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Licensee: Duke Power Company
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 Charlotte, NC 28242

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Facility Name: Oconee

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SUMMARY

Scope:

This special, announced inspection examined the program developed in response to NRC 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:

The inspectors determined that the licensee had developed a good strong program to address GL 89-10. This program was not wholly in accordance with the recommendations of the GL. However, the program had a number of important strengths which helped to balance areas where the recommendations were not being fully met.

The inspectors identified a number of concerns with regard to omissions or uncertainties in the intent or adequacy of the program. The licensee is being

requested to provide a written response to five of those and, in addition, to a concern identified regarding the adequacy of corrective maintenance for the 1990 failure of MOV 2LPSW-4. Both the six concerns for which a response is being requested and the other concerns identified (nine in number) will be evaluated further in subsequent NRC inspections of the licensee's response to GL 89-10. The concerns identified are listed below, separated into those for which a written response is being requested and those for which none is being requested:

Written Response Requested

- (1) The Design Basis Review Guidelines were not clear regarding the consideration of design factors other than differential pressure. GL 89-10 recommended that flow and other factors (e.g., ambient temperature) be considered. [Ref. section 3.b]
- (2) Section 5.3 of the licensee's GL 89-10 Program documents only required verification that motor-operated valves (MOVs) would function during events and scenarios within the existing design basis. Provisions are needed to ensure that alignments during normal and emergency plant operation do not result in conditions that are more severe. [Ref. section 3.b]
- (3) The licensee is performing a study to justify increases in the thrust ratings of Limitorque actuators. To assure the adequacy of this study, an evaluation and approval by Limitorque or an alternate justification (with particular attention to sample size, lubrication frequency, and accelerated wear of internal actuator parts) is needed. [Ref. section 3.c]
- (4) Operability determination requirements for MOVs given in Section 8.1 of the licensee's GL 89-10 program document are unclear. This results in uncertainties regarding reportability. The section can be interpreted to indicate that, if existing incorrect switch settings are found when MOVs are included in the GL 89-10 program, they will not be considered for evidence of past inoperability. Also, Section 8.1 states that operability evaluations will not be performed for MOVs with as-found conditions that do not meet the new, more stringent requirements imposed as a result of GL 89-10. It is not clear what these "new, more stringent requirements" are.

The licensee stated that its GL 89-10 Program document would be reviewed to ensure consistency with the NRC-approved practice for operability determinations and that changes would be made as appropriate. [Ref. section 3.c]

- (5) It was not clear from the licensee's GL 89-10 Program document that an operability determination would be made and that refurbishment or thrust verification frequency would be reconsidered if spring pack relaxation was found. Valve operability should be assessed when spring pack relaxation is identified because it can prevent an MOV from being able to perform its intended function. Spring pack

relaxation occurs as a result of use conditions and time and, therefore, it must also be considered in determining an appropriate MOV refurbishment or thrust verification frequency. [Ref. section 3.e]

- (6) The investigation and repair of the failure of MOV 2LPSW-4 in October 1990 appeared inadequate. The associated breaker trip appeared inadequately addressed. Design philosophy for valves which perform important active safety functions at Oconee normally require that the breaker not trip to protect the valve motor but that the motor be allowed to burn out attempting to perform its safety function. This implication of possibly inadequate design was not recognized. In addition, the possibility of motor insulation damage due to the high current that caused the trip was not checked. The torque switch was replaced without a documented reason. Further analysis of the applicability of problems discovered in this valve to sister valves needs to be considered.

The inspectors considered this issue to be an unresolved item with the potential to become a violation. The matter is identified as unresolved item 269,270,287/91-13-01. [Ref. section 3.f]

No Written Response Requested

- (1) Certain MOVs had been excluded from the GL 89-10 program without adequate written justification. Licensee personnel stated that such documentation will be accomplished. [Ref. section 3.a]
- (2) No margin had been added to sizing calculations to account for any adverse effects of high ambient temperature on motor performance. The licensee stated that these factors will be addressed in its evaluation of ambient temperature effects on motor capability. [Ref. section 3.c]
- (3) Ambient temperature had not been considered in selection of the MOV thermal overload devices. The licensee stated that its thermal overload device selection method is being evaluated and that high ambient temperature effects will be considered in the selection method. [Ref. section 3.c]
- (4) The licensee described an instance in which the plant staff was able to test MOVs at greater than 1000 psid (differential pressure) although the design basis review had assumed the design basis pressure to be approximately 500 psid. This indicates a possible underestimate of design differential pressure. The licensee stated that it will ensure that test information is used to evaluate the adequacy of its design basis reviews. [Ref. section 3.d]
- (5) The standard industry equation was used in the licensee's motor sizing calculations except that the normally used "application factor" was omitted. The licensee stated that it will document its

justification for the omission of this factor in detail for subsequent NRC review. [Ref. section 3.c]

- (6) No margin had been included in setting determinations to account for rate of loading effects that might decrease the available thrust delivered by the actuator during high pressure conditions compared to the thrust delivered during the static conditions when settings are made. The licensee prepared an action plan (June 26, 1991) to address the rate of loading phenomenon. [Ref. section 3.c]
- (7) The Program document did not indicate that MOVs would be tested in situ under worst case differential pressure and flow conditions where practicable and that the two-stage approach would be used where not practicable, as recommended by GL 89-10. The licensee's Program document indicated plans for grouping valves and testing a limited number of valves to determine acceptable settings for the entire group.

