UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W., SUITE 2900
ATLANTA, GEORGIA 30323-0199

Report No.: 50-302/94-18

Licensee: Florida Power Corporation
3201 -34th Street, South
St. Petersburg, FL 33733

Docket No.: 50-302 License No.: DPR-72

Facility Name: Crystal River Nuclear Plant Unit 3

Inspection Conducted: December 5 - 9, 1994

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E. Girard, Reactor Inspector Date Signed

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SUMMARY

Scope:

This special, announced inspection assessed the licensee's completion of implementation of commitments made in response to Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance." The inspection included a detailed review of sizing, switch settings, and test data for a sample of Motor-Operated Valves (MOVs). Additionally, MOV-related engineering evaluations, maintenance, and quality assurance activities were examined.

Results:

The inspectors concluded that Crystal River had implemented a satisfactory GL 89-10 program; however, several issues remained to be resolved. These issues mostly involve the need for better identification/definition of future actions to ensure the capabilities of GL 89-10 MOVs. The letter forwarding this report requests the licensee to provide a written response to these issues.

Enclosure

In addition to the issues referred to above, this inspection identified one non-cited violation, weaknesses in licensee documentation, and several licensee strengths. A previously identified inspector followup item was closed. The non-cited violation, the issues to be resolved, the documentation weaknesses, the strengths, and the inspector followup item are summarized below:

Non-Cited Violation

NCV-50-302/94-18-15, Uncorrected Actuator Capability Calculation for Valve FWV-36. (See Section 2.3.3)

The NRC inspectors found that the licensee's spreadsheet actuator capability calculation for DC MOV FWV-36 (Feedwater Startup Block Valve) had utilized run efficiency rather than pullout efficiency, resulting in an incorrect actuator degraded voltage capability calculation. At its setting, the valve would have been capable of performing its safety function, but could have tripped the overload and/or damaged the motor in doing so. The valve was not required to operate for any safety function following an accident.

Issues to Be Resolved

The licensee is being requested to provide a written response to the following issues, which have been identified as inspector followup items (IFIs). Additional details regarding the responses desired are described in the report text sections identified in parentheses after each issue.

(1) IFI 50-302/94-18-01, Torque Switch Repeatability Errors.

The error resulting from the inaccuracy in torque switch repeatability had not been included in the maximum thrust limits specified by the licensee. Also, the licensee had not accounted for the increased torque switch repeatability error that occurs at a switch setting of 1. This issue was licensee identified. (See Section 2.2)

(2) IFI 50-302/94-18-02, Rate of Loading.

The licensee had used a 15% value to correct calculated settings for rate of loading uncertainty. This was not fully justified by the licensee test results. Additional data should become available from industry testing or the licensee's program to support the value used. (See Section 2.2)

(3) IFI 50-302/94-18-03, Stem Friction Factor.

The licensee had not developed dynamic test data to support the stem friction factor assumed. Additionally, the licensee was changing lubricants and had not evaluated the affect on stem friction factor. (See Section 2.2)

(4) IFI 50-302/94-18-04, Reliance on DMT Results.

Setup and dynamic testing of some valves had been performed using the MOVATS DMT (displacement measuring transducer) to determine torque. Industry testing has found a high degree of uncertainty in thrusts determined using the DMT. (See Section 2.3)

(5) IFI 50-302/94-18-05, Correction of Measured Thrust for Diagnostic Uncertainties.

The licensee's evaluations of differential pressure test thrust measurements against calculated values failed to account for inaccuracies in the measured values. (See Section 2.3)

(6) IFI 50-302/94-18-06, Use of Calculated Thrust Limits Where Directly Measured Thrust Limits Were Appropriate.

Although the licensee had direct torque measurements for most of their dynamically tested valves, they converted actuator and valve torque limits to thrust acceptance limits for dynamic tests. A stem friction coefficient was assumed for the conversion calculation resulting in uncertainty that could have been avoided by directly comparing measured torque with the actuator and valve torque limits. (See Section 2.3)

(7) IFI 50-302/94-18-07, Adequacy of Extrapolations.

The licensee linearly extrapolated the thrust necessary to overcome differential pressure to design-basis conditions. In some cases, the extrapolation was approximately 50% of DP. There is uncertainty regarding the accuracy of such extrapolations. (See Section 2.3)

(8) IFI 50-302/94-18-08, As-Found Static Diagnostic Testing.

Licensee personnel stated that static diagnostic direct thrust measurements would be performed on the GL 89-10 MOVs, for as-found and as-left testing, to better establish confidence in past measurements and assure acceptable margins are maintained. The licensee's preventive maintenance program database identified a requirement for periodic static diagnostic testing but did not specify both as-found and as-left testing. (See Section 2.4.1)

(9) IFI 50-302/94-18-09, Review of Plans for Periodic Verification.

As described in the licensee's internal correspondence NPTS94-0602, entitled Periodic DP Testing, dated December 2, 1994, the licensee plans to dynamically test several MOVs with diagnostic equipment during upcoming outages. The inspectors were not able to determine whether the licensee's planned actions are sufficient to meet the recommendations of GL 89-10 regarding periodic verification of MOV design-basis capability. (See Section 2.4.1)

(10) IFI 50-302/94-18-10, Post-Maintenance Test Requirements.

The licensee's Post-Maintenance Testing Manual was unclear regarding testing requirements following packing adjustment and there were no requirements to verify acceptable thrust following valve repair/replacement or internal repairs. (See Section 2.4.2)

(11) IFI 50-302/94-18-11, MOV Trending Parameters.

The licensee had not established requirements for trending and periodic examination of MOV failures and degradation. (See Section 2.5.2)

(12) IFI 50-302/94-18-12, Mispositioning.

The licensee did not assure the capabilities of non-active GL 89-10 valves to be repositioned should they be mispositioned. There is a PWR owners group position against the related generic letter recommendation which continues under NRC review. Guidance given in an NRC internal memorandum from B. Sheron of July 12, 1994, indicates staff review of GL 89-10 may be closed for a site if the licensee commits to consider the findings of the NRC review of mispositioning, when completed. (See Section 2.11)

(13) IFI 50-302/94-18-13, Functional Testing.

