APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 50-285/94-05

License: DPR-40

Licensee: Omaha Public Power District
Fort Calhoun Station FC-2-4 Adm.
P.O. Box 399, Hwy. 75 - North of Fort Calhoun
Fort Calhoun, Nebraska

Facility Name: Fort Calhoun Station (FCS)

Inspection At: FCS, Fort Calhoun, Nebraska

Inspection Conducted: February 28 through March 4, 1994

Inspectors: M. Runyan, Reactor Inspector, Engineering Branch
Division of Reactor Safety

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Division of Reactor Safety

Accompanying Personnel: R. Cain, Consultant, EG&G Idaho-INEL

Approved: _____ 3-17-94
T. Westerman, Chief, Engineering Section Date
Division of Reactor Safety, Region IV

Inspection Summary

Areas Inspected: Special, announced inspection of the implementation of the licensee's program to meet commitments to Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance."

Results:

- The licensee's MOV program was capable of successfully demonstrating the operability of MOVs subject to GL 89-10. The program was well-organized and was being implemented in a manner consistent with the licensee's commitments to the generic letter. Significant improvements had been made since the previous MOV inspection in August 1991 (Section 1).

- The design basis calculations satisfactorily addressed the design basis considerations of the selected MOVs (Section 1.1).

- Torque switch repeatability was not accounted for in the upper limits for valve and actuator ratings (Section 1.2).

- The licensee did not rely on any of the industry testing programs designed to extend the nominal thrust ratings of MOV actuators. This was considered a strength in the program (Section 1.2).

- The licensee had not established margins to account for the possible effects of thermal growth of the valve stem on MOV operation (Section 1.2).

- The feedwater isolation valves (HCV-1385 and HCV-1386) were not capable of isolating downstream ruptures. This capability was beyond the design basis of the plant (Section 1.2).

- The high percentage of MOVs tested dynamically and high differential pressures and flows attained during the tests were considered strengths in the program (Section 1.3).

- The precision and safety-conscious decision-making exhibited in the evaluation of diagnostic traces was considered a strength (Section 1.3).

- The licensee's procedures did not provide an explicit documented verification that the torque measured at torque switch trip was less than the available torque at degraded voltage, though it was implied that this check was being performed (Section 1.3).

- The licensee's analysis determined that none of the MOVs currently included in the GL 89-10 program were susceptible to pressure locking and thermal binding. This issue will be reviewed further after issuance of a generic letter on this subject (Section 1.4).

- The licensee's intention to dynamically test MOVs on a periodic basis was considered a strength in the program (Section 1.5).

- The licensee stated that the GL 89-10 program would be completed on schedule by June 28, 1994 (Section 1.7).

- The involvement of quality control and quality assurance in the MOV program was minimal, though other reviews somewhat compensated for this situation. The licensee's oversight of the MOV program was found to be sufficient to ensure quality results (Section 1.9).

- Several field walkdown findings were considered to be indicative of poor maintenance and operation practices (Section 1.10).

- All issues identified from a previous MOV inspection (50-285/91-22) and the licensee's January 7, 1992, response letter were closed, with the exception of the results from the licensee's participation in a utility

program to justify the motor equation for voltages under 70 percent (Section 1.11).

- The post-maintenance testing requirements were considered to be a strength in the MOV program (Section 1.11.9.g).

- The trending program was considered a strength in the licensee's GL 89-10 program (Section 1.11.9.h).

Summary of Inspection Findings:

- Inspection Followup Item 285/9405-01 was opened (Section 1.2)
- Inspection Followup Item 285/9405-02 was opened (Section 1.4)
- Inspection Followup Item 285/9405-03 was opened (Section 1.10)
- Inspection Followup Item 285/9405-04 was opened (Section 1.11.9.e)

Attachments:

- Attachment 1 - Persons Contacted and Exit Meeting

- Attachment 2 - Fort Calhoun Gate Valve Data

DETAILS

1 GENERIC LETTER (GL) 89-10, "SAFETY-RELATED MOTOR-OPERATED VALVE TESTING AND SURVEILLANCE" (2515/109)

On June 28, 1989, the NRC issued Generic Letter (GL) 89-10, which requested licensees and construction permit holders to establish a program to ensure that switch settings for safety-related motor-operated valves (MOVs) were selected, set, and maintained properly. Subsequently, six supplements to the generic letter have been issued. NRC inspections of licensee actions implementing commitments to GL 89-10 and its supplements have been conducted, based on guidance provided in Temporary Instruction (TI) 2515/109, "Inspection Requirements for Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance." Instruction TI 2515/109 is divided into Part 1, "Program Review," and Part 2, "Verification of Program Implementation." The TI 2515/109, Part 1, program review at FCS is documented in NRC Inspection Report 50-285/91-22. The inspection documented by this report was the initial inspection at FCS under Part 2 of TI 2515/109 and, thus, was focused on verification of program implementation. Nevertheless, programmatic issues were addressed during this inspection as a result of Part 1 followup and in the context of issues that developed in the course of the inspection.

