

U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Reports No. 50-373/92023(DRS); No. 50-374/92023(DRS)

Docket Nos. 50-373; 50-374 Licenses No. NPF-11; No. NPF-18

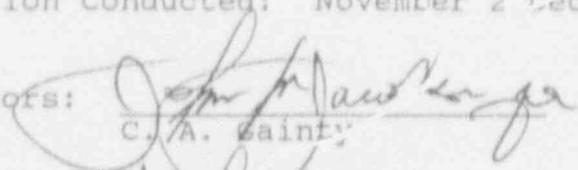
Licensee: Commonwealth Edison Company  
Opus West III  
1400 Opus Place  
Downers Grove, IL 60515

Facility Name: LaSalle County Nuclear Station  
Units 1 and 2

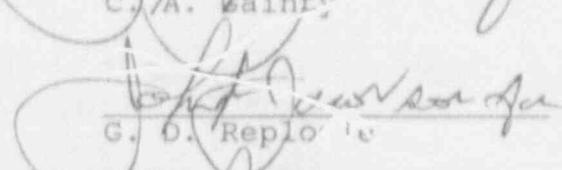
Inspection At: LaSalle Site, Marseilles, Illinois

Inspection Conducted: November 2 December 14, 1992

Inspectors:

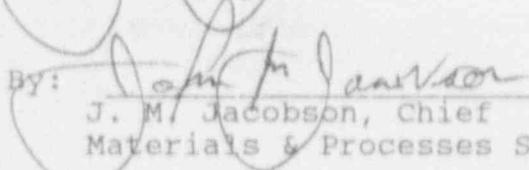
  
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12-16-92  
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12-16-92  
Date

Inspection Summary

Inspection conducted November 2 through December 14, 1992  
(Reports No. 50-373/92023(DRS); No. 50-374/92023(DRS))

Areas Inspected: Announced safety inspection 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 has developed a program which is generally consistent with the guidance of GL 89-10. The inspection disclosed two violations, (Paragraph 2.b.(3)) and three unresolved items (Paragraphs 2.b.(3), 2.b.(4) and 2.b.(5)).

The licensee demonstrated strengths in the following areas.

- ° The licensee conducted testing of DC motors and proved that the torque output of the motors was predictable below the 70% voltage rating that was recommended by the vendor. Although the testing was conducted at significant expense, the licensee freely shared the information with the rest of the industry.

The licensee demonstrated weaknesses in the following areas:

- ° Engineering did not demonstrate a thorough understanding of the equations used to evaluate MOVs and inappropriately used Limitorque's "stall torque" equation to evaluate MOV capability, which resulted in a violation of NRC requirements.
- ° The methods used to evaluate data from design basis testing did not ensure that MOVs could perform their safety functions under design basis conditions. Additionally, when instruments indicated that actual locked rotor current values were greater than assumed, appropriate steps to evaluate the data were not taken.
- ° Additional steps to address negative thrust windows, as specified in the program document and White Paper 107, were not taken until concerns were raised by the NRC inspectors.
- ° Due to the lack of a procedure or adequate training for mechanics on valve stem lubrication, the stem lubrication was not consistently performed.
- ° Torque switches were set in the opening direction, without proper evaluation, at the same value as that calculated for the closing direction. This issue had been identified during previous NRC inspections of CECO facilities.

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## DETAILS

### 1. Persons Contacted

#### Commonwealth Edison Company (CECo)

- G. Diederich, Station Manager
- \*#B. Adams, ENC-Regulatory Assurance
- \* W. Huntington, Technical Superintendent
- \*#L. Melander, LaSalle Technical Staff
- \*#H. Mulderink, BWR MOV Coordinator
- \*#B. Rybak, ENC-Mechanical and Structural Design Superintendent
- #J. Schmeltz, Production Superintendent
- #B. Smith, MOV Coordinator
- \*#R. Ungeran, MOV Program Administrator
- \*#R. Williams, Regulatory Assurance, NRC Coordinator

#### U. S. Nuclear Regulatory Commission (NRC)

- #D. Hills, Senior Resident Inspector
- #C. Phillips, Resident Inspector

#Denotes those attending the exit meeting on November 20, 1992.

\*Denotes those participating in the telephone exit December 1, 1992.