Several MOVs had been functionally tested to demonstrate their capabilities without diagnostics. This was limited to MOVs that are routinely operated under conditions that meet, or exceed design-basis conditions and 1) are normally closed valves of less than 1 inch diameter, 2) are throttle valves that are not required to fully close, and 3) valves with no active safety function. The licensee stated that these tests were done at design-basis conditions. However, the differential pressure test conditions were not clearly documented in the packages reviewed. Also, it was not clear how operability under degraded voltage conditions was ensured. Further, it was not clear how the licensee intended to periodically reverify design-basis capability in the future or monitor for valve degradation. (See Section 2.3)

(14) IFI 50-302/94-18-14, Verification of Setting Assumptions for Valves Not Practical to Test.

The licensee's program did not indicate any long-term plans to validate the valve factors and other assumptions that had been used in setting valves that had not been dynamically tested at design-basis conditions. Data from the licensee's future periodic testing and/or from industry testing (e.g., from the EPRI MOV test program) could be used to provide increased confidence in the capabilities of these valves. (See Section 2.3)

Weakness

The inspectors identified a weakness in the documentation of design-basis calculations, systems' Enhanced Design Basis Documents, post maintenance testing requirements, problem reports, and work request entries. With regard to the problem reports and work request entries, the weakness was only found in pre-1994 documents. (See Sections 2.1, 2.3, 2.4 and 2.5.1)

Strengths

The following strengths were noted:

- The responsible MOV personnel were fully knowledgeable of the important technical issues.
- A large percentage of the licensee's GL 89-10 MOV population had been dynamically tested to assure their capabilities to perform their design-basis functions.
- The importance of future dynamic diagnostic testing had been recognized.
- A good independent audit of the GL 89-10 program had been performed.

Inspector Followup Item

(Closed) IFI 50-302/93-25, Review Licensee Recalculation of MOV Thrust Requirements and Resetting of Torque Switch Trip Setpoint. (See Section 2.11)

REPORT DETAILS

1. Persons Contacted

Licensee Employees

J. Baugardner, Senior Nuclear Quality Auditor
*W. Brewer, Supervisor, Nuclear Plant Technical Support
*M. Fitzgerald, Supervisor, Nuclear Plant Systems Engineering
*P. Fleming, Senior Nuclear Licensing Engineer
*B. Hickle, Director, Nuclear Plant Operations
C. Lee, Decay Heat System Engineer
*R. McLaughlin, Nuclear Regulatory Specialist
*S. Robinson, Manager, Nuclear Quality Assessments
*A. Stern, Senior Nuclear Mechanical Engineer
*R. Widell, Director, Nuclear Operations Site Support
*K. Wilson, Manager, Nuclear Licensing

NRC Employees

*R. Butcher, Senior Resident Inspector
*C. Casto, Section Chief, Division of Reactor Safety, Region II

*Attended exit interview

Acronyms and initialisms used throughout this report are listed in the last paragraph.

2.0 GENERIC LETTER (GL) 89-10 "SAFETY-RELATED MOTOR-OPERATED VALVE (MOV) TESTING AND SURVEILLANCE" (TI 2515/109)

In a letter dated June 22, 1994, the licensee informed the NRC that it had completed its commitments to GL 89-10 recommendations (a) through (h). The current inspection assessed this program completion.

In performing the assessment the inspectors utilized guidance described in an NRC memorandum of July 12, 1994, "Guidance on Closure of Staff Review of Generic Letter 89-10 Programs" and in Temporary Instruction (TI) 2515/109, "Inspection Requirements for Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance." The licensee's GL 89-10 program was previously examined in NRC inspections 50-302/92-01 and 93-02.

Three of the areas covered by this inspection were the design-basis reviews in Section 2.1, setting and sizing determinations in Section 2.2, and testing performed to confirm the capabilities of GL 89-10 MOVs in Section 2.3. The inspection of these areas examined licensee methodologies and data generally for all of the GL 89-10 MOVs and in detail for a representative sample. The inspectors selected the sample of MOVs based on a review of the licensee's Motor Operated Valve Program

Manual, Revision 3; Calculation E92-0214, Revision 3, MOV Operability Assessments; and associated documents specifying available thrust margin. The sample included the following:

Differential Pressure Tests with MOVATS Torque Thrust Cell (TTC)

DHV-12	Decay Heat Discharge Valve from DHP-1A to MUP
FWV-32	Low Load Block Valve
FWV-36	Startup Block Valve

Differential Pressure Tests with MOVATS Displacement Measurement Device

EFV-33	Emergency Feedwater Valve from Pump EFP-1 to Steam Generator
MUV-18	Reactor Coolant Pump Seal Isolation Valve

Functional Differential Pressure Tests with No Diagnostics

CAV-1	Pressurizer Steam Space Sampling Isolation Valve
CFV-11	CFT-1A Sampling (Leakoff Connection) Valve

Other topics and areas examined by the inspectors in this inspection included: periodic verification of MOV capability; MOV failures, corrective actions, and trending; pressure locking and thermal binding; MOV motor brakes; quality assurance program implementation; MOVs deleted from the program; MOV conditions observed in a walkdown inspection; mispositioning; and followup of previous inspection findings (see Sections 2.4 through 2.12).

The inspectors did not identify any concern as to the current operability of the valves. However, the NRC review of the licensee's implementation was not considered closed due to issues described below and identified as inspector followup items (IFIs). The inspection also identified a violation, strengths and a weakness.

2.1 Design-Basis Reviews

The inspectors reviewed the licensee's design-basis documentation to determine and verify its adequacy for the MOVs examined during this inspection. The recommended action "a" of GL 89-10 that requested licensees determine the maximum differential pressure (DP) and flow expected for both normal and abnormal (accident) conditions were examined to verify maximum parameters were used. In addition, follow-up reviews were performed to determine if changes to the design-basis were implemented to address concerns identified during the GL 89-10 Part 1 inspection conducted January 6-10, 1992. That inspection identified several design-basis concerns related to 1) flow and temperature; 2) the effects of high ambient temperature on motor torque had not been accounted for; 3) the ambient temperature had not been considered in the selection of motor thermal overload devices; and 4) the electrical calculations to determine motor terminal voltages for all the MOVs were not completed.

