U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Reports No. 50-315/93006(DRS); No. 50-316/93006(DRS)

Docket Nos.: 50-315; 50-316 Licenses No. DPR-58; No. DPR-74

Licensee: Indiana Michigan Power Company
1 Riverside Plaza
Columbus, OH 43216

Facility Name: Donald C. Cook Nuclear Power Plant - Units 1 and 2

Inspection At: Bridgman, MI

Inspection Conducted: March 22 through April 1, 1993

Inspectors: K. D. Ward FOR
M. P. Huber — 4/23/93 Date

K. D. Ward FOR
G. D. Replogle — 4/23/93 Date

K. D. Ward FOR
J. F. Smith — 4/23/93 Date

Observer: D. E. Roth

Approved By: K. D. Ward FOR
J. M. Jacobson, Chief
Materials & Processes Section — 4/23/93 Date

Inspection Summary

Inspection conducted March 22 through April 1, 1993 (Reports No. 50-315/93006(DRS); No. 50-316/93006(DRS))
Areas Inspected: Announced safety inspection of the implementation of the licensee's response to Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve (MOV) Testing and Surveillance" (2515/109).
Results: The licensee developed and implemented a program which was progressing in accordance with the guidance of GL 89-10. The inspection disclosed two unresolved items (Sections 2.2.2 and 2.3) and two inspection followup items (Sections 2.3 and 2.8.1).

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DETAILS

1.0 Persons Contacted

American Electric Power Service Company (AEP)

D. F. Powell, Assistant Section Manager, Nuclear Engineering
S. J. Brewer, Group Manager, Nuclear Safety Licensing Coordinator
J. B. Kingseed, Manager, Nuclear Safety
J. A. Kobyra, Manager, Nuclear Design and Electrical Systems
S. P. Hodge, Manager, Mechanical Systems
R. L. Simms, Manager, Nuclear Assessment
W. G. Smith, Jr., Chief Nuclear Engineer
J. R. Anderson, Assistant Manager, Power Systems and Human Factors
M. J. Finissi, Electrical Engineer
L. DeMarco, Electrical Engineer
A. J. Lewandowski, Mechanical Engineer
J. G. Nogrady, Mechanical Engineer
R. A. Kadlec, Mechanical Engineer
T. A. Georgantis, Licensing Engineer
M. A. Wilken, Nuclear Safety
P. M. McCarty, Site Quality Assurance
R. H. Hevener, Quality Assurance Engineer
M. T. Buetlemann, Quality Assurance Engineer
G. P. Roulett, Nuclear Safety
C. J. Dudiak, Electrical Training

Indiana Michigan Power Company (IM)

A. A. Blind, Plant Manager
K. R. Baker, Assistant Plant Manager, Production
J. E. Ruteowski, Assistant Plant Manager, Technical Support
J. Wiebe, Safety & Assessment Superintendent
G. A. Weber, Plant Engineering Superintendent
A. Gort, MOV Coordinator
R. West, Licensing Coordinator, Safety and Assessment
P. Helms, Engineering Supervisor, Plant Engineering

Additional plant and corporate personnel were contacted during the inspection.

U. S. Nuclear Regulatory Commission (NRC)

J. A. Isom, Senior Resident Inspector

The persons listed above attended the exit meeting on April 1, 1993.

2.0 Inspection of the Implementation of the Program Developed in Response to Generic Letter 89-10

2.1 Selected MOVs

The licensee had 252 MOVs in the GL 89-10 program and differential pressure (dp) testing was planned for 153 MOVs. The inspectors selected the MOVs listed in Enclosure 2 for a detailed review to verify the adequacy of the program established in response to GL 89-10. The MOVs were selected on the basis of safety significance, previous test results, and to examine a cross-section of the MOV population. The details of the review are discussed in the remainder of the report.

2.2 Design Basis Reviews

2.2.1 Differential Pressure and Flow Requirements

The inspectors reviewed the licensee's design basis maximum expected differential pressure (MEDP) calculations and no significant anomalies were disclosed. The FSAR, technical specifications, normal, abnormal and emergency operating procedures, and other plant documents were reviewed to determine the worst case design basis conditions for each MOV. The most challenging conditions and resulting system condition calculations were used in the switch setting calculations.

