APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report Nos. 50-313/92-18
50-368/92-18

Operating License Nos. DPR-51
NPF-6

Licensee: Entergy Operations, Inc.
Route 3, Box 137G
Russellville, Arkansas 72801

Facility Name: Arkansas Nuclear One, Units 1 and 2 (ANO)

Inspection At: ANO, Russellville, Arkansas

Inspection Conducted: May 4-8, 1992

Inspectors: M. Runyan, Reactor Inspector, Plant Systems Section
Division of Reactor Safety

C. Paulk, Reactor Inspector, Plant Systems Section
Division of Reactor Safety

R. Vickrey, Reactor Inspector, Plant Systems Section
Division of Reactor Safety

M. Holbrook, EG&G, Idaho

Accompanying
Inspector: M. Franovich, Reactor Inspector, Apprentice Intern
Division of Reactor Safety

Approved: T. F. Westerman 5/24/92
T. F. Westerman, Chief, Plant Systems Section Date
Division of Reactor Safety

Inspection Summary

Inspection Conducted May 4-8, 1992 (Report 50-313/92-18; 50-368/92-18)

Areas Inspected: Special, announced inspection of the licensee's program for implementing commitments to Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance." Additionally, the inspectors evaluated the licensee's response to deficiencies identified in accordance with 10 CFR Part 21.

Results: The licensee had initiated a comprehensive program for verifying the capabilities of safety-related motor-operated valves (MOVs). This program generally met the licensee's commitments to GL 89-10. The program should be able to demonstrate satisfactory MOV capability under design basis conditions once weaknesses identified in this report are addressed. The inspection revealed that the licensee had made an effort to implement the program properly and had expended a large amount of resources in that effort. One issue requiring additional information was identified. The licensee committed to provide a response to the item listed below within 90 days of the date of this report:

Response Item - paragraph 3.3.2

Many MOVs appeared to be marginally sized, possessing less-than-desirable thrust windows between minimum required and maximum allowable values. These margins may be further reduced in light of several considerations identified in the report. The licensee is requested to identify all MOVs which can be categorized as marginal and reevaluate the capability of these MOVs using supportable assumptions which account for all known sources of inaccuracy. This evaluation should include the use of on-site test results to validate assumptions for valve factor, stem friction coefficient, and rate of loading. The licensee's submittal should include a description of any actions planned to correct or enhance the performance of the identified MOVs.

During the inspection, the licensee agreed to withdraw a plan to group MOVs for the purpose of reducing the number of dynamic diagnostic tests to be performed. The licensee stated that program documents would be revised to reflect the intention to test all MOVs at the maximum achievable dynamic conditions (paragraph 3.3.3).

Significant weaknesses were identified in the evaluation of post-test diagnostic data. Some of these reviews were not timely and the data was not evaluated to verify original design assumptions. Licensee actions were already in progress to address these problems (paragraph 3.3.3).

Strengths were noted in the identification of practicable-to-test MOVs and in the development of dynamic test conditions (paragraph 3.3.3).

Other areas of weakness and strength are identified in the report.

DETAILS

1. PERSONS CONTACTED

ENTERGY PERSONNEL - ANO

*S. Bennett, Licensing Specialist
*M. Cooper, Licensing Specialist
*W. Eaton, Director, Design Engineering
*R. Fenech, Plant Manager, Unit 2
*R. Gillespie, Manager, Central Support
*J. Haley, Licensing Specialist
*R. King, Supervisor, Licensing
*R. Lane, Design Engineer, Mechanical
*T. Ott, Design Engineer, Electrical I&C Section
*S. Pohl, MOV Engineer
*D. Provenchi, Quality Assurance Manager
*E. Rogers, Superintendent, Maintenance Engineering
*W. Rogers, Design Engineer, Mechanical Civil Section
*T. Rush, Design Engineer, Mechanical Civil Section
*R. Sessoms, Plant Manager, Central
*J. Vandergrift, Plant Manager, Unit 1
*A. Wrape, Design Engineer, Electrical I&C Section

ENTERGY PERSONNEL - WATERFORD

O. Bulich, Mechanical Specialties Engineering Supervisor

NRC PERSONNEL

*L. Smith, Senior Resident Inspector, ANO
*S. Campbell, Resident Inspector, ANO

*Indicates persons present at the May 8, 1992, exit interview.

The inspectors also contacted other licensee personnel during the inspection.

2. 10 CFR PART 21 REPORT FOLLOWUP (92701)

2.1 (Closed) Item (313/89-013): Potential Interference in AD-5500 Snubbers

On July 7, 1989, Anchor/Darling Industries, Inc. wrote a letter to the licensee to advise them that Anchor/Darling Industries had found a potential interference which might affect certain installations of AD-5500 mechanical snubbers. Specifically, snubber installation locations which utilize the AD-5500 snubber in conjunction with an AD-5505 structural attachment may encounter swing clearance problems between the structural attachment and fixed end paddle of the snubber, when pinned, and required to swing to the 90 degree position.

