

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket Nos: 50-315, 50-316
License Nos: DPR-58, DPR-74

Reports No: 50-315/98020; 50-316/98020

Licensee: Indiana Michigan Power Company

Facility: Donald C. Cook Nuclear Generating Plant

Location: 1 Cook Place
Bridgman, MI 49106

Dates: September 28 through October 2, 1998

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Engineering Specialists Branch 1

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EXECUTIVE SUMMARY

D. C. Cook Nuclear Generating Units 1 and 2
NRC Inspection Report 50-315/98020; 50-316/98020

Engineering

- This close-out inspection of NRC's review of Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve (MOV) Testing and Surveillance," determined that the MOV program and implementation at D. C. Cook were not sufficiently complete to close-out the NRC's program review. Although some areas have been sufficiently addressed, the inspectors could not conclude that the licensee had completed verifying all GL 89-10 program MOVs would perform their intended safety functions under design-basis conditions. The three major areas requiring resolution were the 44 potentially inoperable MOVs, finalizing design-basis MOV calculations, and updating several program documents. Specific issues that remain to be resolved are described in sections E1.1.b.1.1; E1.1.b.1.2; E1.1.b.1.3; E1.1.b.1.4; E1.1.b.2.1.; E1.1.b.2.2.; E1.1.b.2.3.; E1.1.b.3; and E1.1.b.4 of this report.
- One violation was identified for which enforcement discretion was exercised. The licensee's failure to perform design-basis calculations for the structural capability of butterfly valves. This, along with not proactively assessing the effects of widely known industry information on the use of non-conservative assumptions in predicting MOV motor actuator output prior to it becoming an operability issue, led to a programmatic concern with the MOV program. (Sections E1.1.b.1.3 and E1.1.b.3)

Safety Assessment/Quality Verification

- The recent self-assessment in the MOV area provided numerous appropriate technical findings, some of which were also identified during this inspection. The use of an outside technical MOV expert provided additional insights into the MOV program. (Section E7.1)

Report Details

Summary of Plant Status

Both units were in an extended shutdown during this inspection period.

III. Engineering

E1 **Conduct of Engineering**

E1.1 Generic Letter (GL) 89-10 Program Implementation

a. Inspection Scope (TI 2515/109)

This inspection evaluated the process for qualifying the design-basis capability of motor-operated valves (MOVs) and closure of NRC's review of GL 89-10. The inspection concentrated on MOVs that were tested under static or low differential pressure (d/p) conditions. A valve sample that included several program closure methods used by the licensee was selected to verify design-basis capability. The inspectors reviewed design-basis documents, thrust calculations, test packages, and engineering evaluations for the following MOVs:

- 1-IMO-255 Boron Injection Tank Train 'A' Inlet Shutoff (S/O) Valve
- 1-IMO-911 Refueling Water Storage Tank to Chemical and Volume Control System Pump Suction Header Train 'B' S/O Valve
- 1-NMO-152 Pressurizer Power-Operated Relief Valve (PORV) Block Valve
- 1-IMO-316 East Residual Heat Removal and North Safety Injection to Reactor Coolant System Loops 1 & 4 Cold Legs
- 2-IMO-326 West Residual Heat Removal and South Safety Injection to Reactor Coolant System Loops 2 & 3 Cold Legs S/O Valve
- 1-IMO-324 West Residual Heat Removal Pump 35 West Discharge Cross-tie S/O Valve

The inspectors also reviewed other licensee documentation used to justify program assumptions, such as stem friction coefficients and load sensitive behavior. Further, the inspectors reviewed the specific concerns identified during the previous GL 89-10 program close-out inspection (inspection report 50-315/96012; 50-316/96012).



b. Observations and Findings on GL 89-10 Program Implementation

The licensee had made some progress on the GL 89-10 program with respect to previous NRC MOV inspections. However, due to recent consideration of actuator output and structural capabilities of MOVs, the licensee's design-basis calculations to verify valve capability were under revision at the time of the inspection. Numerous valves were declared inoperable by the licensee based on preliminary calculation results. In addition, the justifications for several assumptions used for certain valves or valve group calculations were not adequately supported. Based on these concerns, the inspectors were not able to conclude that the licensee had completed verifying all GL 89-10 MOVs were capable of meeting their design-basis requirements. As a result, the NRC's review of the licensee's GL 89-10 MOV program will remain open pending additional support information.