As an overall assessment, the inspectors concluded that the licensee's MOV program was capable of successfully demonstrating the operability of MOVs subject to GL 89-10. The program was well-organized and was being implemented in a manner consistent with the licensee's commitments to the generic letter. Significant improvements had been made since the Part 1 inspection in August 1991.

The principal focus of the inspection was to select and review, in depth, several MOVs from the GL 89-10 program. The selection was based on an information matrix provided by the licensee, as requested by the inspectors. The selection was biased toward MOVs that appeared to have less than average margin; otherwise, an attempt was made to select various valve and actuator sizes and tests conducted under various differential pressure and flow conditions.

For each MOV selected, the inspectors reviewed the design basis calculation of flow, temperature, and the maximum expected differential pressure (MEDP); the sizing and switch setting calculation; the diagnostic test data package; and the diagnostic traces using MOVATS 3000 software. The following nine MOVs were selected for review:

HCV-151	Power Operated Relief Valve Isolation
HCV-258	Concentric Boric Acid Tank Gravity Feed Isolation
HCV-268	Boric Acid Pump to Charging Suction Isolation
HCV-348	Shutdown Cooling Isolation
HCV-383-3	Containment Sump Isolation
HCV-1385	Main Feedwater Isolation

HCV-1386 Main Feedwater Isolation
LCV-218-2 Volume Control Tank Outlet Isolation
LCV-218-3 Safety Injection Reactor Water Tank to Charging Pump Isolation

The selected MOVs were configured as shown below:

	Actuator	Valve Size and Vendor	Valve Type	Closure Control
HCV-151	SMB-00	2.5" Crane	Gate	Torque
HCV-258	SMB-00	3" Crane	Gate	Torque
HCV-268	SMB-00	3" Velan	Gate	Torque
HCV-348	SMB-3	12" Velan	Gate	Torque
HCV-383-3	SMB-00/HBC2	24" Allis Chalmers	Butterfly	Limit
HCV-1385	SMB-4T	16" Crane	Gate	Torque
HCV-1386	SMB-4T	16" Crane	Gate	Torque
LCV-218-2	SMB-00	4" Velan	Gate	Torque
LCV-218-3	SMB-00	3" Velan	Gate	Torque

1.0 Scope

The licensee's GL 89-10 program included 27 safety-related MOVs and 2 nonsafety-related MOVs that were considered to be in a special test category. These two valves, HCV-1103 and HCV-1104, were feedwater regulating isolation valves that were used in the emergency operating procedures for contingency purposes only. Since the previous MOV inspection, the licensee had removed four safety injection tank outlet isolation MOVs (HCV-2914, -2934, -2954, -2974) from the GL 89-10 program. These MOVs were removed because they were left in an open position with power removed during operating modes in which they were required. The inspectors did not identify any issues related to the scope of the licensee's GL 89-10 program.

1.1 Design-Basis Reviews

The inspectors reviewed the calculations determining the MEDP (alternately referred to as the design-basis differential pressure), design flow conditions, design temperature, and other design parameters for each of the MOVs selected for review. These calculations had been prepared for the licensee by a consultant. However, the licensee revised the consultant's conclusions in several cases. The calculations satisfactorily addressed the design basis considerations of the selected MOVs.

The inspectors' review focused on the appropriate design basis differential pressures and the accuracy of the licensee's design basis calculations. The inspectors did not find any errors in the licensee's design basis calculations.

1.2 MOV Sizing and Switch Setting

The inspectors reviewed the licensee's MOV sizing and switch setting procedures, Station Engineering Instructions SEI-5, "Methodology and Switch Setting Procedure," Revision 1, and SEI-10, "Evaluation of In-Situ Testing of GL 89-10 MOVs," Revision 1. The licensee's gate valve thrust equation typically incorporated a valve factor of 0.30 for rising stem wedge gate valves and 1.10 for globe valves. If the gate valve could not be tested dynamically, a valve factor of 0.50 was used to set the valve up statically. A stem friction coefficient of 0.20 was used for determination of actuator output thrust capability. Minimum thrust requirements were adjusted to account for diagnostic equipment inaccuracy and torque switch repeatability. A margin of 20 percent was added for load sensitive behavior (also known as "rate-of-loading").