The inspectors reviewed the licensee's design-basis DP calculations and their referenced documentation, together with applicable system flow drawings, and each system's Enhanced Design Basis Document to verify that the maximum flow and DP were determined. The calculations for DP, electrical degraded grid voltage, flow, and temperature effects on cable were reviewed and verified to be complete and correct. Calculations of thrust and torque were verified to use appropriate inputs of design DP and degraded voltage capabilities.

The inspectors verified that the licensee had updated the electrical and design-basis calculations to meet the recommendations in GL 89-10. The design-basis calculations included the DP, flow and temperature parameters. The electrical calculations addressed the high temperature effects on motor torque discussed in Limitorque Technical Update 93-03 affecting GL 89-10 MOVs.

The inspectors identified a weakness in the system Enhanced Design Basis Documents and DP Calculations. The inspectors noted that these documents lacked consistency in detail and format. Several of the DP calculations did not provide sufficient details on the methodology used to determine the DP. The licensee's independent assessment (audit) expressed similar views concerning the DP calculations. This condition was also previously identified by the licensee as a concern; however, no corrective action had been implemented. The inspectors concluded that to use these documents the user would have to be very knowledgeable of the system.

The inspectors concluded the licensee had satisfactorily implemented the recommendations of GL 89-10 for including all parameters in the design-basis DP calculations.

2.2 MOV Sizing and Switch Setting

Crystal River's thrust calculations applied the industry standard thrust equation to determine thrust requirements. Typical valve factors included 0.50 for gate valves and 1.10 for globe valves. For the determination of actuator output thrust capability, the licensee assumed a stem friction coefficient of 0.15. A minimum margin of 15% (or 30% where margin was available) was set aside to address MOV load sensitive behavior (also known as "rate of loading") for those valves not set up with plant-specific dynamic test data. This margin also was assigned to account for valve degradations.

During review of the licensee's method for determining appropriate MOV switch settings, two issues concerning torque switch repeatability were noted. First, torque switch repeatability was not included when adjustments were made to the peak thrust limits to account for diagnostic equipment uncertainties (accuracy). Second, the torque switch repeatability values used to adjust the maximum allowed torque switch setting did not include the higher values for MOVs with dial settings of "1" as identified in Limitorque's Maintenance Update 92-01. These same issues were identified by a recent self-assessment performed

by the licensee. The licensee stated that the impact of these changes had been reviewed. However, the licensee had not documented the review methodology and results. The involved uncertainties in valve thrust could potentially affect the ability of an MOV to perform its design-basis function. The licensee is being requested to formally respond to provide a schedule specifying when the formal impact assessment will be completed, and when all impacted thrust calculations and thrust windows will be revised. This was identified as IFI 50-302/94-18-01, Torque Switch Repeatability Errors.

The licensee justified their margin assigned for load sensitive behavior in interoffice correspondence NPTS94-0597, dated December 1, 1994. NPTS94-0597 documented the testing performed on 9 MOVs for load sensitive behavior margin. Load sensitive behavior ranged from -9% to 21% for these valves. Based on this data, the licensee chose a value of 15% to be applied to MOVs that will not be dynamically tested. While the 15% value was higher than the average of the data set, the inspectors noted that 3 MOVs had load sensitive behavior values between 14% and 16%, and a 4th MOV had a value of 21%. Therefore, 15% may not be conservative for all non-dynamically tested MOVs. The inspectors did not identify any immediate concerns with the chosen 15% margin, however, the licensee will need to obtain additional data to support their current justification for program closure. The licensee is being asked to formally respond and provide a plan to accomplish this task. This was identified as IFI 50-302/94-18-02, Rate of Loading.

Interoffice correspondence NPTS94-0583, dated November 22, 1994, documented the licensee's stem friction coefficient study. This study consisted of measuring the stem friction coefficient at torque switch trip for multiple tests performed on 23 MOVs. The study concluded that use of 0.15 stem friction coefficient was justified because only 2 MOVs had values that exceeded this level. However, the inspectors noted that the data did not include measurements taken under dynamic conditions. When assessing dynamic test results, it is important to evaluate load sensitive behavior. However, stem friction coefficient also should be evaluated in cases where the torque switch was bypassed (e.g., in the open direction) so that the actuator's degraded voltage capability was not over estimated. The licensee did include margin for load sensitive behavior in the opening direction. However, they did not verify that it was adequate given the possible change in an actuator's thrust output caused by a change in the stem friction coefficient under dynamic conditions. Further, the inspectors noted that the licensee was in the process of changing their stem lubricant from FelPro N-1000 to Chevron EP-2. No effort had been made to see if this grease change would affect the conclusions drawn from the original study. The licensee was formally requested to respond with a plan to resolve these concerns. This was identified as IFI 50-302/94-18-03, Stem Friction Factor.

2.3 Design-Basis Capability

The inspectors reviewed static test results, dynamic test packages, and post-test review packages for the selected valves. The dynamic test data was reviewed using the industry standard equation, the valves' orifice diameters, and the dynamic test conditions. This review indicated closing gate valve factors up to 1.0 and load sensitive behavior as high as 21.2%. Stem friction coefficients for the sample valves were as high as 0.13 under static conditions (see Appendix A). Based on the test packages reviewed, the inspectors did not identify any operability concerns for the selected valves.

2.3.1 Testing Equipment

After review of the licensee's GL 89-10, Supplement 5 (equipment inaccuracies) response and discussions with the licensee, it was determined that some MOVs were set up and dynamically tested with the MOVATS displacement measuring transducer (DMT), also known as the thrust measurement device (TMD). The DMT was calibrated during a test by opening the MOV into a load cell. This method was shown during validation testing by the industry to have had large potential uncertainties for measurements taken in the closing direction. The inspectors reviewed the current torque switch settings for Valves ASV-5, DHV-42, DHV-43, DWV-160, WDV-60, and WDV-94 that had low apparent thrust margin. No operability concerns were identified with these valves. The inspectors were informed that the licensee plans to retest valves that were set based on DMT testing. This would eliminate the reliance on that older technology and its associated large uncertainties. The licensee is being formally requested to provide a response describing the plans and schedule for retesting to eliminate reliance on DMT results. This was identified as IFI 50-302/94-18-04, Reliance on DMT Results.

