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REGION I

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LICENSEE:	GPU Nuclear Corporation P.O. Box 480 Middletown, Pennsylvania 17057
FACILITY NAME:	Three Mile Island Nuclear Station, Unit 1
INSPECTION AT:	Middletown, Pennsylvania
INSPECTION DATES:	June 8-12, 1992 and June 23, 1992
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EXECUTIVE SUMMARY

The Nuclear Regulatory Commission (NRC) conducted a team inspection at the Three Mile Island Nuclear Station, Unit 1, on June 8 - 12, 1992 to assess the programs developed by the licensee in response to NRC Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance." This team inspection was accomplished in accordance with NRC Temporary Instruction (TI) 2515/109, "Inspection Requirements for Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance." The generic letter and its Supplements (1, 2, 3 and 4) provided recommendations to the licensees for the development of adequate programs to ensure operability of safety-related motor-operated valves (MOVs) during design-basis conditions.

The team concluded that the licensee has developed an MOV program description which meets the intent of Generic Letter 89-10. Design-basis reviews have been completed except for a review of functional requirements during emergency operating procedure implementation and the determination of MOV operation during degraded voltage conditions. Design-basis testing for 38 MOVs has been completed. This progress is noteworthy. While the licensee had a process for reviewing design-basis test results, the team concluded that a more rigorous and timely review was lacking and was needed to assess the impact of this test data on MOV performance. The licensee acknowledged this need and was developing structured procedural guidance for such reviews.

During the review of MOV thrust calculations, the team observed several examples where the maximum allowable thrust value was at the operator limit without allowance for any uncertainties, such as diagnostic equipment inaccuracies. This may have contributed to the cracking of the MS-V2A operator housing, as identified by the team during the plant walkdown. It was apparent that MS-V2A had been overthrusted and the licensee had not appropriately evaluated these overthrusting conditions. The failure to identify and repair the cracked housing on valve MS-V2A is a violation of NRC requirements.

The licensee's MOV personnel were well experienced and knowledgeable. A good MOV training program is in place. The effect of this training program was evident in the knowledge level of the licensee's MOV personnel. The material condition, with the exception of MS-V2A, was good.

Trending of MOV problems was considered to be weak. MOV maintenance was identified by the team as requiring further improvements, especially in the preventive maintenance (PM) area where the licensee was considering several changes.

In summary, the licensee has developed a MOV program which addresses many of the recommendations of Generic Letter 89-10. However, additional attention is required to assure a timely test review to improve trending of MOV problems and to establish adequate requirements for post maintenance testing.

1.0 INTRODUCTION

On June 28, 1989, the NRC staff issued Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," which provided recommendations to the licensees for the development of adequate programs to ensure operability of safety-related motor-operated valves (MOVs) during design-basis conditions. The generic letter recommended that each licensee with an operating license complete all design-basis reviews, analyses, verifications, tests and inspections within 5 years or three refueling outages, whichever is later, of the date of the generic letter (June 28, 1989). The staff held public workshops to discuss the generic letter and to answer questions regarding its implementation. On June 13, 1990, the staff issued Supplement 1 to Generic Letter 89-10 to provide the results of the public workshops. In Supplement 2 (issued on August 3, 1990) to Generic Letter 89-10, the staff stated that inspections of programs developed in response to the generic letter would not begin until January 1, 1991. In response to concerns raised by the results of NRC-sponsored motor-operated valve tests, the staff issued Supplement 3 to Generic Letter 89-10 on October 25, 1990, which requested that boiling water reactor licensees evaluate the capability of motor-operated valves used for containment isolation in the steam lines to the high pressure coolant injection system and reactor core isolation cooling system, in the supply line to the reactor water cleanup system, and in the lines to the isolation condenser as applicable. On February 12, 1992, the staff issued Supplement 4 to Generic Letter 89-10 to clarify that considerations for inadvertent operation of MOVs may be excluded from the scope of Generic Letter 89-10 for boiling water reactors.

The NRC inspection team used Temporary Instruction (TI) 2515/109 (dated January 14, 1991), "Inspection Requirements for Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance," to perform this inspection. The inspection focused on Part 1 of the TI, which involves a review of the program being established by the licensee in response to Generic Letter 89-10.

2.0 THE LICENSEE'S GENERIC LETTER 89-10 PROGRAM

On December 28, 1989, GPU Nuclear Corporation responded to GL 89-10 by stating that it would incorporate the GL recommendations into its MOV program for TMI-1 with the following clarifications:

1. Inadvertent MOV operation would not be included in the program.

2. The design-basis events will be limited to those discussed in the Final Safety Analysis Report (FSAR).

3. Bounding valve factors would be used in lieu of design-basis testing.

4. The January 1990, refueling outage would be excluded from the schedule considerations.

In a reply letter on June 7, 1990, the NRC staff commented concerning GPU's positions on GL 89-10. The staff's comments were consistent with the issues as discussed during the public workshops in Supplement 1. Concerning the schedule issue, the staff considered the licensee's exclusion of the January 1990 refueling outage acceptable in establishing its program schedule, but stated that resolution of the MOV issue should not extend significantly beyond the five year schedule of GL 89-10.

The team reviewed the licensee's response to the generic letter and the program details with licensee personnel. The inspection results related to each aspect of Generic Letter 89-10 are described below.