Values for load sensitive behavior and valve factor were adjusted as appropriate depending on the results of dynamic testing. However, the licensee maintained the use of the 0.20 stem friction coefficient even if dynamic tests indicated a lesser value. The licensee used this as an extra margin for error in their calculations. The licensee stated that they measure torque during static and dynamic testing to ensure torque limits are not exceeded. Further, the licensee has placed limiter plates on all of their GL 89-10 valves.

The inspectors were concerned that torque switch repeatability, which was accounted for in the minimum required thrust, was not accounted for in the upper limits for valve and actuator ratings. The licensee stated that they monitored total thrust, including inertia, to ensure that valve and actuator limits had not been exceeded. It was noted that the licensee did not use the Kalsi actuator thrust rerating study to increase their actuator ratings. However, since diagnostic equipment is not attached to the valve each time it is operated, the licensee cannot be certain that actuator or valve limits are not being exceeded when the valve is operated. The licensee reviewed all MOV test results and determined that, if the appropriate margin for torque switch repeatability (those published by Limitorque) were included in total thrust measurements, no overthrust conditions resulted. The licensee stated that it will review this matter for a potential program revision. This issue was identified as an inspection followup item (285/9405-01).

The licensee had completed an evaluation of the effects of Limitorque's Potential 10 CFR 21 condition, "Reliance 3-Phase A. C. Actuator Motors (Starting Torque at Elevated Temperatures)," dated May 13, 1993, which dealt with the effect of elevated temperature on the output of alternating current (AC) motors. The licensee had derated the capability of all AC MOVs according to the Limitorque update and the temperature calculated to be present at the time of MOV operation.

The licensee did not rely on any of the industry testing programs designed to extend the nominal thrust ratings of MOV actuators. This position was facilitated by the generally large margins inherent to the MOVs in the

program, but also appeared to reflect the licensee's engineering philosophy. By not challenging the actuators to the extent of their durability, the licensee retained a safety margin inherent to the establishment of the original ratings. This was considered a strength in the program.

The inspectors noted that the licensee had not established margins to account for the potential effects of thermal growth of the valve stem on MOV operation. This was not considered a deficiency in the program because of the emerging nature and limited impact of this issue. If an MOV is tested under cooler temperatures than those experienced during plant operations, the thermal expansion of the valve stem (which may exceed that of the valve yoke because part of the stem is immersed in the bonnet fluid and the stem above the bonnet is heated by conduction) can result in a change in the relationship between the vertical position of the stem and the limit switch gearing. Consequently, a torque bypass switch set to actuate at a point near seat contact during testing may not actuate until after the valve disc contacts the seat under hot conditions, resulting in possible overthrust or stall. Overthrust events caused by this phenomenon may not be detected by a refueling-outage-based testing program. The licensee stated that torque switches in the closing direction are bypassed 95 to 98 percent of the valve stroke. If thermal growth effects exist at this plant, they would likely be minor. Nevertheless, the inspectors encouraged the licensee to evaluate this potential condition.

The inspectors noted that the feedwater isolation valves (HCV-1385 and HCV-1386) were not capable of isolating downstream ruptures. The MEDP for these valves did not include consideration of this scenario. However, the licensee's design basis does not require a feedwater break to be postulated as a credible accident scenario. If a feedwater rupture were to occur in containment, the inability of the feedwater isolation valves to close could result in pressurization of containment beyond the design limit. The licensee and NRR have had ongoing discussions about this issue, which, for the purpose of this inspection, is considered an observation.

1.3 Design-Basis Capability

The inspectors reviewed the test packages of the selected MOVs. Eight of the nine selected MOVs had been tested under dynamic conditions. The MOVs were tested dynamically only in the direction they must travel to perform their safety function. HCV-151, which was qualified by a prototype test, had been tested under static conditions only. The dynamic tests reviewed by the inspectors were performed under the following conditions:

HCV-258	176 percent of the opening MEDP
HCV-268	101 percent of the opening MEDP
HCV-348	86 percent of the closing MEDP
HCV-383-3	92 percent of the opening MEDP
HCV-1385	126 percent of the closing MEDP
HCV-1386	121 percent of the closing MEDP
LCV-218-2	18 percent of the closing MEDP

LCV-218-3 100 percent of the opening MEDP

The inspectors reviewed the licensee's dynamic test data which used the industry standard equation, the valves' mean seat diameters, and the dynamic test conditions. This review indicated closing gate valve factors up to 0.95 and load sensitive behavior for gate valves as high as 13.6 percent (see Attachment 2). Based on this data, the licensee's valve factor assumption for gate valves was not always bounding. However, almost all valves in the licensee's program had been dynamically tested and there did not appear to be any cases where the licensee depended on a valve factor assumption that was not analytically justifiable. Those valves which could not be dynamically tested, or were tested at a pressure or flow of less than 80 percent of design conditions, were considered to be the first stage of a two stage approach, and a valve factor of 0.5 was assumed in the calculations (unless the partial differential pressure test indicated higher valve factors, in which case the extrapolation incorporated this higher factor). The licensee is not a member of the EPRI validation program and intends to use special testing, engineering analysis, etc., to justify their valves which use the two-stage approach. The licensee understood that resolution of valves requiring a two-stage approach would have to be accomplished prior to the scheduled completion of their GL 89-10 program.

