

ENCLOSURE

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket Nos.: 50-313
50-368

License Nos.: DPR-51
NPF-6

Report No.: 50-313/96-23
50-368/96-23

Licensee: Entergy Operations, Inc.

Facility: Arkansas Nuclear One, Units 1 and 2

Location: Junction of Hwy. 64W and Hwy.333 South
Russellville, Arkansas

Dates: September 16-20 and September 30 through October 4, 1996

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Attachment: Partial List of Persons Contacted
List of Inspection Procedures Used
List of Items Opened, Closed, and Discussed

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EXECUTIVE SUMMARY

Arkansas Nuclear One, Units 1 and 2 NRC Inspection Report 50-313/96-23; 50-368/96-23

This inspection evaluated the licensee's motor-operated valve program for closure under Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," and actions taken in response to previous inspection findings.

Engineering

- The licensee properly developed valve groups and, after several revisions addressing NRC concerns, assigned adequately justified valve factors to each group. Through the application of these valve factors and other assumptions and test data, the licensee acceptably established the design basis capability of each Generic Letter 89-10 motor-operated valve (Section E1.1).
- In response to the inspectors' concerns, the licensee agreed to retain an untested valve's group valve factor and a two-standard deviation random rate of loading margin as operability criteria (Section E1.1).
- Approximately 10 percent of the licensee's Generic Letter 89-10 valves were marginal, meaning that thrust or torque margins in the open or close direction, or both, were less than or near 10 percent. The licensee made tentative plans to modify most of these valves during the next several refueling outages to establish larger margins (Section E1.1).
- An unresolved item was identified for possible noncompliance with 10 CFR 50, Appendix R, as the licensee did not perform analyses or modifications to ensure that Units 1 and 2 could successfully recover from accidental repositioning of motor-operated valves caused by multiple hot shorts during a control room fire. The licensee had assumed that only one hot short needed to be postulated during such an event (Section E1.2).
- The licensee intended to review its maintenance procedures for potential enhancements to more positively control internal valve characteristics (E1.5).
- The licensee's program to trend motor-operated valve performance was weak in scope and application, but adequate for program closure. The licensee intended to review the program for possible enhancements (E1.6).
- The licensee's utilization of quality assurance resources to provide oversight of the Generic Letter 89-10 program was identified as a strength (Section E7).

Report Details

Summary of Plant Status

Unit 1 was in a refueling outage and Unit 2 was operated at 100 power during the inspection.

III. Engineering

E1 Conduct of Engineering

E1.1 Motor Operated Valve Design Capability (TI2515/109)

a. Inspection Scope

On June 28, 1989, the NRC issued Generic Letter 89-10, which requested licensees and construction permit holders to establish a program to ensure that switch settings for safety-related motor-operated valves were selected, set, and maintained properly. Subsequently, seven supplements to the generic letter were issued.

NRC inspections of licensee actions implementing commitments to Generic Letter 89-10 and its supplements have been conducted based on guidance provided in Temporary Instruction 2515/109, "Inspection Requirements for Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance," Revision 2. Temporary Instruction 2515/109 was originally divided into two parts: Part 1, "Program Review"; and, Part 2, "Verification of Program Implementation." The Part 1 program review inspection at Arkansas Nuclear One was documented in NRC Inspection Report 50-313,368/92-18. The Part 2 implementation review inspection at Arkansas Nuclear One was documented in NRC Inspection Report 50-313,368/93-13. In addition, other inspections addressing elements of the licensee's motor-operated valve program were conducted during this period.

The purpose of this inspection was to verify that the licensee had completed its commitments to develop and implement a safety-related motor-operated valve program as described in Generic Letter 89-10. In Revision 2 to Temporary Instruction 2515/109, Part 3, "Program Closure," was added. The guidance contained in Part 3 of TI 2515/109 was used during this inspection.

The process of "closing" a Generic Letter 89-10 program includes verification that the licensee has satisfactorily applied the principles contained in Generic Letter 89-10 (or suitable alternate methods) to demonstrate the design basis capability of each motor-operated valve in the program. The closure process does not preclude additional inspections in this area. Additionally, there remains an expectation that the assumptions and methodologies used to develop the Generic Letter 89-10 program will be maintained for the life of the plant. This concept is commonly referred to as a "living program."

The closure process does not convey final NRC acceptance of a licensee's approach to the areas of periodic verification or pressure locking and thermal binding. These areas will be reviewed by the NRC under separate generic letters and were assessed during this inspection on an interim basis for closure under Generic Letter 89-10.

The inspectors reviewed various plant documents and held discussions with the motor-operated valve engineers to determine whether the licensee had acceptably demonstrated the design basis capability of each Generic Letter 89-10 valve. The expectation was that at this stage of the licensee's Generic Letter 89-10 program (following the licensee's notification to the NRC that activities pursuant to Generic Letter 89-10 had been completed), each motor-operated valve in the program would be qualified on the basis of in-situ design basis testing or by comparison to well-justified, test-based design information.

