used for parallel disk gate valves. GGNS should revise their program documentation to clarify the use of valve factors in their generic letter program.

GGNS' methodology for baseline setup of MOV torque switches included the use of diagnostics to set torque switches above the minimum required thrust and below the maximum allowable thrust, as calculated by engineering. The required thrust numbers were used to develop a "window" that included margins to account for diagnostic equipment inaccuracies. GGNS was also including a margin for "rate of loading" or load sensitive MOV behavior, that can reduce the thrust delivered by the motor operator under high differential pressure and flow conditions from the amount delivered under static conditions. The licensee was setting this margin at 30%, as recommended by their diagnostic equipment vendor. The upper end of the window was determined by the most limiting of the actuator rating or valve allowable thrust rating. This limit was also adjusted for diagnostic equipment inaccuracies and margin to compensate for inertial effects. The diagnostic personnel were directed to set the torque switch for the upper end of the adjusted thrust band as a "target". GGNS personnel indicated that the rate of loading margin could be reduced in order to develop an adequate window, but that this would be done in limited cases. The NRC will review GGNS' consideration of rate of loading effects during future inspections.

GGNS determined the spring pack displacement that corresponds with the actuator's output torque at degraded voltage conditions. This displacement was used to establish a limit for baseline testing to ensure that torque switches are not set too high which would allow actuator stall to occur. This limit, combined with the thrust

window, provided the limits for baseline setup of an MOV at GGNS. The inspectors noted that the licensee's methodology did not consider stem factor or make any assumptions regarding stem friction coefficients. In addition, this methodology did not compare MOV degraded voltage output capability to the minimum thrust requirements to determine if adequate margin existed. An undersized actuator would only be identified during baseline testing when a technician was unable to meet minimum thrust requirements before exceeding the spring pack deflection limit. An evaluation of available margin, using a conservative stem friction coefficient to account for degradation in stem lubrication, needs to be performed early in the program to ensure that marginal or undersized MOVs are promptly evaluated and corrected. This issue will be reviewed during future inspections.

GGNS used the open limit switch to control the opening of all GL 89-10 MOVs. The open limit switch was set at approximately 95% of the open stroke for gate [illegible] globe valves. Torque switch bypass was in effect for the first [illegible] of the open stroke to prevent high unseating loads from prem[illegible]rely stopping valve operation. The inspectors cautioned that [illegible]dustry testing and events at nuclear facilities have shown that [illegible]ak thrust requirements in the open direction do not always oc[illegible] during unseating, as assumed by the licensee. The amount of torque switch bypass in the open direction should be adjusted, on a case-by-case basis, as determined necessary by differential pressure testing. This issue will be reviewed during future inspections.

SUPPLEMENT 3 TO GL 89-10

The licensee identified 6 MOVs in the RCIC, and RWCU systems, respectively, to be within the scope of Supplement 3 to GL 89-10. In response to Supplement 3, the licensee prepared a safety assessment to demonstrate that the 18 month schedule provided by Supplement 3 to correct any MOV deficiencies was justified for GGNS.

The licensee evaluated its MOVs within the scope of Supplement 3 and concluded that each MOV had adequate capacity but that two MOVs will require possible altering of the current torque switch setting based on current knowledge of existing settings. GGNS indicated that this would be performed during the upcoming April 1992 refueling outage. The inspectors reviewed the licensee's MOV evaluations. In its calculations, GGNS utilized thrust requirements based on information provided in NRC Information Notice 90-40. The licensee determined that results from the INEL 10 inch Powell gate valve were directly applicable to the RCIC MOVs and that results from the INEL 6 inch Velan gate valve could be applied to the RWCU MOVs. When using the INEL test results as basis for minimum required thrust, the apparent valve factor for the RCIC MOVs equates to a 0.34 valve factor, and a 0.40 for the RWCU MOVs. These apparent valve factors were based on

the use of mean seat diameter to determine the disk area term utilized by the standard industry thrust calculation.