The licensee's justifications of determinations of size and setting limitations for MOVs that are not differential pressure and flow tested under worst case conditions and its application of failure data from one valve to other untested valves within a group require further NRC evaluation. [Ref. section 3.d]

- (8) Section 6.1.2 of the licensee's Program document indicated that post-maintenance testing following packing adjustments will involve an engineering justification based on available margin or verification that MOV running load has not increased beyond acceptable limits. It was not clear if or what running load values would be suitable for ensuring that adequate thrust remains. The criteria used will require further NRC evaluation. [Ref. section 3.e]
- (9) The licensee indicated that periodic static testing will be used to verify continued capability of MOVs to operate under worst case differential pressure and flow conditions. The inspectors stated that this was not currently considered adequate because of the uncertain relationship between the performance of an MOV under static conditions and under design basis conditions. The licensee's justification for the use of static periodic testing to verify continued adequacy of switch setting will require further NRC evaluation. [Ref. section 3.e]

Licensee strengths identified during the inspection were as follows:

Strengths

- (1) Switch setting calculations were well-documented and thorough.
- (2) Differential pressure testing had been initiated.
- (3) An action plan was developed to address rate of loading.

- (4) There was extensive support for and participation in MOV programs with industry groups and manufacturers, often exhibiting a leadership role in these activities.
- (5) Good communications and cooperation among the corporate and station organizations.
- (6) Effective program for evaluating and responding to industry experience and vendor information.
- (7) Licensee personnel exhibited a high level of expertise in their understanding of the issues involved in GL 89-10.

No violations or deviations were identified.

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REPORT DETAILS

NRC Inspection of the Program Developed in Response to Generic Letter 89-10 at the Oconee Nuclear Station

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 (MOV) 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 which requested that boiling water reactor 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.

In GL 89-10, the NRC staff requested licensees to submit a response to the generic letter by December 28, 1989. The licensee of the Oconee, McGuire, and Catawba Nuclear Stations submitted a response to the generic letter on December 28, 1989. In that letter, the licensee stated that it recognized the need to ensure that safety-related equipment will perform its design functions but took certain exceptions to the recommendations of the generic letter. The NRC staff provided a reply to that submission on August 15, 1990. Consistent with Item 1 of GL 89-10 and the response to Question 44 in Supplement 1 to GL 89-10, the NRC staff stated that the licensee should incorporate any differences between its program and the generic letter in the program description.

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

3.a Scope of the Generic Letter Program

The NRC staff position is that the scope of GL 89-10 includes all safety-related MOVs and other MOVs that are position-changeable in safety-related piping systems. Through Supplement 1 to the generic letter, the staff defined "position-changeable" as any MOV in a safety-related piping system that is not blocked from inadvertent operation from the control room.

The inspectors reviewed and discussed with the licensee the scope of its GL 89-10 program. The "Duke Power Company NRC Generic Letter 89-10 Program" document stated that the GL 89-10 program scope includes all MOVs in safety-related piping systems with certain exceptions. The Program document described the selection of MOVs for the program as starting with identification of all MOVs in safety-related systems; then eliminating non-piping and sluice and weir gate valves; categorizing the remaining valves into three groups (Groups 1, 2, and 3); and lastly, excluding the least safety-significant group (Group 3).

The methodology of grouping the valves was explained in Section 4.2 of the Program document. Group 1 was described as consisting of the MOVs that had an active safety function in safety-related systems and that contributed to core melt scenarios or were significant from an accident analysis viewpoint. These MOVs were considered to be the most critical and, therefore, were assigned the highest priority for program execution and follow-up testing. Approximately 201 MOVs were designated Group 1 for all three Oconee units. The MOVs in Group 2 included the balance of active safety system MOVs not in Group 1. Also included in Group 2 were the passive position changeable MOVs that contribute to core melt scenarios; and for Oconee only, certain emergency feedwater and cold shutdown MOVs. A lower priority was assigned to Group 2 MOVs than Group 1 MOVs. Approximately 135 MOVs were identified in Group 2 for all three Oconee units. The MOVs in Group 3 were described as consisting of passive position changeable MOVs that did not contribute to core melt scenarios, inconsequential position changeable MOVs, non-position changeable MOVs and unit reliability MOVs. The licensee identified approximately 143 Group 3 MOVs. A list of the three MOV groups was provided in updated Attachment IV (June 11, 1991) of Specification No. DPS-1205.1900-0003, "Motor Operated Valve Design Basis Review Guidelines."

The licensee identified 115, 109 and 110 MOVs for Oconee Units 1, 2, and 3, respectively, in its GL 89-10 program (2 of the Unit 1 valves are shared with other units but only included in the Unit 1 number). The inspectors reviewed piping and instrumentation drawings for the Emergency Feedwater System, Component Cooling System, and High Pressure Injection System to sample the completeness of the scope of the licensee's GL 89-10 program. Based on this review, the scope of the licensee's generic letter program was consistent with the intent of GL 89-10.

Consistent with the NRC staff's response to Question 6 of Supplement 1 to GL 89-10, the licensee had excluded from its GL 89-10 program certain MOVs that had no active safety function where the position of those MOVs was inconsequential or where the licensee had taken steps to prevent their inadvertent operation (such as by racking out breakers or installing switch

covers in the control room). As an exception to GL 89-10, the licensee excluded certain passive position changeable MOVs from its GL 89-10 program on the basis that it made little contribution to core melt probability. The inspectors discussed with the licensee the exclusion of each of these MOVs and did not identify any concerns. However, the licensee needs to document more completely the justification for exclusion of MOVs from its program (see Item 1 of GL 89-10 and response to Question 44 in Supplement 1). The licensee stated that such documentation would be accomplished. The NRC will review this documentation during future inspections at the licensee's facilities.

3.b Design-Basis Reviews

In recommended action a of GL 89-10, the NRC staff requested 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.