The inspectors focused on several design parameters used to predict the operating capability of motor-operated valves, specifically: (1) valve factor, which correlates differential pressure to stem thrust requirement; (2) stem friction coefficient, which affects the conversion of actuator output torque to valve stem thrust; and (3) rate-of-loading (a.k.a., load sensitive behavior), which reflects the change (usually a loss) in deliverable stem thrust under dynamic closing conditions as compared to the available closing static thrust.

b. Observations and Findings

Scope of Program

The licensee's Generic Letter 89-10 program included 117 motor-operated valves in Unit 1 and 133 motor-operated valves in Unit 2. Unit 1 included 73 gate valves (Anchor Darling, Borg Warner, Velan, Westinghouse, Crane Alloyco, Velan, and Vogt), 26 globe valves (Anchor Darling, Crane Alloyco, Velan, Control Comp, Hammel Dahl, and Shutte-Koertin), 15 butterfly valves (CLOW C&S, Fisher, and Henry Pratt), and two plug three-way valves (Tuflin). Unit 2 included 85 gate valves (Anchor Darling, Borg Warner, Crane Alloyco, William Powell, and Anchor Darling), 21 globe valves (Anchor Darling, Copes Vulcan, and Borg Warner), and 27 butterfly valves (CLOW C&S, Contromatics, and Fisher).

Valve Grouping and Valve Factors

The inspectors reviewed Report 94-R-0011-01, "ANO MOV Program Design Criteria Valve Factor Report," Revision 4. The purpose of this report was to document the selection of valve factors for gate and globe valve groups in the licensee's Generic Letter 89-10 program. The inspectors noted that the number of valves in the program, the diversity of manufacturers, and the difference in design between the two units (Unit 1- Babcock and Wilcox, Unit 2- Combustion Engineering) provided special challenges to the licensee to determine valve factors for valves that were not practicable to test under differential pressure conditions (untested valves).

The licensee established 53 groups of gate and globe valves and assigned a valve factor for each group based on in situ testing, Electric Power Research Institute (EPRI) testing, or test results obtained from other nuclear facilities. Each group contained valves from only one manufacturer and, with only a few exceptions, the same pressure class and valve type. Valve sizes within the groups were either identical or within a narrow band. The inspectors concluded that the licensee had properly justified the valve groupings and that they were consistent with the guidance provided in Supplement 6 to Generic Letter 89-10.

The licensee applied the group valve factor to each valve within the group even if individual valves within the group exhibited a lower valve factor during testing. However, in some cases, actual test valve factors were used to determine the capability of valves not adequately sized or set to accommodate the group valve factor.

The inspectors identified several valve groups for which the documentation provided in Report 94-R-0011-01 did not sufficiently justify the assigned group valve factor. Some group valve factors appeared inconsistent with test information provided by EPRI or other nuclear facilities. The inspectors requested the licensee to reconsider and provide additional justification for the valve factors assigned to the following groups:

- 2g- 4 Anchor Darling flex wedge gate valves 10-inch, 600 pound class, assigned a 0.55 valve factor
- 4b- 1 Borg-Warner flex wedge gate valve, 3-inch, 900 pound class, assigned a 0.6 valve factor
- 4d- 6 Borg-Warner flex wedge gate valves, 4-inch, 1500 pound class, assigned a 0.6 valve factor
- 4f- 2 Borg-Warner flex wedge gate valves, 24-inch, 900 pound class, assigned a 0.6 valve factor
- 8c- 2 Crane Alloyco gate valves, 12 and 14-inch, 300 pound class, assigned a 0.6 valve factor
- 8d- 4 Crane Alloyco solid wedge gate valves, 14-inch, 150 pound pressure class, assigned a 0.6 valve factor
- 8e- 6 Crane Alloyco flex wedge gate valves, 20 and 24-inch, 150 pound class, assigned a 0.6 valve factor

In each case above, the licensee's valve factor did not appear to completely bound EPRI or industry test information of similar valves. Since EPRI tested only a few comparable valves, the variability in performance between the EPRI test valves and the Arkansas Nuclear One valves was also of concern to the inspectors.

The inspectors noted that the licensee had taken credit for certain general patterns of industry test results to provide additional confidence in their valve factor selections. This included the following observations: larger valves typically display lower valve factors than smaller valves, valves tend to have lower valve factors when operating in hot water than in cold water, valves that are infrequently stroked may have lower valve factors than frequently stroked valves because of a preconditioning effect caused by stroke related degradation of guide and seating surfaces, and stainless steel guides generally have improved frictional performance over carbon steel. The licensee used these observed tendencies to provide additional confidence in their selection of group valve factors. Although generally agreeing with these trends, the inspectors indicated that the licensee could not rely on these observations without the confirmation of plant-specific data.