The inspectors noted that GGNS-MS-25.0, "Mechanical Standard for Motor Operated Valve Torque and Limit Switches," which documents the thrust requirements for all generic letter MOVs, did not include the revised requirements for the Supplement 3 MOVs. GGNS indicated that their thrust requirements documentation will be revised to allow inclusion of best available data from external sources. [Concern (10)]

The inspectors conducted independent verification of the licensee's calculations and determined that the RWCU MOVs have adequate margin using the INEL results. The inspectors determined that the RCIC MOVs had low margin. The licensee will need to ensure that careful consideration is given to account for rate of loading effects, diagnostic equipment inaccuracies, and degraded voltage actuator capability for the RCIC MOVs and ensure that these MOVs receive high priority in their generic letter program. Further, since it may not be practicable to full flow test Supplement 3 valves, the licensee may need to revise their previous assumptions to reflect future test data.

d. Design-Basis Differential Pressure and Flow Testing

Recommended action c of the generic letter requests licensees to test MOVs within the generic letter program in situ under their design-basis differential pressure and flow conditions. If testing in situ under these conditions is not practicable, the staff allows alternate methods to be used to demonstrate the capability of the MOV. A two-stage approach is suggested for situations where design-basis testing in situ is not practicable and, at the time, an alternate method of demonstrating MOV capability cannot be justified. With the two-stage approach, a licensee would evaluate the capability of the MOV using the best data available and then would work to obtain applicable test data within the schedule of the generic letter.

The licensee MOV program documents and letters which address GL 89-10 and its Supplements commit to performing in-situ testing under design-basis conditions where practicable, perform baseline (static tests) on all MOVs in the program and use the "two stage" approach as outlined in the GL 89-10. The inspectors noted that the NRC requested (NRC letters of September 20, 1990, December 4, 1990) that the licensee identify those MOVs for which testing in-situ under design-basis conditions is practicable. In addition the licensee should note the MOVs that will be tested under such conditions. The licensee has not identified these MOVs at the current stage of program development [concern (1)].

The inspectors reviewed test program documents 01-S-17-10, Motor Actuator Thrust Test Program, 17-S-03-16, Safety Related MOV Program and discussed test results of several MOVs that had been baseline

tested. The inspectors confirmed that system parameters such as upstream, downstream system pressure, and differential pressure, were required to be recorded. The licensee indicated that system flow is recorded when system is provided with the instrumentation. The inspector directed the licensee attention to the fact that test data sheets do not require system flow to be recorded.

The licensee test program documents require that MOVs be refurbished prior to conducting baseline testing. The establishing of best obtainable operating conditions for the MOVs prior to testing was considered a strength in the licensee program.

The licensee SMART MOV Program Plan has established a prioritized approach to testing MOVs. The ranking of an MOV is done according to safety significance, valve type, design margin and valve operational history. The effectiveness of this approach has not been realized as only 10 MOVs have been in-situ flow tested and six of these MOVs are small diameter globe valves.

The licensee's MOV program as previously described will require an alternative to in-situ testing of MOVs under design-basis conditions. The grouping of identical/similar MOVs, then test a portion of each group is the methodology being developed. The schedule completion date for the program is June 1992. The inspectors discussed criteria for grouping MOVs and indicated that the licensee should be prepared to address and provide the basis for: (a) The number of valves tested per group should be more than two, to allow a more accurate characterization of the group, (b) The criteria to be used to compare the results from tests of MOVs in the same group should be carefully considered, (c) Assess the effects of differences in the performance of motor actuators on the grouping of MOVs (d) The internals of a sample of MOVs should be considered for inspection to verify its capability to predict the onset of damage (e) The effects of fluid conditions (ie flow and temperture) on MOV grouping should be adequately considered. [Concern (3)].

In addition the inspectors cautioned that grouping of MOVs should not replace in-situ testing of MOVs that are practicable to test. The NRC should be promptly informed if testing is discontinued and the basis. [Concern (2)].