The licensee had completed the design-basis reviews for approximately 120 MOVs in the GL 89-10 program at Oconee. The inspectors reviewed the licensee's GL 89-10 Program document and Motor Operated Valve Design Basis Review Guidelines (Specification DPS-1205.19-00-0003, February 8, 1991). The licensee stated in its GL 89-10 Program document that it would review safety analyses, plant procedures, and other necessary documents to determine design review parameters (such as differential pressure, fluid flow and temperature). However, the Design Basis Review Guidelines were not clear regarding the consideration of design factors other than differential pressure. The inspectors discussed with licensee personnel the recommendations ... GL 89-10 (including the NRC staff response to Question 16 in Supplement 1 to GL 89-10) to consider all design factors. The licensee agreed that design factors beyond differential pressure need to be addressed to ensure MOV capability and stated that its documentation would be revised to demonstrate that all appropriate design factors were addressed. [Response Item (1)]

In Section 5.3 of its GL 89-10 Program document, the licensee stated that only events and scenarios within its existing, approved design basis would be considered. In discussing the performance of its design basis reviews, the licensee stated that it would attempt to ensure that MOVs could function against their worst case differential pressure and flow conditions but that this might not be accomplished for certain MOVs, where the approved design basis is not the worst case condition. GL 89-10 intends licensees to verify the capability of MOVs to operate against the worst case conditions under which they might be called upon to function. Therefore, the licensee needs to identify any MOV that might have limitations regarding its capability and to ensure that such limitations are reflected in plant procedures and any necessary hardware changes (such as interlocks). [Response Item (2)]

3.c MOV Switch Settings

In recommended action b of Generic Letter 89-10, the NRC staff requested licensees to review, and to revise as necessary, the methods for selecting and setting all MOV switches.

The inspectors reviewed the licensee's "Guideline for Performing Motor Operated Valve Reviews and Calculations" (Specification No. DPS-1205.19-00-0002, January 25, 1991, Rev. 1) and several completed calculation packages. In addition, they discussed the process used for sizing MOVs and setting switches with plant and corporate personnel. The licensee had reportedly completed sizing and switch setting calculations for approximately 120 MOVs at Oconee.

The inspectors review of switch setting calculations found that the typical industry thrust equation was used. However, in light of current industry operating experience and research results, the licensee selected valve factors for the calculations that were greater than those commonly used in the past. For example, it generally used valve factors of 0.35 to 0.5 for solid and flexible wedge gate valves depending on the temperature or pressure application, whereas a valve factor of 0.3 was typically assumed in past standard industry calculations. A valve factor of 0.5 was being used for all of Oconee's solid and flexible wedge gate valves. An exception was made for valves with a safety function only in the open direction in that the closing thrust for these valves was determined assuming a valve factor of 0.35 to reduce seating forces. The licensee used a valve factor of 0.35 for parallel disc gate valves (compared to the valve factor of 0.2 typically assumed in the past). The licensee also adjusts the valve factors based on the results of its MOV tests, where appropriate.

The licensee normally employs VOTES diagnostic equipment in setting valve thrusts and adds 10 percent thrust as margin to its calculated minimum requirements to account for instrument inaccuracies and other uncertainties associated with this equipment. An additional 10 percent margin is included in the few instances when it will use MOVATS diagnostic equipment. However, no margin was included to account for rate of loading effects that might decrease the available thrust delivered by the actuator during high pressure conditions compared to the thrust delivered during the static conditions when settings are made. Following initial discussions with the inspectors, the licensee prepared an action plan (June 26, 1991) to address the rate of loading phenomenon. The action plan includes assessment of past test data for rate of loading trends and magnitude, monitoring of current tests for rate of loading effects, assessment of rate of loading in the next revision of the licensee's Design Engineering Component Review Guideline, and participation in a program being initiated by the Electric Power Research Institute to evaluate the rate of loading phenomenon. The NRC will review the licensee's consideration of rate of loading effects in its MOV sizing and switch setting calculations during future inspections.

The licensee uses the Auxiliary System Design Optimization Program (ASDOP) computer software to determine voltages at all GL 89-10 MOV 208VAC Motor Control Center (MCC) buses. The ASDOP program considers motor starting characteristics, line impedances, transformer impedances, and cable impedances. The licensee assumes cable temperatures of approximately 200°F in its calculations. The licensee has examined all voltages at the GL 89-10 MOV 208VAC MCC busses but has only determined motor terminal voltages for selected MOVs. In response to GL 89-10, the licensee indicated that separate calculations are being developed that would expand the present calculations to

examine the voltage at each GL 89-10 MOV. The NRC will review these efforts during future inspections.

The licensee had not included additional margin in its sizing calculations to account for any adverse effects of high ambient temperature on motor performance. It relies on a study by Rotork, for that manufacturer's actuators, which indicated that available torque should be reduced by 17 percent to cover potential effects of sustained elevated temperatures. The licensee assumes this adverse temperature effect to be bounded by the reduction in available torque assumed in its calculations to account for degraded voltage conditions (typically 80 percent of nominal voltage). The inspectors observed that the Rotork study had not been justified to be applicable to Limatorque actuators. Further, they noted that the licensee's assumption did not address MOVs located in high temperature areas that might need to operate upon initiation of an accident during degraded voltage conditions, or MOVs that might need to operate later in the scenario but when voltage has not recovered to nominal conditions. The licensee stated that these factors would be addressed in its evaluation of ambient temperature effects on motor capability. The NRC will review the licensee's consideration of these effects during future inspections.