### 2. Inspection of the Program Developed in Response to Generic Letter 89-10

#### a. Supplement 3 to Generic Letter 89-10

In a letter to the NRC dated September 5, 1991, the licensee stated that 4 MOVs within the scope of Supplement 3 to GL 89-10 were deficient and that modifications were planned to resolve the deficiencies. The NRC inspectors reviewed the progress of the modifications and found that the necessary work was being completed on schedule.

#### b. Generic Letter 89-10 Program Review

The NRC reviewed Commonwealth Edison's commitments to Generic Letter 89-10, submitted to the NRC by letter dated September 28, 1990. Additional commitments regarding the program were submitted to the NRC by letter dated May 11, 1992. The CECO corporate level GL 89-10 program and Nuclear Operations Directive NOD-MA.1, "Guidelines for Motor Operated Valve (MOV)

Testing, Maintenance and Evaluation," Revision 2 were implemented at LaSalle by procedure LAP-300-31, "Motor Operated Valve Program." The licensee had developed a program that was generally consistent with the GL and this is discussed in more detail below.

(1) Scope of the Generic Letter Program

The inspectors reviewed system drawings for reactor water cleanup, residual heat removal, high pressure core spray, and low pressure core spray as a sample check for the completeness of the scope of the program. There were 301 MOVs included in the program at LaSalle Station. At the time of the inspection, the licensee was in the process of removing six MOVs from the program with appropriate justification. The inspectors determined that the scope of the licensee's program was consistent with the guidance of GL 89-10.

(2) Design Basis Reviews

(a) Differential Pressure (dp) Requirements

The NRC inspectors reviewed design basis dp requirements for a sample of MOVs. No problems were noted.

(b) Reduced Voltage Capability

Some of the design basis documents incorrectly specified the use of the diesel generator voltage instead of the worst case grid voltage (as specified in the GL) as a starting point in the calculations. However, further investigation revealed that the proper worst case grid voltage was actually used in the calculations. Changes to the design basis documents to correct the inaccurate information may be appropriate.

During design basis testing, the actual motor current measured, for some MOVs, exceeded the nameplate locked rotor current and appeared to indicate that the locked rotor current was higher than originally assumed. However, the licensee had not taken steps to evaluate new information with respect to the degraded voltage calculations. The inspectors

considered the failure to evaluate pertinent data from testing in the MOV evaluations to be a weakness.

The program did not consider the effects of high ambient temperatures on the performance of MOV motors. However, Limitorque was performing testing and analysis to address this issue. The licensee planned to incorporate the information from the testing into the program when it becomes available.

The licensee conducted testing of DC motors and demonstrated that the torque output of the motors was predictable below the 70% voltage rating that was recommended by the vendor. Although the testing was conducted at significant expense, the licensee freely shared the information with the rest of the industry. The licensee's efforts in the area of DC motor testing was considered to be a strength.

(3) MOV Switch Settings

MOVs that appeared to be undersized using the standard industry equation for sizing were reevaluated using Limitorque's "stall torque" equation to determine operability. The inspectors considered the use of the stall torque equation, for this application, to be inappropriate. Limitorque's intended use of the equation was to evaluate the potential for damage to valves and/or actuators using conservative factors that bounded the capability of the actuator. The equation included conservatism to account for the inertial energy imparted to the unit when the valve disc was mechanically stopped by slamming it into the seat and does not represent potential MOV capability. The licensee did not have appropriate technical justification for deviating from the standard industry equation. The inappropriate use of the stall torque equation is an example of a 10 CFR 50, Appendix B, Criterion III violation (50-373/92023-01(DRS); 50-374/92023-01(DRS)).

On November 18, 1992, the NRC inspectors met with representatives from the licensee's staff to discuss the violation. At the meeting, the licensee presented a telephone conversation record (dated February 6, 1991) which was drafted on Bechtel letterhead and was signed by a Bechtel

representative and a Limitorque representative. The record outlined the factors that could be used to determine MOV capability for "blowdown valves" (addressed in Supplement 3 to GL 89-10) and was presented as justification for deviating from the standard industry equation for sizing. The approach closely approximated Limitorque's stall torque equation, but made no mention of the application factor (normally assumed to be .9 in the standard sizing equation and 1.0 in the stall torque equation). The licensee's use of an application factor of 1.0 yielded an even less conservative result than would have been obtained by following the guidance specified in the Bechtel document. The inspectors were concerned with the specifics of the document because they appeared to conflict with documented guidance which Limitorque published in Maintenance Updates 89-1 (issued in 1989) and 92-1 (issued February, 1992). Furthermore, the Electrical Power Research Institute's "Application Guide for Motor-Operated Valves in Nuclear Power Plants," (dated March 1990) specifically recommended against using stall efficiency to evaluate MOV capability.

