U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-461/94011(DRS)

Docket No. 50-461 License No. NPF-62

Licensee: Illinois Power Company
500 South 27th Street
Decatur, IL 62525

Facility Name: Clinton Power Station

Inspection At: Clinton Site, Clinton, Illinois

Inspection Conducted: May 9 - June 23, 1994

Inspectors: M. P. Huber — Date: 7/14/94

J. G. Guzman — Date: 7/15/94

W. D. Pegg — Date: 7/15/94

Approved By: John Jacobson, Chief
Material and Processes Section — Date: 7-14-94

Inspection Summary

Inspection from May 9 through June 23, 1994, (Report No. 50-461/94011(DRS)).
Areas Inspected: Routine, 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: This inspection focussed on the program implemented to address GL 89-10. No violations were identified. The MOV program was implemented in accordance with the licensee's commitments, however, progress towards completing the GL 89-10 was slow. Reliance on static testing to evaluate MOV performance was not adequately supported by the dynamic test database and its use was considered premature. An additional inspection will be necessary to close-out the GL 89-10 program review at Clinton Power Station (CPS). One unresolved item was identified (Section 3.2.2).

DETAILS

1.0 Persons Contacted

Illinois Power Company (IP)

*J. Cook, Vice President
*R. Morgenstern, Manager - CPS
*J. Miller, Manager - Nuclear Station Engineering Department (NSED)
*R. Phares, Director - Licensing
*R. Wyatt, Manager - Quality Assurance
*D. Korneman, Director - Systems and Reliability
*J. Langley, Director - Design and Analysis
*K. Moore, Supervising Engineer - Reliability
*J. Pilarski, Engineer - Licensing
*M. Reandeau, Licensing Specialist
*T. Wiggins, Supervising Engineer - NSED
*S. Hong, Engineer
*G. Smith, Assistant Supervisor - Maintenance
*J. Funston, Engineer - Generic Letter (GL) 89-10 Program
*J. Puzauskas, Project Manager - GL 89-10 Program
*M. Halstead, Assistant Project Manager - GL 89-10 Program
*K. Baker, Supervisor - GL 89-10 Mechanical Design
*D. Chiou, Project Engineer
*T. Danley, Supervising Engineer - GL 89-10 Program
*E. Halverson, Supervising Engineer - Mechanical Design
*M. McMenamin, Supervising Engineer - Electrical Design
*T. Ramanuja, Supervising Engineer - Civil/Structural
*D. Tucker, Project Specialist

Sergeant and Lundy

*T. Papadopoulos, Senior Engineer
*C. Martin, Mechanical Engineer

U. S. Nuclear Regulatory Commission

*M. Ring, Acting Deputy Director, Division of Reactor Safety (DRS), Region III
*G. Wright, Chief, Engineering Branch, DRS, Region III
*J. Jacobson, Chief, Materials and Processes Section, DRS, Region III

* Denotes those present during the exit interview on June 23, 1994.

The inspectors also contacted and interviewed other licensee personnel during the course of this inspection.

Mr. Tom Scarbrough from the Mechanical Engineering Branch, Nuclear Reactor Regulation (NRR), was also present on the inspection to review the licensee's reasonable assurance evaluations and collect information to support Clinton Station's GL 89-10 schedule extension request.

2.0 Licensee Action on Previous Inspection Findings (92701)

(Closed) Inspection Followup Item 50-461/93010-02(DRS): Question of consideration of abnormal events for MOVs. Guidelines for performing bounding valve differential pressure (DP) analysis specified that normal and abnormal operating conditions within the design basis be considered to determine maximum design-basis DP conditions. No problems were noted with the DP calculations reviewed by the inspectors. This item was closed.

(Closed) Inspection Followup Item 50-461/93024-01(DRS): Acceptance criteria justification for leak rate testing grouped containment isolation valves. The licensee performed leak rate testing of grouped containment isolation valves instead of individually, as allowed by relief from the ASME Code, Section XI requirements. Justification for the acceptance criteria was developed and appeared acceptable. This item was closed.