The licensee reviewed the installation configuration of the three AD-5500 snubbers installed at ANO and noticed that two of the three snubbers were connected to the pipe with an AD-5505 clevis, and were in fact installed in the 90 degree rotation position at the piping connection. However, this particular installation was not subject to the problems of the interference between the snubber body and the AD-5505 for two reasons. The first reason was that these snubbers were installed with the body of the snubber located at the end that was not rotated 90 degrees from the clevis. The second reason was that these two snubbers had extension kits installed. This effectively reduces the diameter of the snubber at the point where the interference occurs and allows the full 90 degree rotation no matter which end is located at the 90 degree rotated clevis.

Although the snubber connections at the pipe are turned 90 degrees from the clevis on two of the three AD-5500 snubbers, none of these snubbers are subject to the interference problem. The licensee's actions were timely and appropriate. This item is considered closed.

2.2 (Closed) Item (313/91-05): Defective Roll Pins Used in Torque Switches

On December 11, 1990, and April 4, 1991, Limitorque Corporation issued letters to the licensee to advise pursuant to 10 CFR Part 21 that torque switch roll pins used in the SMB, SB, and SBD 00 actuators with heavy spring packs were potentially defective. Several torque switch roll pins had failed when the actuator was declutched under maximum rated load. The licensee was requested to replace the defective parts with improved design torque switches.

The licensee reviewed its data base and found that 16 actuators were applicable to the Part 21 letter. New torque switches have been placed in the two applicable Unit 1 actuators. The remaining 14 Unit 2 actuators are scheduled for torque switch replacement during refueling outage 2R9 which will begin in September 1992. Replacement of torque switches in Unit 2 was delayed because the vendor did not make the new torque switches available on its original schedule.

Additional industry experience has shown that the defective rolls pins can fail even when medium spring packs are used. Accordingly, the licensee is planning to change torque switches on affected actuators using medium spring packs where the closed torque switch is set at 2 1/2 or higher. Training has been performed to alert operators to the dangers of the declutching operation.

The licensee's actions were timely and appropriate. This item is considered closed.

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

3.1 Background

On June 28, 1989, the NRC issued GL 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," which requested licensees and construction permit holders to establish a program to assure that they properly selected, set, and maintained switch settings for safety-related motor-operated valves (MOVs) and certain other MOVs in safety-related systems. The NRC held public workshops to discuss the GL and to answer questions about its implementation.

In GL 89-10, the NRC requested licensees to submit a response to the GL by December 28, 1989. On December 28, 1989, Arkansas Power and Light (AP&L), which operated ANO prior to turning this function over to Entergy Operations, submitted a response to GL 89-10. In that letter, AP&L addressed in detail its plans to implement the GL. In this letter and in a supplemental letter dated January 16, 1991, the licensee expressed reservations on meeting the recommendations of GL 89-10 with respect to full-flow differential pressure testing and on meeting the deadline for completing all valves once through the program (June 1994 or three refueling outages after June 28, 1989). The NRC replied to the two licensee letters on May 30, 1990, and February 12, 1991, respectively. The issues surrounding differential pressure testing and schedule are discussed in Sections 3.3.3 and 3.3.6 of this report, respectively.

On June 13, 1990, the NRC issued Supplement 1 to GL 89-10 to provide the results of the public workshops. In Supplement 2 to GL 89-10 (August 3, 1990), the NRC stated that inspections of programs developed in response to GL 89-10 would not begin until January 1, 1991.

Licensees raised concerns about the results of NRC-sponsored MOV tests. In response, the NRC issued Supplement 3 to GL 89-10 on October 25, 1990. The NRC requested boiling water reactor licensees to evaluate the capability of MOVs used for containment isolation in several systems. In Supplement 3, the NRC stated that all licensees and construction permit holders should consider the applicability of the information contained in the NRC-sponsored test reports to other MOVs within the scope of GL 89-10. The NRC also said that licensees should consider this information in the development of priorities for implementing the GL program.

3.2. Inspection Plan

The inspectors followed Temporary Instruction 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 inspectors focused on Part 1 of the temporary instruction (TI). Part 1 involved a review of the program the licensee established in response to GL 89-10. The inspectors addressed Part 2 of the TI only where necessary to assess the development of the licensee's GL 89-10 program.

3.3 GL 89-10 Areas

As required by Section 04.01 of the TI, the inspectors reviewed the licensee's commitments in response to GL 89-10. The letters defining the licensee's commitments are discussed in Section 3.1 of this report.

As required by Section 04.02 of the TI, the inspectors reviewed each aspect of GL 89-10. The inspection findings are described below.

3.3.1 Scope of the Generic Letter Program

The NRC staff position is that the scope of GL 89-10 includes all safety-related MOVs that are position-changeable in safety-related piping systems. Through Supplement 1 to the GL, 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 licensee's response to GL 89-10 committed to the scope of the program as recommended in GL 89-10.

The inspectors reviewed the licensee's program plan, "ANO MOV Program Plan," Revision 2, dated April 15, 1992, for determining scope and noted that the plan required valves which served a safety function and those which were "position-changeable" as defined in GL 89-10 to be included within the scope of their program. The licensee identified 124 MOVs in Unit 1 and 160 MOVs in Unit 2 to be included in their program for a total of 284 MOVs. The inspectors reviewed piping and instrumentation drawings for Unit 1 Emergency Feedwater (EFW) and Makeup & Purification systems and Unit 2 Service Water system as a sample of the scope of the licensee's program. The sample covered 37 Unit 1 valves and 44 Unit 2 valves. The inspectors did not find any discrepancies in the licensee's GL 89-10 scope. The MOVs which the licensee had excluded from their program were appropriately justified.