b.1 MOV Sizing and Switch Settings

The licensee's thrust calculations used the industry's standard thrust equation to determine thrust requirements for rising stem gate and globe valves. Applied valve factors were based on licensee testing or industry data, such as data from the Electric Power Research Institute's (EPRI) Performance Prediction Methodology (PPM) or other utility sources. A 15 percent margin was added to the closed target thrust to account for the effects of load sensitive behavior and 5 percent to account for degradation of stem factors. The inspectors found that the licensee was developing another MOV calculation methodology, but that it had not been approved as part of the licensee's MOV program, and that the licensee's two methodologies had not been fully integrated to provide for consistent determination of MOV capability. The inspectors' review of the MOV program assumptions are discussed in the following paragraphs.

b.1.1 Valve Factors

The licensee's valve factor justification (Duke Engineering & Services [DE&S] Report No. 0012-00204-R01, "Valve Factor") divided MOVs into groups based on valve type, size, manufacturer, and pressure class. The licensee used in-plant testing, the EPRI PPM, industry data, or a combination of these to justify the valve factors applied to the valves in a particular group. In those cases where the PPM was used, the licensee would use the minimum required thrust obtained from the PPM to back-calculate a valve factor. Further, the licensee reviewed several industry data points to confirm the EPRI PPM results. The following valve groups had minimal or incomplete justification for the applied valve factor.

- (a) Valve groups AAAA, AAAB, and AAAC contained Anchor/Darling double-disc gate valves that used valve factors ranging from 0.5 to 0.7 after considering PPM results, industry test data, and a few valve-specific dynamic test results. The inspectors noted that the justifications for these valve groups used close valve factors that were based on flow isolation that does not provide for full wedging of the valve discs. Without mechanical wedging of the valve discs, proper sealing of the valve may

not be maintained. For example, Group AAAA included one dynamically tested valve (2-IMO-314) that had a close valve factor of 0.9 due to mechanical wedging of the valve discs, but was considered an outlier by the licensee. To verify that design-basis requirements have been adequately established, the licensee needs to review the safety functions for valves in these groups to ensure that specific valve leakage requirements do not exist and that flow isolation valve factors are adequate.

- (b) Valve group AABA contained 10-inch Anchor/Darling 1500# double-disc gate valves that used a close valve factor of 0.5 and an open valve factor of 0.55. These valve factors were selected after reviewing five dynamic tests performed by Commonwealth Edison (ComEd) (documented in ComEd White Paper 164, "Anchor/Darling Double-Disk Gate Valve Factors"). The inspectors noted that this group's justification did not use the regression analysis contained in ComEd's white paper. Therefore, the valve factors were not selected based on the variation in the ComEd data set. To resolve this concern, the licensee needs to re-analyze the ComEd data to ensure that the selected valve factors adequately bound the expected performance of this valve group.
- (c) Valve group BBAA contains 10-inch Crane-Aloyco 300# solid-wedge gate valves that use close and open valve factors of 0.6. These valve factors were selected after reviewing several dynamic tests performed by ComEd (documented in ComEd White Paper 160, "Crane Valve Factors") on a set of Crane valves that varied in valve size and pressure class. This group's justification did not use the regression analysis contained in ComEd's white paper to account for the variation in the ComEd data. To resolve this concern, the licensee needs to re-analyze the ComEd data to ensure that the selected valve factors adequately bound the expected performance of this valve group.
- (d) Valve group DAAA consists of 3-inch Velan 1500# flex-wedge gate valves and included the PORV block valves (1/2-NMO-151, -152, and -153). The valve factors used for the PORV block valves were based on PPM thrust requirements that assumed that the disc guide bottom edge radius was at least 0.065 inches to remove an "unpredictable" thrust determination. This calculation also assumed that the valves have an unsupported guide length that does not exceed 2 inches to ensure that guide bending will not occur. Licensee personnel stated that the discs for these valves were recently replaced and that maintenance work packages need to be reviewed to ensure that assumptions made by the PPM thrust calculations were valid.
- (e) Valve groups EABA and EABB consisted of 4-inch and 8-inch Walworth 1500# flex-wedge gate valves, respectively, which use close and open valve factors of 0.5. The available in-plant test data for these groups was considered to be weak because: 1) one valve was not dynamically tested in the closing direction, 2) a second valve test was tested using a questionable diagnostic sensor calibration, and 3) the remaining tests resulted in abnormally low valve factors. Therefore, a

clear basis for the selected valve factor did not exist. The licensee needs to obtain applicable information to improve the valve factor justification for these valve groups.