The licensee determines the maximum allowable thrust based on structural limits, motor undervoltage capability, and spring pack capability. It includes a 10 percent tolerance in structural limit and motor undervoltage capability calculations while ultimate spring pack capability is evaluated during tests. The licensee contracted Rotork to justify increases in the thrust ratings (up to 200 percent of published ratings with no cycle limitations) for many of the manufacturer's actuators. The licensee is performing a separate study to justify increases in the thrust ratings of Limatorque actuators. A draft copy of this latter study has been provided to Limatorque for review. In an effort to provide conservatism, the licensee has assumed actuator ratings below the levels considered acceptable by the draft study (i.e., 130 percent versus 162 percent). In accordance with design requirements, the licensee will need to justify its reliance on the capability of the Limatorque actuators beyond the manufacturer's original ratings. This may best be accomplished in concert with Limatorque, as through its evaluation and approval of the actuator study. If this proves impractical because of Limatorque's commitments to other projects or for other reasons, the licensee will need to provide alternate justification with particular attention to sample size, lubrication frequency, and accelerated wear of internal actuator parts. The inspectors noted their particular concern with regard to the adequacy of the justification obtained. [Response Item (3)]

Section 6.2 of the licensee's MOV Calculation Guideline discusses the capability of MOVs to satisfy their intended safety functions when supplied with less than nominal voltage. To demonstrate this capability, the licensee described its calculation of the stall torque and thrust available from the actuator at undervoltage conditions. The inspectors discussed these calculations with licensee personnel and raised questions concerning the omission of the "application factor" in those calculations. This factor is a constant used as margin in motor sizing. The licensee stated that it would

document in more detail its justification for the omission of this factor. The NRC staff will review this justification during future inspections.

Section 7.1 of the licensee's GL 89-10 Program document stated that motor overload protection at its facilities meets the intent of Regulatory Guide 1.106 (Rev. 1), "Thermal Overload Protection for Electric Motors on Motor-Operated Valves." The inspectors reviewed the licensee's Specification RE-3.03, (Rev. 0, January 5, 1987), "Relaying - Motor Control Center Breaker and Overload Heater Selection - Oconee," for sizing thermal overload devices for motors. The thermal overload devices in Class 1E motors were reported to be sized to allow full attempted motor operation, but provide a control room alarm at a lower current value. The licensee sizes thermal overload devices in non-Class 1E motors to provide motor protection. Torque switch availability is relied on to help prevent motor damage during valve closure by having minimal bypass of closing torque switches. The licensee stated that only two MOVs had their closing torque switches bypassed for significant lengths of travel (98 percent of valve stroke), but that these MOVs had thermal overload devices sized to protect the motor in the event of excessive thrust requirements. It bypasses the opening torque ⁴ in MOVs in its GL 89-10 program for 25 to 50 percent of valve stroke to allow the motor to overcome extended opening thrust requirements that have been revealed in some MOV research tests. The inspectors discussed with licensee personnel the criteria provided by its supplier of thermal overload devices and raised a question regarding the consideration of high ambient temperature at the location of the motor in the selection of the thermal overload device. The licensee stated that its thermal overload device selection method is being evaluated and that high ambient temperature effects would be considered in the selection method. The NRC will review the licensee's selection of thermal overload devices and its consideration of ambient temperature effects during future inspections.

Section 6.5 of the GL 89-10 Program document stated that new limiter plates are to be installed on the torque switches in the MOVs within its GL 89-10 program, where necessary. If the maximum limiter plate setting does not allow adequate thrust, the licensee modifies the limiter plate to allow an appropriate setting as long as the torque rating of the operator is not exceeded. The inspectors discussed with licensee personnel the regulatory requirements for the performance of safety analyses. The licensee provided its procedures requiring safety analyses in accordance with 10 CFR Part 50.59 when a torque switch is to be set above the manufacturer's maximum recommendations.

Section 8.1 of the GL 89-10 Program document described the evaluation of the operability of GL 89-10 program MOVs. The description focused on hardware and did not adequately consider current torque switch settings. Also, it stated that operability evaluations will not be performed for MOVs with as-found conditions that do not meet the new, more stringent requirements imposed as a result of GL 89-10. It is not clear what these "new, more stringent requirements" are. The inspectors discussed operability determination and reporting requirements concerning MOVs with licensee personnel. The licensee stated that its GL 89-10 Program document would be reviewed to ensure its consistency with its NRC-approved practice of operability determinations and

reportability and that changes would be made as appropriate. [Response item (4)]

The inspectors review of the calculation package for MOV 2-HP-409 and 410 revealed an incorrect stem factor. The inspectors considered the error to be in a conservative direction and not to be generic in nature. The licensee stated that the error would be corrected. The inspectors were satisfied with the licensee's response to this concern.

3.d Design-Basis Differential Pressure and Flow Testing

In recommended action c of the generic letter, the NRC staff 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 those conditions is not practicable, the staff allows alternate methods to be used to demonstrate the capability of the MOV. The staff suggests a two-stage approach for a situation where (1) design-basis testing in situ is not practicable and, (2) at this 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 is performing diagnostic tests under static conditions for each MOV within the GL 89-10 program. It reported that static diagnostic tests had been completed on 1, 45, and 50 MOVs in Oconee Units 1, 2, and 3, respectively, as of June 17, 1991.

In Section 13 of the GL 89-10 Program document, the licensee discussed plans to test GL 89-10 program MOVs with an objective of ensuring that the MOVs are capable of performing their intended functions. The document indicated plans to minimize the scope and extent of differential pressure testing to the degree justified. In this regard, preliminary grouping criteria were established for the MOVs based on factors such as manufacturer, size, type, design, and pressure class. It stated that at least 3 MOVs from each group would be tested in an effort to demonstrate the similarity of performance characteristics of MOVs in the group. Section 13.3.8 of the Program document specified criteria for determining the valve factor for the non-tested MOVs in a group based on results from the tested valves. This valve factor is used in calculations of switch settings for the non-tested MOVs. Where valve factors determined from the results for the 3 tested valves are within 10 percent of their mean, the valve factor used in calculations for non-tested valves will be the most conservative result of the 3 tested MOVs in the group plus 10 percent. Where the test results for the 3 vary more than 10 percent from the mean, the Program document (June 27, 1991) stated that the valve factor for the non-tested MOVs will be assumed equal to the mean plus one standard deviation, or the most conservative valve factor plus a margin.