2.1 Scope and Administration of the Program

The program administration was reviewed to assure that the licensee has an adequate program plan and schedule and has delineated responsibilities to complete the Generic Letter 89-10 program commitments.

GPU Nuclear Corporation has developed an MOV program description in response to GL 89-10. This document was initially issued on October 24, 1991. The team reviewed Revision 1 dated June 4, 1992. The program description establishes the specific responsibilities of the corporate and plant technical personnel, for the GL 89-10 requested actions. This document contains Appendices A and B which describe the engineering guidelines for design-basis reviews and MOV thrust calculations respectively. Appendices C and D contain MOV switch setpoint information and the licensee's response to GL 89-10. Also, Appendix E, titled "Open Issues," includes a discussion of industry wide issues and GPU Nuclear Corporation's interpretation of these issues. The team observed inconsistencies in several statements in Appendix E after reviewing and discussing several MOV thrust calculations with licensee personnel as discussed in section 2.4 below. Specifically, the team noted that initial thrust calculations for gate valves in blowdown applications did not contain valve factors greater than 0.3 although Appendix E indicated that this approach would be taken. The licensee agreed to make the necessary changes in Appendix E.

The team reviewed the piping and instrumentation diagrams, emergency operating procedures, technical specifications and the updated final safety analysis report to verify that MOVs in safety-related systems were included in GPU Nuclear's GL 89-10 MOV program. The inspectors verified, on a sampling basis, that the safety-related MOVs in the reactor coolant (RC), reactor building spray, emergency feedwater, decay heat removal, and main steam (MS) systems had been included in the program. However, review of the reactor coolant and main steam systems indicated that the licensee had excluded RC-V1 and RC-V3, MOVs in the pressurizer spray line, and MS-V8A and MS-V8B, MOVs that isolate the steam dump to the main condenser. These valves are included in the licensee's Inservice Testing (IST) program, but were excluded from the GL 89-10 program. The licensee agreed to reassess these valves for inclusion into the GL 89-10 program.

2.2 Design-Basis Reviews

Item "a" of the Generic Letter 89-10 and Generic Letter 89-10, Supplement 1, recommended that the licensee review and document the design-basis for the operation of each motor-operated valve within the program for such parameters as:

1. Differential Pressure
2. Flow
3. Valve Orientation
4. External Factors
5. Ambient Temperature
6. Fluid Temperature
7. Minimum Voltage

The licensee has completed design-basis reviews for all MOVs in their GL 89-10 program. The inspectors considered the licensee's process for design-basis reviews to be consistent with GL 89-10, with exceptions noted in EOP review, voltage transient analysis, degraded voltage calculations and differential flow requirements.

At the time of this inspection, the licensee was reviewing their EOPs to ensure design-basis conditions assumed in their analyses bound the conditions during the implementation of the EOPs. The licensee committed to completing the EOP review by August 31, 1992.

The inspectors observed that the licensee did not fully account for the transient undervoltage during motor start conditions. The undervoltage calculation did not use the correct cable impedance, nor did it account for higher temperatures in the plant. The licensee agreed to reevaluate their degraded voltage calculation, taking the above factors into account.

The team observed that the licensee's design basis review did not incorporate a commitment made as part of the TMI-1 restart hearings, to assure closure of FW-V92A and B during a main steam line break accident. The licensee's design basis review specified a differential pressure of 240 psid for FW-V92A and B whereas, the differential pressure during a main steam line break accident would be 625 psid.

2.3 Diagnostics Systems

The Motor-Operated Valve Analysis and Test System (MOVATS) diagnostic equipment was used to set the torque switches and perform diagnostic evaluations for motor-operated valves addressed in the Generic Letter 89-10 program. The licensee has evaluated 58 safety-related valves using ITI MOVATS-3000 equipment under static conditions to provide baseline information. Additionally, 38 safety-related valves have been tested under differential pressure conditions. These differential pressure tests have utilized stem strain rings and stem strain transducers, in conjunction with load cells and a thrust measuring device (TMD), for measuring spring pack displacement. MOV test results and data are entered into the General Maintenance System II (GMS-II) mainframe computer system. The test results are also entered into the LAN network, which has controlled access. Instrumented test signatures and motor load trace signatures are downloaded into an electrical maintenance personal computer.

The inspectors noted that the data acquisition process was well controlled. The team reviewed numerous TMD and current traces and found the traces to be easily retrievable and of good quality. However, the team noted that engineering analysis of acquired data is not always detailed or timely. An example of this was the treatment of the MS-V2A test results. Tests conducted by the licensee in 1991 showed MS-V2A to have been overthrusted by more than 20% of the actuator rating. The actual trace for MS-V2A was markedly different from the MS-V2B trace. Irregularities in the trace remained unexplained until the inspectors found the cracked MS-V2A housing during a plant walkdown and reviewed the overthrust data on the valve.

The licensee is aware that recent testing sponsored by the MOV Users Group (MUG) has raised questions concerning the ITI MOVATS accuracies. The ITI MOVATS potential issue notification, dated February 28, 1992, indicates that the equipment accuracies may be greater than those specified by ITI MOVATS in Engineering Report (ER) 5.0, when using spring pack open-calibration methodology. The licensee is monitoring ITI MOVATS activities as well as Nuclear Management and Resources Council (NUMARC) efforts to develop industry guidance in responding to MOV diagnostic validation testing. MOVATS has issued ER 5.2 to evaluate the open versus close inaccuracy issue.