- (f) Valve group GL1 included 4-inch Hammel-Dahl 900# balanced-plug globe valves. Due to the balanced-plug design of these valves, the licensee used an alternative thrust determination method that did not include a side-load term, but still resulted in several valves having less than 20 percent available thrust margin in the close safety function direction. The inspectors noted that eight valves in this group were dynamically tested under significant differential pressure conditions. Given the low available thrust margins, the licensee needs to compare its alternative thrust determination method to the available in-plant test data to determine if side-loading was a concern, or consider using other available industry thrust prediction methods for these valves.
- (g) Valve group GL2 consisted of 4-inch Rockwell 900# globe valves that have a safety function to close under steam blowdown flow conditions. The licensee had assumed that a valve factor of 1.1 would be adequate for this group's standard unbalanced plug design and did not identify any test data to support this valve factor for steam blowdown conditions. The inspectors noted that most of the valves in this group had less than 10 percent thrust margin for the closed safety function and that margin improvement may be appropriate for these valves. The licensee agreed to reassess the valve factor justification for this valve group.
- (h) Valve group GL10 consisted of 4-inch Rockwell 1500# y-design globe valves, which used a valve factor of 1.1 based on EPRI globe valve testing (including a single Rockwell valve) that showed that globe valve factors ranged from 0.9 to 1.1. The inspectors noted that all of the valves in this group had less than 15% thrust margin for the closed safety function and that the licensee had obtained minimal valve data that was directly applicable to these valves. The licensee needs to acquire additional applicable valve factor data to improve the justification for the valve group.

During the review of valve factor justifications, the inspectors noted that licensee personnel had not formally reviewed the NRC's Safety Evaluation (SE) of Topical Report TR-103237, "EPRI Motor-Operated Valve Performance Prediction Program," for information that may affect the use of EPRI's PPM. To correct this, the licensee agreed to formally review the NRC's SE to ensure that all applicable conditions and limitations were considered for the models used by the MOV program.

c.1.1 Conclusions on Valve Factors

Valve factors for 11 groups were considered not adequately justified. In addition, the conditions and limitations noted in the NRC's SE of the EPRI PPM were not formally reviewed. The reviews noted to resolve the above concerns need to be completed prior to closure of the NRC staff's review of the licensee's GL 89-10 program.

b.1.2 Load Sensitive Behavior (LSB) and Stem Friction Coefficient (SFC)

The justifications for LSB and SFC were contained in DE&S Report No. 0012-00204-R02, "Rate of Loading," and DE&S Report No. 0012-00204-R01, "As-Left Stem/Stem Nut Coefficient of Friction." Based on a statistical evaluation that analyzed gate and globe valves combined, gate valves only, and globe valves only, the worst case LSB performance was for gate valves: mean of 1.4 percent with a 2 standard deviation value of 19.4 percent. A statistical review of all available static SFCs found that a value of 0.174 was adequate to provide a 95 percent confidence level assumption for MOV performance under static test conditions.

Thrust calculations used a 15 percent bias margin for LSB, which was combined with a degradation margin (5 percent) before being used to increase the minimum required thrust. Equipment accuracies and torque switch repeatability were combined in a square root sum of the squares methodology as part of the overall error adjustments. The licensee demonstrated that this methodology was equivalent to breaking down LSB into its bias and random components and adjusting the minimum required thrust using these terms.

DE&S Report No. 0012-00204-R02 recommended the use of a 15 percent thrust margin when assessing open actuator capability to account for any potential loss of thrust capability caused by open SFC changes under dynamic conditions. However, the inspectors noted that Calculation No. DCCV112MV001-"GL-89-10 Thrust/Torque Calculation," which established the design-basis requirements for each MOV, did not include this margin when calculating the open minimum required thrust. In response, the licensee initiated Condition Report (CR) No. 98-5343 to identify this concern and to initiate corrective actions to revise the appropriate calculations. This issue was also identified during the previous NRC inspection.

Another issue from the previous NRC inspection was that changes in SFC from static values to dynamic values should be accounted for in the closing direction by the licensee's LSB margin. During the inspection, the licensee was unable to provide the dynamic SFC data for review to verify that LSB margins accounted for these changes in SFC and results incorporated into the MOV program.