2.2.2 Degraded Voltage Calculations

Degraded voltage calculations performed by the licensee were not done using the methodology described in GL 89-10 and its supplements. The calculations did not assume the worst case grid voltage as the starting point for evaluating the available voltage at MOV motors. The worst case grid voltage was considered by the NRC to be 0.896 per unit (pu) (just above the 4kV degraded voltage relay setpoint minimum value). Instead, the licensee used the minimum expected grid voltage (0.938 pu) based on a study of the previous grid history. The licensee considered this minimum expected value, not the minimum degraded voltage relay setpoint, as the licensing basis.

In response to the inspectors' concerns, the licensee performed MOV capability calculations for several marginal MOVs using .896 pu as the starting point. No immediate MOV operability concerns were noted as a result of the reduced electrical system capacity. However, further NRC review is required to determine the applicability of the licensee's grid history study to MOV capability determinations. Therefore, this issue is considered an unresolved item pending further review by the NRC (50-315/93006-01(DRS); 50-316/93006-01(DRS)).

The degraded voltage calculations did not include margins to account for the high ambient temperature effects on motor performance. However, Limitorque was evaluating the issue and was expected to provide the industry with information concerning this matter. The licensee planned to incorporate the information from Limitorque into the GL 89-10 program when it becomes available.

2.3 MOV Switch Settings

The inspectors reviewed the licensee's calculations and the MOV switch setting methodology for the selected MOVs. Independent calculations were performed by the inspectors for each MOV in the sample population to confirm the licensee's results. Concerns identified are discussed below.

The licensee did not justify assumptions for valve factors, stem friction factors and load sensitive behavior in the calculations for torque switch settings. Additionally, the licensee did not account for MOV degradation that may occur over the maintenance and refurbishment intervals. The stem lubrication interval for most MOVs was three refueling outages (approximately 54 months), which was considered excessively long. The Limitorque recommended lubrication interval was 18 months. The inspectors evaluated VOTES static test data for valve 1-ICM-305 and found the actual degradation of the MOV to be significant (the tests were performed just prior to and just after maintenance). The calculated stem friction coefficient prior to maintenance was 0.30 while the factor just after maintenance was 0.13. The analysis demonstrated that MOV degradation can occur and can be significant. Furthermore, the limitations in the OATIS diagnostic equipment used during testing inhibited the ability to quantify the assumptions. The licensee purchased the VOTES diagnostic equipment which will allow assumptions to be evaluated and quantified. The licensee planned to appropriately evaluate future test data and justify the assumptions for valve factors, stem friction factors, load sensitive behavior and MOV degradation used in the switch setting calculations. This issue is considered an inspection follow-up item pending further review of the licensee's justification (50-315/93006-02(DRS); 50-316/93006-02(DRS)).

Some thrust windows were calculated to be negative after the application of the OATIS inaccuracies. That is, the minimum required thrust exceeded the maximum permissible thrust. Torque switches on some MOVs were set at a point that may be greater than the motor capability under design basis conditions. As a result, the subject MOV motors could stall while closing, without tripping the torque switches. The licensee started an evaluation for each affected MOV to determine the potential consequences. This issue is considered an unresolved item pending further NRC review of the licensee's evaluation (50-315/93006-03(DRS); 50-316/93006-03(DRS)).

Valve structural limits were not included in the weak-link analysis performed for all safety-related MOVs. However, the licensee identified this deficiency prior to the inspection and planned to obtain the appropriate information from the valve manufacturers. This issue will be reviewed during a future inspection.

2.4 Design Basis Capability

The inspectors reviewed completed static and dp testing packages to verify the methodology used to demonstrate MOV capability. Fifty-two dp tests were complete at the time of the inspection and approximately 100 additional tests were scheduled to be performed prior to June 1994. The licensee had completed

more dp tests than most other licensees in Region III. The inspectors considered the progress of the dp testing program to be a strength.

2.4.1 Review of OATIS Diagnostic Traces

Anomalies observed during diagnostic testing were not always comprehensively evaluated. For example, OATIS diagnostic traces for MOVs 1/2-MCM-221 and 231 (auxiliary feed turbine isolation globe valves with flow under the seat) indicated that an unexpected pull-out force was required in the opening direction and the thrust requirements for closing were much less than expected. These irregularities could indicate lower than expected dp across the valves in the closing direction, reverse installation, or valve degradation. The lack of an evaluation for these particular MOV test results was not safety significant because the valves did not have a safety function to reposition against dp. However, the licensee was not aware of this fact at the time the traces were evaluated and indicated that other diagnostic traces, involving other MOVs, were evaluated in a similar manner.