2.4 MOV Switch Settings and Setpoint Control

Item "b" of Generic Letter 89-10 recommended that licensees review and revise as necessary, the methods used for selecting and setting all motor-operated valve switch settings.

The inspectors reviewed the licensee's response to the recommendations of the GL 89-10 regarding the sizing of MOVs and setting of the switches. Among the documents reviewed by the inspectors were the TMI-1 GL 89-10 Program Description; Babcock & Wilcox (B&W) Nuclear Services Company, "MOVE (Version 3.1)" manual; and calculation packages for MOVs DH-V3, EF-V2A/B, IC-V2, MS-V2A, MU-V36/37, RC-V2, and RR-V4A.

In Appendix B of its GL 89-10 Program Description, the licensee describes the engineering guidelines for performing MOV sizing and switch setting calculations. The licensee is using a computer program developed by B&W and referred to as "MOVE" to evaluate the proper sizing and switch settings for MOVs within its GL 89-10 program. The MOVE program uses the standard industry equation to predict the thrust required to open and close valves under differential pressure and flow conditions. The licensee had performed hand calculations to validate the results of the MOVE program. The licensee is assuming valve factors of 0.3 and 0.2 for flexwedge and double disk gate valves, respectively. The MOV tests conducted by the licensee at the time of the inspection indicated that these valve factors maybe greater than 0.3 for some MOVs. The licensee stated that its valve factor assumptions would be corrected to reflect the results of its MOV tests.

In Appendix E of its GL 89-10 Program Description, the licensee stated that it would assume a valve factor greater than 0.3 for flexwedge gate valves in high blowdown conditions. However, the licensee had assumed a valve factor of 0.3 for its PORV block valve. Furthermore, with respect to the PORV block valve RC-V2, the licensee considered the technical specification design-basis differential pressure to be approximately 1600 psid. The NRC Safety Evaluation Report (SER) for the licensee's response to NUREG-0737, TMI Action Item II.D.1 (attached to an August 22, 1984, letter from the NRC staff) stated that the block valve must be capable of closing over a range of steam and water conditions. The SER states that a high pressure steam test at 2500 psig performed by EPRI on a similar MOV was adequate to bound the operation requirements of the TMI-1 block valve. Also the licensee noted that the PORV block valve closed against a ΔP of greater than 2000 psid during testing performed in 1981 prior to restart. This data certainly demonstrated adequate PORV block valve operation at that time. However, the licensee recently tested the PORV block valve RC-V2 under static conditions to determine the thrust output at torque switch trip. Although the closing torque switch was intended to be set at 166 ft lbs based on the Limitorque spring pack curves, to provide 11,448 lbs of thrust, the thrust output was only 8436 lbs. Further, the licensee had tightened the packing of the valve following the thrust validation test and had not reverified the thrust available to the valve. Also, the team's discussions with the licensee indicated that the technical specification design-basis differential pressure of 1600 psid appeared to be too low and not consistent with the differential pressure expected in response to operator action during a stuck-open PORV. The licensee agreed that the Plant Review Group (PRG) would review this matter and update the licensee's position as necessary. The licensee further intends to ensure the capability of the block valve, under degraded voltage conditions, to close at the PORV setpoint pressure of approximately 2367 psid, as part of its GL 89-10 program. Pending completion and review of the licensee's evaluation of MOV capability per the GL 89-10 program and the PRG review of the technical specification design-basis differential pressure requirement, these items concerning RC-V2 are considered unresolved (Unresolved Item 50-289/92-80-001).

The licensee assumes a stem friction coefficient of 0.2 in its MOV sizing calculations. The results of some MOV tests at TMI-1 (for example, MU-V36, DH-V3, IC-V2 and RC-V2) did not appear to support the use of this stem friction coefficient. An internal licensee memorandum dated May 19, 1992, also states that stem friction coefficients higher than 0.2 had been observed at TMI-1.

The licensee had not included margin to account for load sensitive behavior (sometimes referred to as rate of loading) which causes the motor operator to deliver less thrust under differential pressure conditions than under static (no load) conditions. The vendor of the diagnostic equipment used by the licensee (ITI-MOVATS) has provided discussions of the need to address this phenomenon. The licensee stated that they would develop a method to address load sensitive behavior.

The inspectors reviewed the B&W MOVE Manual with several comments on the methodology. For example, the inspectors found the consideration of torque requirements by the MOVE program to be insufficient in evaluating MOV capability. Also, the MOVE program appears to assume that the actuator is the weak link of the MOV in some instances, since it includes actuator limits and does not specifically identify other possible limits, such as motor or valve limits. Further, the MOVE program assumed an Application Factor for actuator efficiency of 1.0 as opposed to the standard Limitorque value of 0.9 for certain calculations. The licensee stated that its GL 89-10 Program Description will be revised to justify its use of the MOVE program.

The licensee noted that they had obtained valve data from valve vendors to support weak link analyses for some MOVs. They indicated that a review would be conducted, with consultant assistance as needed, to determine any further data or assistance required from valve vendors for supporting MOV weak link analyses. The licensee expects to complete this review by October 1, 1992.