On November 19, 1992, the NRC inspectors contacted a Limitorque representative in an attempt to resolve the above noted discrepancy. The Limitorque representative informed the inspectors that the individual that signed the Bechtel document was once a sales representative for Limitorque but was not authorized to sign technical concurrence documents. Furthermore, the information contained in the document did not represent Limitorque's technical position, nor did it reflect Limitorque's position at the time the document was issued. The representative also indicated that he had previous discussions with CECO on this issue and advised the utility that Limitorque recommended against that the use of the stall torque equation for determining operability. The inspectors considered the Bechtel document to be inappropriate justification for the licensee's position. Furthermore, the information given to the NRC was not accurate because it was presented in a manner which implied that it was Limitorque's technical position. The presentation of inaccurate information to the NRC inspectors was considered to be a violation of 10 CFR 50.9 (50-373/92023-02(DRS); 50-374/92023-02(DRS)).

The results from the dp testing at LaSalle appeared to indicate higher stem friction factors, higher valve factors and greater effects from load sensitive behavior for some MOVs than was originally assumed. The licensee had compiled test data from all six CECO sites and estimated that an average valve factor was between 0.4 and 0.5. It is the intent of GL 89-10 that test data be evaluated for applicability to the overall MOV program.

The "Generic Letter 89-10 Program Document," (Revision 1, dated October 15, 1991) and "White Paper 107" (Revision 0, dated January 24, 1991) indicated that additional steps would be taken to address MOVs which had negative thrust windows (the maximum thrust capability or structural limit was below the minimum required thrust for operation). However, several MOVs had negative windows (at the end of the maintenance cycle, a degraded condition) but additional steps to address the deficiencies had not been taken. As a result of the concerns expressed by the NRC inspectors, the licensee increased the lubrication frequencies on the subject MOVs. At the new maintenance frequency the windows were no longer negative. The failure to address the negative thrust windows as specified in the above noted documents was considered to be a weakness.

Close torque switches were set to values consistent with design basis thrust requirements for closing. Open torque switches were set to match the close torque switch settings, although, in some instances the required opening thrust was much greater than the required closing thrust. As such, the open torque switch setting may be inadequate because of the potential to set the switches too low. In response to the NRC concern, the licensee reviewed all the existing open torque switch settings at LaSalle to ensure that operability concerns did not exist. This issue was previously raised at other CECO facilities. Because this inspection at LaSalle showed that the licensee's practice had not changed, the inspectors considered the failure to previously evaluate this issue to be a weakness.

Upon completing its evaluation of the backlog of MOV test data, CECO will be expected to incorporate the results of the assessment of the test data into its MOV sizing and switch setting

methodology in accordance with GL 89-10 guidance. For example, the thrust windows for the tested MOVs will need to be corrected where the thrust requirements were found to be greater than predicted. For those MOVs that will not be tested under dynamic conditions, test results from valves similar in type and service, must be considered in the evaluation of valve capability.

The licensee stated that, in determining the acceptability of certain MOVs, it had relied on the results from a study by Kalsi Engineering of the capability of Limitorque actuators to withstand thrust greater than their published ratings. The Kalsi study has been endorsed by Limitorque for thrust levels above the published ratings for its SMB actuators for those licensees that have the report and have addressed its caveats. CECo however, did not have a documented evaluation addressing the provisos of the Kalsi report. The lack of a documented evaluation of the provisos constitute an unresolved item pending NRC review of the licensee's evaluation (50-373/92023-03(DRS); 50-374/92023-03(DRS)).

(4) Design Basis Differential Pressure and Flow Testing

Approximately 14 dp tests had been performed at the time of the inspection. In general, the test results indicate that several original assumptions utilized for MOV operability evaluations were not conservative. It is, however, recognized that bounding all factors considered in the evaluation of MOV performance may not be practicable or appropriate and may lead to an unrealistic compounding of conservatisms. However, it is the intent of GL 89-10 that values of individual factors be evaluated such that when combined, they provide reasonably conservative bounds on actuator performance. Results from the testing are summarized below.