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

This Phase 2 inspection verified and evaluated the licensee's GL 89-10 program implementation by examining a cross-section of the Clinton MOV population. The following MOVs were reviewed during this inspection.

1E12F014A Residual heat removal (RHR) heat exchanger (HX) 1A shutdown service water (SX) inlet valve

1E12F014B RHR HX 1B SX inlet valve

1E22F012 High pressure core spray (HPCS) minimum flow bypass valve to suppression pool

1E51F019 Reactor core isolation cooling (RCIC) recirculation to suppression pool valve

1E51F063 RCIC steam line inboard isolation valve

1E51F064 RCIC steam line outboard isolation valve

1G33F004 Reactor water cleanup (RWCU) pump suction isolation valve

1SF001 Suppression pool cleanup (SPCU) return line outboard isolation

1SF002 SPCU return line inboard isolation

3.1 Program Scope

The inspectors reviewed the safety-related MOV population and found eight valves removed from the program with justifications which were not consistent with GL 89-10 recommendations. The licensee contended that operation of the valves during an accident was outside the design-basis (the valves would be in their safe position if an accident were to occur). The inspectors concern was that the valves would need to return to their safe position in the event that an accident were to occur while the valve was out of position during testing.

No testing was done to demonstrate that the MOVs could return to their safety position and Technical Specification limiting conditions for operation were not entered during testing. If the valves were not evaluated during the GL 89-10 program, it appeared that the protection provided by the Technical Specifications to prevent an excessive number of systems being unavailable to perform their safety function at any particular time would have been bypassed (by the inability of the valves to return to their safe position). The MOVs were added back into the program during the inspection, however, the licensee planned to further evaluate and determine if the MOVs should remain in the program.

The eight valves incorrectly deleted were:

1E12-F021, RHR pump 1C test return valve to suppression pool
1E21-F012, LPCS test return valve to suppression pool
1E22-F010, HPCS test return line valve
1E22-F011, HPCS test return line valve
1E22-F023, HPCS suppression pool test bypass valve
1E51-F022, RCIC test return valve
1E51-F059, RCIC test return valve
1E51-F076, RCIC steam line warmup inboard containment isolation valve

The justification for the removal of all other MOVs from the GL 89-10 program was satisfactory.

3.2 Design Basis Reviews

3.2.1 Differential Pressure and Flow Requirements

The inspectors reviewed the design basis maximum expected DP calculations and found them to be acceptable. The piping diagrams; Final Safety Analysis Report (FSAR); technical specifications; normal, abnormal and emergency operating procedures (EOP), and other plant documents were reviewed to determine the worst case design basis conditions for the sample of MOVs reviewed. The conditions assumed were appropriate.

3.2.2 Degraded Voltage Calculations

The methodology used for calculating MOV motor terminal voltage was not consistent with both current industry practice and NRC accepted methods. The licensee used a lesser current value equivalent to that required to produce rated motor torque, instead of the currently accepted locked rotor value. Using the smaller current value gives less of a voltage drop and therefore, greater apparent motor capability. This position was not justified at the time of the inspection, however, the licensee was participating in a test program designed to evaluate motor performance characteristics with the intent of justifying their position. Using locked rotor current and recalculating the voltages for the capability analysis did not result in any degraded or inoperable valves, although the available margins decreased. Since the voltage calculation methodology may overestimate the capability of the MOVs, the position was considered an unresolved item pending the completion of the licensee's test program and further review by the NRC (50-461/94011-01(DRS)).