During the inspection, in response to the inspectors' concerns, the licensee revised its valve factor assignments for groups 8c, 8d, and 8e. During a conference call conducted on October 9, 1996, the licensee informed the NRC of additional changes to valve factors assigned to groups 2g, 4b, 4d, and 4f. The original and revised group valve factors were as follows:

- 2g- originally 0.55, changed to 0.58
- 4b- originally 0.60, changed to 0.63
- 4d- originally 0.60, changed to 0.63
- 4f- originally 0.60, changed to 0.63
- 8c- originally 0.60, changed to 0.65
- 8d- originally 0.60, changed to 0.65
- 8e- originally 0.60, changed to 0.65

At the inspectors' request, the licensee provided additional justification for valve factors assigned to certain other groups. At the conclusion of this process, the inspectors determined that the licensee had adequately justified the valve factors assigned to every valve group in the program.

Valve Opening Capability

To evaluate opening capability, the licensee generally used the assigned group valve factor, and applied standard calculations of motor actuator capability. In some cases, the licensee used direction-specific test information to define a specific open valve factor for a group. In all cases, the inspectors found the assigned open valve factors to be adequately justified. The inspectors reviewed open capability margins and concluded that the licensee had satisfactorily demonstrated the opening capability of the Generic Letter 89-10 valves.

The licensee evaluated unseating loads against limits but did not extrapolate static unseating loads to dynamic conditions. NRC Information Notice 96-48 addressed the tendency for unseating loads to increase with increasing differential pressure. The licensee was in the process of reviewing this information. The inspectors reviewed the unseating test data for the entire population of Generic Letter 89-10 valves and concluded that immediate margins for differential pressure effects were

not warranted, but noted that the licensee was still in the process of reviewing this element of the information notice and that additional data may become available in association with the licensee's periodic verification program.

Butterfly Valves

The inspectors reviewed test data and analyses of the licensee's Generic Letter 89-10 butterfly valve population. The licensee performed dynamic testing for most of butterfly valves in the program and extrapolated torque measurements to design basis conditions. The licensee assigned required torque levels to various groups of butterfly valves by considering Arkansas Nuclear One test information, the manufacturer's torque equations, and the location of upstream flow disturbances. The inspectors reviewed this information and concluded that the licensee had acceptably demonstrated the design basis capability of the Generic Letter 89-10 butterfly valves.

Stem Coefficient of Friction

The licensee generally applied a 0.20 stem coefficient of friction in its calculation of maximum permissible actuator torque. For certain marginal valves, the licensee used a coefficient of friction that was intermediate between 0.20 and the coefficient measured during the static test. The inspectors reviewed a tabulation of test results and observed that a 0.20 stem coefficient of friction was bounding for most valves. In a small number of cases where stem friction exceeded 0.20, the licensee used actual test results. The inspectors considered the licensee's approach to be acceptable.

Rate of Loading

The rate of loading margin is applied to account for the usual loss in torque switch trip thrust under dynamic conditions as compared to static conditions. It is significant for valves that can be tested only under static conditions but which must operate under dynamic conditions to perform a safety-related function. For gate valves, the licensee applied a biased margin of 1.84 percent and a random margin of 16.8 percent. For globe valves, the licensee applied a biased margin of 8.47 percent and a random margin of 28.04 percent. The biased margin was the average of all relevant test data and the random margin was equal to two standard deviations based on an assumed normal distribution.

Other Margins

The licensee applied a 5 percent margin for stem lubrication degradation but eliminated this margin for certain marginal valves by establishing an enhanced lubrication schedule. For torque switch repeatability, the licensee performed on site testing to establish a 5 percent margin for all motor-operated valves in lieu of the Limitorque margins that range from 5 to 20 percent. Limitorque had endorsed the licensee's methodology of determining the torque switch repeatability of its valves.

The licensee applied a margin of approximately 3 percent to account for springpack relaxation, but this margin was only applied to valves with new springpacks and that met other criteria. The inspectors considered these margin applications to be acceptable.

Operability Criteria

In response to a self assessment, the licensee changed several design assumptions related to motor-operated valves. As a result, the calculations of some motor operated valves revealed inadequate capability to perform as designed. The licensee issued Condition Reports CR-1-96-0300 and CR-2-96-0229 to evaluate the operability of 17 Unit 1 and 21 Unit 2 valves, respectively, that either indicated inadequate capability based on the new assumptions or had a very small operating margin. The licensee determined that all of the 38 valves were operable, but considered many of them to be marginal and subjects for future margin enhancement.

The inspectors reviewed Condition Report CR-1-96-0300 and CR-2-96-0229 and concluded that the licensee had adequately established the operability of the subject valves.