The inspectors reviewed Appendix 2 of 01-S17-19, "MOV Actuator Thrust Program," Rev. 1, dated December 31, 1991, and noted that the MOV test program acceptance criteria did not include an evaluation of test results to determine available thrust margins. Differential pressure test acceptance criteria should ensure operability under all conditions including degraded voltage. In addition, differential pressure test results should be used to validate assumptions used in GGNS' thrust equations to ensure that design basis thrust requirements used for MOV baseline setup remain valid. Further, GGNS should review differential pressure test results to the extent

necessary to ensure the operability of an MOV prior to returning the system to operation. This issue will be reviewed during future inspections. [Concern (11)]

e. Periodic Verification of MOV Capability

Recommended action d of the generic letter requests the preparation or revision of procedures to ensure that adequate MOV switch settings are determined and maintained throughout the life of the plant. In Section j of the generic letter the staff recommends performance of surveillances to confirm the adequacy of the settings. The interval of the surveillance is to be based on the safety importance of the MOV as well as its maintenance and performance history, but is not to exceed 5 years or 3 refueling outages. Further, the capability of the MOV is to be verified if the MOV is replaced, modified, or overhauled to an extent that the existing test results are not representative of the MOV.

In discussions with Licensee's engineering personnel it was stated that static diagnostic test would be performed to periodically reverify the design basis capability of the MOVs within the Generic Letter 89-10 program. The static tests were scheduled to be repeated every five years. However, test controls provided for increasing or decreasing the frequency with a justified basis. The inspectors observed that at this time it is not clear that static tests can demonstrate design basis capability. The reason given was the uncertainties between MOV performance under static and design basis conditions. The inspectors were informed that it is GGNS position that static periodic testing will yield more concise and trendable data which will be indicative of degradation of the MOV actuator assembly. The licensee will need to justify, during additional NRC inspection, that the periodic testing methodology can demonstrate the capabilities of MOVs at design basis condition. [Concern (5)]

Procedure 07-S-14-4, Lubrication of Motor Operated Valves and Manual Valves with Gearboxes, Revision 11, established requirements for performing periodic inspection of the lubricant in the main gear case. Requirements for periodic cleaning/lubrication of the valve stems for MOVs have also been specified. The inspectors determined that these maintenance activities were performed in accordance with requirements delineated in Appendix B to Engineering Standard ES-19. This standard specifies maintenance requirements for EQ MOVs and delineate a frequency of 45 months. Additionally, requirements for cleaning and lubricating valve stems for rising stem application's were specified to have a frequency of 18 months.

Preventive maintenance of thermal overloads have not been included in the periodic test program. Surveillances are being performed to demonstrate operability of TOL circuitry via channel calibration and channel functional tests in accordance with specified frequencies in the TS. Post maintenance test requirements have been specified for

MOVs that have been baseline tested. Additionally, administrative procedure 01-S-07-2, Tests and Retest Control, Revision 12, has been revised to established post modification test requirements for MOVs previously baseline tested. These MOVs are to be retested to meet the requirements of Attachment VI, paragraph 1.e (10), Diagnostic Test. The inspectors did not identify any concerns in this area.

f. MOV Failures, Corrective Actions, and Trending

Recommended action h. of the generic letter requests that licensees analyze or justify each MOV failure and corrective action. The documentation should include the results and history of each as-found deteriorated condition, malfunction, test, inspection, analysis, repair, or alteration. All documentation should be retained and reported in accordance with plant requirements. It is also suggested that the material be periodically examined as part of the monitoring and feedback effort to establish trends of MOV operability. These trends could provide the basis for a licensee revision of the testing frequency established to periodically verify adequate MOV capability. The generic letter indicates that a well-structured and component-oriented system is necessary to track, capture, and share equipment history data.

The inspectors reviewed the licensee's activities related to evaluating MOV failures. The licensee stated that due to the sensitivity and recent emphasis placed on MOVs as a result of their Generic Letter 89-10 Program, all MOV failures and major deficiencies are evaluated by the Performance and System Engineering section (P&SE). As part of the normal Maintenance Work Order process, P&SE is notified prior to maintenance performed on any MOVs which have been baseline tested (static test). Post maintenance test requirements and evaluation of results are then determined as delineated in procedure 17-S-03-16, Rev. 2, Safety Related MOV Program. Thus, MOV failures are brought to the attention of P&SE, which then determines corrective action and performs evaluation of diagnostic test results. As the GL 89-10 Program continues, all MOVs will be baseline tested, thus requiring participation by P&SE.