3.3 Design Basis Capability

3.3.1 MOV Switch Settings

The licensee intended to justify use of a valve factor of 0.5 for all MOVs by using what was termed as the "anomaly factor" methodology. This methodology was based on using data obtained during static testing and correlating the static test performance to the expected DP performance. This method attempted to correlate the duration of an interference observed in a static trace during unseating and/or prior to wedging and the measured valve factor. Ultimately, it was hoped that the method would minimize the need to dp test since the static test would verify a valve's ability to function at design basis conditions. The amount of DP testing performed to justify the anomaly factor methodology was extremely limited and was not sufficient to demonstrate that the valve factors assumed would be adequate. Although the method shows promise for determining the expected dynamic performance of an MOV based solely on static testing, additional DP testing would be necessary to justify the anomaly factor methodology. Based on the inspectors concerns, 20 MOVs were added to the DP test program and grouping would be used to justify the operability of those MOVs not DP tested. The licensee's grouping methodology was discussed in Section 3.3.3 of this report. The decision to rely almost entirely on an unconfirmed method to partly justify valve operability was considered a weakness in the management of the MOV program.

Torque and thrust calculations were based on the standard Limitorque methodology with margin added for stem lubrication degradation, diagnostic equipment inaccuracies, torque switch repeatability, and degraded voltage. No margin was include for load sensitive behavior (LSB) based on the Clinton DP test results which showed LSB outside of the instrumentation errors on only two MOVs. The evaluations for the two MOVs and their potential generic impact will be documented. Additionally, any LSB observed during future DP tests and information from other industry testing will be evaluated for potential generic implications and an appropriate margin provided (if necessary) prior to program closure.

A stem lubrication degradation test program was underway at CPS to justify the margin for stem lubrication degradation incorporated into the thrust calculations. The documented resolution of this issue will be reviewed by NRC prior to program closure.

3.3.2 MOV Testing Acceptance Criteria

The NRC inspectors reviewed procedures ME-07, "Engineering Evaluation of MOV Test Results", Revision 5, dated May 6, 1994 and ME-04 "Stem Thrust/Torque Evaluation for MOVs," Revision 3, dated May 6, 1994. Both procedures provided instructions for the evaluation of data from design basis testing. Although, overall, the procedures were adequate, the inspectors noted some reduced margins and the need for clarification including:

(a) The maximum opening forces at the design basis DP were determined using the force at disc pullout (09). In some cases, the maximum forces may be after disc pullout (010), therefore, evaluations should be done using the greater of either 09 or 010, extrapolated as appropriate.

(b) Appropriate accuracy adjustments in accordance with recommendations from the diagnostic equipment manufacturer, specifically Liberty Customer Service Bulletin 31, had not been made for data outside the calibration range.

(c) DP test acceptance criteria did not specifically verify that the thrust, extrapolated as necessary, was above the bottom of the calculated thrust window at Control Switch Trip (C14).

The licensee reviewed all MOVs that had been dp tested and confirmed that the issues raised above did not impact valve operability. The procedures were revised to make the necessary corrections.

During review of the dynamic test package for MOV 1SF002 (SF Return Inboard Isolation Valve) it was noted that the valve had been accepted with little or no margin for stem lube degradation. Supplemental evaluations were performed to demonstrate continued operability. The as-left torque switch setting did not allow for stem lube degradation and the setting could not be raised because the resulting thrusts would be too close to the top of the thrust window (the valve disc being the weak link). Long-term modifications were planned to replace the disc and possibly other valve components. For the short term, the licensee reduced the stem lube frequency from eighteen to three months to address the lack of margin for degradation. This response was acceptable.

Linear extrapolation was used to determine MOV operating characteristics at design-basis conditions if the DP test did not achieve 100% of design-basis conditions. Information from the EPRI MOV performance test program was used as justification for using linear extrapolation. The licensee planned to document this position before program closure.

3.3.3 Differential Pressure Testing

Early in the inspection, the licensee presented the NRC with Clinton's initial grouping concept. Grouping was based on the anomaly factor methodology discussed in Section 3.3.1. However, due to the preliminary nature of the methodology and the low number of supporting DP tests, the NRC informed Clinton that without further justification and validation, the method was unacceptable as a basis for grouping. Additionally, the low number of gate valves that were DP tested at Clinton (19 gates) did not provide sufficient data to validate or strongly justify other programmatic assumptions. The licensee agreed to expand the DP testing scope and revised their grouping plan to reflect twenty additional MOVs scheduled for DP testing. The new grouping plan was reviewed by the inspectors and appeared to meet the guidance of GL 89-10 Supplement 6. CPS also intends to pursue a parallel path and continue to collect and evaluate test data to support the anomaly factor methodology.