The licensee ensured immediate operability of an MOV, prior to returning the valve to service, by completing Attachment 10, Sections 3 through 6 of Maintenance Procedure EM-RR-VX-0404, "Static and Dynamic Testing of Motor Operated Gate, Globe, and Butterfly Valves," Revision 4. If conditions were less than 100 percent design basis differential pressure, these sections required the extrapolation of thrust and torque to ensure the MOV was capable of performing its design basis function and to ensure that valve and actuator limits had not been exceeded. Thrust margins, torque margins, and any anomalies seen during the test were also evaluated. Stem friction coefficient and valve factor were determined at a later date, but the inspectors considered that these evaluations were performed within a reasonable timeframe.

Where testing was conducted at 80 percent or greater of the design-basis differential pressure, the licensee utilized a straight line extrapolation of the thrust to overcome differential pressure using the ratio of design-basis differential pressure to the test differential pressure. The licensee had performed limited multi-point testing and had developed an engineering basis to justify its extrapolation method. The inspectors considered the licensee's extrapolation method to be currently acceptable; however, the validity of linear extrapolation will be reassessed during a future inspection when additional information regarding this generic issue is available. When testing was conducted at less than 80 percent of the MEDP, the licensee still performed an extrapolation but considered the MOV to be subject to the two-stage qualification process discussed in GL 89-10, where the MOV is set up using the best available information.

The licensee had conducted differential pressure tests on 25 of the 27 safety-related MOVs in the GL 89-10 program, which represents a high percentage of dynamic tests. Of the 25 MOVs that were dynamically tested, 20 were tested under conditions greater than 80 percent of the MEDP and 80 percent of the maximum expected flow rate. The licensee considered these 20 tests to be sufficient (with extrapolation, if necessary) to close out the MOV under the generic letter. MOVs tested under less severe conditions will be subject to the two-stage approach discussed in GL 89-10 and its supplements. The inspectors considered this demarcation between "one-stage" and "two-stage" MOVs to be reasonable. The high percentage of MOVs tested dynamically and high differential pressures and flows attained during the tests were considered strengths in the program.

The inspectors reviewed the diagnostic traces of the nine selected MOVs using MOVATS 3000 software provided by the licensee. In every instance, the licensee appeared to use the information on the traces in an appropriate manner. The inspectors did not find any cases where points of interest on the traces were marked incorrectly. When in doubt, the licensee interpreted the trace forms in a safety-conscious manner. The precision and prudence exhibited in the evaluation of diagnostic traces was considered a strength.

The inspectors noted that the licensee's procedures did not provide an explicit documented verification that the torque measured at torque switch trip was less than the available torque at design degraded voltage. The licensee stated that this verification was performed by the MOV engineer as part of a documented review to approve the as-left torque switch setting. The inspectors considered this practice to be acceptable, but recognized the potential for the check to be overlooked in the absence of a formal signoff.

1.4 Pressure Locking and Thermal Binding

The NRC Office for Analysis and Evaluation of Operational Data (AEOD) completed a study of pressure locking and thermal binding of gate valves. AEOD concluded in its report that licensees have not taken sufficient action to provide assurance that pressure locking or thermal binding will not prevent a gate valve from performing its safety function. The NRC regulations require that licensees design safety-related systems to provide assurance that those systems can perform their safety functions. In Generic Letter 89-10, the staff requested licensees to review the design bases of their safety-related MOVs.

The inspectors reviewed the licensee's evaluations of the potential for pressure locking and thermal binding of gate valves. The licensee contracted Asea, Brown, and Boveri (ABB) to perform a study and calculation of the potential for pressure locking and thermal binding at Fort Calhoun Station. This study was entitled, "Evaluation of OPPD Fort Calhoun's MOVs for Pressure Locking and Thermal Binding," Calculation 0-MECH-CALC-061. The licensee reviewed the calculation by ABB and renumbered the calculation as Calculation FC06103, with the same title and including the same material as the ABB calculation. This calculation reviewed all of the original 33 valves

in the licensee's GL 89-10 program for bonnet cavity pressure locking, system pressure locking, and thermal binding. The licensee identified 4 parallel disc gate valves in which system pressure locking was a potential concern and recommended drilling a small hole in the upstream side disc to prevent this occurrence. Subsequent to this recommendation, the 4 valves, HCV-2914, -2934, -2954, and -2974, were removed from the GL 89-10 program, leaving 29 valves in the licensee's program and no valves apparently susceptible to pressure locking and thermal binding. The inspectors noted the licensee's position. Pending the anticipated issuance of a generic letter on this subject, this issue was identified as an inspection followup item (285/9405-02).