The inspectors expressed concern to the licensee regarding its specific plans for grouping valves, testing a limited number of valves and regarding its methods for determining acceptable settings for an entire group from the limited testing. It was not clear that the licensee's practice would be

consistent with the recommendations of GL 89-10 that each MOV be tested in situ under worst case differential pressure and flow conditions where practicable; or, if differential pressure testing was not practicable, that the two-stage approach referred to at the beginning of this subsection be used. Licensee personnel stated that it was their intent to test all MOVs in the program at worst case differential pressure and flow conditions where practicable, until the grouping concept can be fully justified. The inspectors noted that development of as comprehensive test database as practicable would aid in properly determining and justifying sizings and settings for non-tested valves and in determining the applicability of the test failure of one valve within a group to other valves in the group. The licensee's justifications of determinations of size and setting limitations for MOVs that have not been differential pressure tested and its application of failure data from one valve to other valves within its group will be examined in subsequent NRC inspections.

As of June 17, 1991, the licensee had tested 6 MOVs in Oconee Unit 3 in accordance with its GL 89-10 program. Two of the tested MOVs were 6-inch Crane flexible wedge gate valves with test differential pressures of over 1000 pounds per square inch differential (psid). The thrust requirements to open these 6-inch valves during the test revealed an actual valve factor below the typical industry valve factor of 0.3 for flexible wedge gate valves. However, the thrust requirements to close the 6-inch valves revealed valve factors ranging from 0.36 to 0.55. The other 4 MOVs tested were 10-inch flexible wedge gate valves (2 manufactured by Crane and 2 manufactured by Velan) with test differential pressures of 190 psid. The thrust requirements for opening and closing the 10-inch valves revealed valve factors ranging from 0.31 to 0.54. Because some of these actual valve factors were above the licensee's initial estimates, the licensee adjusted switch setting calculations as appropriate. The licensee's testing demonstrated that the valve factors applicable to some valves is significantly above that typically assumed by the industry. This confirms the need for the licensee to maintain its MOV effort and to complete the GL 89-10 program on a prompt basis.

With respect to the 6-inch tested MOVs, the licensee stated that the plant staff was able to test the MOVs at greater than 1000 psid differential pressure although the design basis review had assumed the design basis pressure to be approximately 500 psid. The inspectors discussed with licensee personnel the use of test information to identify any underestimates of design basis differential pressure. The licensee stated that it will ensure that test information is used to evaluate the adequacy of its design basis reviews. The NRC will review these efforts during future inspections.

3.e Periodic Verification of MOV Capability

In recommended action d of the generic letter, the NRC staff requests that licensees prepare or revise 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 that the surveillance interval be based on the safety importance of the MOV as well as its maintenance and performance history, but that the interval not exceed 5 years or 3 refueling outages. Further, the capability of the MOV will need 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 Section 6.1.4 of its GL 89-10 Program document, the licensee indicated that Group 1 MOVs would be diagnostically tested within 3 refueling outages or 5 years from the previous baseline or surveillance test, or at extended or reduced intervals based on trending results. In response to an inquiry by the inspectors, the licensee stated that other MOVs within the GL 89-10 program would also be diagnostically tested according to this frequency and that the GL 89-10 Program document would be revised accordingly. The licensee is attempting to develop a "trendable" parameter to allow the capability of the MOVs to be determined based on diagnostic tests under static conditions. The inspectors stated that the use of static testing to verify continued capability of an MOV to operate under worst case differential pressure and flow conditions is not considered adequate at this time because of the uncertain relationship between the performance of an MOV under static conditions and under design basis conditions. The NRC staff will evaluate the licensee's justification for the use of its selected parameter under static testing conditions during future inspections.

In Section 6.1.2 of its GL 89-10 Program document, the licensee outlined criteria for conducting post-maintenance testing for MOVs within the GL 89-10 program. With respect to valve stem packing adjustments, the licensee stated that post-maintenance testing would involve verification that MOV running load had not increased beyond acceptable limits or engineering justification based on available margin. The NRC staff discussed the need for post-maintenance testing to verify MOV design basis capability in response to Question 38 to Supplement 1 to GL 89-10. The NRC will evaluate the specific justification for individual post-maintenance tests during future inspections.

The licensee stated that preventive maintenance is performed on each MOV within its GL 89-10 program on an 18 month schedule. The preventive maintenance includes lubricating the valve stem, checking for mechanical or electrical problems, and sampling lubricants in the main gear housing and limit switch gear boxes. The licensee has not established a specific frequency for MOV refurbishment but bases that decision on the results of the preventive maintenance. The licensee should ensure that its preventive maintenance is sufficiently detailed to confirm an appropriate refurbishment frequency.

The inspectors discussed with the licensee the evaluation of spring pack relaxation where it is identified during valve refurbishment. It was not clear from the licensee's GL 89-10 Program document that an operability determination would be made and that refurbishment or thrust verification frequency would be reconsidered if spring pack relaxation was found. Valve operability should be assessed when spring pack relaxation is identified because it can prevent an MOV from being able to perform its intended function. Spring pack relaxation occurs as a result of use conditions and time and, therefore, it must also be considered in determining an appropriate MOV refurbishment or thrust verification frequency. [Response Item (5)]

3.f MOV Failures, Corrective Actions, and Trending

In recommended action h of the generic letter, the staff 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 (every 2 years or after each refueling outage after program implementation) 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 verify periodically 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' review found that the licensee's general programmatic requirements for identifying and analyzing MOV failures and degradation and for MOV failure trending were described in Section 6 (June 27, 1991 revision) of the Program document. It specified that the cause be determined for all MOV failures and that station engineering and technician level personnel involved in MOV maintenance activities be trained in failure analysis. Also, it included a list of common types of degradation experienced by MOVs and stated that the program was to be capable of identifying these, with diagnostic testing and preventive maintenance being the primary identification methods.