- (a) Stem friction factors varied between 0.08 and 0.16 during design basis testing (seven dp tests) and did not appear to be bounded by the 0.15 stem friction factor that was assumed for most safety-related MOVs in a non-degraded condition. Furthermore, testing conducted at other facilities, and at the Electrical Power Research Institute, indicated that some MOVs may experience stem

friction factors significantly greater than the 0.15 value that was originally assumed.

- (b) Flex-wedge gate valve factors varied between 0.22 and 0.9 during design basis testing. Of the nine valves tested, only one valve (which was tested at a very low dp) exhibited a valve factor which was bounded by the 0.3 valve factor that was assumed for most gate valves.
- (c) Globe valves exhibited valve factors that varied between 0.02 and 2.08 during design basis testing. Of the five globe valves tested, only one had a valve factor greater than 1.0. Since it is not theoretically possible to have a globe valve with a valve factor less than 1.0, the data may indicate inaccuracies in the measurement of dp or some other parameter. Generic difficulties in measuring test parameters may affect the data generated for all design basis tests. Further investigation into this issue is appropriate.
- (d) The licensee had not accounted for load sensitive behavior (rate-of-loading) in the methods for setting torque switches. However, load sensitive behavior was observed during most of the design basis tests and varied between 2% and 23%.

The inspectors reviewed the results and the licensee's evaluation of the 14 design basis tests that had been completed at LaSalle. LTS-600-26 requires that the acceptance criteria for differential pressure tests be satisfied before tested MOVs are returned to service. The acceptance criteria of LTS-600-26 evaluate the capability of the tested MOV to provide the required thrust extrapolated to design-basis conditions for both opening and closing the valve. The inspectors identified several weaknesses in the acceptance criteria. Specifically, the acceptance criteria did not include consideration of diagnostic equipment inaccuracy or torque switch repeatability in evaluating the capability of the MOV (for example, motor actuator capability). The acceptance criteria also did not consider torque requirements or load sensitive behavior to ensure motor actuator capability under degraded voltage conditions. Finally, the

acceptance criteria did not justify the omission of extrapolation of the opening thrust requirement from test conditions to design-basis conditions (an example was the acceptance criteria evaluation for 2WR040). The inspectors did not identify any operability concerns for the tested MOVs resulting from these specific weaknesses in the acceptance criteria at this time. The licensee was currently in the process of revising its acceptance criteria in response to a violation of 10 CFR 50 Appendix B Criterion V identified at Dresden. This is an area that will be reviewed during the part 2 inspections.

LaSalle had performed some testing at less than 80% of the design basis differential pressure for the MOV, which does yield valuable information. However, the inspectors found that LTS-600-26 did not require the evaluation of test data if the test was conducted at less than 80% of full dp. The inspectors reminded the licensee that testing MOVs at less than 80% of their design basis differential pressure can indicate MOV operability problems. For example, the test may reveal that little margin exists between MOV capability and thrust requirements at the test pressure such that the operability of the MOV under design basis conditions is questionable. The results of tests at less than 80% of design basis differential pressure can also be important in supporting the basis for any planned grouping of MOVs in demonstrating their design basis capability. As with any data that may reveal problems with safety-related equipment, the licensee is required to assess the applicability of the test data and to determine whether any operability concerns exist based on that data. The licensee agreed that such an evaluation should be conducted and stated that the results of tests conducted below 80% of design basis differential pressure would be evaluated before returning the MOV to service. This is considered an unresolved item pending review of the licensee's acceptance criteria for tests that are performed at less than 80% of full dp (50-373/92023-04(DRS); 50-374/92023-04(DRS)).

(5) Periodic Verification of MOV Capability

The licensee's plan for ensuring that adequate MOV switch settings were established and maintained throughout the life of the plant included static diagnostic testing of MOVs of valves classified as

priority 1 on an interval that will be determined once the initial stages of the GL 89-10 program are completed. The period recommended by GL 89-10 was every third refueling outage. The inspectors informed the licensee that static testing was not currently a technically justified method of periodic verification because of uncertainties in the relative performance of MOVs under static and design basis conditions. For valves classified as priority 2, NOD-MA.1 specified that periodic testing would not be required provided preventive maintenance was performed. This is inconsistent with the GL and the licensee's commitment, which indicated plans to meet the intent of the GL. This is an unresolved item pending review of the licensee's justification for not periodically testing priority 2 valves (50-373/92023-05(DRS); 50-374/92023-05(DRS)).