2.3.2 Dynamic Testing

The licensee's method for evaluating dynamic test data consisted of comparing the thrust measured at flow isolation with what their thrust calculation would predict at the tested pressure. If the equation prediction bounded the measured thrust, the equation was considered valid for design-basis conditions. If the measured thrust exceeded the equation predication, then a new thrust requirement was determined using the measured valve factor. The inspectors noted that these comparisons used the as-read thrust value from the diagnostic trace and did not account for the uncertainty in these values. Licensee personnel stated that diagnostic uncertainties were accounted for in the original setup of the torque switch. However, this only accounts for the uncertainty in the thrust measurement at torque switch trip, not for additional uncertainty that may exist in the thrust requirement at flow isolation. The licensee was formally requested to respond to this concern providing a schedule for proposed resolution actions. This was identified as IFI 50-302/94-18-05, Correction of Measured Thrust for Diagnostic Uncertainties.

The licensee's dynamic test acceptance criteria was found in Section 6.3 of the MOV Program Manual. The inspectors noted that this criteria did not directly address the valve's or operator's torque rating. The licensee was converting the actuator torque rating to thrust using an assumed stem friction coefficient and included this value as part of the thrust structural ratings. However, if peak torque was not compared directly to torque limits, the acceptance criteria would need to validate the assumed stem friction coefficient used by the original thrust window. This was of particular importance for an open DP test when the torque switch was bypassed and the stem friction coefficient may increase from that which existed during the static test. The licensee is being formally requested to respond to this concern. This was identified as IFI 50-302/94-18-06, Use of Calculated Thrust Limits Where Directly Measured Thrust Limits Were Appropriate.

2.3.3 Thrust Calculations

During review of the thrust calculations for the direct current (DC) powered MOV FWV-36, the inspectors discovered that the spreadsheet actuator capability calculation used a run efficiency of 0.5, instead of the appropriate pullout efficiency of 0.4. As referenced in March 9, 1994, letter from Cleveland Electric Illuminating Co. to Limitorque Corp. and as stated at the 1994 Summer Motor Operated Valve User's Group (MUG) meeting, conducted August 3 - 4, 1994, at Dearborn, Michigan, the MOV actuator manufacturer (Limitorque) considers use of run efficiency for the closing direction inappropriate for DC MOVs. Licensee personnel stated that they had intended to assure that DC MOV calculations used run efficiency but failed to do so in the case of FWV-36. The inspectors noted that this indicated a deficiency in design control measures. This is contrary to 10 CFR 50 Appendix B, Criterion III, Design Control, which requires design control measures which assure design bases are properly translated into drawings, specifications, instructions, and procedures. In response to this finding, the licensee generated Problem Report 94-0338. The licensee determined that FWV-36's motor torque capability under degraded voltage conditions was greater than the minimum needed to close the valve and satisfy its originally identified safety function. However, the existing torque switch setting was set above the actuator's degraded voltage capability. Therefore, if closed, insufficient torque would be generated to open the torque switch and turn off the motor. The integrity of the actuator motor would rely on protection afforded by the thermal overloads which are typically oversized to ensure the MOV's ability to perform its safety function. Licensee personnel verified that this valve was not required to operate for any safety function following an accident scenario, therefore, determined that no immediate corrective action was necessary. Further, they stated that a review of thrust calculations for all other DC MOVs was conducted which determined that this error was an isolated case. The root cause was identified as a combination of factors. The licensee had used run efficiencies for selected DC MOVs in the past. This was stated in the "assumptions section" of the calculation cover sheet. Previous revisions of the calculation for FWV-36 stated that run efficiency had been used. The current revision had this statement

removed without changing the actual value in the calculation. An informal review by the licensee of the thrust calculations for DC powered MOVs only looked at the cover sheet assumptions and missed the continued use of run efficiency for FWV-36. The inspectors considered the licensee's inappropriate use of "run efficiency" in the thrust calculation for a safety-related component to be a violation. However, this NRC identified violation is not being cited because the criteria specified in Section VII.B of the NRC Enforcement Policy were satisfied. The misuse of "run efficiency" in the thrust calculation for Valve FWV-36 was identified as non-cited violation NCV-50-302/94-18-15, Uncorrected Actuator Capability Calculation for Valve FWV-36.

To determine the operability of an MOV, the licensee linearly extrapolated the thrust necessary to overcome differential pressure to design-basis conditions. In some cases, the extrapolation was approximately 50%. The licensee's justification for this method was stated as "Industry experience has shown that valve factors obtained from reduced pressure/temperature tests are conservative and can be used for straight line extrapolation." Because of uncertainty regarding the adequacy of such extrapolations, the licensee is being requested to provide a response describing future use of industry and/or Crystal River test data to ensure the adequacy of settings based on extrapolation. This was identified as IFI 50-302/94-18-07, Adequacy of Extrapolations.

The licensee identified several MOVs that have been functionally tested without diagnostics. This was limited to MOVs that are routinely operated under conditions that meet, or exceed design-basis conditions and 1) are normally closed valves of less than 1 inch diameter, 2) are throttle valves that are not required to fully close, and 3) valves with no active safety function. The licensee stated that these tests were done at design-basis conditions. However, the differential pressure test conditions were not clearly documented in the test packages reviewed. Also it was not clear how operability under degraded voltage conditions was ensured. Further, it was not clear how the licensee intended to periodically reverify design-basis capability in the future or monitor for valve degradation. The licensee is being formally requested to respond with a plan to resolve this concern. This was identified as IFI 50-302/94-18-13, Functional Testing.

For 21 valves in the licensee's program, design-basis testing was not practical. The inspectors noted that 10 of these appeared to have minimal thrust margin; MUV-40, -41, and -505; RCV-11; DHV-5 and -6; and MUV-258, -259, -260, and -261. Licensee personnel stated that evaluations had already been initiated to improve the margin of these valves. The licensee's program did not indicate any long-term plans to validate the valve factors and other assumptions that had been used in setting valves that had not been dynamically tested. Data from the licensee's future periodic testing and/or from industry testing (e.g., from the EPRI MOV test program) could be used to provide increased confidence in the capabilities of these valves. The licensee is being requested to provide a written response indicating its plans to further

ensure that setting assumptions for valves not practical to test are satisfactory. This was identified as IFI 50-302/94-18-14, Verification of Setting Assumptions for Valves Not Practical to Test.