3.3.2 Design-Basis Reviews and MOV Switch Settings

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

The inspectors reviewed the following documents: "ANO Motor-Operated Valve Program," Revision 2, April 15, 1992, Arkansas Nuclear One; Engineering Standard MES-03, "Guidelines for Preparation of Maximum Expected Differential Pressure in Motor Operated Valves," Revision 0, dated April 21, 1992; and Arkansas Nuclear One Engineering Standard EES-12, "Motor-Operated Valve (MOV) Electrical Evaluation," Revision 2, dated April 30, 1992. The inspectors also reviewed MOV design basis calculations for CV-1000, CV-2802, CV-3807, 2CV-0340, and 2CV-4920.

The licensee's program included a review of the Safety Analysis Report (SAR), Technical Specifications, normal operating procedures, and emergency operating procedures as part of the identification of design-basis conditions. Consideration of valve mispositioning was included as part of this evaluation. The licensee's methodology used conservative assumptions including consideration of relief valve setpoints (such as use of the last safety setpoint for reactor pressure), tank levels, piping elevations, and system lineups that would direct the discharge of one pump to the suction of a second pump.

The licensee's program considered various parameters (such as differential pressure, fluid flow, temperature, and seismic considerations) and was consistent with the recommendations of GL 89-10 and its supplements. However, flow rate was not identified as part of the design-basis packages for CV-1000 and 2CV-0340. Question 16 of Supplement 1 of GL 89-10 stated that the effects of factors such as flow should be addressed analytically with the most conservative differential pressure to ensure that design-basis conditions were adequately accounted for by the testing program. Licensee personnel stated that a review of design-basis review packages would be conducted to ensure that other omissions have not occurred.

ANO had not evaluated the effects of high temperature on the output of the AC motors. The licensee intends to evaluate ongoing Limitorque research with respect to such temperature effects and to revise its determinations of available torque and thrust if necessary.

During review of Engineering Standard EES-12, the inspectors noted that Section 6.4.3, Item C., and Section 6.4.4, Item D., stated that "Cable resistance values at 90°C should be used for conservatism. For MOVs outside containment, a lower temperature may be used on a case-by-case basis." Calculation No. 92-E-009-01, "AC Motor Operated Valve Terminal Voltage," Revision 0, dated April 29, 1992, stated that cable resistance was based on 75°C outside containment. The licensee was advised to determine if their assumptions used in the AC calculations were consistent with the intent of the engineering standard. Further, an evaluation will be necessary to show that the assumed cable temperature would bound the worst-case conditions for all MOVs in the GL program.

The inspectors noted during discussions with licensee personnel that ANO did not routinely test thermal overloads that were not bypassed with an accident signal present. NRC Regulatory Guide 1.106, "Thermal Overload Protection for Electric Motors on Motor-Operated Valves," Revision 1, dated March 1977, Section C., stated that "In order to ensure continued functional reliability and the accuracy of the trip point, the thermal overload protection device should be periodically tested." The licensee was advised to review the requirements for testing of thermal overloads and incorporate the results of this review, where appropriate.

The licensee was conducting a seismic review that addressed the natural frequency of a given valve and calculated the stresses in the valve's critical components for the loads identified as part of the analysis. At the time of the inspection, this review was not complete. The licensee plans to complete this task and incorporate this review as part of their design-basis documents.

The inspectors reviewed various documents for the calculations of MOV sizing and switch settings. These documents included the ANO Motor-Operated Valve Program, Arkansas Nuclear One, Engineering Standard MES-01, "Guidelines for Preparing Motor Operated Valve (MOV) Setpoint Calculations," Revision 1, dated April 27, 1992, and thrust calculations for CV-2802, CV-3807, CV-3815, CV-1219, 2CV-4920, and 2CV-1531.

A standard industry equation was used for determining the required minimum thrust for gate and globe valves. The worst-case differential pressures identified in each MOV's design-basis calculation was applied in sizing and setting the MOVs for opening and closing capability. The licensee had begun to revise valve factors for flex wedge gate valves from a value of 0.30 to a more conservative value of 0.50. Valve factors for parallel disk gates valves were being changed from 0.20 to 0.40. A value of 1.10 was used for globe valves.

After review of the licensee's thrust equations, it was not clear if the disk area terms were based on orifice diameters or mean seat diameters. Licensee personnel indicated that orifice diameters were generally used. The inspectors indicated that if valve factors are back-calculated from measured test results, they may not be directly applicable to another valve if the seating surface of the second valve was unknowingly measured differently. The licensee needs to determine the basis of measurement for each MOV in the GL program so that apparent valve factors derived from design-basis test results are applied appropriately to other MOVs that cannot be tested.