Some MOVs that appeared to be testable were not included in the DP test plan. Although the licensee reviewed the testability of the emergency core cooling system (ECCS) injection valves and documented that the valves were not testable, the inspectors stated that ECCS injection valves at other same or similar vintage plants were tested. Additionally, these valves were part of a group that had no valves which would be tested at CPS. If the MOVs were

tested, CPS DP test data would be available to justify the design-basis capability for this class of valves. Without any plant specific DP test data, this justification would be more difficult. The licensee was continuing to review the testability of these valves.

3.4 MOV Brakes

Motor brakes were not added to any MOV in the Clinton GL 89-10 program and therefore were not a concern.

3.5 Schedule

The licensee applied for a schedule extension to complete their GL 89-10 program. Initially, only static testing not yet performed on MOVs and three DP tests were included in the extension request. However, 20 DP tests were added to the test program during the inspection. The approval of the extension request is largely dependent on the reasonable assurance that the MOVs would be capable of performing their design basis functions. Preliminary review of the valves included in the extension did not result in operability concerns. The licensee will pursue formal approval of the extension with NRR.

3.6 Periodic Verification of MOV Capability

The licensee intends to periodically verify the capability of the GL 89-10 valves as part of an Equipment Reliability Program that uses trending and feedback of results from testing, maintenance and monitoring/managing of MOV related activities. The periodicity and extent of further testing had not been established at the time of the inspection, and will be finalized by August of 1994. The licensee planned to perform static tests on valves and dynamically test valves "if necessary" to validate the anomaly factor and other MOV-related issues.

If validated, the anomaly factor methodology may possibly be applied to minimize dynamic testing for the purposes of periodic verification. Periodic verification will be reviewed prior to program closure.

3.7 Maintenance

The inspectors performed a review of MOV maintenance histories, reviewed relevant maintenance procedures, and interviewed maintenance personnel. The inspectors concluded that MOV preventive and corrective maintenance was generally performed in an acceptable manner.

The majority of maintenance work requests (MWRs) were well documented, the maintenance procedures reviewed were well written, and the quality of maintenance performed was acceptable. Several problems were noted, however, particularly with the 1E12F014A gear modification and testing during refueling outage (RF) 4. Procedural inadequacies contributed to multiple overthrusts of the actuator during testing and inattention to detail resulted in inadvertent removal of the declutch spacer and improper installation of the declutch link. In addition, when it was initially discovered that the declutch spacer was missing, the maintenance personnel questioned whether the spacer was required

and concluded, improperly, that the actuator may not require the spacer. This lack of a questioning attitude appeared to be an isolated instance and the error was quickly discovered and resolved by the following shift. While none of these problems resulted in degraded equipment, they did significantly increase the time devoted to the modification and testing. These problems had been identified by the licensee and appropriate corrective actions were taken.

Additional evidence of inattention to detail was found in a quality assurance audit of maintenance performed on 1CY017. During this maintenance activity, a damaged torque switch was removed and inadvertently reinstalled due to a failure of the technicians to tag, and later recognize, the defective switch. Other minor instances were noted, such as in MWR D52667, where two mutually exclusive steps were signed off. The incidence of and consequences of inattention to detail did not appear to be excessive or egregious. On the positive side, quality verification and maintenance personnel did a commendable job in identifying and recovering from these errors. However, the limited scope of review indicated that this area may warrant increased attention.

Preventive maintenance activities appeared to be well controlled and PM periodicity, such as stem lube frequency, were consistent with vendor recommendations. No problems were noted.

3.8 MOV Failures, Corrective Actions and Trending

The inspectors reviewed condition reports, primarily those issued within the past year, involving safety-related MOVs. The conditions identified within those reports were not indicative of generic problems and the corrective actions taken appeared to be appropriate.