The inspectors were interested in the operability assessments because they revealed the extent to which the licensee would deviate from Generic Letter 89-10 information in the evaluation of operability. This threshold level for operability is important in establishing the credibility the licensee assigns the Generic Letter 89-10 program in predicting the actual performance capability of motor-operated valves. Understanding the operability criteria is important for program closure because of future Technical Specification ramifications related to motor-operated valve failures or degraded conditions. Within the operability determinations for the 38 marginal valves, the licensee established the following operability criteria (one or more may have been used for any given valve):

- (1) Stem lubrication degradation, normally five percent, was reduced to zero, with increased lubrication inspection.
- (2) Valve factors were reduced from a bounding to a nominal or tested value.
- (3) The biased portion of the rate of loading was reduced from two to one standard deviation, which the licensee explained was justified by considering that the diagnostic system error was incorporated in the test results and caused additional data scatter.
- (4) The maximum expected differential pressure (MEDP) was lowered by removing conservatisms in the original evaluation.
- (5) The stem friction coefficient was lowered from 0.20 to a value intermediate between 0.20 and a recent test value for the subject valve.

- (6) The valve was classified as having only a passive function to stroke in the marginal direction, meaning that the function was not safety related.
- (7) Allowable thrust and torque limits were changed by removing conservatism in the original calculations.
- (8) Undervoltage levels were increased based on a reevaluation of the original analysis including consideration of the length of time following the event before the valve would have to be operated.
- (9) Actual dynamic test results were used to determine thrust and torque requirements and maximum expected differential pressure because the test accurately simulated the accident condition (minus undervoltage).

The inspectors challenged methods 2 and 3 above. The valve factor assigned to a group of untested valves should be considered equivalent to a tested valve factor for the purposes of operability. The application of a single standard deviation for rate of loading does not provide sufficient assurance that the rate of loading has been bounded for an untested valve. The licensee agreed to change its operability methodology by removing methods 2 and 3. The licensee documented its revised operability criteria in draft Topical Report TP-14, "Operability Analyses." The inspectors considered the operability criteria, as revised, to be acceptable.

Valve Margins

Although the licensee satisfactorily established the current operability of each motor-operated valve in the Generic Letter 89-10 program, the inspectors noted that many valves had opening or closing margins that were less than 10 percent. The proportion of marginal motor-operated valves was approximately 10 percent of the total Generic Letter 89-10 population. The licensee intended to address this concern by performing additional modifications to increase margins for these valves. In the interim, the licensee will be expected to place additional emphasis within the periodic verification program to ensure that these valve do not degrade into a state of inoperability.

c. Conclusions

The licensee established valve groups consistent with the guidance in Generic Letter 89-10, Supplement 6. The final revision of the program assigned suitably-justified valve factors to each valve group. The licensee satisfactorily demonstrated the design-basis capability of each valve in the Generic Letter 89-10 program. To address a large number of marginal motor-operated valves, the licensee intended to perform additional modifications.

E1.2 Mispositioning (TI 2515/109)

a. Inspection Scope

Supplement 7 to Generic Letter 89-10 deleted the original recommendation to assure that motor-operated valves in pressurized water reactors can recover from inadvertent mispositioning resulting from operator error. The inspectors reviewed the licensee's consideration of inadvertent motor-operated valve repositioning due to faults postulated to occur during a fire in the control room.

b. Observations and Findings

The inspectors reviewed the licensee's actions related to a potential design deficiency identified in Information Notice 92-18, "Potential for Loss of Remote Shutdown Capability During a Control Room Fire." Information Notice 92-18 addressed a concern for spurious uncontrolled operation of motor-operated valves caused by hot shorts occurring in control cables during a control room fire. Information Notice 92-18 identified wiring changes in the valve actuator control circuit that would prevent damage from hot-short operation, allowing subsequent valve repositioning if required. The licensee had not performed wiring modifications to preclude motor-operated valve damage resulting from hot-short operation.

The licensee considered that the redundancy in its alternate shutdown capability was adequate to satisfy the requirements of 10CFR50 Appendix R. The licensee considered hot-short maloperation to be a low probability design basis condition which was postulated to affect only one motor-operated valve and, therefore, at most only one train of any system required for safe shutdown. The licensee considered that its assumptions were consistent with the guidance of Generic Letter 86-10, "Implementation of Fire Protection Requirements." The licensee considered that multiple spurious hot-short failures of the type described in Information Notice 92-18 were beyond the design basis required for its alternate shutdown capability in satisfying Appendix R.

The inspectors were concerned that the licensee had not considered the possibility that more than one motor-operated valve may experience a hot short maloperation during a control room fire, as required by 10 CFR 50, Appendix R.