ANO had recently changed the assumed value for stem friction coefficient from 0.20 to a less-conservative value of 0.15. The use of 0.15 for stem friction coefficient may not be valid unless specific maintenance, lubrication, and frequency requirements are carried out to ensure the continued high efficiency of torque to thrust conversion. Engineering Report 92R-0018-01, "ANO Motor-Operated Valve Program Position Paper, Stem Factor Variations," Revision 0, dated May 1, 1992, justified use of 0.15 stem friction coefficient based on improved stem lubrication and results of other industry testing. This paper indicated that the licensee would be measuring thrust and torque to validate its assumptions.

The licensee's engineering standard did not specify a method to account for MOV load sensitive behavior otherwise known as "rate of loading." MOV load sensitive behavior can reduce the thrust delivered by the motor operator under high differential pressure and flow conditions from the amount delivered under static conditions. Engineering Report 92-R-0019-01, "Accounting for Rate of Loading Effects in MOV Operation and Testing," Revision 0, dated April 30, 1992, stated the licensee's plan for addressing MOV load sensitive behavior.

The licensee intends to review dynamic test results from each unit's upcoming outage, and consider the results of Electric Power Research Institute's (EPRI) Performance Prediction Program Separate Effects Study that is scheduled for completion in early 1993. Test results would be used to identify the magnitude of MOV load sensitive behavior. Minimum required stem thrust would then be converted to torque by using a stem factor that incorporates a stem friction coefficient conservative enough to bound MOV load sensitive behavior. This would identify the lower allowable torque limit for the torque switch setting. While technically feasible, the inspectors were concerned that a thrust margin was not included to address MOV load sensitive behavior in the interim period while the licensee conducted its review. The licensee acknowledged that it must develop a method to ensure that the effects of MOV load sensitive behavior are addressed for all MOVs.

To determine the maximum allowable total thrust for a given actuator, the licensee would identify the lesser of the actuator thrust rating or the valve's design thrust limit. SMB-000 through SMB-1 Limitorque actuators were evaluated using the results of an industry study that would extend the total thrust ratings for these actuators to 162 percent of its nominal rating. Torque switch settings would be allowed as high as 140 percent of actuator thrust rating. This study is currently under review by the NRC staff. The staff will address the licensee's use of this study during future inspections.

Once thrust calculations were completed, the licensee evaluated the percent margin between the minimum required and the maximum allowable thrust (adjusted for diagnostic inaccuracies and torque switch repeatability). If the margin was less then 10 percent, the thrust calculations were revised until a 10 percent window was achieved. An "Acceptability Criteria" was used to provide guidance on how conservatism would be removed from the thrust calculations. The purpose of this process was to provide temporary setpoints until the next outage when MOV modifications could be accomplished. At the time of the inspection, 29 MOVs for Unit 1 and Unit 2, combined, had been identified as needing review under the licensee's Acceptability Criteria.

Acceptability Criteria assessments were reviewed by the inspectors for the following valves:

Unit 1:	CV-1234	CV-1414	CV-1415	CV-2221
	CV-2420	CV-2630	CV-2663	CV-2870
Unit 2:	2CV-1002	2CV-1026	2CV-1075	2CV-1076

Modifications to the original calculations for actuator output torque included changing the application factor from 0.9 to 1.0, and using run efficiency in place of pullout efficiency. Modifications to minimum required thrust calculations included reduction in the assumptions for packing load, removal of stem rejection (for the opening direction only), and reduction in the valve factor (no lower then 0.30). The inspectors were concerned that these reviews resulted in calculations with little, or no conservatism included. Further concerns were expressed due to the lack of margin for MOV load sensitive

behavior. The inspectors also identified several other marginal MOVs where the minimum required thrust calculations had not been revised to incorporate the licensee's more conservative valve factor assumption. These revisions may result in additional MOVs that will require review using the licensee's acceptability criteria. The licensee was requested to provide a complete list of MOVs requiring review under the acceptability criteria (using conservative assumptions for valve factor, stem friction coefficient, and load sensitive behavior) and the results of that review. In addition, the licensee had not completed a review of recent dynamic test results to validate all relevant design assumptions including justification for valve factors as low as 0.30, stem friction coefficient coefficients as low as 0.15, and which includes an appropriate margin for MOV load sensitive behavior. This issue was identified as a 90-day response item as indicated in the "Results" section of this report.

Unit 1 torque switches were generally bypassed in the opening direction for approximately the first 20 percent of the stroke. Unit 2 torque switches were bypassed approximately 50 percent of the open stroke. Most Unit 1 and Unit 2 torque switches remain in the circuit for the closing stroke except for Unit 2 MOVs that receive accident condition signals, in which case torque switches are bypassed for 95 percent of the closed stroke. The open limit switch was used to control termination of the open stroke for rising stem valves to prevent inadvertent backseating of the valve. Butterfly valves used limit switches to control operation in both directions.

Summary

The licensee had developed a rigorous methodology for predicting design basis conditions and MOV performance under those conditions. Some of the assumptions in these analyses were not fully supportable at the time of the inspection. The licensee was requested to review its more marginal valves applying estimates of design factors based on industry and site specific testing. This issue was identified as a 90-day response item.