The inspectors noted that the licensee's LSB and SFC justifications had not been updated to reflect testing that has been performed subsequent to completion of the program justifications in early 1997. Licensee personnel stated that periodically updating the program justifications was not considered necessary. However, trending MOV performance over time and assessing the impact of degradations was important to maintaining MOV design-basis capability. Therefore, as part of the long-term MOV program the licensee should periodically review LSB and SFC performance to ensure that MOV program assumptions remain valid. The licensee stated these periodic reviews would be added as part of the long-term MOV program.

c.1.2 Conclusions on Load Sensitive Behavior and Stem Friction Coefficient

In general, LSB and SFC justifications were acceptable. However, potential SFC changes under dynamic conditions were not assessed to account for any loss of thrust capability for the open actuator capability. Dynamic SFC data needs to be reviewed and incorporated into the MOV program to verify that LSB margins account for changes in SFC from static to dynamic conditions. In addition, the long-term MOV program did not periodically review LSB and SFC performance. Prior to closure of the NRC staff's review of the licensee's GL 89-10 program, the open thrust calculations, taking potential changes in SFC into account, need to be completed, along with adding periodic reviews of LSB and SFC justifications as part of the long-term MOV program.

b.1.3 Actuator Efficiencies

The previous NRC inspection indicated a concern regarding the licensee's use of actuator "run" efficiency (rather than the more conservative "pullout" efficiency) particularly for the licensee's marginal MOVs based on then-ongoing industry and NRC studies of the overall reliability of the actuator output predictions. Limatorque Corporation recently issued Technical Update 98-01 including Supplement 1, dated July 1998, which provided guidance for determining the output of Limatorque actuators. This guidance stipulated the use of actuator pullout efficiencies and application factors of 0.90. Special configurations needing additional analysis were also identified: 1) 25 ft-lb, 3600 rpm, frame 56 motors, 2) 60 ft-lb, 1800 rpm, frame 56 motors, 3) SMB-1 actuators with a 66:1 worm gear ratio, and 4) all motors that operate at less than 70 percent of rated voltage. The licensee issued CR 98-4653 on September 4, 1998, documenting that 32 rising stem gate and globe valves may not be capable of producing enough torque and thrust to meet their intended safety functions. Although this recently issued information was known throughout the industry for several years, the licensee was not proactive in assessing its effects prior to it becoming an operability issue. The CR also addressed the implications of degraded voltage and environmental qualifications. Licensee personnel stated that this issue was a Mode 4 constraint that will be resolved prior to plant startup.

c.1.3 Conclusions on Actuator Efficiencies

The licensee was not proactive in assessing the effects of recently issued vendor information concerning assumptions in design-basis calculations prior to it becoming an operability issue. The design-basis requirements of the potentially inoperable valves need to be verified or a schedule established to accomplish the required actions prior to closure of the NRC staff's review of the licensee's GL 89-10 program.

b.1.4 Open Unseating Forces

An issue from the previous NRC inspection was the need to revise the static test acceptance criteria to address the MOVs' unseating force versus the operator and valve structural limits, and operator capability. The inspectors verified 12IHP5030.EMP.002, "MOV Diagnostic Testing - VOTES," was revised to address the above concern.

During review of the PPM calculations for valve group ABAB (Anchor/Darling flex-wedge gate valves), the inspectors noted that the licensee had not completed an EPRI unwedging calculation that was required to estimate the unwedging performance of a flex-wedge gate valve under design-basis conditions. In response, the licensee initiated CR No. 98-5343 to identify this issue and to initiate corrective actions to complete the required calculations.

c.1.4 Conclusions on Open Unseating Forces

The unwedging calculations for valve group ABAB were not performed and need to be completed prior to closure of the NRC staff's review of the licensee's GL 89-10 program.

b.2 Miscellaneous Program Issues

b.2.1 Direct Current (DC) Motors

Licensee personnel stated that an analysis for DC motor performance was not performed to ensure the MOVs would perform under design-basis conditions. A DC motor slows as load increases. Therefore, estimating the time it would take a DC powered MOV to complete its valve stroke under design-basis conditions would be important if it is relied upon by the plant's safety analysis or Technical Specifications to complete a safety function within a given period of time. The licensee initiated CR No. 98-5343 to review this issue and to initiate any needed corrective actions. An initial screening determined that 10 DC powered MOVs need to be reviewed.