According to the licensee, Information Notice 92-18 was not applicable to either Arkansas Nuclear One Units 1 or 2 because its alternate shutdown capability differed from other plants which protect only one train of safe shutdown equipment. The licensee stated that both safety trains were credited for safe shutdown following a control room fire. In addition, the licensee credited thermal overload protection to protect the motor (but not necessarily the actuator or valve) under hot-short maloperation. Furthermore, only manual operation of valves is credited in the Arkansas Nuclear One alternate shutdown capability.

The inspectors were concerned that, absent the recommended wiring modifications, hot-short maloperation of motor-operated valves would result in uncontrolled closing or opening thrust, up to the stall capability of the motor. The excessive thrust could cause valve and/or actuator damage to an extent that subsequent manual operation would not be possible within the required timeframes. The capability to manually operate safe shutdown valves following hot-short overthrusting had not been determined by the licensee. However, the licensee determined that manual repositioning of valves would not be necessary until approximately 40 minutes following a design basis control room fire. This interval would provide time to take certain extraordinary steps to change a valve's position, but would be insufficient for some of the actions proposed in this context.

The inspectors noted that the licensee had narrowly defined the hot-short condition as affecting only the multiple conductors within a single cable in the control room. The licensee had analyzed only for a potential hot-short to occur due to physical contact of an energized conductor with another conductor within a single fire-damaged cable. Only combinations of two conductors within a single, multiconductor cable were analyzed. The licensee did not analyze for hot-shortening from the interaction of adjacent cables within the same fire area. The inspectors observed that the licensee's analysis was narrowly defined and did not appear to consider worst case hot short conditions as the basis for the adequacy of the existing alternate shutdown capability.

On September 30, 1996, the inspectors conducted a conference call with the licensee and NRR, Plant Systems Branch, to further discuss the adequacy of the licensee's assumptions regarding multiple hot shorts in design of its alternative shutdown capability. During the discussion, the NRC and licensee disagreed as to whether existing regulations required the postulation of more than one hot short actuation during a control room fire.

In response to the inspectors' concerns, the licensee initiated a review of the capability of all motor-operated valves credited for safe shutdown to be manually repositioned following hot-short maloperation. The licensee provided preliminary results of their review during the onsite inspection. This information indicated that several valves may experience sufficient damage to preclude subsequent manual operation. The licensee identified that both trains of service water to the emergency diesel generators may be affected in Unit 2. The licensee identified a preliminary concern with butterfly valve shaft keys shearing under stall conditions for Valves 2CV-1503-1 and 2CV-1504-2 in the redundant service water trains providing cooling for the Unit 2 emergency diesel generator lube oil coolers. Shearing of the shaft keys would preclude subsequent manual operation to reopen the valves. In Unit 1, the preliminary calculations indicated that emergency feedwater and high pressure injection valves may not be manually repositionable following a hot short.

The inspectors identified the adequacy of the licensee's design basis assumptions regarding multiple hot-shorts as an Unresolved Item (50-313, 368/9623-01).

c. Conclusions

The licensee had not analyzed for the possibility of multiple hot shorts occurring during a control room fire. The licensee interpreted existing regulations as requiring only a single hot short. Consequently, the licensee did not modify the control circuitry of motor-operated valves subject to this phenomenon. Preliminary calculations indicated that certain safety functions could be lost during a control room fire, if redundant control circuits experienced hot shorts. The issue was considered unresolved pending further interpretation of 10 CFR 50, Appendix R, Generic Letter 86-10, and Information Notice 92-18.

E1.3 Pressure Locking and Thermal Binding (TI 2515/109)

a. Inspection Scope

Supplement 6 to Generic Letter 89-10 identified that pressure locking and thermal binding were considered to be within the existing design basis of susceptible motor-operated valves. The design basis reviews required for Generic Letter 89-10 should include pressure locking and thermal binding when determining worst-case design basis conditions. Most licensees had not initially considered pressure locking and thermal binding to be within their design basis reviews, but had initiated separate reviews in response to industry notifications. For closure of Generic Letter 89-10, licensees were expected to have initiated comprehensive engineering reviews to identify susceptible motor-operated valves and to have taken timely corrective actions. These corrective actions could include modifications or operating procedure changes to preclude pressure locking, or analyses to justify the existing capability of the motor-operated valve to overcome pressure-locked conditions.

The NRC inspection of pressure locking and thermal binding under Generic Letter 89-10 was superseded by the issuance of Generic Letter 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves." Final NRC reviews of the licensee's program to address pressure locking and thermal binding will be performed under Generic Letter 95-07. For purposes of closure of this issue under Generic Letter 89-10, the inspectors focused on licensee corrective actions taken to date in response to those motor-operated valves that had been determined to be susceptible to pressure locking or thermal binding.

b. Observations and Findings

The inspectors reviewed the licensee's 180-day submittal dated February 13, 1996, in response to Generic Letter 95-07. The inspectors concluded that no immediate issues affecting operability existed. The inspectors considered this area to be closed under Generic Letter 89-10. Final NRC reviews of this area will be performed under Generic Letter 95-07.