3.3.3 Design Basis Differential Pressure and Flow Testing

In recommended action "c" of the GL, the NRC requested licensees to test MOVs within the GL program in situ under their design basis differential pressure and flow conditions. If testing in situ under those conditions was not practicable, the NRC would allow licensees to use alternate methods to demonstrate the capability of the MOV. The NRC suggested a two-stage approach for a situation where design basis testing in situ was not practicable and the licensee could not justify an alternate method of demonstrating MOV capability. With the two-stage approach, a licensee would collect test data at the highest achievable conditions within the schedule of the GL and evaluate the capability of the MOV using the best data available for design basis conditions.

The licensee had determined that 85 of the 124 MOVs included in the Unit 1 GL 89-10 program and 105 of the 160 MOVs in the Unit 2 GL 89-10 program were

"practicable" to test at flow and differential pressure (dynamic) conditions. The high percentage of valves judged "practicable" to test indicated that the licensee had made a good effort and had not been overly cautious in deciding whether MOVs could be tested dynamically. The inspectors selected at random 10 MOVs which were designated for static testing only and concluded that the licensee had a justifiable reason in each case for omitting dynamic testing.

The inspectors determined that the licensee had developed a testing plan which, if implemented, would deviate from the recommendations of GL 89-10. The GL and subsequent supplements state that all MOVs which are practicable to test under differential pressure conditions should be tested at the maximum achievable dynamic conditions. The licensee's program documents described a plan to group similar MOVs in an effort to reduce the number of dynamic tests to be performed. The licensee had tentatively scheduled 66 dynamic tests in total with the remaining 124 "practicable-to-test" MOVs being assigned to groups under one of the 66 tested MOVs. The 124 grouped MOVs were to be tested at static conditions only. The technical position of the NRC is that grouping MOVs testable at dynamic conditions must be fully justified by detailed evaluations of the MOVs and test results. Grouping is more likely possible for small globe valves or valves possessing very large margins but should not be used strictly for the convenience of reducing the program test scope.

The licensee's plan to group MOVs apparently resulted from a miscommunication in the official correspondence with the NRC. The inspectors reviewed the four letters in question (discussed in Section 3.1 of this report) and concluded that the licensee could have been led to the belief that the NRC had tacitly approved grouping of testable valves. This, however, was not the NRC's intent, as confirmed with the NRR Projects and Program offices during the inspection. To resolve the issue, the licensee agreed to revise its program documents to reflect the intention to test all MOVs at the maximum achievable dynamic conditions. The licensee also agreed to notify NRC if at a future time grouping of testable MOVs is again planned. At that time, the licensee would have an engineering basis for the grouping available on site for review. The inspectors considered this agreement to fully resolve the issue at this time.

During several previous MOV inspections, the NRC discovered that some licensees have set up dynamic tests using hydrostatic pressure or small hydrostatic pumps as the sole pressure source. As a result, on an opening stroke test the differential pressure dissipates as soon as the valve backs off the closed seat and very little flow is experienced. On a closing stroke, differential pressure develops only after almost all flow is restricted. From a review of test procedures, the inspectors concluded that these questionable testing techniques have not been employed at ANO. The licensee has typically conducted its differential pressure tests with the tested system in its normal operating state, i.e., with pumps running and valve positions configured to generate normal flow rates. This testing philosophy is consistent with the intent of the GL and should result in meaningful test results.

The inspectors identified weaknesses in the licensee's program with regard to post-test analysis of diagnostic results. Some of these post-test reviews have not been timely. This was best typified by MOV 2CV-0340 which was tested in April 1991, but not evaluated until January 1992. Additionally, the post-test reviews have not included an evaluation to confirm assumptions made in the original sizing and switch setting calculations. This setup is essential in developing confidence that the analytical techniques used to qualify statically-tested MOVs are valid. The licensee had previously identified these weaknesses. To avoid untimely reviews, the work document covering each MOV test was changed to require a review of test data for valve operability prior to the valve being declared operable. The inspectors reviewed a draft procedure that would provide this "first-phase" review for immediate operability and also a partial draft of a "second-phase" procedure to address the validation of design input assumptions. It appeared that once these procedures are fully developed and implemented, a timely and complete test review program will be in place. The subsequent reviews did not reveal any operability concerns.

Summary

The licensee had developed a plan to group MOVs to reduce the number of dynamic tests that otherwise could have been performed, but agreed to withdraw this plan and notify the NRC of any future plan to group MOVs. The classification of MOVs practicable to test under differential pressure conditions and the plant conditions established for the tests were both considered strong points in the program. Weaknesses identified in the post-test analysis of diagnostic data were in the process of being corrected by the licensee.

3.3.4 Periodic Verification of MOV Capability

In recommended action "d" of the GL, the NRC requested that licensees prepare or revise procedures to assure that the licensees determined and maintained adequate MOV switch settings throughout the life of the plant. In paragraph "j" of the GL, the NRC recommended that the licensees base the surveillance interval on the safety importance of the MOV as well as its maintenance and performance history. The interval should not exceed 5 years or three refueling outages. Further, the licensees will need to verify the capability of a MOV to operate under design basis conditions after replacement, modification, overhaul, or maintenance that would affect the thrust or torque output of the MOV.

The inspectors found that the licensee had scheduled periodic verification of MOV capability every third refueling outage, as recommended in GL 89-10. The inspectors noted, however, that the licensee was intending to perform static tests only for this verification. The licensee had not developed justification to show that such tests could confirm design basis capability. Such justification would be necessary because, to date, a reliable correlation between static and dynamic test results has not been demonstrated.