The inspectors identified areas where the licensee's program documentation was weak. These areas are outlined below:

- The differential pressure test evaluations contained the test data and a conclusion section, but did not contain the test acceptance criteria that was applied. The licensee explained that the acceptance criteria existed in Section 6.3 of the MOV Program Manual. Any exceptions to those criteria were documented in the conclusion sections. However, the test evaluation documents did not contain a reference to the program's acceptance criteria and the conclusion section did not include statements to document the successful completion of the acceptance criteria. The inspectors were concerned that there was no documented evidence that all aspects of the acceptance criteria were met for any given DP test prior to returning the valve to service. Further, the evaluations did not contain a clear statement of thrust margin available (as compared to the thrust available at torque switch trip) once actual thrust requirements were extrapolated to design-basis conditions and appropriate uncertainties and margins were accounted for. Given the lack of explicit acceptance criteria, it was not clear what would prevent returning an MOV to service prior to evaluation of the dynamic test data.

- Section 6.4 of the MOV Program Manual describes the method used to evaluate dynamic test data. This section consists of five steps that state the thrust value determined with the thrust equation is to be compared to the thrust measured at flow isolation. No details are provided for addressing diagnostic equipment inaccuracies, calculating load sensitive behavior, calculating valve factor, or determining the stem friction coefficient.

Based on the sample of selected MOVs, the inspectors did not identify any unanalyzed nonconformances with the program's acceptance criteria. However, the weaknesses noted above were considered to increase the potential for omissions or errors.

2.4 Periodic Verification of MOV Capability

Recommended action "d" of GL 89-10 requested that the preparation or revision of procedures to ensure that adequate MOV switch settings are determined and maintained throughout the life of the plant. Section "j" of GL 89-10 recommends surveillance to confirm the adequacy of the settings. The interval of surveillance is to be based on the safety importance of the MOV as well as its maintenance and performance history. The surveillance was recommended not to exceed five years or three refueling outages. Further, GL 89-10 recommended that the

capability of the MOV be verified if the MOV was replaced, modified, or overhauled to the extent that existing test results are not representative of the MOV.

2.4.1 Surveillance

The inspectors reviewed the licensee's Motor Operated Valve Program Manual for periodic test requirements and found that it stated that periodic testing was not required. (The licensee's preventive maintenance (PM) program specifies testing requirements.) The licensee's GL 89-10 MOVs had been set on the basis of dynamic tests performed without prior valve/actuator maintenance. However, licensee personnel stated that static diagnostic direct thrust measurements would be performed on the GL 89-10 MOVs, taking as-found and as-left data, to better establish confidence in past measurements and assure acceptable margins are maintained. The requirement for the static testing was in the licensee's PM database rather than in the Motor Operated Valve Program Manual. The licensee's PM program database specified a six year frequency for periodic static diagnostic testing using PM procedure PM-178. The six year period was based on a two year refueling frequency. However, procedure PM-178 only required data for as-left testing. When questioned, licensee personnel responded that this omission had been recognized and was to be corrected. The licensee is being requested to specify a schedule for this correction. Verification of the correction is identified as IFI 50-302/94-18-08, As-Found Static Diagnostic Testing.

Internal licensee correspondence NPTS94-0602, Periodic DP Testing, dated December 2, 1994, stated the licensee plans to dynamically test several MOVs with diagnostic equipment during upcoming outages. The inspectors were not able to determine whether the licensee's planned actions are sufficient to meet the recommendations of GL 89-10 regarding periodic verification of MOV design-basis capability. Therefore, the licensee is being requested (1) to describe its plans for periodic verification of the design-basis capability of its GL 89-10 MOVs, including the performance of static and dynamic testing of MOVs with or without the use of diagnostic equipment; (2) to establish a specific margin for potential dynamic performance degradation in its GL 89-10 MOVs (both gate and globe valves); (3) to evaluate its planned dynamic tests to determine whether a sufficient sample of MOVs had been selected to justify a selected margin for potential dynamic performance degradation; and (4) to describe the actions that will be taken in the event that periodic static testing reveals that margin for degradation is not available. The NRC will review this information when provided by the licensee to determine whether the licensee's commitments satisfy the recommendations of paragraph d of GL 89-10 on the periodic verification of MOV design-basis capability. Completion of the staff's review was identified as IFI 50-302/94-18-09, Review of Plans for Periodic Verification.

2.4.2 Post Maintenance and Post Modification Testing

The inspectors identified that the licensee's Motor Operated Valve Program Manual did not provide any requirements for post maintenance or post modification testing. In the manual it was stated that DP testing re-verification should be considered if a valve was replaced or modified, system parameters were changed beyond acceptable extrapolation methodologies, or if the margin for valve degradation was a concern. Licensee personnel referred the inspectors to their Post-Maintenance Testing Manual, Revision 0, and to Nuclear Engineering Procedure NEP 235, Design Considerations for Motor-Operated Valves, Revision 3, for the respective testing requirements.

The inspectors reviewed the Post-Maintenance Testing Manual to determine what testing was specified following packing adjustment and valve repair/replacement. For packing adjustment, it was unclear whether a test was required to verify that the adjustment did not cause an unacceptable increase the thrust required for opening or closing the MOV. In the manual a "Note 1" was referenced in the description of requirements but there was no "Note 1." Instead, there was an unnumbered note that stated "verify stroke time/current/differential pressure tests as required by ASME ISI or GL 89-10 (if valve is in stated programs)." There were no requirements to verify acceptable thrust following valve repair/replacement or internal repairs, though these categories of maintenance were listed in the Post-Maintenance Testing Manual. However, in several of the reviews of Work Requests described below in Section 2.5.2 of this report, the inspectors specifically checked for post-maintenance testing and found that it was being appropriately performed.