As shown in Appendix C of the program description, the licensee uses a computerized database in the control of MOV switch settings. The licensee performed analyses before approving increases in torque switch settings. The inspectors found that test reports for MU-V36 and 37 indicated lower settings than previously recorded. The licensee provided justification to show that the differences were due to errors in readings as the torque switch position did not change. The licensee stated that the involved personnel would be cautioned in future training sessions about the need for careful reading and recording of torque switch settings.

2.5 Motor-Operated Valve Testing

Item "c" of the generic letter recommended that licensees test motor-operated valves in situ under their design-basis differential pressure and flow conditions. If testing in situ under those conditions is not practicable, the NRC recommends a two-stage approach for demonstrating motor-operated valve capability. With the two-stage approach, a licensee would evaluate the capability for the motor-operated valve using the best data available and develop valve specific test data within the schedule of the generic letter.

The team reviewed the licensee's response to the recommendations of GL 89-10 for performing tests of MOVs in situ under design-basis differential pressure conditions and discussed this issue with licensee personnel. The licensee identified MOVs that can be tested at full or partial design-basis conditions in their GL 89-10 Program Description. For MOVs tested under partial design-basis conditions, the licensee stated that it will use analytical means to extrapolate the results to full design-basis conditions. If extrapolation to design-basis conditions cannot be justified, the licensee stated that it would follow the "two stage" approach described in GL 89-10 for qualification. The licensee also stated that, where justified, the data from other MOVs (such as identical system MOVs) or a industry-wide

database would be used in lieu of testing under design-basis conditions. Similarly, the licensee stated in the response to GL 89-10 on December 28, 1989, that a bounding valve factor might be used in an effort to justify not testing MOVs under design-basis conditions.

GL 89-10 recommended that licensees test MOVs in situ under design-basis differential pressure and flow conditions where practicable because of the differences in performance demonstrated by apparently identical MOVs. Such differences in performance have been identified in MOVs at TMI-1. For example, the differential pressure tests of valve EF-V2A indicated a valve factor greater than 0.3, whereas the differential pressure test of valve EF-V2B appeared to show only a minimal valve factor. The licensee stated that it would review the results of its MOV tests to justify grouping of valves for dynamic testing.

The licensee had conducted differential pressure and flow tests of 38 MOVs at the time of the inspection. Although the licensee had prepared procedures for the conduct of the tests, the licensee had not ensured that the collection of all relevant performance data (such as differential pressure in the test of RR-V4A) for use in evaluating the test results.

The licensee's GL 89-10 Program Description states that test results will be evaluated. The licensee had prepared a summary of its method for evaluating test data, but principally relied on the capability of its technical staff to evaluate the test results. The B&W MOVE Manual provided a section on reviewing test data, but that section focused on thrust without adequate attention to torque requirements.

The licensee performed a test of DH-V3 at approximately 175 psid, which is less than half of its design-basis differential pressure. The test results raised concerns regarding the capability of the MOV to operate under its design-basis conditions. The licensee stated that the MOV had a safety function to open but not to close. The licensee was attempting to contact the valve vendor (Anchor Darling) to discuss the operating characteristics of this MOV at the end of the inspection. Also, the licensee noted that the design-basis requirements currently established for GL 89-10 may be too conservative and should be reevaluated. Pending the completion of the evaluation and further review of the DH-V3 test results, this item is considered unresolved (Unresolved Item 50-289/92-80-002).

2.6 MOV Maintenance and Post Maintenance Testing

The licensee has developed the following procedures for performing maintenance on various models of Limitorque operators:

1. Corrective Maintenance Procedures

   a. 1420-LTQ-8A, "Limitorque Operator (SMB-000) Disassembly/Reassembly," Rev 4,
   b. 1420-LTQ-8B, "Limitorque Operator (SMB-00) Disassembly/Reassembly," Rev 0,

c. 1420-LTQ-8C, "Limitorque Operator (SMB-0 through 4/4T and 5B-3) Disassembly/Reassembly," Rev 0,
d. 1420-LTQ-8D, "Limitorque Operator (SMB-5T) Disassembly/Reassembly," Rev 0,
e. 1420-LTQ-1, "Limitorque Valve Operator Maintenance," Rev 15,
f. 1420-LTQ-2, "Limitorque Operator, Limit Switch and Torque Switch Adjustment," Rev 13, and
g. 1420-LTQ-7, "Dynamic Testing of Motor Operated Valves Using MOVATS Series 3000 Valve Analysis System," Rev 4.

2. Preventive Maintenance Procedures

a. E-13, "Limitorque Valve Operator Inspection," Rev 21.

The inspectors determined that the procedures were technically detailed and of high quality; however, a few exceptions were noted. For example, the procedures did not require an inspection for spring pack relaxation. Also, post maintenance testing requirements described at the end of each procedure did not fully address appropriate retests for packing adjustments. The Post Maintenance Testing (PMT) used for motor-operated valves after valve packing adjustments or repacking, is a motor load test. The criteria for acceptance is that the motor load data be within -20% to +10% of baseline. If a motor load test cannot be performed then motor current is taken along with the valve stroke time. The licensee was unable to demonstrate a correlation of motor load or motor current with changes in packing load. The licensee acknowledged that this method should be justified or another method should be developed to perform an appropriate PMT.