(6) MOV Failures, Corrective Actions and Trending

The inspectors reviewed licensee actions for a number of LER's, deviation reports, and other MOV failures. In the cases reviewed, the root cause determination and corrective actions were complete and well documented. There were no specific failures that appeared to indicate any program weaknesses.

The trending program was recently improved to include a number of parameters, including thrust at torque switch trip, maximum thrust, and other parameters that should become useful as more data is collected. The trending for indication of when a refurbishment would be required was based mostly on the results of grease inspections and no periodic refurbishments were planned. This could limit the effectiveness of the station personnel to detect degradation prior to failure. Some forms of wear may not be detectable until the actuators are virtually inoperable. In such a case, periodic visual inspections may provide a measure of added assurance. A recent example where a problem could have been identified prior to failure by a periodic inspection was 1WR180 where the staking of the stem nut apparently caused a crack in the drive sleeve and resulted in failure of the valve to cycle.

(7) Schedule

The licensee committed to implementation of all GL 89-10 actions by the end of the fifth refueling outages, beginning with the 1991 outages. The schedule was beyond the time frame recommended by the GL and there were no plans to dynamically test MOVs where at least 80% of design basis dp and flow could not be achieved. This position and the implementation schedule for GL 89-10 will be reviewed by NRR to determine acceptability. The inspectors did note, however, that LaSalle had developed an aggressive, but reasonable schedule to dynamically test those valves considered practicable to test by the end of the third refueling outage, which is more consistent with the GL schedule than the corporate position.

(8) Liberty Technologies 10 CFR Part 21 Review

During a meeting with the NRC staff in April 1992, CECO committed to evaluate the data from tests of motor-operated valves (MOV) performed at its facilities in response to GL 89-10. In accordance with 10 CFR Part 21, Liberty Technologies notified the NRC staff and nuclear power plant licensees in October 1992 of a generic issue regarding the accuracy of its VOTES diagnostic equipment used in measuring the thrust delivered by motor actuators in opening and closing their valves. At the time of the inspection at LaSalle, CECO had completed a preliminary evaluation of the MOV test data including an initial effort at addressing the effect of the increased inaccuracy of the VOTES equipment. In an internal memorandum on October 29, 1992, CECO stated that its consideration of the increased inaccuracy of the VOTES equipment would be completed within six months of receipt and validation of new VOTES software, expected in December 1992.

c. Associated Programmatic Reviews

The NRC inspectors reviewed other licensee programs associated with MOVs.

(1) Design Control for Thermal Overload Protection

The NRC inspectors reviewed the licensee's methods for the design control of thermal overloads. The licensee's methods appeared to be acceptable.

(2) MOV Setpoint Control

The NRC inspectors reviewed licensee documents and discussed MOV setpoint control with personnel. The licensee's MOV setpoint control program for torque switches was based on thrust windows for those valves that had been diagnostically tested. For those valves that had not been diagnostically tested, the torque switch setpoints were set according to original manufacturer recommendations. The control of switch settings appeared to be acceptable.

(3) Maintenance

The licensee's nominal preventive maintenance (PM) frequency was 36 months, which exceeded the manufacturer's (Limitorque) recommended frequency for stem lubrication of 18 months. The exact effects of the extended maintenance frequency are not known, however, some additional degradation and increased stem factors would be expected. The licensee planned to perform some static as-found diagnostic testing to justify their position and had completed a few tests. Such justification would be better supported by as-found design basis testing since static diagnostic testing may not be as valuable due to uncertainties in the relationship between the performance of MOVs under static and design basis conditions.

The NRC inspectors were concerned that data from some as-found testing may not adequately reflect the worst case degradation that could be experienced by MOVs in the plant. The inspectors witnessed one as-found test on a reactor core isolation cooling valve, which was located in the drywell. Although the stem was last lubricated approximately 18 months prior to the test, the lubrication on the stem appeared to be in a pristine condition, possibly due to the atmosphere in the drywell. Data from this particular test may not yield useful information related to the effects of degraded stem lubrication on MOV performance. Performing as-found testing on MOVs known to be in the most degraded conditions, possibly based on direct inspections, would strengthen the program.