E1.4 Periodic Verification (TI 2515/109)

a. Inspection Scope

The inspectors reviewed the licensee's program for conducting periodic verification of the adequacy of motor-operated valve switch settings to assure design basis capability.

b. Observations and Findings

The licensee planned to conduct a static diagnostic test of each Generic Letter 89-10 motor-operated valve every 5 years or 3 refueling outages. In addition, the licensee planned to participate in the Entergy Periodic Verification Program which was in development. This plan assigned testing intervals depending on the safety significance and design margin of each valve. It also included a limited amount of periodic differential pressure testing, which was to be incorporated with the results of dynamic testing from other Entergy sites. The inspectors found the licensee plans in this area to be adequate. Further NRC review of this subject area will be conducted under Generic Letter 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves."

E1.5 Post-Maintenance Testing (TI 2515/109)

a. Inspection Scope

The inspectors reviewed the post maintenance/modification testing requirements identified in licensee Procedure 1025.0011, "Motor-Operated Valve Maintenance Program," Revision 6.

b. Observations and Findings

The licensee had incorporated static and dynamic diagnostic testing following maintenance activities or modifications that could affect the design basis capability of motor-operated valves.

The inspectors discussed the need for several enhancements in the licensee's procedural controls to assure that skill-of-the-craft maintenance activities, which are recognized to affect design basis capability, are positively controlled. For example, the licensee considered match-mark reassembly of valve disks as a good maintenance practice for fitup of the valve internals but the practice was not specifically directed within maintenance procedures. Likewise, chamfering or edge radius operations following disk or seat machining were also considered standard practice for personnel safety but not specifically controlled by procedure. As determined by licensee and industry testing, valve disk orientation and edge condition are critical in assuring the predictability of design basis capability. The licensee stated that these comments would be considered as potential enhancements to the existing procedural controls.

c. Conclusions

The inspectors determined that the licensee's post-maintenance testing program was adequate for Generic Letter 89-10 program closure. The licensee had established sufficient requirements for testing following maintenance and modification activities that could affect the design basis capability of motor-operated valves. In response to the inspectors' observations, the licensee stated that maintenance and testing procedures would be reviewed for potential enhancements related to valve internal configuration and dimensional controls.

E1.6 Trending of Motor-Operated Valve Failures and Test Results (TI 2515/109)

a. Inspection Scope

The inspectors reviewed licensee Procedure 1025.0011, "Motor-Operated Valve Maintenance Program", Revision 6, which identified the performance and failure trending program for motor-operated valves.

b. Observations and Findings

The inspectors noted several areas of weakness in the licensee trending activities. The licensee trended only six diagnostic testing performance parameters. These parameters were thrust and torque at control switch trip, total thrust and torque, stem factor, and torque switch setting. The inspectors noted that the licensee did not trend pullout thrust, motor current, spring pack relaxation, or packing loads. The licensee did not specifically trend testing anomalies, but rather annotated any unusual characteristics in the test data analysis sheets as information. The licensee had not established trend criteria, allowable limits, or projection of trend data to assure acceptable performance between testing. The licensee did not have a formal procedure for performance trending; instead, a department level desk guide was used for this purpose.

While the current personnel displayed a high degree of expertise in evaluating diagnostic data for indications of performance trends, the inspectors were concerned for the long-term capability of the existing procedural controls in maintaining an effective trending activity. The licensee acknowledged the need for procedural enhancement of its trending activities to address this long-term concern.

The inspectors noted that the licensee had planned to review motor-operated valve failures every two operating cycles rather than every 2 years as recommended by Generic Letter 89-10. In response to the inspectors' observation, the licensee corrected the procedural error in its program document to be consistent with its commitment to the recommendations of Generic Letter 89-10.

c. Conclusions

Although an area of weakness in the licensee's motor-operated valve program, the inspectors concluded that the licensee's trending activities were adequate for closure of the NRC review of Generic Letter 89-10. The licensee recognized the need for additional procedural guidance as a long term area of improvement.

E1.7 Evaluations and Corrective Actions Taken in Response to Motor-Operated Valve Failures (TI 2515/109)

a. Inspection Scope

The inspectors reviewed selected condition reports to assess the adequacy of the licensee's corrective actions for recent motor-operated valve problems. The inspectors sampled 27 of 74 condition reports for motor-operated valves problems encountered during the last 2 years.

b. Observations and Findings

The inspectors found the licensee's root cause evaluations to be thorough in all cases. The inspectors concluded that the licensee's corrective actions were consistent with its Generic Letter 89-10 program for assuring the design basis capability of motor-operated valves.

The inspectors noted that many of the condition reports addressed non-safety related equipment. The inspectors found that the licensee had expanded the scope of its motor-operated valve program to include risk-significant, non-safety related valves and valves considered to require high operational reliability. The inspectors considered the scope of the licensee program to be aggressive in providing a large, plant specific data base for justifying its design methodology.