1.5 Periodic Verification of MOV Capability

During the GL 89-10 Part 1 inspection, the licensee stated that periodic verification of MOV capability had been scheduled on a 5-year interval or every third refueling outage, whichever is longer, as recommended by GL 89-10. The licensee was intending to perform static testing for this verification. During this inspection, the licensee stated that their position on periodic verification had changed to include the use of dynamic testing. The licensee also stated that grouping may be used in accordance with Supplement 6 to GL 89-10. The licensee's intention to dynamically test MOVs on a periodic basis was considered a strength in the program. The NRC will review the licensee's actions with regard to this issue during future inspections.

1.6 MOV Failures, Corrective Actions, and Trending

This area is discussed in Section 1.11.9.h.

1.7 Schedule

The licensee stated that the GL 89-10 program would be completed on schedule by June 28, 1994. The inspectors considered this to be a realistic goal based on the present stage of program completion and the fact that all diagnostic testing was completed.

1.8 Motor Brakes

No motor brakes were installed on MOVs in the GL 89-10 program. Several motors containing motor brakes had been replaced in the Fall 1993 outage.

1.9 Quality Assurance/Quality Control

The involvement of quality control and quality assurance in the MOV program was limited to surveillances and audits. Quality control inspectors were not involved in the evaluation of testing or maintenance activities either from a holdpoint perspective or in review of program documentation on a real-time basis. This limitation was somewhat compensated for by an aggressive review process within engineering that included reviews by "second" engineers, the design engineering department, and outside organizations. The inspectors concluded, based on the positive results of this inspection, that the

licensee's oversight of the MOV program was sufficient to ensure high quality results.

1.10 Field Inspection of Motor-Operated Valves

During the week of February 14-18, 1994, an inspector observed the condition of Valves HCV-1041C, "Main Steam Isolation Valve Bypass"; HCV-1103 and 1104, "Feedwater Regulating Valve Isolation Valves"; HCV-1384, "Auxiliary Feedwater to Main Feedwater Header Cross-Connect Valve"; and HCV-1386, "Main Feedwater Isolation Valve." The inspector noted that significant improvement had been made and maintained in the material condition of these valves since the August 1991 inspection.

During this inspection, the inspectors observed the material condition of the remaining valves that were inspected during the August 1991 inspection. The inspectors noted that Valve HCV-258, "Concentrated Boric Acid Tank Gravity Feed Isolation Valve," had approximately 60 ml (2 oz) of grease in a glob on the stem of the valve and a small amount of boric acid buildup. The amount of boric acid was significantly less than observed during the previous inspection, but the amount of grease indicated a need for additional training of the personnel performing maintenance activities on motor-operated valves. The licensee stated that training would be provided to the appropriate personnel to ensure proper lubrication of valve stems so that valve performance would not be impaired.

The inspectors also noted that Valve HCV-265, "Concentrated Boric Acid Tank Gravity Feed Valve," had an excessive amount of boric acid accumulated on the stem and around the packing gland. The licensee had identified a packing leak on this valve, but repairs had not been implemented. The licensee intended to replace the stem during the next refueling outage and correct the packing leak.

The inspectors found paint chips in the grease on the stem of Valve HCV-268, "Boric Acid Pump to Charging Pump Suction Isolation Valve." During the previous inspection, paint was noted on the stem of this valve. The paint had been removed; however, paint had peeled off of the valve yoke and had fallen onto the grease on the stem.

The inspectors considered these findings to be indicative of poor maintenance and operation practices. The licensee stated that consideration would be given to periodic inspection of the material condition of accessible motor-operated valves in order to ensure that the condition of the valve stem and packing area had not deteriorated to a point that the operability of the valve would be impaired. This finding was identified as an inspection followup item (285/9405-03).

1.11 Followup to Issues Identified in Previous MOV Inspection

During the initial inspection of the licensee's program developed in response to GL 89-10, several items were identified that required additional information from the licensee. These items were identified as "Response Items." Additionally, there were other items that required licensee attention. The licensee provided its response to the NRC by a letter dated January 7, 1992.

1.11.1 Response Item 1

The scope of the licensee's motor-operated valve program did not include feedwater regulating Valve Isolation Valves HCV-1103 and 1104. Additional information was needed to ensure that these motor-operated valves were capable of performing their intended function, or that emergency operating procedures and training would alert the operators to the potential failure of these motor-operated valves.