More detailed Oconee station requirements were found in the Oconee Valve and Valve Operator Manual (VVOM), Section 3.11 (Revised June 24, 1991), Trending on Valve Operators. This document was reviewed and discussed with station personnel. The inspectors found that documentation of MOV failures (including cause) and corrective actions was to be generally accomplished through entries on the licensee's normal corrective maintenance work requests (Maintenance Directive 7.5.3, Work Request Implementation, dated April 10, 1991) and entries on Failure and Trending (FAT) information sheets attached to the work requests. The more significant failures are examined in greater detail through the licensee's Maintenance Investigation Report or Problem Investigation Report process - the latter covering failures that may be reportable to the NRC. Four databases are used to maintain the records for work history and trending. These include the Equipment Module, which contains engineering information such as manufacturer and model number; the Work Management System, which contains corrective and preventive maintenance work request history and is replacing a more limited Nuclear Management Database; the Failure and Trending Module which accumulates the failure, cause and corrective action information from the FAT sheets previously mentioned; and the Nuclear Plant Reliability Data System, which contains industry-wide failure records.

The inspectors reviewed procedural documents covering several of the databases and reports of failure information referred to in VVOM Section 3.11. In addition, examples of the database printouts and reports were briefly examined. The inspectors concluded that the licensee had developed programmatic requirements for determining and recording corrective action and failure information and for generally analyzing equipment failure information.

However, it was initially not clear that the detail of MOV trending recommended by GL 89-10 would be provided. The licensee revised VVOM Section 3.11 during the inspection (6/27/91) to specify requirements for periodic preparation of a GL 89-10 trending report which resolved the inspectors concern. The new requirements called for a computer program that would specifically address the GL 89-10 population and provide failure symptom, cause and action taken. The report developed using the program would then be used to identify problems and proposed solutions. This report is to be generated annually, with the first report to be available January 1, 1992.

The inspectors selected and reviewed the licensee's documentation of one Ocone valve failure. They found that the example, for the October 1990 failure of valve 2LPSW-4, appeared inadequately documented, analyzed and corrected. This MOV is the Decay Heat Cooler 2A outlet valve for cooling flow and is normally closed. The valve must open on an accident signal to allow cooling flow through Decay Heat Cooler 2A. Review of the MOV history from 1983 to date indicates that the history was reasonably typical for a MOV including switch repair, packing leak repair, electrical and mechanical preventive maintenance inspections, diagnostic testing, valve refurbishment, and valve operator refurbishment. The historical information of interest begins with VOTES diagnostic testing performed on September 26, 1990 to verify plant operability prior to plant startup. The licensee indicated that 2LPSW-4 performed within acceptable limits with no obvious abnormal conditions, but no detailed analysis of the data was performed. The test results could not be reverified later since, due to a lack of storage capacity, the data was not retained. During an Engineered Safeguards (ES) test of the Low Pressure Injection System on October 23, 1990, MOV 2LPSW-4 failed to open on the ES signal and the breaker tripped. A second attempt to open the valve resulted in a second breaker trip. On a third attempt the licensee had bypassed the torque switch and motor overload devices and the valve opened. It is not clear that these actions had any effect on the valve opening since the torque switch is bypassed for the first 50% of the opening stroke and the motor overload protection device did not de-energize the motor. The documentation available did not indicate a malfunction of either of these devices. The MOV was successfully cycled several times and a diagnostic test was run to verify correct operation. This test showed that the valve thrust exceeded the specified thrust range. Consequently, the valve operator was examined. The licensee found that the spring pack had an extra Belleville washer installed. The spring pack was repaired, a new torque switch installed and a diagnostic (VOTES) test performed to set the torque switch for the specified thrust value. The valve was cycled once a day for the next five days to verify that it was operable. The inspectors identified several concerns regarding the licensee's corrective actions:

(1) Cause of Failure:

The tacit assumption was that the failure occurred from overtightening the valve disk into the seat. However, the valve was apparently closed with normal thrust based on the diagnostic test performed September 26. Information on MOV manipulations between September 26 and failure on October 23 had not been assembled and reviewed.

Also, no evidence of torque switch adjustment or malfunction was documented.

(2) Motor:

The valve motor was not meggered to verify that insulation damage did not occur as a result of exposure to excessive current and heat that may have occurred during the attempts to open the valve. Degraded insulation would not be identified in the VOTES testing.

(3) Breaker:

Correct breaker sizing was not verified at the time of the MOV failure nor was the breaker tested to verify that it did not open prematurely or malfunction. During this inspection, Design Engineering did review breaker sizing for ES valves and concluded sizing was correct.

(4) Design:

A design assessment was not performed to reconcile the valve being disabled by the breaker tripping while the motor was still able to drive the valve. It is the inspectors understanding that the philosophy for design of the licensee's ES valves is to allow the motor to drive to destruction in attempting to position a valve.

(5) Spring Pack:

The equipment history did not address the cause of the extra washer in the spring pack or any action to prevent recurrence.

(6) Torque Switch:

No reason was recorded in the equipment history for the torque switch replacement.

The licensee stated that a maintenance investigation would be initiated on this event which would include detailed review of work requests, diagnostic testing of the breaker, meggering the motor, and discussion with Design Engineering on the breaker sizing and function.