The inspectors did not identify any examples of inadequate corrective actions for the identified problems.

E1.8 Generic Letter 89-10, Supplement 5, "Inaccuracy of Motor-Operated Valve Diagnostic Equipment" (TI 2515/109)

a. Inspection Scope

Supplement 5 to Generic Letter 89-10 informed licensees of the need to verify that vendor recommendations concerning uncertainties associated with diagnostic test systems were properly incorporated into the licensee's motor-operated valve program. The inspectors reviewed the licensee's program to verify that the application of diagnostic uncertainties was consistent with the licensee's response to Supplement 5.

b. Observations and Findings

The inspectors found the licensee's method of applying diagnostic uncertainties to be consistent with its response to Supplement 5 of Generic Letter 89-10.

E2 Engineering Support of Facilities and Equipment

a. Inspection Scope

A recent discovery of a licensee operating their facility in a manner contrary to the Updated Final Safety Analysis Report description highlighted the need for a special focused review that compares plant practices, procedures and/or parameters to the Updated Final Safety Analysis Report descriptions. While performing the inspections discussed in this report, the inspectors questioned the licensee concerning the accuracy of Safety Analysis Report that related to the areas inspected.

b. Observations and Findings

In anticipation of the NRC's interest in this area, the licensee had performed a comprehensive review of the Units 1 and 2 Safety Analysis Reports for all entries pertaining to motor-operated valves and the Generic Letter 89-10 program. The licensee found six discrepancies that required correction or clarification, but none were considered to be safety significant. The licensee had initiated licensing document change requests to correct these items. The inspectors concluded that the licensee's review was comprehensive.

E7 Quality Assurance in Engineering Activities (TI 2515/109)

a. Inspection Scope

An important element in closing the Generic Letter 89-10 program is the degree to which the licensee's quality assurance program is involved in the oversight of the program. This oversight function will compensate, in part, for an expected decrease in NRC inspection in this area following the Generic Letter 89-10 closure. The inspectors reviewed quality assurance audits, surveillances, and self assessments of the motor-operated valve program performed during the past 2 years.

b. Observations and Findings

During this period, the licensee completed one motor-operated valve program self assessment (ANO Motor Operated Valve Program Self-Assessment, April 10, 1996). The assessment team included representatives from the three other Entergy nuclear sites in addition to engineers from several other nuclear facilities. As a result of the assessment, 10 condition reports were issued addressing a broad range of issues including valve overthrust events, control room hot shorts, motor brakes, out-of-range diagnostic calibrations, weak link calculations, and the operability of marginal

motor-operated valves. The inspectors considered the self assessment to have been of commendable quality. The issues identified by the assessment were central to the inspectors' review for closure of Generic Letter 89-10. The licensee had initiated aggressive actions to resolve the identified concerns.

The licensee performed two quality assurance audits and 112 quality control surveillances during the past 2 years. The inspectors found these efforts to be less technically oriented than the self assessment, but to represent, in the aggregate, a major commitment to provide quality oversight of the motor-operated valve program.

c. Conclusions

The licensee effectively utilized quality assurance resources to provide oversight of the motor-operated valve program. This was identified as a strength.

E8 Miscellaneous Engineering Issues (92903)

E8.1 (Closed) Inspection Followup Item 50-313,368/9313-12:

Background

This item involved the licensee's efforts to account for the effects of pressure locking and thermal binding of motor-operated gate valves.

Followup

As stated in Section E1.3, the inspectors did not identify any current concerns related to the performance of motor-operated valves under pressure locked or thermally bound conditions. This item has been closed; final resolution of this issue will be completed under Generic Letter 95-07.

E8.2 (Closed) Inspection Followup Item 50-313,368/9411-01

Background

This followup item concerned the seismic analysis of the Main Feedwater Isolation Valves CV-2630 and CV-2680. When in the closed position, the licensee had determined that the yoke stresses substantially exceeded allowable design stress under combined design basis earthquake (DBE) and design basis accident (DBA) loading. These valves are normally open with a safety function to close to isolate main feedwater flow from a faulted steam generator.

The licensee concluded that there were no specific regulatory requirements for combined DBE/DBA of any safety-related motor-operated valve, although various commitments in the Safety Analysis Report did apply to valves within the reactor coolant pressure boundary.

Followup

During the inspection, the inspectors contacted the NRC's Office of Nuclear Reactor Regulation, Mechanical Engineering Branch. As a result of this consultation, the inspectors concluded that the licensee had correctly identified the required seismic loading cases for the main feedwater isolation valves and that no safety or regulatory issue existed. Nevertheless, the licensee planned to replace the existing valve yokes with stiffer yokes during the next outage. Given the lack of a clear requirement for these valves to accommodate the combined loading case, the inspectors considered the licensee's intention to modify these valves to be proactive.