Several actuator overthrusting events were reviewed. The cause of each incident was addressed through procedural revisions, when appropriate. The engineering evaluations were reasonable and corrective actions, such as component inspection and replacement, were performed as required.

Three instances of loose motor pinion gears were documented in recent condition reports. The motor pinion gears set screws had backed off and were not engaged in the drilled spot on the motor shaft. The root cause was attributed to inadequate installation of the motor pinion gear set screw due to insufficient detail in the maintenance procedure.

Thirty-three safety-related MOVs, of which 17 were PRA significant valves, had the motor pinion removed and reinstalled utilizing the aforementioned maintenance procedures. From this population, a sample of three PRA MOVs were selected for inspection. If any of the valves in this sample were found to have loose motor pinion gears, then the remaining PRA MOVs would be inspected. The inspectors were concerned with the small sample size chosen and focus of the inspection; however, the existing corrective actions, licensee testing efforts in this area, and heightened sensitivity to this issue should be sufficient to identify any equipment problems. The MOV inspections were not complete at the time of the inspection and the results of efforts in this area will be reviewed at a later date.

The licensee was implementing an integrated MOV database to trend and feed back known trending parameters and results from PM tasks, MOV testing, and corrective maintenance actions down to the component level. The program appears to be effective as evidenced by a reduction in the number of MOV failures experienced at the plant over the past few years.

The NRC inspectors reviewed sample problem reports associated with recent MOV failures. The failures appeared to be properly diagnosed and corrective actions appeared to be adequate.

3.9 Supplement 5 to GL 89-10

GL 89-10, Supplement 5, issued June 28, 1993, requested licensees to reexamine increased inaccuracy of MOV diagnostic equipment, such as MOVATS, and any other information reasonably available to them.

Prior to issuance of Supplement 5, thrust verification testing was performed to determine if MOVs set up using MOVATS would be able to operate under design basis conditions. The maximum diagnostic inaccuracies available at that time were applied to the MOVs in the program and a population of thirty MOVs was chosen, based on available margin, to retest using VOTES test equipment. The licensee concluded from the test results that the equipment was inaccurate and caution must be taken when using the as-left MOVATS data.

The September 30, 1993, response to Supplement 5 stated that IP had taken appropriate actions to address inaccuracy concerns of diagnostic equipment and that future inaccuracy issues associated with diagnostic equipment will be evaluated and appropriate actions will be taken. However, the January 1994, extension request stated that the MOVs in the extension request included no allowance for potential diagnostic inaccuracy or torque switch repeatability. The licensee concluded that this was acceptable as an interim analysis since these were low-safety-significance MOVs and there was margin in the design assumptions.

The inspectors were concerned that there was no margin to account for equipment accuracies and torque switch repeatability and noted ten MOVs which had insufficient margin to encompass these inaccuracies. At the inspector's request, the licensee performed capability analyses for these and other MOVs to provide reasonable assurance of MOV operability. Plans were in place to retest all MOVs, incorporating appropriate accuracies, prior to program closure. Although the inspectors did not identify any operability problems with the MOVs reviewed, it was apparent that the issue of diagnostic equipment inaccuracies was not thoroughly addressed following issuance of Supplement 5. The corrective action taken in response to Supplement 5 was considered a weakness and will be reviewed during a future inspection.

3.10 Pressure Locking and Thermal Binding

The inspectors reviewed the evaluation of the potential for pressure locking and thermal binding of gate valves. The licensee evaluated the fifteen most safety significant valves, as determined by PRA, and was scheduled to complete the evaluation of all MOVs in the program by October 1994. Four valves (RHR LPCI mode isolation valves 1E12F042 A, B & C and LPCS injection valve

1E21F005) were found to be susceptible to pressure locking. Modifications were scheduled for three of the valves in the next refueling outage (RF5), the remaining valve was scheduled for modification during RF6.