The licensee stated in its January 7, 1992, letter that the valves did receive a steam generator isolation signal to close; however, the steam generator isolation function was provided by two safety-related check valves (FW-161 and FW-162) and two safety-related motor-operated valves (HCV-1385 and HCV-1386). The review of the subject valves' relative importance to safety showed that there was a redundancy requirement for preventing main feedwater pump runout flow during a main steam line break accident.

In order to ensure that HCV-1103 and HCV-1104 were capable of performing their intended function, the licensee created a special testing category for these valves. The inspectors found that the licensee had established a test frequency consistent with the safety-related motor-operated valves included in the GL 89-10 program.

1.11.2 Response Item 2

The licensee had committed to the use of design basis parameters in establishing the setpoints for the torque switch settings. The implementation of this provision on the pressurizer power-operated relief valve block valves did not utilize the design basis value, but a lower value. Additional information was required to clarify the licensee's position on the use of design basis values.

The licensee performed a design basis re-evaluation of the motor-operated valves in the GL 89-10 program. This included a detailed system level design basis review of motor-operated valve operations during normal, abnormal, surveillance and test, accident response, and emergency operations for both valve opening and closing scenarios. The inspectors evaluated a sample of the re-evaluated valve parameters (including those applicable to the pressurizer power-operated relief valve block valves) and found them to be acceptable.

1.11.3 Response Item 3

The licensee was using valve factors of 0.3 for flexwedge gate valves and 0.2 for double disk gate valves. These values had been shown to be inadequate for some motor-operated valves during industry testing and research tests. The licensee needed to address the capability of their tested valves and to assess the methodology to be used in selecting valve factors.

The licensee, in its January 7, 1992, letter, stated that the use of a 0.3 valve factor was bounding and acceptable on the basis of a prototype test for the pressurizer power-operated relief valve block valve. Subsequent to that statement, the licensee elected to use valve factors of 0.5 in the sizing calculations until additional test data was available. The licensee has found valve factors derived from test data to be in the range of 0.37 to 1.22. The inspectors noted that the licensee considered the issue of valve factors to be a living issue in that they will be calculated after each test.

Unlike most GL 89-10 programs, the licensee was relying on valve factor assumptions for only seven safety-related MOVs that could not be tested at conditions in excess of 80 percent MEDP and maximum expected flow. Of these seven, two were prototype tested and four were tested at greater than 80 percent MEDP (but less than 80 percent flow). The remaining MOV from this group of seven was tested at 18 percent MEDP. Therefore, the inspectors concluded that a valve factor assumption was critical to the capability determination of only one safety-related MOV in the program, LCV-218-2, which was reviewed during this inspection and determined to be acceptable.

1.11.4 Response Item 4

The licensee indicated that actuator, motor, and valve limitations would be addressed for the torque switch settings. This would imply that inertia effects would be addressed. Information was required to ensure that all applicable limitations, including inertia effects, would be considered in the establishment of torque switch settings and incorporated into the final guidance document.

The licensee performed a detailed valve weak link analysis for each valve in the GL 89-10 program. The licensee determined conservative maximum allowable valve thrust values to be used for initial testing purposes. These values were provided to a consultant to determine the recommended maximum switch settings. The maximum allowable thrust limits incorporated appropriate conservatisms. The inspectors found that these values were incorporated in the design basis documents and considered them to be acceptable.

1.11.5 Response Item 5

The licensee indicated a stem friction coefficient of 0.15 would be used. The licensee was requested to provide justification for the use of the 0.15 assumption, the use of its selected stem lubricant, and the frequency of preventive maintenance to support these positions.

The inspectors found that the licensee had revised its methodology to utilize a stem friction coefficient of 0.2 instead of 0.15. The licensee had not determined the stem friction coefficients for many of the motor-operated valves in the GL 89-10 program; however, for those that were available, the inspectors noted that the values ranged from 0.086 to 0.28. The 0.28 stem friction coefficient appeared to be an outlier, as no other dynamic values exceeded 0.14. The inspectors verified the values at the extremes and found that the licensee had accurately determined the stem friction coefficients.

The inspectors also noted that the licensee had changed to Mobilux EP-1 grease as the stem lubricant. The licensee has performed as-found testing on valves that had the Mobilux EP-1 lubricant on the stem for 18 months and did not detect any significant degradation. On the basis of this test data, the inspectors considered the licensee position on the type of stem lubricant and frequency of lubrication to be acceptable.

1.11.6 Response Item 6

The licensee had committed to perform design basis testing; however, the project plan listed exceptions to design basis testing. The licensee was requested to provide information addressing any deviations from its commitments to GL 89-10 and incorporate that information into plant documents.