The inspectors noted that the licensee had developed guidelines for the performance of post-maintenance testing to assure MOV capability. These guidelines included the use of motor current to check the effects of valve packing adjustments on available stem thrust. The licensee could use such information to identify a major problem; however, the amount of force the motor transferred to the valve through the operator gears could not be reliably quantified. This was considered a weakness because small energy transfer losses would not be detected.

The licensee stated that each of these weaknesses would be reviewed for action as appropriate.

Summary

The inspectors identified weaknesses in the area of post-maintenance testing and in the intended use of static testing for periodic verification. The NRC will review the licensee's actions in response to these identified weaknesses during future inspections.

3.3.5 MOV Failures, Corrective Actions, and Trending

In recommended action"h" of the GL, the NRC requested that licensees analyze or justify each MOV failure and each corrective action. The documentation should include the results and history of each as-found deteriorated condition, malfunction, test, inspection, analysis, repair, or alteration. The licensee should keep all documentation and make reports according to plant requirements. The NRC also suggested that the licensees review the material (every 2 years or after each refueling outage after program implementation) as part of the monitoring and feedback effort to identify trends of MOV operating characteristics. Trends could provide the basis for a licensee revision of the testing frequency established to assure adequate MOV capability. The GL stated that a well-structured and component-oriented system would be necessary to track, capture, and share equipment history data.

The inspectors reviewed Procedure 1025.011, "Motor Operated Valve (MOV) Maintenance Program," Revision 3; Procedure 1025.004, "Maintenance Trending Program," Revision 4; Procedure 1045.001, "Equipment Failure Trending Program," Revision 2; and, Station Directive No. A4.604, "Trending Program," Revision 1. The inspectors concluded that these procedures provided guidance that, if followed, would result in a trending program meeting the recommendations of the GL. Because the licensee has not fully implemented its GL 89-10 MOV program, the NRC will review the implementation of the tracking and trending program during a future inspection.

The insoectors also reviewed the licensee's corrective and preventive maintenance Procedures 1403.038, "Unit 1 and Unit 2 MOV Testing and Maintenance of Limitorque SMB-000 Actuation," Revision 7; 1403.039, "Unit 1 and Unit 2 MOV Testing and Maintenance of Limitorque SMB-00 Actuators," Revision 7; and 1403.040, "Unit 1 and Unit 2 MOV Testing and Maintenance of Limitorque SMB-0 through 4 Actuators," Revision 6. These procedures were

considered to control maintenance activities on MOVs. The inspectors observed that the licensee was performing lubrication of the stems on MOVs located in harsh environments every 18 months. For those MOVs not located in a harsh environment, the stems were lubricated every 36 months. The licensee informed the inspectors that the 36 month periodicity for lubricating the stems was not compatible with the planned periodic verification of MOV capability. The licensee stated that a review was underway to determine the effects of performing the stem lubrication every 18 months. The NRC will evaluate the licensee's justification for valve stem factors based on the chosen periodicity during a future inspection.

During the inspectors' review of the preventive maintenance (PM) program, the licensee disclosed that valve stem lubricant trending is not currently being performed at ANO. This is due to the PM procedures which permit PM personnel to lubricate valve stems, if needed, without generating a job request. The licensee is evaluating options to incorporate trending of stem lubricant conditions into the ANO MOV program.

The licensee plans to use job requests and changes in torque switch settings as benchmarks for evaluating spring pack relaxation. The licensee has performed specific spring pack curves for each valve overhauled in the ANO GL 89-10 program. The licensee's use of specific spring pack curves was noted as a strength.

The inspectors reviewed the licensee's PM procedures. Specifically, Procedure 1412.001, Revision 4, "Preventive Maintenance of Limitorque Motor Operated Valves" and Procedure 1412.083, Revision 3, "Rotork Valves and Valvops Inspection and Lubrication" were examined. Also, Procedure 1403.039, Revision 7, "Unit 1 & Unit 2 MOV Testing and Maintenance of Limitorque SMB 00 Actuators" was reviewed with respect to actuator lubrication. Procedure 1412.001 appeared to be well developed and comprehensive for cleaning, inspecting, and lubricating Limitorque actuators. The procedure required the approval (signature controlled) by the MOV engineer prior to performing the PM to assure all as-found diagnostic testing had been completed on the actuator being serviced. The environmentally qualified Nebula EPO-0 grease was specified in the procedure for use in the main gear box and the valve stem. Appropriate steps for protecting gaskets, seals, and O-rings from damage during grease injection by allowing for venting was also provided. For the limit switch assembly, the licensee used Beacon 325 grease and Mobil 28 grease. The procedure contains a precautionary note to prevent inadvertent mixing of different greases since such mixtures deleteriously affect grease integrity. When refurbishment is required, only Mobil 28 grease is used, replacing the Beacon 235 grease, if present. The licensee stated that the concerns over grease mixing were also within the skill of the MOV craft.

Procedure 1412.083 and portions of Procedure 1403.39 reviewed also appeared to appropriately address lubrication. Similar control steps were provided for as-found testing and lubrication. The Rotork PM procedure specified use of Exxon-Spartan EP-150 oil which is environmentally qualified for nuclear service.