Procedure 17-S-03-16, Rev. 2, describes the current trending requirements for MOV failures and degradation. On a yearly basis, a report is compiled providing information on observed failures, degradations, and general MOV performance. The report should include an itemization of the individual observations, and provide any conclusions and recommendations to increase overall reliability of MOVs. The inspectors reviewed MOV Program Annual Report #1, dated 1/21/91. The report was generated from information obtained from plant specific NPRDS data, MWOs, and diagnostic testing information. The report contained detailed information not only on valve failures, but included observations on specific valve degradation. Failures and/or degradations are reviewed on a component level.

Recommendations or conclusions were provided for each MOV failure or anomaly. The inspector arbitrarily selected seven recommendations from the Report to determine if any action had been performed or planned. The licensee stated that all recommendations for inspection or maintenance had been performed or scheduled for the upcoming outage. The inspectors also inquired about trending MOV diagnostic testing data. The licensee stated that data is currently evaluated, however, testing to date has not provided a sufficient data base to trend diagnostic data. As additional testing is performed, the licensee will determine which parameters (e.g. spring pack displacement, motor current, etc...) will be trended to provide meaningful information. Although this part of the licensee's trending program is still under development, the inspectors concluded that the current trending program of MOV performance, failures, and degradation is a strength in that is provides beneficial information which will increase the overall reliability of MOVs at the facility.

g. Schedule

GL 89-10 requested that licensee's complete all design-basis reviews, analyses, verifications, tests, and inspections that are initiated in order to satisfy the generic letter recommendations by June 28, 1994, or 3 refueling outages after December 28, 1989, whichever is later.

Entergy Operations requested and extension (letter dated October 1, 1990) to the above described schedule presented in the generic letter. The NRC agreed to a schedule extension (letter dated December 4, 1990) to include four refueling outages, June 30, 1995.

The licensee design basis reviews are over 90% completed. Baseline testing (static) and MOV switch setting will reach approximately 60 percent upon completion of refueling outage 5, April 1992. The licensee thrust validation program is still being developed to include valve grouping methodology, identification of in-situ testing and the availability of empirical MOV test data from industrial sources to support the MOV program at Grand Gulf. The inspectors concluded that the licensee intends to comply with newly established generic letter completion schedule.

h. Overall Administration of MOV Activities

The inspectors found that the overall administration of Grand Gulf GL 89-10 program was described in the SMART MOV Program Plan and Administrative Procedure 01-S-17-19, Motor Actuator Thrust Test Program. These procedures contained detailed guidance for MOV program activities. The licensee's organization interface between design engineering performance and system engineering, project management and maintenance was identified. The areas of responsibility were also provided. The license intends to issue Site Directive G4.401, GL 89-10 MOV Program to replace the Project SMART document when the project is phased out.

The licensee has located both the design engineering and performance and system engineering on site to accomplish the implementation of the MOV program. Performance and System Engineering provides three engineers to conduct day to day MOV program activities and MOV testing. The assigned engineers and project personnel were found to very knowledgeable regarding the on going issues and the state of the art. This was considered a strength in the licensee program.

The inspectors held discussions with project management personnel responsible for MOV program development. It was determined as a result of these discussions and the review of project team meeting minutes that the licensee is participating in industry groups working with GL 89-10 related issues. The meeting minutes also reflect an on going interface between engineering groups to resolve MOV issues, plan test schedules and develope the program for thrust verification.

1. MOV Setpoint Control

Based on review of mechanical standard MS-25.0, Revision 6, the inspectors determined that specified values of upper and lower limits of thrust had been calculated based upon maximum and minimum design requirements. The thrust values were calculated during the design review process and were issued as approved design outputs under the controls of the design engineering control program. Performance of baseline tests using the calculated values of thrust as the "setting window" established torque switch settings required by existing plant design requirements. Pending completion of the baseline tests the computerized CDB will be updated to reflect the correct as-left torque switch setting and further changes to torque switch settings will be controlled via the design engineering review process. Thermal overload settings documented in Appendix A of MS-25.0 are controlled by applicable MCC Tabulations listed on MCC Tabulation Index Drawings E-1100-01 and -02.