The licensee restated its intention to meet its commitment to perform design basis testing where practicable. The licensee also stated its intentions to follow a two-stage approach for any valve that could not be tested under design basis conditions (greater than 80 percent design basis flow and design basis differential pressure). The inspectors found that the licensee had tested approximately 80 percent of the safety-related valves in the GL 89-10 program under dynamic conditions meeting the above criteria with only seven valves requiring the two-stage approach. The licensee's plans for performing design basis testing are considered to be acceptable.

1.11.7 Response Item 7

The licensee had not established plans for periodic verification of MOV operability. The licensee was requested to provide information regarding how it intended to address the commitment for periodic verification of motor-operated valve operability.

The inspectors were informed during this inspection that the licensee would perform design basis differential pressure testing on a periodic basis consistent with GL 89-10. This testing would include all GL 89-10 program valves and the two special category valves. However, the licensee stated that grouping of similar valves consistent with Supplement 6 to GL 89-10 would be considered. The licensee's plans for periodic verification of MOV operability are considered to be acceptable.

1.11.8 Response Item 8

The licensee had not implemented an effective program to evaluate vendor information. The licensee was requested to provide information as to how vendor information would be evaluated, including what actions would be taken, if necessary, to address any items of concern.

The licensee revised Standing Order SO-G-62, "Control of Vendor Manuals," to require technical review of vendor manual information updates or revisions which could affect maintenance or operating procedures. The inspectors reviewed SO-G-62, Revision 9, and found that the licensee had adequately addressed this item.

1.11.9 Other Areas of Weakness

In addition to the Response Items discussed above, there were other areas of weakness identified during the previous MOV inspection that required further licensee effort. They were:

1.11.9.a Develop justification for the use of selected globe valve opening and closing valve factors.

The licensee determined that the assumed valve factor of 1.1 for the opening direction bounded all of the globe valves in the GL 89-10 program. The inspectors reviewed the test data and verified this fact.

1.11.9.b Address the results of the Motor-Operated Valve Utility Group testing.

The inspectors found that the licensee relied on its own test results for specific valve information. The licensee had incorporated the information related to equipment accuracies provided in Supplement 5 to GL 89-10, and procedures were in place to update the information if any additional revisions would be initiated.

1.11.9.c Address load-sensitive-behavior effects on the torque switch setting.

The inspectors found that the licensee had applied a 20 percent margin in the sizing calculations for load-sensitive-behavior. Based on a review of the dynamic and static test results, the inspectors considered this to be a conservative assumption.

1.11.9.d Address temperature effects on the motors.

The inspectors found that the licensee had completed its evaluation of the Limitorque study of temperature effects on motor-operated valve motors. The licensee did not identify any resulting MOV capability problems.

1.11.9.e Evaluate the effects of degraded voltage on the motor-operated valves after the degraded voltage study is completed.

The licensee evaluated the effects of degraded voltage on the motor-operated valves. The inspectors found that the licensee had adequately demonstrated that GL 89-10 MOVs were capable of performing their safety functions at the reduced voltage levels. The licensee's evaluation included consideration of the operability of motor control center equipment at the reduced voltage levels.

However, the inspectors noted that one safety-related MOV in the GL 89-10 program (HCV-1386, one of the MOVs selected for review) could be subjected to a voltage as low as 66.6 percent of the rated voltage. The licensee was using the standard degraded voltage capability equation for this MOV although Limitorque has not endorsed use of this equation for voltage levels below 70 percent of rated voltage. The licensee is participating in an AC motor test program being sponsored by the Commonwealth Edison Company and stated that the justification of its use of the motor equation for voltages under 70 percent rated voltage will be available for review by its GL 89-10 compliance date of June 28, 1994. This information will be reviewed during a future inspection. The inspectors considered the interim use of the standard equation for the affected MOV to be acceptable based on the available torque margin of the motor (Inspection Followup Item 285/94-04).

1.11.9.f Complete preventive maintenance procedure improvement.

The licensee revised its maintenance procedures to address the concerns related to overfilling limit switch gear boxes, spring pack relaxation, and hydraulic lock. The inspectors reviewed the following maintenance related procedures:

EM-PM-VX-0400, Revision 8, "Limitorque Operator Maintenance";

EM-RR-VX-0400, Revision 9, "Motor Operated Valve Operator Inspection and Overhaul (SMB-00)";

EM-RR-VX-0401, Revision 6, "Motor Operated Valve Operator Inspection and Overhaul (SMB-000)";

EM-RR-VX-0402, Revision 8, "Motor Operated Valve Operator Inspection and Overhaul (SMB-0 to 4 and SMB-4T)";

PE-PM-VX-0400, Revision 2, "Valve Maintenance."