The inspectors were also concerned with the accuracy of data taken during dp tests. The dp test data and subsequent analysis of the data must be accurate and comprehensive to allow for comparison of data and to justify assumptions that may be applied to valves that cannot be dp tested. The inspectors cautioned the licensee to thoroughly evaluate data and anomalies observed during testing. The licensee's evaluation of the traces was considered a weakness.

Dynamic testing results at less than design basis conditions were evaluated using a one point extrapolation method. The licensee did not provide multi-point testing or other justification for using the one point extrapolation. The program specified that the technique was sufficient for valve closure when at least 80% of the MEDP was achieved for some MOVs (MEDP greater than or equal to 500 psid) and 50% of the MEDP was achieved for other MOVs (MEDP less than 500 psid). The NRC inspectors considered the approach to be acceptable for the first stage of the two-stage approach outlined in GL 89-10. Extrapolating test results to the design-basis MEDP may require further qualification. This issue will be reviewed during a future inspection.

2.5 Periodic Verification of MOV Capability

The licensee planned to use static diagnostic testing to periodically verify MOV capability, however static testing may not be adequate to model MOV behavior under dynamic conditions. The plans met the GL 89-10 guidance with respect to frequency, but the licensee needs to justify the method used to provide assurance that an MOV would work properly when called upon. This issue will be reviewed during a future inspection.

2.6 MOV Failures, Corrective Actions and Trending

The inspectors reviewed problem reports associated with recent MOV failures. Evaluation of MOV failures and corrective actions appeared effective. The trending program was still evolving. Only failures were trended, but a program was under development that would trend performance parameters, with the intent of being more predictive.

2.7 Schedule

The licensee planned to meet the recommended schedule in GL 89-10 and testing was being accomplished as prescribed by the Program. However, the number of tests that remained indicate that it may be difficult to complete the planned dp testing within the schedule. Additionally, since the licensee was transitioning from the use of OATIS diagnostic equipment to the more comprehensive VOTES system, they may decide that some MOVs should be retested in order to obtain more useful data. The inspectors notified the licensee that results of the planned testing needed to be evaluated and incorporated into the program, as necessary, prior to program completion. If a testing schedule extension becomes necessary, the NRC should be notified as soon as possible.

2.8 Associated Reviews

2.8.1 Maintenance

Diagnostic testing was not performed after packing adjustments as long as the packing gland nut torque was not adjusted beyond a predetermined value. However, the licensee did not demonstrate that the torque limitation method was used since plant startup and sufficient testing was not performed to determine the actual packing loads for each MOV. An incorrect assumption for packing loads could cause other factors (such as valve factor) to be incorrectly calculated and excessive packing loads could challenge MOV operability.

The licensee based its position on a study performed by Chesterton Packing Company. The study showed that if the original packing gland nut torque was not exceeded the packing load would not change significantly. However, the test data was limited in that testing was only performed on one MOV and neglected the effects of various foreign materials (such as boric acid crystals that may be present at the stem/packing interface) or packing damage (that may occur as a result of a packing leak). As a result of the GL 89-10 Part 1 inspection, the licensee planned to perform testing on a sample of MOVs to justify the assumptions concerning packing loads. However, adequate measurement techniques were unavailable until recently when the licensee acquired VOTES diagnostic equipment. This is considered an inspection follow-up item pending a review of the licensee's justification (50-315/93006-04(DRS); 50-316/93006-04(DRS)).

Stem lubrication was required to be checked (not replaced) every three refueling outages for most MOVs and every refueling outage for MOVs in harsh environments. The licensee had not included a term for degradation in the switch setting calculations and the 3 refueling outage interval was excessive when compared to the 18 month interval recommended by Limitorque. Furthermore, since the procedure only required checking (not replacing) the lubrication, the actual lubrication interval for individual MOVs could be as long as six or more refueling outages. The licensee planned to implement changes to require replacing lubrication every three outages and to evaluate degradation as discussed in Paragraph 2.3.