The licensee's current preventive maintenance (PM) schedule for GL 89-10 MOV's ranged from 2 to 4 years. The PM includes lubrication of the operators. Limitorque recommends that an eighteen month inspection period be used as a base until experience (i.e., location, use, and history) indicates otherwise. The inspector reviewed a memorandum dated July 25, 1985 from the Preventive Maintenance Manager to the Plant Review Group Chairman, on the subject of PM Task Frequency Assignment. This memorandum details the method used, by the licensee, to assign appropriate PM frequencies. This method is based on: (a) valve plant location (mild to harsh), (b) its use (cycled less than once per month to cycled once or more per day), and (c) its maintenance history (zero malfunctions to 9 or more malfunctions). Evaluation of the above factors have been broken down into a numbering system from 1 to 5. Five being the harshest or most critical condition and one would reflect a mild condition. The three factors, with numbers assigned, are summed together for each MOV and correlated into an assigned frequency of PM. This formula adequately assessed most of the licensee's MOVs, with the exception of a few in harsh environments. The licensee stated that they will reassess the PM frequency of those valves.

Further discussion with the licensee indicated that a balanced approach between periodic diagnostic testing and physical PM activities was warranted to determine the optimum maintenance for each MOV. The licensee indicated that a reevaluation of PM frequencies was being undertaken in this regard. The licensee also acknowledged that the periodic maintenance activities should support the assumptions used in their MOV thrust calculations. For example, the stem friction coefficient of 0.2, now used in thrust calculations, should be supported by an appropriate stem lubrication frequency.

The MOV test program does not require each MOV to be overhauled prior to performing baseline testing. However, the licensee has initiated a complete spring pack changeout of all GL 89-10 MOVs, to the new modified spring packs with the slotted belleville washers, in an attempt to address hydraulic lock and spring pack relaxation concerns. The licensee is considering overhauling on a sampling basis and performing a MOVATS test before and after, to correlate the physical condition to the maintenance history.

Based on the above observations, the team determined that the MOV procedures were good, but that MOV maintenance should be improved, especially in the PM area. The licensee agreed to take actions to address the weaknesses identified in the PM program.

2.7 Periodic Verification of MOV Capability

Item "d" of the generic letter recommended that licensees prepare or revise procedures to ensure that adequate motor-operated valve switch settings are established and maintained throughout the life of the plant. Paragraph "j" of the generic letter recommended that surveillance intervals be commensurate with the safety function of the motor-operated valve as well as its maintenance and performance history. The surveillance interval, in no case, should not exceed 5 years or 3 refueling outages, whichever is longer. Further, the capability of the motor-operated valve has to be verified if the motor-operated valve is replaced, modified, or overhauled to an extent that the test results are not representative of the motor-operated valve performance.

The team reviewed the licensee's program description relating to periodic verification of MOV capability. The provisions that relate to periodic retest are stated in section 6.8.4 of the program description. The frequency of periodic retests of MOVs is specified as initially not to exceed three refueling outages (or a six year period). However, the type of retest is not defined other than the minimum to be performed is a motor load test. Additionally, the effectiveness of motor load testing to determine valve capability was not fully demonstrated. The team concluded that the licensee's program presentation of periodic verification requires a clear narrative that adequately defines the periodic verification plan.

The ability to correlate MOV performance under static conditions with performance under design-basis ΔP was discussed with the licensee's staff. The licensee did not provide the necessary data to correlate static to dynamic tests. The licensee acknowledged this concern and stated that the issue of future static versus dynamic testing would be reevaluated following the completion and review of the dynamic test program and the results of the in-process industry studies attempting to resolve this issue.

2.8 MOV Failures, Corrective Actions, and Trending

Item "h" of the generic letter recommended that licensees analyze each motor-operated valve failure and justify corrective action. The results and history of each as-found deteriorated condition, malfunction, test, inspection, analysis, repair, or alteration were recommended to be documented and maintained. This motor-operated valve information was recommended to be periodically examined (every 2 years or after each refueling outage after program implementation) as part of the monitoring and feedback effort to establish trends of motor-operated valve operability.

The team assessed the effectiveness of the licensee's MOV corrective actions by evaluating past actions concerning two valves, CA-V13 and MS-V2A. CA-V13, a pressurizer sample isolation valve, had a history of problems providing sufficient torque to fully close and open the valve. The valve had a packing leak which could not be alleviated because the motor could not provide enough torque output with the packing gland tightened to the manufacturer's recommended value. To increase the operator's torque output, during the last outage, modification TI-MM-123265-001 was performed which changed the motor pinion and worm gear to increase the gear ratio and provided a larger spring pack to control the higher torque output. However, the larger spring pack was changed because subsequent engineering calculations demonstrated that the motor could not provide sufficient torque at degraded voltage to trip the torque switch with the larger spring pack. On May 12, 1992, CA-V13 would only partially close because a small amount of nickel anti-seize, which was used to lubricate the packing gland nuts, was inadvertently placed on the valve stem. The motor did not have sufficient torque to compensate for the resulting additional friction. This condition was corrected the same day to restore proper operation. To correct further problems, with CA-V13, the licensee plans to review the degraded voltage calculations to reverify whether a larger spring pack can be installed. The licensee is also evaluating replacing the valve with a solenoid-operated valve.

The team concluded that the licensee's modification package to increase the thrust of CA-V13 was weak because it did not initially take into account the effects of degraded voltage on valve operation.