The inspectors considered this issue to be an unresolved item with potential to become a violation. The matter is identified as unresolved item 269,270,287,91-13-01, Concern Regarding Design and Maintenance Actions Stemming From 1990 Failure of Valve 2LPSW-4. [Response Item (6)]

3.g Schedule

In GL 89-10, the staff requested that licensees complete all design-basis reviews, analyses, verifications, tests, and inspections that were initiated in order to satisfy the generic letter recommended actions by June 28, 1994, or 3 refueling outages after December 28, 1989, whichever is later.

The licensee indicated that all design basis review activities will be completed by February 1, 1992. Further, baseline and differential pressure testing are to be completed on all Group 1 MOVs and Group 2 MOVs considered to have minimal margin by December 28, 1994. The balance of Group 2 MOVs are scheduled for test completion by December 26, 1998. This exceeds the recommended generic letter time frame for completion of the generic letter program. The remaining Group 2 MOVs account for approximately 25 percent of the MOVs in the licensee's generic letter program. This is a concern, but due to the licensee's efforts to test the highest priority MOVs first, the large number of MOVs that require testing, and the small population of MOVs that will be tested beyond the schedule recommendations, the licensee's schedule for completion is acceptable. The licensee should continue to evaluate its schedule during the testing program to ensure that any necessary revisions are made.

3.h Overall Administration of MOV Activities

The inspectors found that the overall administration of the licensee's GL 89-10 program was described in the Program document, which has been referred to previously. It was observed to contain detailed guidance regarding most required program activities and was supplemented by plant specific documents. Discussions with corporate and plant personnel regarding the guidance revealed that they were very knowledgeable of the issues involved in GL 89-10 of the activities required to address these issues. Their expertise in these matters was further demonstrated in calculations, diagnostic test records, etc. reviewed by the inspectors and in related discussions.

Program responsibilities were distributed among two corporate organizations and the licensee's three nuclear stations. The corporate organizations are Nuclear Maintenance and Design Engineering. Nuclear Maintenance is responsible for corporate management oversight and coordination. Design Engineering is divided into station specific groups which provide the program design functions for each station. The stations are responsible for their individual hardware testing and maintenance-related activities.

A MOV Task Force had been formed to facilitate communication of technical information among the corporate and plant organizations. It includes station and design engineering working level personnel. Based on discussions with both corporate and plant personnel, the inspectors concluded that communications and cooperation among the organizations was currently good.

A MOV Steering Committee chaired by the Manager of Nuclear Maintenance provides oversight of the program. Its members include the station Maintenance Superintendents and the Design Engineering Group Managers.

The licensee had developed a strong interface with the industry in addressing MOV concerns. The inspectors found that the licensee was extensively supporting and participating in programs with industry groups and manufacturers to aide in and keeping knowledgeable of valve, actuator and diagnostic testing-related technological developments. The licensee often exhibited a leadership role in these activities. Examples included participation in the MOV Users Group (termed MUG) and the Electric Power

Research Institute MOV Performance Prediction Program Technical Advisory Group.

The inspectors found that one of the key individuals in the site GL 89-10 work was advancing to a position within the Oconee Operations organization. This was the Oconee maintenance engineer who had acted as a coordinator in the MOV work. The inspectors expressed concern that the licensee ensure smooth transition of a replacement into this position.

The inspectors concluded that the licensee had devoted considerable resources to the GL 89-10 program. This was reflected in the detail of program documentation, the expertise of the personnel contacted, the good internal communications, and the participation and leadership in industry efforts observed. Licensee management expressed concern with the amount of resources that had been required to support the program. The inspectors noted the need to maintain an adequate level of expertise and resources to ensure successful implementation.

3.i MOV Setpoint Control

The licensee controls the setpoint for MOV output by thrust values obtained from VOTES diagnostic equipment and, in a few cases, from MOVATS diagnostic equipment. The inspectors reviewed the setpoint control documents for all three Oconee units. MOV thrust calculations and operator capabilities are summarized on Test Acceptance Criteria data sheets which are used as input for MOV test procedures. Changes to these setpoint documents are controlled by means of an exempt change process. The inspectors reviewed the licensee's Exempt Change Program (MD 3.2.10, May 2, 1991 and Oconee Directive 2.3.7, February 25, 1991, Rev. 1) and did not identify any concerns in this area.

3.j Training

The inspectors discussed the licensee's training with training and other licensee personnel, reviewed course outlines and records, and toured the training facility. The licensee conducts a basic 40 hour Limatorque training class that includes MOV theory, actuator disassembly/reassembly, and approximately 8 hours of troubleshooting instruction. The licensee is currently developing a 40 hour advanced Limatorque training course. Diagnostic equipment training is also provided including advanced diagnostic data evaluation. Some MOV-related refresher training has been conducted in the past, but not for all classes and not on a periodic basis. The inspectors discussed with licensee personnel the importance of regularly conducting refresher training for all aspects of MOV training. The inspectors did not identify any other concerns with the training department.

The licensee contracts Babcock & Wilcox (B&W) to provide training services to its personnel regarding MOV diagnostic equipment. A statement was obtained from B&W asserting that the instructors supplied had received appropriate training. The licensee stated that it had audited B&W to ensure that the instructors had been trained adequately.