The inspectors reviewed Nuclear Engineering Procedure NEP 235 to determine what testing was specified for MOV modifications. The procedure stated that testing was required to validate thrust calculations when MOVs were affected by the change. To further assess the licensee's post-modification testing requirements, the inspectors reviewed the documentation for a largely completed modification involving upgrading Emergency Feedwater valves EFV-32 and -33. The modification, identified MAR 92-04-02-04 and including Field Change Notices through FCN-8, involved motor and stem changes and installation of Torque Thrust Cell (TTC) diagnostic sensors. The inspectors found that appropriate post-modification testing was specified by the work documentation.

The inspectors concluded that the licensee specified and performed appropriate post-modification testing. It also appeared that appropriate post-maintenance testing was being performed, but the requirements were not satisfactorily described in the Post-Maintenance Testing Manual. Licensee personnel informed the inspectors that they would undertake to clarify the post maintenance test requirements. The licensee is being requested to provide a description of their plans and schedule. This was identified as IFI 50-302/94-18-10, Post-Maintenance Test Requirements.

2.5 MOV Failures, Corrective Actions, and Trending

Recommended action "h" of the generic letter requested that licensees analyze and justify each MOV failure and corrective action. The documentation should include the results and history of each as-found deteriorated condition, malfunction, test, inspection, analysis, repair, or alteration. All documentation should be retained and reported in accordance with plant requirements. It was also suggested that the material be periodically examined (every two years or after each refueling outage after program implementation) as part of the monitoring and feedback effort to establish trends of MOV operability.

2.5.1 Documentation, Analysis, and Corrective Actions for MOV Degradation and Failures

The inspectors reviewed and assessed the adequacy of the licensee's documentation, analyses, and corrective actions for MOV degradation and failures through a review of selected licensee maintenance Work Requests (WRs) and Problem Reports (PRs). The WRs were chosen from the printout of summaries of MOV maintenance in the licensee's database for 1991 - 1994. The PRs, covering significant failures, were chosen from a listing of all PRs starting in 1992.

The WRs reviewed by the inspectors included the following:

WR Nos.	Description of Maintenance
0289551	During performance of preventive maintenance on October 19, 1991, the torque switch limiter plate was found to be missing from Valve MUV-53. Additionally, problems were identified involving declutching and manual actuation. Gearing was found to have missing teeth and was replaced. (Note: The inspectors found the maintenance and corrective actions were not well-documented in this WR.)
0293188	Valve DHV-39 was repacked for the Valve Reliability Packing Program. Completed July 1992.
0298178	On June 23, 1992, Valve CAV-3 would not fully close. The problem could not be duplicated during troubleshooting. It closed satisfactorily when actuated electrically. Completed June 23, 1992.
0298245	On June 24, 1992, Valve DHV-35 would not operate manually. The handwheel shaft key was found damaged and was replaced. Completed July 4, 1992.
0298707	On July 5, 1992, Valve CAV-3 would not fully close. The torque switch contacts were not fully closing and were cleaned. The cleaning corrected the problem. Completed July 12, 1992.

0309463 On April 22, 1993, a packing leak was reported for Valve CFV-5. The valve was manually backseated and the packing was torqued until the leakage was almost eliminated. Completed April 23, 1993. (Note: The inspectors questioned why no-post maintenance thrust verification was performed on this valve after torquing the packing. Licensee personnel reviewed the associated flow diagram with the inspectors to verify that the valve performed no active safety function.)

0308774 On April 1, 1993, a packing leak was identified for Valve FWV-32. The valve was unpacked and repacked. The WR referenced MOVATS diagnostic testing that was to be performed using another WR. Completed April 24, 1993.

0266317 This was a WR for preventive maintenance to perform an actuator inspection/lubrication check on Valve MSV-35. Spring pack relaxation was found and the spring pack was replaced. The WR indicated diagnostic testing following spring pack replacement. Completed May 30, 1994. (Note: The inspectors found the maintenance well-described in this WR.)

The PRs reviewed by the inspectors included the following:

PR No.	Condition and Corrective Action
92-0958	During an inspection of valve CAV-1, cracks were identified in the disc and seat. The valve was replaced with a new valve. Completed July 14, 1992. (Note: The inspectors found that no entry for the cause of the cracks was documented on this PR. No action to preclude recurrence or check for cracks in the future was specified. The PR presented no analysis of the condition.)
93-0055	During a performance test on March 6, 1993, Valve FWV-31 was electrically stroked closed followed by an opening attempt. It would not electrically stroke open and the breaker was found to have tripped. Hydraulic lock was suspected and it was initially reported that excessive grease had been found in the spring pack. An "investigation close-out report" attached to the PR stated that the cause was determined to be an incorrect breaker trip setting and the grease found in the spring pack was not considered excessive. It noted that an NRC Electrical Distribution System Functional Inspection had identified similar problems, which were identified on PR 93-0176. This latter PR was referred to for detailed corrective actions. It was reviewed by the inspectors and found to provide for correction of field settings, additional guidance and/or training for craft, a resistor repair, and various engineering document corrections, etc.

93-0125 The fuse for Valve EFV-33 blew on April 23, 1993, while the valve was being closed. The torque switch roll pin was found to be sheared. The cause was recorded to be still under evaluation. Corrective actions for the individual failure included replacement of the actuator, inspection to verify the valve was not damaged, and diagnostic testing following valve reassembly. The proposed action to preclude recurrence involved replacement of current torque switches with enhanced torque switches. The PR was still open pending completion of the action to preclude recurrence.

93-0198 This PR was initiated October 18 1993. It reported that the thrust settings for Valve DHV-12 might be low because of potential error associated with an extrapolation of test results. The licensee had extrapolated results from testing the valve at 52% of design-basis pressure to confirm the capabilities of the valve at full design-basis differential pressure. The settings for Valve DHV-12 had been based on a 0.4 valve factor. The PR noted that the latest requirements would have used settings based on a 0.5 valve factor and, because of the extrapolation uncertainty, the settings for DHV-12 should be increased to values based on the 0.5 valve factor. An analysis documented in the PR concluded that the valve would be capable of opening with its current settings, even if a 0.5 valve factor applied, because of a 21% torque switch bypass. Additionally, the analysis indicated that a review had determined that the original closing design requirements were incorrect and closing requirements could be met with the current setting. The closing setting had been based on closure against pump shutoff head which was not required. The PR stated that settings would corrected at the next available system maintenance outage to thrusts based on the 0.5 valve factor. The PR specified a re-evaluation of the as-left torque switch settings for all GL 89-10 valves. (Note: The PR corrective actions were not signed-off as complete. The inspectors were informed that this was because the resetting of Valve DHV-12 had not been performed yet.)