The inspectors determined that changes to MOV Limit Switch settings are performed outside the controls of the approved ANSI N45.2.11-1974 design control program. Discussions with Licensee engineering personnel revealed that an evaluation is presently being performed to define the basis for MOV limit switch settings documented in mechanical standard MS-25.0. Upon completion of this evaluation a determination will be made concerning design controls that will be implemented for changes to limit switch settings. Additional NRC inspections will be required to evaluate these MOV limit switch change process controls [Concern (12)]

3. Training

The inspectors reviewed the licensee's MOV training program, courses, facilities, and held discussions with training personnel. Training requirements are stated in Site Directive G4.401, Section 4.9. The inspectors noted that the Site Directive only delineates general

training requirements appropriate to maintain the expertise necessary to implement the program, and does not specifically delineate the training necessary for individuals responsible for implementing the GL 89-10 program. The inspectors reviewed the formal and informal training for individuals responsible for implementing the program, and did not note any deficiencies. In addition, discussions with licensee personnel throughout the inspection indicated that they were knowledgeable in their respective areas of responsibility. However, the licensee should consider whether stipulating training requirements for specific positions would enhance the overall MOV Program.

A training class has also been conducted for engineers and technical managers on the general requirements of GL 89-10. This one day class involved discussions of GL 89-10 recommendations, diagnostic testing, design thrust calculations, and the facility's general approach toward satisfying GL 89-10 commitments. This training class will be conducted again prior to the April 1992 refueling outage.

The inspectors reviewed course outlines for training classes associated with maintenance of MOVs, MOVATS diagnostic equipment installation, and MOVATS signature analysis. The licensee stated that only individuals which have passed a written exam could perform maintenance on MOVs, and that the maintenance supervisors were responsible for ensuring this. The licensee stated that only four technicians were qualified to install diagnostic equipment and evaluate signature analyses. The licensee has limited the size of this group to increase the experience level of those involved. In addition to the qualification training, the licensee periodically conducts continuing education training on MOV maintenance and diagnostic equipment installation.

During the upcoming refueling outage, the licensee intends to use VOTES diagnostic equipment. The licensee stated that appropriate training would be conducted prior to using this equipment for the GL 89-10 Program.

k. Industry Experience and Vendor Information

The licensee's program for reviewing industry experience and vendor information is controlled under procedure EDP-023, Rev. 5, Operational Analysis Section Operating Experience Review Program. This document provides guidance for the receipt, review, handling, distribution, and disposition of operating experience information received from both industry and in-house sources. Examples of information reviewed under this program include NRC Information Notices and Bulletins, 10CFR Part 21 submittals, Institute for Nuclear Power Operations (INPO) documents, Nuclear Network information, GE service information letters, industry NPRDS data, and in-house information. The licensee processes this information through the use of a computer data base, which ensures information is reviewed and dispositioned in a timely manner. The

inspectors chose a random sample which included the following industry information:
NRC Information Notices 90-72, 91-42, and 91-58 GE Services Information Letters 435 and 528 Limitorque Part 21 dated 9/29/89

For the above documents, the licensee had adequately reviewed, dispositioned, and provided recommendations. The inspectors concluded the licensee had in place an adequate program for formal review of industry experience.

The licensee formally controls vendor manuals through the use of Site Directive No G5.610, Rev. 0. The inspectors inquired how the licensee reviews and ensures complete and most recent information for maintenance updates for Limitorque actuators, and vendor information for MOVATS diagnostic testing equipment. The licensee stated that this information is received informally. To remedy this potential problem, the licensee has contacted Limitorque and MOVATS to obtain all related vendor information. The licensee has also held discussions with other Boiling Water Reactor Owners Group members to ensure information is up to date. The inspectors reviewed the licensee's MOVATS technical manual, which contains various test procedures and Engineering Reports, and found it to be complete and up to date. The licensee recognized the need to maintain this information as a controlled vendor document, and was in the process of reviewing the information for completeness. After this review and concurrence, this information will be maintained as a controlled document.

1. Use of Diagnostics

Grand Gulf had previously been using MOVATS diagnostic equipment to provide a measurement of thrust delivered by motor operators for rising-stem valves. In light of the results of recent industry diagnostic equipment accuracy testing and the concerns over measurement and detection of effects due to rate of loading, it decided to purchase VOTES diagnostic equipment designed to provide direct measurement of available thrust.