3.k Industry Experience and Vendor Information

Through Department Directive 4.8.1, the licensee ensures that operating experience is distributed, communicated, and tracked until resolved. The inspectors reviewed the licensee's method of handling vendor information letters. These letters are received under the Vendor Equipment Technical Information Program and are directed to the Operational Nuclear Safety Assurance (ONSA) organization. ONSA is responsible for the receipt, screening and distribution of the vendor letters and other documents under the Operating Experience Program. Relevant information is then routed to Technical Engineering Support (T/ES) and Production Training Services, and then to the Station Training Group and Station Work Group Contacts to initiate the appropriate action. The inspectors questioned whether controls were in place to ensure vendor letter information would be routed back to ONSA if T/ES or station personnel received such information. The licensee indicated that Section 3.0 of Department Directive 4.8.1 provides guidance if this situation occurs. The licensee has also informed vendors to forward their letters directly to ONSA. The inspectors considered the licensee's program for handling vendor information letters to be appropriate and a strength.

The inspectors questioned the licensee about the evaluations for selected MOV-related issues. A review of the licensee's implementation of these issues showed that the licensee is following the guidance of Department Directive 4.8.1. The licensee has taken actions to identify and correct problems by revising procedures and training plant personnel when needed. The inspectors also considered this area to be a strength.

3.1 Use of Diagnostics

The licensee originally employed MOVATS diagnostic equipment to determine MOV thrust values. However, it has obtained and begun using VOTES diagnostic equipment and plans to use it predominantly in the future. As discussed above, the licensee includes 20 and 10% margin in its thrust calculations to account for uncertainty in the thrust values provided by MOVATS and VOTES equipment, respectively. Licensee personnel stated that they will evaluate the current industry testing of MOVATS and VOTES equipment and incorporate the results of that testing, as necessary. Also, they have an action plan to address rate of loading effects to ensure adequate margin exists in the capability of MOVs within the GL 89-10 program. During future inspections the NRC will review the licensee's efforts to ensure adequate margins for diagnostic equipment accuracy and rate of loading are incorporated into the licensee's calculations.

3.m Walkdown

The inspectors conducted a walkdown of several MOVs for external evaluation. Debris was observed on the valve stem of Emergency Feedwater MOV EFW-2C-391. The licensee assumed a small stem friction coefficient (0.15). Therefore, it is important to maintain properly lubricated valve stems. In response to inspector comments, the licensee initiated a work request to clean and relubricate the stem. The inspectors also viewed the MOV switch covers used in the control room to prevent inadvertent operation and identified no concerns.

4. Conclusions

The licensee has made a strong effort in developing a program to ensure that MOVs within the scope of its program are capable of performing their intended functions under worst case conditions. Its initial MOV testing has demonstrated the importance of the program by the determination of thrust requirements greater than predicted by the typical industry calculations. If the licensee adequately resolves to each of the items highlighted in this report, the NRC staff will consider the licensee's program to meet the intent of Generic Letter 89-10. As the licensee intends to apply this program at McGuire and Catawba Nuclear Stations, the NRC will consider reducing its inspection efforts involving review of the licensee's GL 89-10 program at those stations. The NRC will conduct inspections of program implementation at each of the licensee's facilities.

5. Exit Interview

The inspection scope and all findings were summarized on June 28, 1991, with those persons indicated in Appendix 1. During a telephone call on July 12, 1991, the licensee was apprised of the response concerns listed in the "SUMMARY" at the beginning of this report. No dissenting comments were received from the licensee.

APPENDIX 1

PERSONS CONTACTED

Licensee Employees

- M. Alexander, Planning Coordinator, Oconee Nuclear Station (ONS)
- *B. Barron, Station Manager, ONS
- *S. Batson, Maintenance Engineer (Coordination of MOV Work), ONS
- *K. Beasley, Diagnostic Testing Engineer (Contracted From Babcock and Wilcox - Assigned to Maintenance Engineering), ONS
- *L. Beck, Nuclear Production Engineer (Operator Mechanical Lead Engineer and Station GL 89-10 Lead), Maintenance Engineering, ONS
- *R. Boyer, Assistant Engineer (Operator Electrical Lead Engineer), ONS
- T. Cline, Nuclear Production Specialist (Diagnostic Testing), Nuclear Production Department (NPD)
- T. Coutu, Unit 1 Operations Manager, ONS
- T. Curtis, Compliance Manager, ONS
- B. Dolan, Onsite Design Manager, ONS
- *N. Estep, Nuclear Production Engineer (GL 89-10 Program Director), NPD
- *W. Foster, Superintendent of Maintenance, ONS
- S. Hall, Instructor, ONS
- *M. Hipps, Mechanical Engineering Supervisor (Valve and Valve Operator Support Engineer), Maintenance Engineering, ONS
- D. Jamil, Design Engineering - Electrical, ONS
- *S. Karriker, Design Engineering and Oconee Design GL 89-10 Program Lead, Design Engineering Department
- W. Matheson, Senior Instructor, ONS
- K. McMurray, Unit 3 Nuclear Production Engineer, Operations, ONS
- B. Millsaps, Maintenance Engineering Manager, ONS
- S. Nader, Design Engineering - Systems, ONS
- *S. Perry, Assistant Licensing Coordinator, ONS
- J. Price, Unit 1 Operations Coordinator, ONS
- G. Rothenberger, Superintendant Integrated Scheduling, ONS
- M. Tuckman, Vice President Nuclear Operations

NRC Personnel

- *K. Poertner, Senior Resident Inspector
- *A. Herdt, Branch Chief, Division of Reactor Projects, Region II

*Attended exit interview

APPENDIX 2

ACRONYMS AND INITIALISMS

ASDOP	Auxiliary System Design Optimization Program
CFR	Code of Federal Regulations
ES	Engineered Safeguards
FAT	Failure and Trending
GL	Generic Letter
MCC	Motor Control Center
MOV	Motor Operated Valve
NPD	Nuclear Production Department
NRC	Nuclear Regulatory Commission
ONS	Oconee Nuclear Station
ONSA	Operational Nuclear Safety Assurance
TI	Temporary Instruction
VAC	Volts Alternating Current
VVOM	Valve and Valve Operator Manual