2.8.2 Diagnostics

The accuracy recommendations provided by the OATIS diagnostic equipment manufacturer (ABB Impell) were based solely on test data from the MOV Users Group (MUG) validation testing program. The data from the MUG validation testing was very limited and may not be comparable to the results that might be observed at the D.C. Cook plant. Additionally, another diagnostic equipment manufacturer, with an almost identical system, performed independent testing and reported inaccuracy values significantly greater than the ABB Impell recommendations. This issue will be addressed in a future Supplement to GL 89-10. The licensee will be expected to justify the diagnostic equipment accuracy assumptions in response to the Generic Letter Supplement. The review of the OATIS equipment accuracy was identified as an unresolved item (50-315/91009-01(DRS); 50-316/91009-01(DRS)) during the Part 1 inspection and will remain open.

2.8.3 Walkdown

The inspectors performed a general inspection of the plant as well as a detailed inspection of several MOVs. In general, housekeeping was reasonable in most areas. However, four MOVs were leaking oil from the actuators. The licensee agreed to evaluate the leaks and take appropriate corrective actions.

2.8.4 Pressure Locking and Thermal Binding

The licensee's actions in the areas of pressure locking and thermal binding were considered acceptable. The early recognition and response to pressure locking was considered a strength.

Around 1975 (prior the publication of SOER 84-07), the licensee recognized the pressure locking/thermal binding problem and began modifying applicable gate valves by means such as equalizing lines. As subsequent information about pressure locking and thermal binding became available, additional corrective actions were implemented to resolve these problems. These actions included both equipment modification and procedure revisions. About 30 gate valves were modified.

The inspectors reviewed the normally closed valves in the systems where these problems were observed in other plants. The licensee took steps to preclude either pressure locking or thermal binding in all valves subject to those problems.

3.0 Licensee Self-Assessment

The licensee performed surveillances and audits of the GL 89-10 MOV program. The efforts in this area were considered to be acceptable. The audit compared the MOV program to the recommendations of GL 89-10 and to results of other MOV inspections. The surveillances reviewed aspects of the program related to plant quality control requirements.

4.0 Unresolved Items

Unresolved items are matters about which more information is required in order to ascertain whether they are acceptable items, items of noncompliance, or deviations. Unresolved items disclosed during this inspection are discussed in Sections 2.2.2 and 2.3 of this report.

5.0 Inspection Follow-up Items

Inspection follow-up items are matters which have been discussed with the licensee which will be reviewed further by the inspectors and which involve some action on the part of the NRC or licensee or both. Two inspection follow-up items were identified during this inspection and are discussed in Sections 2.3 and 2.8.1.

6.0 Exit Meeting

The inspectors met with licensee representatives (denoted in Paragraph 1) at the conclusion of the inspection on April 1, 1993. The inspectors summarized the purpose and scope of the inspection and the findings, including the unresolved items and inspection follow-up items identified during this inspection. The inspectors also discussed the likely informational content of the inspection report with regard to documents or processes reviewed by the inspectors during the inspection.

ENCLOSURE 2

MOV REVIEW LISTING

1-ICM-251 - BORON INJECTION TANK (BIT) TRAIN "B" OUTLET CONTAINMENT ISOLATION VALVE - SMB-0 - 4" gate

1-IMO-262 - SI PUMPS RECIRC TO RWST TK-33 TRAIN "A" S/O VALVE - SMB-00 - 2" globe

1-IMO-263 - SI PUMPS RECIRC TO RWST TK-33 TRAIN "B" S/O VALVE - SMB-00 - 2" globe

1-IMO-270 - SI PUMPS DISCHARGE CROSS-TIE TRAIN "A" S/O VALVE - SMB-00 - 4" gate

1-IMO-316 - EAST RHR & NORTH SI TO RCS LOOPS #1 & #4 COLD LEGS S/O VALVE - SMB-1 - 8" gate

2-IMO-262 - SI PUMPS RECIRC TO RWST TK-33 TRAIN "A" S/O VALVE - SMB-00 - 2" globe

2-IMO-263 - SI PUMPS RECIRC TO RWST TK-33 TRAIN "B" S/O VALVE - SMB-00 - 2" globe

2-IMO-256 - BIT TRAIN "B" INLET S/O VALVE - SMB-0 - 4" gate

1-IMO-340 - EAST RHR HX TO CENTRIFUGAL CHARGING PUMP (CCP) SUCTION S/O VALVE - SMB-1 - 8" gate

1-IMO-910 - RWST TO CVCS CCPS SUCTION HEADER TRAIN "A" S/O VALVE - SMB-00 - 8" gate

2-IMO-911 - RWST TO CVCS CCPS SUCTION HEADER TRAIN "B" S/O VALVE - SMB-00 - 8" gate