The licensee indicated the results of the MOV Users' Group (MUG) testing of diagnostic equipment will be addressed. The inspectors cautioned that, during this time period when the results of the diagnostic testing are being finalized by MUG, the licensee would be expected to evaluate each MOV for which diagnostic equipment had been used to established MOV switch settings. The final MUG report is scheduled to be released in February 1992, and the licensee should be prepared take prompt action in response to the MUG findings regarding new accuracy values for diagnostic systems. The new accuracies could effect the available thrust and require MOV switch setting changes or hardware modifications to ensure MOV operability. This area will be evaluated during a future inspection. [Concern (9)]

4. Followup (62701)

(Closed) Inspector Followup Item 50-416/89-13-02, Verification of the Adequacy of Current Miniflow Capacity by the Pump Vendor

This IFI was opened as a result of the licensee's response to NRC Bulletin 88-04, Potential Safety-Related Pump Loss. The licensee's original response to one of the recommended actions concerning pump miniflow capacity was not acceptable. The licensee was requested to obtain from the vendor pump specific miniflow rates for various pumps to ensure that actual flow rates would not result in pump damage from low flow operation.

The inspectors reviewed information provided by the licensee, which included vendor information on recommended miniflow rates, actual miniflow rates, and the licensee's evaluations and corrective actions for the affected pumps. The licensee's evaluation resulted in a planned design change for the upcoming refueling outage in the High Pressure Core Spray pump miniflow line. The orifice in the miniflow line will be changed to allow at least 1000 gpm. The Reactor Core Isolation Cooling pump surveillance testing procedures were also affected as a result of the licensee's evaluation. Testing procedures will be revised to ensure pump miniflow will be greater than the vendor recommended flow rate of 163 gpm. Based on the inspector's review of the licensee evaluation, this item is considered closed.

5. Conclusions

A program had been developed which adequately addressed the generic letter recommendations, although some concerns were identified. These concerns involved licensee assumptions and methods whose adequacy will require further review. Concerns similar to these have been identified in the programs of other licensees and are largely the result of technological uncertainties regarding the predictability of MOV operation.

6. Exit Interview

The inspection scope and findings were summarized on January 10, 1992, with those persons indicated in Appendix 1. The licensee was apprised of the concerns identified during the inspection and listed in the "SUMMARY" section of the report.

# APPENDIX

## PERSONS CONTACTED

Licensee Employees

*M. Brandon, Senior Engineer, Nuclear Safety and Regulatory Assessment
*S. Burris, Engineering Supervisor, Performance and System Engineering
*J. Dimmette, Manager, Performance and System Engineering
*C. Hutchinson, Plant General Manager
*D. Jones, Project Manager, Systematic Motor Actuator Reliability Testing Project
*A. Khandfar, Electrical Engineer, Entergy Operations
*M. Meisner, Director, Nuclear Safety and Regulatory Assessment
*K. Moorman, Superintendent, Performance and System Engineering
*D. Pace, Director Nuclear Plant Engineering
*J. Roberts, Manager Plant Maintenance
*M. Rohrer, Engineer, Performance and System Engineering
*S. Saunders, Superintendent Performance and system Engineering
*T. Thornton, Electrical Engineer, Nuclear Plant Engineering
*J. Turner, Engineer, Performance and System Engineering
*R. West, Assistant Manager, Performance and System Engineering
*R. Wright, Supervisor, Nuclear Plant Engineering

NRC Personnel

*C. Hughey, Resident Inspector
*J. Mathis, Senior Resident Inspector
*D. Verrelli, Chief Reactor Projects Branch No. 1

*Attended exit interview

# APPENDIX 2

## ACRONYMS AND INITIALISM

| | |
|---|---|
| LOCA | Loss of Coolant Accident |
| DBA | Design Basis Accident |
| DC | Direct Current |
| MNCR | Material Nonconformance Report |
| ESF | Engineered Safeguard Feature |
| IEEE | Institute of Electrical and Electronics Engineers |
| CDB | Component Data Base |
| MCC | Motor Control Center |
| NRC | Nuclear Regulatory Commission |
| MOV | Motor Operated Valve |
| GGNS | Grand Gulf Nuclear Station |
| EQ | Environmentally Qualified |
| TOL | Thermal Overload |
| TS | Technical Specification |
| INEL | Idaho National Engineering Laboratory |
| HPCS | High Pressure Core Spray |
| RWCU | Reactor Water Cleanup |
| RCIC | Reactor Core Isolation Cooling |