Calculation IP-M-309 evaluated the capability of the four susceptible MOVs to overcome a predicted thrust requirement for pressure locking on an interim basis until the modifications were performed. For the capability evaluation, a stall torque efficiency of 1.4 was used to determine actuator capability during pressure locking conditions. It was noted that 1.4 was not the correct efficiency. The calculations were revised using a more realistic maximum motor output torque and all the valves were still able to overcome the predicted thrust requirements. Interviews with the licensee's staff and a review of design and testing documents indicated that the licensee was aware that stall torque efficiency of 1.4 should only be used for actuator overload analysis and not for reliable actuator output. Its use in the pressure locking calculation was considered an anomaly, caused by a lack of communication between the design engineering groups. Actions regarding pressure locking and thermal binding will be reviewed and evaluated during a future inspection following issuance by NRC of generic correspondence on this issue.

4.0 Licensee Self-Assessment

GL 89-10 program reviews and other MOV related activities were frequently evaluated by the licensee. Engineering Assurance Informal Assessments evaluated the entire program and related modifications. Periodic GL 89-10 Program Reports was a method where one individual provided continuous feedback on GL 89-10 related activities. The self-assessment scope was broad and the Informal Assessments and Program Reports were thorough when addressing issues. One assessment (issued May 6, 1994) identified many issues related to those in this report, however, it did not appear that the lack of DP testing to justify program assumptions was identified. Items were identified as "potential issues" for this inspection and the report stated these issues needed to be resolved prior to this inspection. Although the report identified concerns, there was little time for any action to be taken by the licensee prior to this inspection. Self-assessment findings, particularly from the May 6, 1994 Informal Assessment should continue to be pursued and resolved in a timely manner.

5.0 Training

Training was provided to plant maintenance and engineering personnel on various GL 89-10 related topics. A test loop, consisting of piping, pumps, and valves, was installed at the plant to allow students to become familiar with the type of situations that may be seen in the plant. No training deficiencies were noted during this inspection.

6.0 Unresolved Items

Unresolved items are matters about which more information was required in order to ascertain whether they are acceptable items, items of noncompliance, or deviations. An unresolved item disclosed during this inspection was discussed in Section 3.2.2 this report.

7.0 Exit Meeting

The inspectors met with licensee representatives (denoted in Paragraph 1) at the conclusion of the inspection on June 23, 1994. The inspectors summarized the purpose and scope of the inspection and the findings. The inspectors also discussed the likely informational content of the inspection report with regard to documents or processes reviewed during the inspection. The licensee did not identify any such documents or processes as proprietary.

ATTACHMENT 1

CLINTON VALVE DATA

VALVE NUMBER	VALVE SIZE	TEST CONDITIONS (psid)		PERCENT DESIGN BASIS		STEM FRICTION COEFFICIENT[2]		DYNAMIC VALVE FACTOR[1]		LSB[3] %
		OPEN	CLOSE	OPEN	CLOSE	DYNAMIC	STATIC	OPEN	CLOSE	
1E12F014A	18" 150# GATE	*	131	*	86	*	0.20	*	0.42	4.6
1E12F014B	18" 150# GATE	106	113	73	72	0.13	0.13	0.41	0.36	-3.7
1E22F012	4" 900# GATE	1477	1477	102	100	0.14	0.14	0.48	0.19	-13.0
1E51F019	3" 900# GLOBE	790.9	800.9	70	69	*	0.08	*	0.20	8.8
1E51F063	8" 600# GATE	*	*	*	*	*	0.14	*	*	*
1E51F064	8" 600# GATE	*	*	*	*	*	0.13	*	*	*
1G33F004	6" 600# GATE	*	*	*	*	*	0.08	*	*	*
1SF001	10" 150# GATE	*	124	*	98	0.16	0.15	*	0.35	*
1SF002	10" 150# GATE	*	121	*	95	0.11	0.12	*	0.64	-2.4

ALL VALVES ARE ANCHOR/DARLING

[1] The dynamic valve factors listed were calculated by the licensee using a mean seat diameter.

[2] Stem Lubricant Nebula EP-0

[3] A negative number indicated that the thrust observed at CST during the dynamic test was greater than the thrust observed at CST during the static test.

* Not Applicable