In assessing the above WRs and PRs, inspectors found that the licensee's analysis and corrective actions for MOV degradation and failures were generally satisfactory. A weakness was noted, however, in the documentation of the older WRs and PRs. The descriptions of work in the 1992 and especially the one 1991 WR were difficult to understand and required some clarification from licensee personnel. The 1992 PR reviewed lacked any cause entry. Although the 1993 and 1994 WRs and PRs were generally much better documented, the inspectors required aid in understanding the entries in 1993 PR 93-0198.

2.5.2 Trending and Periodic Examination of Failures and Degradation

The inspectors found that the licensee had not implemented trending. In a letter to the NRC dated September 18, 1992, the licensee stated that the tracking and trending program would be in place within two years after program implementation. Licensee personnel indicated that they had interpreted this to mean that the documented trending program was not required until two years after completion of program implementation, at which time they would perform the first periodic examination of failures and degradation. The NRC had expected licensee's to have the trending program in place at the completion of GL 89-10 program implementation, defining the trend data to be accumulated and the method of trending. The inspectors were informed that the licensee already had provisions for accumulating necessary trend data. The licensee is being requested to specify the parameters that will be tracked and the procedures for accumulating the associated data in a written response to this report. Resolution of this matter was considered necessary for completion of the NRC review of the licensee's GL 89-10 program implementation and was identified as IFI 50-302/94-18-11, MOV Trending Parameters.

2.6 Pressure Locking and Thermal Binding

The Office for Analysis and Evaluation of Operational Data had completed a study of pressure locking and thermal binding of gate valves. It concluded that licensees have not taken sufficient action to provide assurance that pressure locking and thermal binding will not prevent a gate valve from performing its safety function. The NRC regulations require that licensees design safety-related systems to provide assurance that those systems can perform their safety functions. In GL 89-10, the staff requested licensees to review the design basis of their safety-related MOVs.

The licensee's letter, 3F0394-03, dated March 8, 1994 to the NRC stated their position on pressure locking and thermal binding (PL&TB). The licensee's followup letter to the NRC, 3F0694-15, dated June 22, 1994, further clarified the licensee's position concerning PL&TB. The licensee's stated in the letter that "activities and discussions associated with PL&TB will be managed outside of the GL 89-10 arena. FPC has applied considerable resources to address the PL&TB issue. All safety significant valves affected by PL&TB have been appropriately modified."

The inspectors reviewed Plant Document Review Evaluation M94-0003, Design Analysis/Calculation, Pressure Locking/Thermal Binding, Revision 0, dated May 25, 1994, to verify that PL&TB was adequately addressed. All of the GL 89-10 MOVs were evaluated for PL&TB in M94-0003. The inspectors concluded that although the licensee had addressed the recommendations to evaluate MOVs for PL&TB, their actions may not be sufficient. Pressure locking and thermal binding are currently under NRC review and the issue has not been resolved.

2.7 Motor Brakes

The inspectors reviewed two problem reports, a memorandum, and a licensee event report (LER) that discussed MOV motor brakes. LER 93-008-01 stated in the EVENT EVALUATION Section that "seven safety related valves were identified with motor brakes installed." Problem Report PR 93-0159 identified that the minimum operating brake voltage for FWV-28 was 414 VAC and the minimum degraded voltage was 345 VAC. Problem Report PR 93-173 and interoffice correspondence memorandums File: ENG 4, NEA93-0173 dated August 2, 1993, and NEA93-0819 dated July, 7, 1993, had addressed and described the evaluation of MOVs with motor brakes. The completed evaluations and corrective action for these MOVs are:

AHV-1B and 1C - Locked closed during plant operation.

CFV-5 and 6 - Locked open during plant operation.

FWV-28 - The MOV was successfully tested as it is.

MUV-58 and 73 - Brakes removed July 12, 1993 per MAR 93-07-01-01.

The inspectors concluded the licensee has satisfactorily addressed the MOV motor brake concern.

2.8 Quality Assurance Program Implementation

The inspectors discussed the site quality assurance (QA) program and quality control inspection program with the licensee personnel. The licensee's position for quality assurance in the GL 89-10 program was that the requirements were in the existing quality assurance program. The existing Plant Operating Quality Assurance Manual was used as the implementing document for the GL 89-10 program.

The inspectors reviewed three Quality Assurance audit reports that addressed some areas pertaining to motor operated valves. The 1993 Audit Report of Engineering, 93-09-NOEO, identified four MOV concerns: 1) the acceptance criteria for MOV testing was adequately developed; 2) consideration for expanding the MOV Manual to include the maintenance program for balance-of-plant MOV; 3) implementation of a corrective action plan for MOVs DHV-5 and 6 concerning thermal binding and pressure locking; and 4) re-evaluation of pressure locking and thermal binding.

The 1994 Audit Report of Nuclear Plant Operations, 94-02-OPS, identified six MOV concerns; 1) Refresher training for electricians; 2) Procedure Review Packages do not require necessary notification when administrative controls are changed; 3) MP-402E needs revised for second level verification of test data; 4) Conduct self assessment of accuracy of data and calculations; 5) No requirements for tracking and trending MOV problems; and 6) Correct deficiencies of MOVs identified during walkdown.

The 1994 Audit Report of Nuclear Operations Engineering Organizations, 94-09-NOEO, included the final report of an audit assessment performed by an outside contractor. The contractor performed a detailed audit to assess the GL 89-10 MOV program. Eight concerns were identified and recommendations for each concern were listed. The inspectors concluded that the audit conducted provided an adequate assessment of the licensee's GL 89-10 MOV program and addressed the appropriate concerns.