c.2.1 Conclusions on DC Motors

An analysis for DC MOVs performance was not performed to ensure the valves would perform under design-basis conditions and needs to be completed prior to closure of the NRC staff's review of the licensee's GL 89-10 program.

b.2.2 PORV Design-Basis Open Differential Pressure

During review of Calculation No. HXP900814JRT, "Differential Pressure Calculation for Valves 1-NMO-151, 152, and 153," the inspectors noted that the licensee's calculation had determined that the worst-case opening d/p for the PORV block valves was 0.0 psid. The design-basis thrust calculations for the PORV block valves used a default opening d/p of 50 psid because this value was used by the licensee when the design-basis review documents determine that no d/p existed for a given valve stroke. After discussions with personnel involved with performance of the d/p calculation, the inspectors found that the PORV block valves' open scenarios were not properly analyzed and a complete review of necessary emergency and abnormal operating procedures was not performed. Therefore, the licensee was requested to review the PORV block valve opening scenarios to ensure that the thrust calculations use the worst-case open d/p under which the PORV block valves may be expected to operate.

c.2.2 Conclusions on PORV Design-Basis Open Differential Pressure

The analysis for determining the worst-case opening d/p for the PORV block valves appeared incomplete. The licensee needs to review the PORV block valve opening scenarios to ensure that the thrust calculations used the worst-case open d/p under which the PORV block valves may be expected to operate. This review needs to be completed prior to closure of the NRC staff's review of the licensee's GL 89-10 program.

b.2.3 Program Documentation

Several issues were identified with the documentation of the MOV program. Although this was a close-out inspection, there were several programs, procedures, and calculations that were not up-to-date. This included out-of-date references and methodologies, along with incomplete design-basis calculations. Documents included the following:

- The D. C. Cook Nuclear Plant Motor-Operated Valve Closure Document and Cook Nuclear Plant Units 1 & 2 Motor-Operated Valve Program Description were not up-to-date with how the program was being implemented;
- Several calculations performed by DE&S were not formally approved by the licensee;
- Review and acceptance of certain contractor MOV documents had not been completed;
- The MOV degraded voltage and thrust calculations were not completed with the latest information.

c.2.3 Conclusions on Program Documentation

Numerous programs and calculations were not up-to-date and need to be updated prior to closure of the NRC staff's review of the licensee's GL 89-10 program.

b.3 Butterfly Valve Testing

The previous NRC inspection identified three issues to be addressed with respect to butterfly valves in completing the GL 89-10 program. These issues were addressed as follows:

- The licensee used a seating/unseating factor in predicting the performance of its butterfly valves (similar to valve factor for gate and globe valves) based on the bearing equation described in EPRI's Application Guide for Motor-Operated Butterfly Valves. Because of the revision underway of the EPRI Application Guide, the licensee was requested to address the effect of the revised application guide on its butterfly valve methodology, including the extrapolation of test data to design-basis conditions. The licensee's response included Vectra Report 0012-



00192-R01, "Justification for Extrapolation of Butterfly Valve Dynamic Test Data," and a letter from EPRI to DE&S that forwarded the revised extrapolation guidance in the planned revision of the EPRI butterfly valve application guide. The inspectors found that the licensee had not performed a documented comparison of their butterfly valve methodology to the accepted industry practice in the EPRI butterfly valve application guide. Also, the licensee had not performed a documented feedback analysis of its test results for seating/unseating factor to compare with its assumed factors. Although the licensee had dynamically tested a large percentage of its butterfly valves, it was not apparent that the licensee had evaluated the test flow conditions to ensure that the test results could be extrapolated to design-basis conditions.

- The licensee needed to verify its assumption that closing hydrodynamic loads were negligible for butterfly valves with symmetrical discs. The EPRI letter confirmed the assumption that these valves were found to be self-closing through EPRI's testing program. The letter also noted that the planned revision to the EPRI butterfly valve application guide would include a provision for the evaluation of stem structural capability in cases where the stroke direction was assisted by flow.
- The licensee needed to perform evaluations of the structural and weak link margins for its GL 89-10 butterfly valves. Based on completion of the weak link evaluation, the licensee determined that 41 of 69 butterfly valves might exceed their structural limits as documented on CR 97-1744 (dated June 9, 1997). The licensee's analysis concluded that valves remained operational and would have performed their safety function. In its letter dated July 31, 1998, the licensee stated that those operability determinations were being re-evaluated using more up-to-date expectations. As a result of its re-evaluations, the licensee identified 12 butterfly valves in CR 98-4755 (dated September 11, 1998) where operability could not be determined based on exceeding the continuous structural limit of the valve. It was unclear if the evaluation of structural capability included consideration of the valve stem where the stroke direction was assisted by flow as indicated in the EPRI butterfly valve application guide.