The lubrication of the valve stems was considered to be a weakness. There was no formal procedure to specify the details for lubrication of the

valve stem, which is a significant task in that the friction at the stem to stem nut interface has a direct effect on thrust output of the actuator. In addition, training for the mechanics was inconsistent in this area and resulted in inconsistent results in the past. For example, some mechanics would clean and lubricate only the exposed portion of the stem and would not cycle the valve. If the valve happened to be in the open position at the time, the stem threads could receive little maintenance. The 2WR029 valve, which was last lubricated in February 1992, had caked-on lubricant on the valve stem, indicating incomplete cleaning at the last lubrication. Although there were no specific concerns with the operability of 2WR029 due to the actual location of the caked-on lubricant, this was an example of where procedures or additional training would ensure consistency. Since the valves are already lubricated on a 36 month frequency instead of the recommended frequency of 18 months, the importance of complete lubrication should be reinforced.

The NRC inspectors reviewed the licensee's position in the area of valve stem packing adjustments. The practice was to perform a motor current signature test after packing adjustments. However, changes in power requirements associated with packing loading may not be accurately reflected in ac motor current analysis due to the changing power factor. Large changes in thrust requirements due to packing adjustments may result in only small changes in motor current. The licensee committed to evaluate data from testing efforts and provide the status of the post maintenance testing program for MOVs to the NRC at the end of 1992.

(4) Training

The inspectors reviewed the training provided to personnel performing work associated with the implementation of the LaSalle MOV program. The MOV training program at LaSalle was considered acceptable. However, training for contractors performing lubrication and refurbishment was limited to what was covered by the procedures, and in the case of stem lubrication as discussed above, could be strengthened.

(5) Operating Experience and Vendor Notification

The NRC inspectors found some weaknesses in the area of processing and control of vendor information from various sources. The licensee had taken steps to ensure that certain information, such as Part 21 information and NRC Information Notices, was properly screened, evaluated and maintained by appropriate organizations and that appropriate actions were planned. However, in the case of Limitorque maintenance and technical updates, no formal review that would ensure proper tracking and screening, especially for possible procedure or training updates was established.

The "stall efficiency" was used to evaluate MOV capability (as part of the stall thrust equation). The NRC inspectors were especially concerned about the use of the stall efficiency because at least three industry documents (Limitorque Maintenance Updates 89-1 and 92-1, and the Electrical Power Research Institute's "Application Guide for Motor-Operated Valves in Nuclear Power Plants," dated March 1990) specifically recommended against using stall efficiency to evaluate MOV capability. The NRC inspectors assessed the licensee's program for reviewing information from vendors and found that all three documents had been reviewed by appropriate members of the licensee's staff. Deviations from vendor recommendations are expected to be evaluated for technical justification.

The LaSalle program for the processing and control of operating experience and vendor notifications was found to be in need of improvement, especially for thorough review and use of Limitorque maintenance and technical updates.

(6) Diagnostics

The licensee uses the Valve Operational Test Equipment System (VOTES) to test MOVs under both static and dynamic conditions. However, testing plans did not always include the use of the VOTES torque cartridge (VTC) to allow the measurement of spring pack displacement. Because of this, stem friction factors may not be quantifiable at different points of interest, such as flow cut-off. The expanded use of the VTC would strengthen the program.

(7) Walkdown

The inspectors performed a general inspection of the plant as well as a detailed inspection of several MOVs. In general, housekeeping appeared to be satisfactory in most areas. The valve stems that were accessible were well lubricated and most valves appeared to be in good condition. However, valve 2E51-F022 had the motor located at the bottom of the actuator, which may increase the potential for damage due to grease leaking into the motor. Additionally, grease (oil) was observed leaking past one of the housing gaskets.

3. Licensee Self Assessment

The licensee had performed self-assessments of the MOV program as compared to the commitments of the CECO Response to Generic Letter 89-10, dated September 28, 1990, and to the GL in general. In addition, the station had prepared an action plan to address certain aspects of the MOV program. Most of the items in the action plan were either completed or were scheduled for January 1993. In general, the licensee showed a good effort in this area.

4. 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 paragraphs 2.b.(3), 2.b.(4), and 2.b.(5) of this report.

5. Exit Meetings

The inspectors met with licensee representatives (denoted in Paragraph 1) at the conclusion of the inspection on November 20, 1992. Supplemental exits were held by telephone conference on December 1 and 14, 1992. The inspectors summarized the purpose and scope of the inspection and the findings. The inspectors informed the licensee of the two violations and two unresolved 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.