E8.3 (Closed) Inspection Followup Item 50-313/9420-01

Background

This issue involved a set of circumstances, within the design basis of Unit 1, which could result in failure of the service water system to perform its safety function. Starting with a specific initial lineup of pumps and valves and power supply alignments permitted by the plant's operating procedures, a loss-of-coolant accident concurrent with the loss-of-offsite power and failure of one emergency diesel generator would require operator action within approximately 2 to 4 minutes to transfer Load Centers B55/B56 to the operating bus. This would permit the isolation of auxiliary service water loads, ensuring sufficient flow to the vital coolers.

The inspectors were concerned that manual operator action was needed to enable automatic safety systems to function in this scenario. Although not part of Arkansas Nuclear One's licensing basis, American National Standard ANSI/ANS-58.8-1994, "Time Response Design Criteria for Nuclear Safety Related Operator Actions," states that credit should not be taken for operator actions within 20 minutes following a loss-of-coolant accident. The concern was lessened by the fact that the required operator action would be needed only following the obvious failure of a diesel generator, and that the action was prominently placed in the emergency operating procedures.

Followup

During the inspection, the licensee reiterated that it was not committed to ANSI/ANS-58.8-1994. The inspectors reviewed Procedure 1202.007, "Degraded Power," Revision 4, and confirmed that the transfer of load centers B55/B56 was the first step in the procedure. The inspectors interviewed a control room operator who stated that the load transfer was commonly practiced in the simulator and that the need to perform this step would become obvious because the control room lights would go out. The inspectors concluded that this additional information had satisfactorily resolved the concern.

E8.4 (Closed) Inspection Followup Item 50-313,368/9526-01

Background

This inspection followup item involved a concern for the licensee's practice of manually seating motor-operated valves for leakage control and returning the valves to service without electrically stroking the valve. In this condition, the motor is declutched from the actuator gear train. The inspectors had considered this practice to be contrary to the manufacturer's (Limitorque) recommendations and industry practice.

Followup

The inspectors reviewed licensee Procedure 1015.035, "Valve Operations," Revision 2. The inspectors found that the licensee had eliminated the procedural directions for manually seating safety-related motor-operated valves. The revised procedure required the valves to be declared inoperable after manual operation until they are electrically operated to reengage the motor. The inspectors considered the revised procedure to adequately resolve this concern.

V. Management Meetings

X1 Exit Meeting Summary

The inspectors presented the inspection results to members of licensee management at the conclusion of the inspection on October 4, 1996 and during a conference call conducted October 9, 1996. The licensee acknowledged the findings presented. The licensee did not identify as proprietary any of the information presented to the inspectors during the inspection.

ATTACHMENT

PARTIAL LIST OF PERSONS CONTACTED

Licensee

M. Cooper, Licensing Specialist
R. Edington, General Manager
R. Fuller, Operations Manager, Unit 1
D. Graham, Engineering Program Supervisor
M. Harris, Maintenance Manager, Unit 2
R. Lane, Director, Design Engineering
C. Little, Unit 2 Coordinator, Design Engineering
G. Loftis, Mechanical/Civil/Structural Design
E. Miller, Senior Engineering Assistant
D. Mims, Licensing Director
T. Mitchell, SYE Manager, Unit 2
R. Partridge, Chemistry
S. Pohl, Senior Lead Engineer, SYE, Unit 2
R. Rispoli, Senior Lead Engineer
B. Rogers, Engineering Supervisor, Mechanical/Civil/Structural
L. Schwartz, Supervisor, SYE Diagnostic Group, Unit 2
M. Smith, Supervisor, Licensing
R. Starkey, Manager, SYE, Unit 1
M. Stroud, Manager, Electrical and Instrumentation and Control
C. Turk, Manager, Mechanical/Civil/Structural Design Engineering
W. Walker, Fire Protection Engineer
C. Zimmerman, Plant Manager, Unit 1

NRC

T. Reis, Project Engineer
J. Melfi, Resident Inspector

LIST OF INSPECTION PROCEDURES USED

| | |
|--------------|---|
| TI 2515/109: | Inspection Requirements for Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance" |
| IP 92903 | Followup- Engineering |

LIST OF ITEMS OPENED AND CLOSED

Opened

50-313,368/9623-01 URI Consideration of Multiple Hot Short Actuations
(Section E1.2)

Closed

50-313,368/9313-12 IFI Pressure Locking and Thermal Binding (Section E8.1)

50-313,368/9411-01 IFI Seismic Qualification of Main Feedwater Isolation Valve
(Section E8.2)

50-313/9420-01 IFI Potential Single Failure Concern (Section E8.3)

50-313,368/9526-01 IFI Declutched Actuator Considered Operable (Section E8.4)