The failure to perform design-basis calculations for the structural capability of butterfly valves was considered a violation of 10 CFR 50, Appendix B, Criterion III, "Design Control." This violation is of concern to the NRC since it resulted in 12 butterfly MOVs not being able to meet their design-basis structural capability. However, because the violation was based upon activities prior to the events leading to the current extended plant shutdown, the NRC is exercising discretion in accordance with Section VII.B.2 of the Enforcement Policy and refraining from issuing a citation for this violation (NCV 50-315/316-98020-01).

c.3 Conclusions on Butterfly Valve Testing

The design control violation concerning the structural capabilities of butterfly MOVs, along with not proactively assessing the effects of widely known industry information on

the use of non-conservative assumptions in predicting MOV motor actuator output prior to it becoming an operability issue, led to a programmatic concern with the MOV program.

The inspectors concluded that the licensee had not completed its verification of the design-basis capability of the motor-operated butterfly valves within the GL 89-10 program. Prior to the closure of NRC staff's review of the licensee's GL 89-10 program the licensee must resolve the operability concerns for the identified butterfly valves that were determined to exceed their continuous structural limit. Further, the licensee needs to (1) confirm the reliability of its dynamic test data by reviewing the flow conditions under which its butterfly valves were dynamically tested, (2) validate its prediction of torque requirements using seating/unseating factors by comparison to actual test data, (3) support its extrapolation methodology by quantitative comparison of the approach used to the industry accepted practice in the planned revision of the EPRI butterfly valve application guide, (4) ensure that its evaluation of structural capability included consideration of the valve stem where the stroke direction was assisted by flow as indicated in the EPRI butterfly valve application guide, (5) complete a documented review and acceptance of its contractor reports on butterfly valve performance, and (6) update its GL 89-10 program documentation to reflect validation of its butterfly valve methodology and any revisions necessary as result of its evaluation based on EPRI guidance and other new information.

b.4 Marginal Valves

The inspectors noted during the previous NRC inspection that a number of MOVs in the GL 89-10 program were considered marginal based on design-basis calculations. The licensee performed a review in early 1997 of valves in the program and identified 23 valves with less than a 10 percent margin. Corrective action plans were scheduled for the 23 valves and in the majority of cases, these action plans were implemented. Two of the valves' corrective actions were yet to be completed, while six valves were included on the inoperable valve condition report. Although these actions were appropriate at the time, the design basis calculations were under revision to address the Limitorque update, environmental qualification issues, and degraded voltage, which may identify other marginal valves.

c.4 Conclusions on Marginal Valves

Although previous action to improve valve margin appeared acceptable, based on the design basis calculation revisions, the inspectors requested that prior to the closure of NRC staff's review of the licensee's GL 89-10 program, the licensee develop any revised margin improvement plans to address MOVs with less than 10 percent margin.

b.5 Manual Operation of MOVs

One issue identified during the previous NRC inspection was the potential MOV overloading due to handwheel operation. The licensee initiated CR 96-0687 in April 1996 as a result of identifying that operations personnel had manually "hand

wheeled" MOV 2-ICM-311 into the seat with enough force to exceed the torque switch settings. The licensee verified that the manual operation did not exceed the limiting torque valve component (wedge T-head). The root-cause was determined to be the use of the hammer blow feature of the actuator to seat the valve. Based on these conclusions, operations standing order OSO.25, "Limitorque Valve Operators," was revised to identify susceptible MOVs and provide guidance not to use the valve's hammer blow feature or "cheaters" on the handwheel to seat MOVs. This standing order was subsequently superceded by OHI-4016, "Conduct of Operation Guidelines," which provided the same guidance on manually operating MOVs. In addition, training lesson UO-C-3700, "MOV Local-Manual Operations (Lab)," provided instructions to the operators for proper manual valve operation of MOVs. Based on the actions taken, the inspectors had no further concerns.

c.5 Conclusions on Manual Operation of MOVs

Adequate actions were taken to resolve the potential overtorque of MOVs by manual operation.

c. Conclusions on Generic Letter (GL) 89-10 Program Implementation

Although some issues related to the MOV program have been resolved, a number of issues relating to the design-basis capability of program valves remain open. Therefore, the NRC's GL 89-10 program review will remain open pending completion of the open issues as discussed in the details of this report and subsequent review by the NRC.