During a plant walkdown on June 10, 1992, the team identified a through-wall crack approximately six inches long in the operator housing for MS-V2A. This normally open, 12-inch valve serves as the first isolation valve between the "A" steam generator and the steam header that serves the atmospheric and main condenser dump valves and the emergency

feedwater pump turbine. After further inspection concerning the possible causes for this deficiency, it was apparent that overthrusting of this MOV during prior tests had occurred. In a Plant Engineering memorandum, dated May 12, 1988, the licensee stated that during diagnostic tests, "in no case should the adjustment exceed the maximum torque switch setting or the maximum operator rating" and that "special attention must be paid to MS-V2A/B and MU-V2A/B with regard to this constraint." However, a test report, dated August 8, 1988, indicates that the thrust values for as-found and as-left torque switch settings of MS-V2A were above the operator ratings and that diagnostic equipment inaccuracy had apparently not been considered. The housing for MS-V2A developed a crack which may have been caused by the overthrusting of the valve. Review of a MOVATS test of MS-V2A, on November 11, 1991, indicated that the as-found thrusts were high. The thrust limit for this valve is 45,000 lbs which corresponds to 49,500 lbs at 110% and 54,000 lbs at 120%. The open available thrust was 48,519 lbs with a total at 54,216 lbs. The closed available thrust was 47,882 lbs with a total thrust of 52,567 lbs. No Engineering Evaluation Report (EER) was written to address exceeding the 120% thrust value in the open direction. During the last refueling outage, when this test was performed, there was an understanding with Plant Material that an EER would be written if the 120% value was exceeded in the closed direction. A Limitorque letter to B&W, dated July 26, 1990, in the licensee's possession, stated that, if an actuator was overthrusted by more than 20%, then the actuator should be examined for damage. Among other areas of examination, the Limitorque letter said the actuator housing should be examined for cracks. The licensee did not provide any information to indicate that it had performed such an examination following the overthrust events. The failure to properly evaluate the test data to determine if an overthrust condition existed and to followup that information to determine if the valve suffered damage is a violation of 10 CFR 50, Appendix B, Criterion XI (Violation 50-289/92-80-003). Aspects of the foregoing violation that should be considered are 1) documentation of a possible nonconforming condition and formal evaluation for corrective actions; 2) test procedure precautions and limiting criteria to prevent overranging valves; and 3) ensuring engineering considerations are properly translated into test programs and procedures.

The licensee's Plant Review Group (PRG) met on June 11, 1992, to assess the operability of MS-V2A and to recommend corrective action. The PRG recommended that the operator housing be replaced as soon as practical. No specific time requirement was indicated by the PRG although the licensee indicated to the team that it would be replaced in two weeks. The PRG also recommended that a design review be performed for the operator rating, operating speed, degraded grid voltage, and operability needs. On June 29, 1992, the licensee replaced the cracked operator housing on MS-V2A.

The team reviewed the licensee's program which trends maintenance failures/deficiencies and implements corrective action when necessary. Trending of failures and deficiencies is performed in accordance with Administrative Procedure 1073 "Maintenance History Assessment." A quarterly assessment report is written to discuss component performance over the previous twelve months. The licensee's assessor reviews the data to determine if a

multiple failure or deficiency trend exists (i.e. two or more failure/deficiency descriptions for a component or component model are the same). Corrective actions for multiple component/model failures or deficiencies is accomplished by the Maintenance Trend Action Notice (MTAN). The MTAN tracks these corrective actions through completion.

The team interviewed the individual responsible for trending Limitorque operator deficiencies and reviewed the last two quarterly assessment reports. The inspector found that trending of the deficiencies was being accomplished in accordance with Administrative Procedure 1073. However, the inspector observed that no MTAN had ever been written on a Limitorque operator within the scope of Generic Letter 89-10.

The licensee's threshold for writing MTANs on Limitorque operators appears to be too high. With a lower threshold, problems such as grease separation in high temperature applications may have been identified and corrected had a MTAN been written to identify the root cause of this problem.

2.9 Motor-Operated Valve Training

The team evaluated the licensee's MOV training courses, training facilities, and training staff qualifications. The licensee's training program is Institute of Nuclear Power Operations (INPO) accredited. MOV training integrates classroom and hands-on training with on-the-job training. The licensee's program outlines specific course requirements for electrical and mechanical maintenance personnel involved with motor operated valves.

Limitorque (and EIM) MOV maintenance is performed by in-house electrical maintenance department personnel under the direction of the electrical group supervisor. The electrical craft personnel who perform work on both Limitorque and EIM valve operators are trained to formal training lesson plans and on-the-job qualification card requirements. Lesson plan number 11.1.01.337 and on-the-job training E-16a for Limitorque valve operators provide description information and visual aids for training of craft personnel. A separate lesson plan, number 11.1.01.234 and on-the-job training E-16b is used to train craft on EIM operators. Auxiliary operators who align the system valves also receive training on Valve and Valve Operator Fundamentals to lesson plan 11.2.01.156. Work on valve internals is performed by the mechanical craft personnel who are trained to lesson plan 11.2.01.230, titled Valve Techniques, that includes disassembly, reassembly, seat repair, and packing, and to on-the-job training M-06. The team reviewed the training lessons and found them to be fully descriptive of the work requirements.

In addition to classroom training, hands-on training is performed with typical fully assembled MOVs that are part of the training department equipment aids. A simplified open panel board is used as a preliminary training aid for the craft personnel to learn how to wire the valve. A representative motor control center panel is used for advanced hands-on training after proficiency is achieved on the open panel board wiring. Completion of wiring with either panel enables the valve to be stroked and panel light indication of disc position.