No deficiencies were identified during the review of the licensee's PM and maintenance procedures.

The inspectors reviewed the licensee's corrective action process with respect to Condition Report (CR)-1-92-0173. CR-1-92-0173 was initiated during the licensee's 1R10 refueling outage to address an incorrect spring pack installed in Unit 1 emergency feedwater (EFW) Suction Valve CV-2800. CV-2800's safety function is to close and transfer EFW pump suction from the condensate storage tank to the service water system (SWS).

On March 5, 1992, the licensee performed an as-found VOTES test of the MOV which the licensee suspected had indication of hydraulic lock. CR-1920173 stated that the spring pack was removed, cleaned first, and then tested with a hydraulic spring pack tester to obtain a specific spring pack curve for torqu capability.

Based on a review of the generic and specific spring pack curves, the licensee determined that a Limitorque Part 0301-109 spring pack was installed in the actuator (Limitorque SMB-00). Per design change package (DCP) 86D-1128, a 0301-111 spring pack should have been installed in CV-2800. The licensee replaced the incorrect spring pack in CV-2800 with a 0301-111 spring pack; however, further VOTES testing of the actuator still indicated a high torque/low thrust condition. The licensee overhauled the actuator and determined the root cause was a worn stem nut and inadequate stem lubrication. Hydraulic lock was not indicated as the root cause since a high torque/low thrust condition was recorded during testing. This determination supports the need for periodic refurbishment.

During the inspection, the licensee was in the process of investigating the root cause for installing an incorrectly sized spring pack. The licensee attributed the root cause to a loss of design control in the previous MOV program. After discussions with the licensee, the inspectors considered this condition to be not indicative of the licensee's current MOV program. The licensee was not aware of any other instances of improper spring packs. Sister Valve CV-2802 was verified to have the proper spring pack installed. The licensee's present program for valve refurbishment and testing will verify that proper spring packs are installed. Sufficient measures appeared to be structured in the licensee's GL 89-10 program to safeguard against repetition of this problem.

The inspectors evaluated the licensee's methodology for determining past operability of CV-2800 and considered the process a weakness. Based on a review of maintenance records, the licensee determined that CV-2800 was operable for the time period between 1986 and 1992. Therefore, the licensee concluded the condition was not reportable. However, the licensee did not compare as-found test data in 1992 with as-left test data from 1986, after implementation of DCP-86D-1128, to justify past operability. A cursory review of maintenance records absent an evaluation of available diagnostic test data was considered a weakness. Without a proper evaluation of this condition, the potential existed for misdiagnosing valve operability and inaccurately

determining the reportability of the condition. It should be noted that the supporting calculation in the condition report only supported valve operability with the correct replacement spring pack (0301-111) installed and not the as-found condition with the incorrect spring pack (0301-109) installed.

The inspectors requested the licensee to perform an evaluation of the available diagnostic test data to determine past operability. After accounting for inaccuracies in diagnostic test equipment, the licensee concluded the valve would have performed its safety function even with the incorrect spring pack installed based on the acceptance criteria (thrust window) for the time period involved. The inspectors found the licensee's response acceptable.

Finally, the inspectors were concerned that the as-found spring pack testing process may introduce errors in the measurement of torque capability. The inspectors questioned maintenance engineering personnel on the testing process which could allow a spring pack to be cleaned prior to testing as apparently indicated in CR-1-92-0173. This appeared to defeat the intent of ANO Procedure 1403.039, Revision 7, which called for testing prior to cleaning of the spring pack. The licensee stated that spring packs removed from actuators located inside the radiation controlled area (RCA) were decontaminated prior to removing them outside the area. Removal of spring packs from the RCA was necessary for testing since the hydraulic spring pack tester was located outside the RCA. To alleviate this concern, the licensee stated that maintenance engineering currently intends to place test equipment within the RCA for future testing. The inspectors found this response acceptable.

3.3.6 Schedule

In GL 89-10, the NRC requested that licensees complete all design-basis reviews, analyses, verifications, tests, and inspections that they initiated to satisfy the GL recommended actions by June 2, 1994, or three refueling outages after December 28, 1989, whichever was later.

The licensee had developed a milestone schedule which showed that the capability of all GL 89-10 MOVs would be completely assessed by the June 1994 deadline date of the GL. This schedule, however, was contingent on the licensee's plan to group MOVs and thereby reduce the number of dynamic tests from 190 to 66. As discussed in Section 3.3.3 of this report, the licensee agreed to abandon this plan at the present time. The potential change in test scope may have an effect on the scheduled completion date. The inspectors advised the licensee to keep the NRC informed of any schedule changes in a timely manner and to have a justification onsite for any such change.

3.4 Other MOV Areas Address

Section 04.03 of the TI lists certain aspects of the licensee's overall program that the inspectors should review, as appropriate. Those aspects reviewed are discussed below:

3.4.1 MOV Setpoint Control

The licensee used diagnostic equipment to determine the appropriate thrust settings for its MOVs. The procedures used to perform diagnostic testing contained steps to record "as found" and "as left" torque switch settings.