E7 Quality Assurance in Engineering Activities

E7.1 Licensee Self-Assessment Activities

a. Scope

The inspectors reviewed a MOV self-assessment performed by a contractor the week prior to this inspection.

b. Observations and Findings

The assessment identified a number of issues with the GL 89-10 program. These observations/recommendations included: weak valve factor justifications; no comparison of unwedging thrust to actuator output thrust capability; bearing coefficient not determined for all butterfly valves; and no comparison of test versus design flow rates for butterfly valves. Many of the issues identified in the self-assessment were also identified during this inspection. Issues identified in the self-assessment were to be addressed by CR 98-5343.

c. Conclusions

The self assessment identified numerous appropriate technical issues, a number of which were also identified during this inspection. The use of an outside MOV expert provided additional insights into the MOV program.

E8 Miscellaneous Engineering Issues (92902)

- E8.1 (Closed) Violation (50-315/96012-01(DRS); 50-316/96012-01(DRS)): Failure to initiate a condition report and perform a prompt operability determination for the PORV block valves: The best available valve factor information was not used in the design calculations and no condition report initiated to assess operability. Immediate corrective actions taken during the inspection were to evaluate the operability of the PORV block valves. This review determine one PORV block valve to be inoperable, which was removed from service.

The inspectors verified the corrective actions described in the licensee's response letter, dated January 27, 1997, to be reasonable and complete. The licensee performed a review of valve factor assumptions for other MOV groups and identified one other valve group (Conval), which needed additional support. Based on a review of other plant differential pressure testing results, the valve factor for this group was revised from 1.1 to 1.3. In addition, training was provided to MOV personnel to ensure condition reports were initiated when adverse information was received that could affect MOV operability. Based on the actions taken, this item is closed.

- E8.2 (Closed) Licensee Event Report (50-315/96006-01): One hour action statement requirements not met for inoperable Unit 1 PORV block valve. Licensee corrective actions were acceptable as discussed in closure of the above violation on the same issue. This item is closed.
- E8.3 (Closed) Inspection Follow-up Item (50-315/96012-02(DRS); 50-316/96012-02(DRS)): Modifications not completed for the PORV block valves. The licensee completed the modifications to the valves and verified the valves have sufficient margin to perform their function. This item is closed.
- E8.4 (Closed) Inspection Follow-up Item (50-315/96005-04(DRS); 50-316/96005-04(DRS)): Use of 5-year grid study of worst case grid voltage for GL 91-18 operability evaluations in lieu of second level undervoltage relay setpoint. Based on a response from NRR, which concluded the use of the 5-year grid study was unacceptable, the licensee revised Motor-Operated Valve Program Description to delete allowing MOV operability calls based on the study. Based on the actions taken, this item is closed.

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 2, 1998. The licensee acknowledged the findings presented at the exit, however, the enforcement actions discussed in this report were not decided upon by NRC management until after the exit. The inspectors asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

PARTIAL LIST OF PERSONS CONTACTED.

Licensee

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D. Cooper, Plant Manager
M. Depuydt, Nuclear Licensing
E. Eckstein, Chief Nuclear Engineer
A. Gort, MOV Coordinator
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R. Powers, Senior Vice President
J. Sampson, Site Vice President
T. Scott, MOV Engineer
K. Worthington, Inservice Testing Coordinator

Duke Engineering & Services

J. Kelly, MOV Engineer

INSPECTION PROCEDURE USED

TI 2515/109 Safety-Related Motor-Operated Valve (MOV) Testing and Surveillance

ITEMS OPENED and CLOSED

Opened

50-315/316-98020-01 NCV Failure to perform design-basis calculations for the structural capability of butterfly valves

Closed

50-315/96005-04(DRS);
50-316/96005-04(DRS) IFI Use of 5-year grid study for MOV operability

50-315/96012-01(DRS);
50-316/96012-01(DRS) VIO Failure to initiate a condition report and perform a prompt operability determination for the PORV block valves

50-315/96012-02(DRS);
50-316/96012-02(DRS) IFI Modifications not completed for the PORV block valves