Hands-on training also involves installation of all valve operator parts and observations by the trainee that requires a determination that the part is good or bad.

The training department maintains a log of MOV industry experience items that include NRC notices, vendor maintenance updates, industry problems from Nuclear Network reports, Part 21 notifications and procedure updates. These industry experience items are conveyed to personnel through the licensee's continuous training program that is given a minimum of twice a year. The continuous training includes tasks selected from the initial task listing where upgrading is needed, experience items, actual encountered performance or repair problems, and new tasks as needed.

The team determined that the licensee has been performing MOVATS diagnostic testing of MOVs since the mid 1980's. The MOVATS 3000 system test equipment in use at the site was purchased in late 1990. Training on the use of MOVATS was attended by 12 engineering and craft personnel at the MOVATS facility. More recently, in May of 1992, 7 engineering and craft personnel attended advanced diagnostic signature training that included recognition of degradation and specific valve problems. Currently, the maintenance supervisor and training management are considering attendance at one of the MOV Maintenance and Application Workshops to be given by the Nuclear Maintenance Application Center that is operated by the Electric Power Research Institute. The licensee's MOV instructor has former plant engineering experience and has taken Limitorque actuator training.

Diagnostic signature testing during outages is performed by qualified MOVATS personnel and the licensee's electrical technicians. Diagnostic signature testing during non-outages is performed by the licensee's electrical technicians. The licensee's electrical maintenance supervision is responsible for both outage and non-outage testing.

During review of maintenance activities, several instances were noted where there may have been a discrepancy in the precise recording of a torque switch setting. The importance of recording precise information to enable proper determination of problems was discussed with the training director, who stated he would make a point of the importance of recording precise information as part of the training lessons.

The team concluded that the licensee has a comprehensive and effective MOV training program.

2.10 Industry Experience and Vendor Information

The team reviewed the licensee's vendor information program to assess its effectiveness in disseminating industry data into the various areas of the MOV program. Control of vendor information is provided through procedures, AP-1065, "Vendor Document Control," EP-021, "Control of Technical Manuals and Vendor Technical Information," and Vendor Document Control Site Instruction Number 6, "Vendor Contact Program." The team reviewed the licensee's actions taken in response to ITI MOVATS Engineering Report 5.0, "Equipment

Accuracy Summary" and the following Limitorque Maintenance Updates (MU) and Part 21 Notifications (P21N):

1. MU 88-2, Hydraulic Lock,
2. MU 89-1, Maximum Torque Switch Settings,
3. MU 90-1, Hydraulic Lock and Spring Pack Relaxation,
4. P21N 11/3/88, Melamine Torque Switches,
5. P21N 11/3/88, DC Motors,
6. P21N 9/28/89, Torque Switch with Fiber Spacers, and
7. P21N 3/20/90, Motor Pinion Keyway.

The team verified that proper action on all the above documents had been taken by the licensee's Vendor Document Control department. The licensee had evaluated each document for relevance to the site and has completed the appropriate corrective actions with the following clarifications:

1. Even though MOVATS Engineering Report 5.0 is referred to in the licensee's generic letter program description, all the information contained in the report concerning diagnostic equipment accuracies has not been fully addressed.

2. Limitorque MU 89-1 recommends that limiter plates not be removed from torque switches. The licensee has implemented a program to insure that all Limitorque operators in the GL 89-10 scope have limiter plates installed in accordance with Limitorque's recommendations. Currently, eight, out of eighty-one, operators do not have limiter plates. The licensee plans to complete this corrective action by the end of the next refueling outage in September 1993.

3. In response to Limitorque MU 90-1, concerning hydraulic lock and spring pack relaxation, the licensee has implemented a program to change all old model spring packs in safety-related systems to the newest design to prevent hydraulic lock and spring pack relaxation. The licensee has currently completed the replacement of approximately 74% of the spring packs in GL 89-10 MOVs.

The team determined that the licensee's vendor control group and tracking of vendor information was good, as evidenced by the licensee's effectiveness in receiving vendor information, disseminating the information to the proper individuals, and evaluating and completing the recommendations of the vendors.

The team also reviewed the licensee's action with respect to selected NRC Information Notices that address various MOV issues. The licensing department is responsible for controlling the information provided by the NRC and providing the information contained in NRC Information Notices to the appropriate individuals. The team verified that the information contained in NRC Information Notices 90-40, 91-61, and 92-17 was provided to the responsible individuals in a timely manner.

2.11 Schedule

In Generic Letter 89-10, the staff requested that licensee's complete all actions initiated to satisfy the generic letter recommendations by June 28, 1994, or 3 refueling outages after December 28, 1989, whichever is later. The licensee's target for completing all requested actions of GL 89-10 is July 1, 1994. This includes disposition of all test results and completion of alternative qualification methods for valves that cannot be tested in situ. As discussed in sections 2.2 and 2.4 of this report, GPU Nuclear Corporation agreed to completion dates for several key tasks that were still open and important to support program completion by July 1, 1994. These tasks were the completion of EOP reviews with their impact on design-basis reviews, the obtaining of valve vendor data for the completion of MOV weak link analyses and completion of a steam generator overfill transient analysis for evaluating ΔP requirements for FW-V92A and V92B. The licensee indicated that program corrective actions, such as additional design-basis testing prompted from feedback developed during the first program interval, would not occur until after July 1, 1994 during refueling 12R.