The three audits identified strengths in addition to the weaknesses and concerns. Recommendations were suggested to correct the deficiencies. Each issue or concern was assigned a tracking number to ensure there was corrective action followup. The use of an outside contractor provided additional expertise for assessing the MOV program. The inspectors concluded that the licensee had implemented an effective quality assurance program for the GL 89-10 MOVs. The QA audits and functions were considered a strength for the licensee's MOV program.

2.9 MOVs Deleted From the Licensee's Program

In assessing the licensee's completion of its GL 89-10 program, the inspectors noted that the licensee had deleted over ten valves from the program scope originally examined and determined acceptable by the NRC during TI 2515/109, Part 1 Inspection 50-302/92-01. To determine if the deletions were adequately justified, the inspectors verified that the licensee had a listing of documentation that justified all the deletions and then evaluated a sample of the justifying documents. The documentation reviewed was as follows:

- Modification Approval Record (MAR) 88-05-01-02, which decommissioned the sodium hydroxide storage tank and associated circuits, permitting removal of Valves BSV-11 and -12 from the program.

- Drawing FD 302-641, Rev. 2 and Correspondence NPSE92-0104, dated February 27, 1992, which documented justification for removal of Valves DHV-75, -76, -105, and -106 from the program.

- Request for Engineering Assistance 91-006, which documented the basis for removal of Valves DOV-210 and -238 from the program.

The inspectors found the justifications were satisfactory and concluded that the licensee had adequately justified its deletions of valves from the GL 89-10 program.

2.10 Walkdown

The inspectors conducted a walkdown of MOVs to observe the lubrication of the valve stems and the general condition of the valves and actuators. They found that the stem lubrication and valve conditions were satisfactory. However, several apparently minor discrepancies were noted which were identified to the licensee:

- Two actuator limit switch compartment bolts on Valve DHV-6 were not tightened down. Approximately 3/8 inch of thread was exposed between the screw heads and actuator casing.

- The stems on Valves ASV-5 and DHV-11 did not appear well lubricated.

2.11 Mispositioning

GL 89-10 recommended actions to assure that valves inadvertently mispositioned could be repositioned to perform their safety functions. The inspectors verified that the licensee had determined the DP involved for mispositioned valves in the Design-Basis DP Calculations discussed in Section 2.1. However, the licensee had not established switch setting requirements for mispositioning. The PWR owners group's position is that "mispositioning" should not be included in the GL 89-10. The need for "mispositioning" for PWRs continues under NRC review. Guidance given in an NRC internal memorandum from B. Sheron of July 12, 1994, indicates that the staff may close its review of GL 89-10 if the licensee commits to consider the findings of the NRC review of mispositioning, when completed. The licensee is being requested to provide a response stating whether it will appropriately consider the findings of the NRC review of mispositioning. This was identified as IFI 50-302/94-18-12, Mispositioning.

2.12 Followup on Previous Inspection Findings (92702)

(Closed) IFI 50-302/93-25-01, Review Licensee Recalculation of MOV Thrust Requirements and Resetting of Torque Switch Trip Setpoint.

This item was opened for further review of the licensee's corrective actions from Problem Report (PR) 93-0198 for Valve DHV-12. The condition identified by the licensee and the corrective action were re-reviewed during this inspection. Details of the review are described in Sections 2.1, 2.2, 2.3, and 2.5 above. The review included the bases for the licensee's previous conclusion that the valve would function as intended without a setting change. The inspectors agreed with the licensee's conclusion and consider the actions taken for DHV-12 and other valves were adequate for the present. However, additional actions related to the concern addressed by the PR may be required. The principal concern of the PR involved use of extrapolations to determine design-basis MOV setting requirements from testing performed at less than design-basis differential pressure. As described in 2.3 above, the licensee is being requested to provide a response describing future use of industry and/or Crystal River test data to ensure the adequacy of settings based on extrapolation. With the identification of that matter as an issue for resolution, the inspectors consider IFI 50-302/93-25-01 closed.

3.0 Exit Interview

The inspection scope and results were summarized on December 9, 1994, with those persons indicated in paragraph 1. The inspectors described the areas inspected and discussed in detail the inspection results listed in the Summary at the beginning of this report. Although reviewed during this inspection, proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

4.0 Acronyms and Initialisms

ASME	American Society of Mechanical Engineers
CFR	Code of Federal Regulations
DMT	Displacement Measurement Device
DP	Differential Pressure
EPRI	Electric Power Research Institute
FCN	Field Change Notice
FPC	Florida Power Corporation
GL	Generic Letter
IFI	Inspector Followup Item
INEL	Idaho National Engineering Laboratory
ISI	In Service Inspection
MOV	Motor Operated Valve
MOVATS	Motor Operated Valve Analysis Testing System (Company)
NRC	Nuclear Regulatory Commission
PR	Problem Report
PWR	Pressurized Water Reactor
QA	Quality Assurance
TI	Temporary Instruction
TTC	Torque Thrust Cell
WR	Work Request

APPENDIX A. CRYSTAL RIVER GATE VALVE DATA

Diagnostics: MOVATS

VALVE NUMBER	VALVE TYPE	TEST CONDITIONS (PSID)		% DESIGN BASIS		DYNAMIC VALVE FACTOR [1]		STEM [2] FRICTION COEFFICIENT		% LOAD SENSITIVE BEHAVIOR
		Open	Close	Open	Close	Open	Close	Static	Dynamic	
DHV-12	4" Crane 300# Solid Wedge Gate	248	248	53	51	N/C [4]	0.45	0.13 [2]	N/C	15
EFV-33	6" Chapman 900# Flex-Wedge Gate	1500	1500	96	97	N/C	0.41	0.13 [3]	N/C	N/C
FWV-32	10" Chapman 900# Flex-Wedge Gate	439	439	89	89	N/C	0.63	0.08 [3]	N/C	14.2
FWV-36	6" Chapman 900# Flex-Wedge Gate	438	438	80	80	N/C	1.0	0.10 [3]	N/C	21.2
MUV-18	4" Walworth 1500# Flex-Wedge Gate	2624	782	339	73	N/C	N/C	N/C	N/C	N/C

[1] The dynamic valve factors listed were calculated by the licensee using an orifice diemeter.
[2] Stem Lubricant: FelPro N-1000
[3] Stem Lubricant: Chevron EP-2
[4] "N/C" = Not Calculated.