50-315/96006-00/01 LER One hour action statement requirements not met for inoperable unit 1 PORV block valve

LIST OF ACRONYMS USED

ComEd	Commonwealth Edison
CR	Condition Report
d/p	Differential Pressure
DC	Direct Current
DE&S	Duke Engineering & Services
DRS	Division of Reactor Safety
EPRI	Electric Power Research Institute
GL	Generic Letter
IFI	Inspector Follow-up Item
INEEL	Idaho National Engineering and Environmental Laboratory
LSB	Load Sensitive Behavior
MOV	Motor-Operated Valve
NRC	Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
PORV	Power-Operated Relief Valve
PPM	Performance Prediction Methodology
S/O	Shutoff
SE	Safety Evaluation
SFC	Stem Friction Coefficient
TI	Temporary Instruction
VIO	Violation

LIST OF DOCUMENTS REVIEWED

Program Documents

- *D.C. Cook Nuclear Plant Motor-Operated Valve Closure Document, Revision 0, January 31, 1997
- *Cook Nuclear Plant Units 1 & 2 Motor-Operated Valve Program Description, Revision 5, February 1998

Procedures

- *Standing Order No. OSO.025, "Limitorque Valve Operators," Revision 6, October 22, 1997 (Superceded)
- *OHI-4016, "Conduct of Operations Guidelines," Revision 2, September 21, 1998
- *12IHP5030.EMP.002, "MOV Diagnostic Testing - VOTES," Revision 5, Change No. 11, December 2, 1997
- *EG No. PH&F-003, Generic Letter 89-10 Thrust Calculation Methodology," Revision 2, January 10, 1992
- UO-C-3700, "MOV Local-Manual Operations (Lab),"

Self-Assessments

- *EPRI Review of D. C. Cook Units 1 and 2 GL 89-10 Program, September 1998

Reports

- *Vectra Report 0012-00192-R01, "Justification for Extrapolation of Butterfly Valve Dynamic Test Data," Revision 1, January 20, 1997
- *DE&S Report 0012-00204-R01, "As-Left Stem/Stem Nut Coefficient of Friction," Revision 1, January 20, 1997
- *DE&S Report 0012-00204-R02, "Rate of Loading," Revision 1, January 20, 1997
- *DE&S Report 0012-00204-R03, "Valve Factor," Revision 1, February 5, 1997
- *GL 89-10 Compliance Sizing Factors Based on "Best Available Data," August 24, 1994
- *ComEd White Paper 164; "Anchor/Darling Double-Disk Gate Valve Factors," Revision 1
- *ComEd White Paper 160, "Crane Valve Factors," Revision 0
- *2272000-STG-69000-01 "Differential Pressure Test Review - Gate/Globe Valves," Revision 1, September 26, 1997

Letters

- *EPRI Letter, Planned Revisions to EPRI NP-7051 "EPRI Butterfly Valve Application Guide," January 30, 1997
- *Internal Memorandum A. R. Gort to F. R. Pisarsky, "Review of Motor Operated Valve Thrust Margin," February 5, 1997
- *Letter from Licensee to NRC dated July 31, 1998, with response to IR 96012 open issues.

MOV Information

- *GL 89-10 Closure Summary Reports
- *Matrix for Rising Stem MOV's, September 28, 1998
- *Matrix for Butterfly Valves, September 26, 1998

Calculations

- *Calculation No. DCCPV12MV001N, "GL 89-10 Thrust/Torque Calculation," Revision 11, March 3, 1997
- *Vectra Calculation No. 0012-00204-C02, "EPRI PPM Calculation for the PORV Block Valves 1(2)-NMO-151/152/153," Revision 0, October 11, 1996
- *Vectra Calculation No. 0012-00204-C03, "EPRI PPM Calculation for the SI Pump Suction Valves 1(2)-IMO-261," Revision 0, October 11, 1996
- *Vectra Calculation No. 0012-00204-C04, "EPRI PPM Calculation for 1(2)-IMO-314, 324,340,350," Revision 0, October 11, 1996
- *Calculation No. DCCPV12MV002N, "FMO Capabilities," Revision 1, May 6, 1992
- *Calculation No. HXP900814JRT, "Differential Pressure Calculation for Valves 1-NMO-151, 152, and 153," Revision 1, dated June 21, 1991

Condition Reports

96-0687, 97-1744, 98-2246, 98-4653, 98-4755, 98-3555, 98-5343