The inspectors considered the procedures to be well-written and comprehensive. The inspectors noted that the licensee not only addressed the concerns raised in the previous inspection, but also addressed emerging issues identified in vendor and industry documents.

1.11.9.g Complete post-maintenance matrix.

The licensee opted to address post-maintenance testing requirements in a standing order instead of developing a matrix. The inspectors reviewed Standing Order SO-M-102, Revision 7, "Post-Maintenance Testing." The inspectors considered the post-maintenance testing requirements to be thorough and effective, and this was identified as a strength in the program.

1.11.9.h Complete program to address motor-operated valve failures, corrective actions, and trending.

The licensee was in the final stages of developing a program to address tracking and trending of motor-operated valve failures, corrective actions, maintenance activities, and test data. The inspectors observed a demonstration of the licensee's capability to trend test data and were informed that similar capabilities were intended for the tracking of the other areas. The licensee had not collected and entered all pertinent information into the data base, but planned to complete this task by the end of June 1994.

The inspectors considered the licensee's planned trending program to be consistent with the intent of GL 89-10 and, if properly implemented, would become a useful tool. It was considered a strength in the licensee's GL 89-10 program.

ATTACHMENT 1

1 PERSONS CONTACTED

1.1 Licensee Personnel

*W. Bateman, Acting Manager, Quality Assurance/Quality Control
*C. Bloyd, Lead Engineer, Special Services Engineering
*L. Boughter, Supervisor, Special Services Engineering
*G. Cavanaugh, Licensing Engineer
*J. Chase, Plant Manager
*G. Cook, Supervisor, Station Licensing
*J. Gasper, Manager, Training
K. Hyde, Nuclear Design Engineer
*R. Jawarski, Manager, Station Engineering
*L. Kusek, Manager, Nuclear Safety Review Group
*R. Phelps, Acting Division Manager, Plant Engineering Department
*S. Resch, Engineer, Special Services Engineering
W. Weber, Supervisor, Reactor Performance Analysis

1.2 Other Organizations

*B. Kochanowicz, NPPD
J. Summers, ITT-MOVATS

1.2 NRC Personnel

R. Mullikin, Senior Resident Inspector

In addition to the personnel listed above, the inspectors contacted other personnel during the inspection.

* Denotes personnel that attended the exit meeting.

2 EXIT MEETING

An exit meeting was conducted on March 4, 1994. During this meeting, the inspectors reviewed the scope and findings of the report. The licensee did not express a position on the inspection findings documented in this report. The licensee did not identify as proprietary any information provided to or reviewed by the inspectors.

ATTACHMENT 2

FORT CALHOUN STATION GATE & BUTTERFLY VALVE DATA

Diagnostics: MOVATS TTC/DMT

VALVE NUMBER	VALVE SIZE & MANUFACTURER	TEST CONDITIONS psid	DYNAMIC VALVE FACTOR[1]	STEM FRICTION COEFFICIENT [2]	LOAD SENSITIVE BEHAVIOR[3]
Prototype of HCV-151	2.5" Crane 2500# Solid Wedge Gate	2518 (Close) 2690 (Open)	0.232 (Close) N/A (Open)	0.158 (at CST)	0.0
HCV-258	3" Crane 150# Solid Wedge Gate	N/A (Close) 114.0 (Open)	Not Determined	Not Determined	Not Determined
HCV-268	3" Velan 150# Flex Wedge Gate	N/A (Close) 120.0 (Open)	N/A (Close) 0.95 (Open)	0.086 (at CST)	-6.1%
HCV-348	12" Velan 1500# Flex Wedge Gate	161.0 (Close) N/A (Open)	Not Determined	Not Determined	Not Determined
HCV-383-3	24" Allis Chalmers 150# Butterfly	N/A (Close) 61.0 (Open)	N/A	N/A	N/A
HCV-1385	16" Crane 900# Flex Wedge Gate	613.0 (Close) N/A (Open)	Not Determined	Not Determined	Not Determined
HCV-1386	16" Crane 900# Flex Wedge Gate	589.0 (Close) N/A (Open)	0.55 (Close) N/A (Open)	0.28 (at CST)	13.6%
LCV-218-2	4" Velan 150# Flex Wedge Gate	13.0 (Close) N/A (Open)	Not Determined	0.11 (at CST)	3.5%
LCV-218-3	3" Crane 150# Solid Wedge Gate	N/A (Close) 99.0 (Open)	Not Determined	Not Determined	Not Determined

1. The dynamic valve factors listed were calculated by the licensee using a mean seat diameter in the safety direction only.
2. Grease used at the time of testing was Mobilux EP-1. SFC's calculated for the safety direction only.
3. A negative number indicates that the thrust observed at CST during the dynamic test was greater than the thrust observed at CST during the static test.