3.0 WALKDOWN

During a plant walkdown, the inspectors observed the general overall conditions of the MOVs to be good, with the exception of the following:

1. Feedwater Isolation Valve, FW-V92B indicated possible grease separation, as evidenced by oil leaking from the housing onto the floor.

2. A 6-inch, through-wall crack was found on the operator housing for MS-V2A.

The licensee stated that for FW-V92B, the oil leakage was observed by the operations department on June 7 1992, and a subsequent job order was issued.

The housing crack on MS-V2A is discussed in Section 2.8.

No further concerns were identified in this area.

4.0 CONCLUSION

The licensee is developing an MOV program that is consistent with the recommendations of Generic Letter 89-10. However, several other areas, as summarized in Table 1, remain yet to fully address the generic letter recommendations. Design-basis reviews have been completed except for the review of EOPs and the completion of degraded voltage calculations.

Design-basis testing for 38 MOVs has been complete[illegible] The licensee acknowledged that a more rigorous and timely review of test results was lacking to assess the impact of this test data on MOV performance.

The team identified a crack in the operator housing of MS-V2A for which the licensee was taking corrective actions. The material condition for other GL 89-10 MOVs observed in the plant by the team was good. A good MOV training program is in place. MOV maintenance was identified by the team as requiring further improvements, especially in the preventive maintenance area.

5.0 UNRESOLVED ITEMS

Unresolved items are matters for which more information is required to ascertain whether they are acceptable items, violations or deviations. Two unresolved items are discussed in sections 2.4 and 2.5 of this report.

6.0 EXIT MEETING

The inspectors met with those denoted in Appendix A on June 12, 1992, to discuss the preliminary inspection findings as detailed in this report. The licensee acknowledged the inspection findings and agreed to review the items listed in Table 1 for resolution and further improvement of the MOV program.

TABLE 1

Licensee Plans and Commitments for Further Program Improvements

	Reference Paragraph
Section 2.1 Scope and Administration of the Program	
• Correct Appendix E of program description to reflect current actions and positions regarding valve factors used for gate valves in blowdown applications	2
• Reassess RC-V1 and V3 and MS-V8A and B for inclusion into the GL 89-10 program	3
Section 2.2 Design-Basis Reviews	
• Completion of EOP reviews by August 31, 1992	3
• Reevaluate degraded voltage calculation to account for correct cable impedance and high ambient temperatures	4
• Evaluate ΔP requirements for FW-V92A and V92B by December 31, 1992	5
Section 2.4 MOV Switch Settings and Setpoint Control	
• Correct valve factor assumptions to reflect the results of MOV tests	3
• Resolve items concerning RC-V2 capability and PRG review of the design-basis differential pressure requirement (Unresolved Item 50-289/92-80-001)	4
• Develop a method to address load sensitive behavior	6
• Revise program description to justify use of MOVE program	7
• Complete valve data review for weak link analyses by October 1, 1992	8
• Train personnel concerning careful reading and recording of MOV switch settings	9

Section 2.5 Motor Operated Valve Testing

- Review results of MOV tests when determining the ability to justify applying data from one MOV to another — 3
- Resolve DH-V3 open operability issue (Unresolved Item 50-289/92-80-002) — 6

Section 2.6 MOV Maintenance and Post Maintenance Testing

- Justify stem lubrication frequency for the use of stem friction coefficient of 0.2 used in thrust calculations — 5
- Consider overhauling MOVs on a sampling basis before and after performing a MOVATS test to correlate the physical condition of the MOV to the maintenance history — 6

Section 2.8 MOV Failures, Corrective Actions, and Trending

- Complete engineering evaluation of CA-V13 for degraded voltage and possible operator replacement — 2
- Formalize method of evaluating MOV tests to ensure a more thorough and timely review of static and dynamic test results including overthrusting evaluations with operator physical inspections if necessary (Violation 50-289/92-80-003) — 4
- Replace cracked operator housing on MS-V2A during the week of June 29, 1992 — 5

APPENDIX A

Persons Contacted

GPU Nuclear Corporation

* D. Atherholt, Operations Engineer
* R. Bensel, Plant Engineer
* T. Broughton, Director TMI-1
* R. Cook, PA-DER/BRP
* D. Distel, Licensing
* C. Faust, IOSRG
* C. Hartman, Manager Plant Engineering
* D. Johnson, Licensing Engineer, Contractor
* B. Kalemevitch, RCM
* D. Laudermilch, Maintenance Training Manager
* J. Mateychick, Project Engineer
* R. Maag, Manager Plant Material
* M. Moore, Engineer Sr. I
* R. Rogan, TMI Licensing Director
* M. Ross, Director OGM
* H. Shipman, Plant Operations Director
* G. Skillman, Plant Engineering Director
* C. Smyth, NSCC Staff
* M. Snyder, Manager Plant Material Assessment
* S. Turns, Technical Analyst
* R. Warren, IOSRG
* R. Zimmerman, Plant Engineer

Nuclear Regulatory Commission (NRC)

* Dr. P. K. Eapen, Chief, Systems Section
* F. Young, Senior Resident Inspector TMI-1

* Denotes present at exit meeting held at Three Mile Island Nuclear Station, Unit 1, June 12, 1992.