Engineering Report 91-R-1010-15, "ANO One Setpoints Report," Revision 1, dated April 30, 1992 and Engineering Report 91-R-2019-10, "ANO Two Setpoints Report," Revision 0, dated April 30, 1992 were used to provide setpoint limits that incorporated VOTES diagnostic equipment inaccuracies and allowance for torque switch repeatability. If the minimum required thrust was > 4400 lbf, the combined allowance for inaccuracies and torque switch repeatability [identified by the licensee as setting limit factor (SLF)] was determined to be 10.5%. If the minimum required thrust was $\leq$ 4400 lbf, the SLF was determined to be 13.6%. The combined inaccuracy for torque measurements was 6% (for > 50 ft-lb) and 10.4% (for $\leq$ 50 ft-lb).

The results of these adjustments were documented on Setpoint Report Sheets that were provided to maintenance for use during diagnostic testing. These sheets identified the engineering design limits, the adjusted setpoints for use with VOTES, and the adjusted setpoints for use with MOVATS.

3.4.2 Training

The inspectors discussed the licensee's training program with licensee personnel, reviewed training lesson plans and records, and toured the training facility. MOV training consisted of a recently developed (over the last 6 months) series of four on-the-job training (OJT) Qualification Cards for ANO electricians, support craft, and modifications group training. The four areas of qualification were Limitorque Actuator, Rotork Actuator, MOV Diagnostic Testing Using MOVATS, and MOV Diagnostic Testing Using VOTES. The qualification process consisted of both classroom and hands-on training in the laboratory followed by a written examination and a practical examination. The enabling objectives are conducted under supervision of a qualified OJT instructor.

The licensee's control of vendors/contractors who perform maintenance and/or testing on motor operated valve actuators required that documentation be provided which clearly defined the qualification of the vendor/contractor. These qualifications were reviewed by the contracts coordinator to determine if the qualifications were acceptable. In addition, vendors/contractors who were expected to perform a task which required the use of a procedure were given procedure training related to that task. The inspectors reviewed the licensee's records related to evaluating the training and experience of the contract personnel provided by the MOV service group for use during 1R10. The inspectors found the contractor qualification reviews and subsequent training to be appropriately documented.

3.4.3 Industry Experience and Vendor Information

To assess performance in this area, the inspectors reviewed the licensee's response to a 10 CFR Part 21 report and maintenance update report both submitted by the Limitorque Corporation. The results of the Part 21 review are documented in Section 2.2 of this report. For unknown reasons, Limitorque Maintenance Update 90-1, addressing hydraulic lock and spring pack relaxation, was never formally received on site. However, individual engineers had received copies of it at various industry meetings. The inspectors found that the licensee had addressed the subject issues appropriately. No concerns were identified in this area.

3.4.4 Use of Diagnostics

The inspectors found that the licensee was using the Liberty Technology VOTES system as a diagnostic tool. Prior to 1990, the licensee used the ITI MOVATS system. The licensee plans to conduct a review of current torque switch settings that were set using MOVATS, according to the guidance recently provided by MOVATS regarding the OPEN versus CLOSED issue. Licensee personnel said that they would follow the guidance provided by the Nuclear Management and Resources Council (NUMARC), when available. In the limited cases where MOVATS may still be used, the licensee will be expected to review the results of the MOV Users Group (MUG) diagnostic accuracy testing, and incorporate those results in their program, as applicable. The licensee stated that if any operability concerns were identified, they would be reported in accordance with its guidelines.

The inspectors found that the licensee took as-found data for each MOV and then refurbished the actuator prior to taking baseline data. The inspectors considered this to be a strength in the MOV program.

Flow was not recorded as part of the system conditions during dynamic testing. Licensee personnel later provided a new data sheet that indicated that flow will be recorded as part of the test conditions. The licensee will be expected to reevaluate any testing where flow rate was not recorded and determine if the test conditions were an acceptable representation of design basis conditions.

3.5 Walkdown

The inspectors conducted a walkdown of four MOVs. 2CV-4920 and CV-3807 were viewed with the limit switch compartment covers removed. Comments specific to each examined MOV are discussed below:

> 2CV-4920 - Liquified lubricant was observed dripping from the clutch housing and the limit switch compartment. A portion of a field installed wire in the limit switch compartment was lying bare (no insulation) against the melamine foundation. High angles were observed on lugged connections. Lubrication was good on the upper part of the stem but had some buildup on the lower portion.

2CV-4921 - An excessive amount of lubricant was observed on the stem

CV-3806 - An uneven distribution of lubricant was observed on the stem

CV-3807 - No lubricant was evident on the lower portion of the stem

None of the observed conditions were considered to affect the operability of the MOVs. However, the stem lubrication conditions were consistently marginal and suggested that the assumed stem friction coefficient values used in the switch setting calculations may not be conservative. The licensee had previously identified a problem in lubrication techniques and had issued CR 92-038. The disposition of this CR should sufficiently address the inspectors' concern in this area.

General housekeeping was observed to be excellent, especially in the diesel generator rooms.

4. EXIT INTERVIEW

The inspectors held an exit meeting with those persons indicated in paragraph 1 on May 8, 1992. The inspectors summarized the scope and findings of the inspection. The licensee stated that some of the information provided during this inspection was proprietary. The inspectors stated that none of the proprietary information would appear in the report.