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

Report Nos.: 50-259/95-19, 50-260/95-19, and 50-296/95-19

Licensee: Tennessee Valley Authority
6N 38A Lookout Place
1101 Market Street
Chattanooga,TN 37402-2801

Docket Nos.: 50-259, 50-260 and 50-296

License Nos.: DPR-33, DPR-52 and DPR-68

Facility Name: Browns Ferry Units 2 and 3

Inspection Conducted: July 10-14 and 24-28, 1995

Lead Inspector: H. Whitener — 8-25-95
H. Whitener, Reactor Inspector — Date Signed

Other Inspection Personnel: M. Miller, Reactor Inspector
R. Cain, Contractor INEL

Approved by: for M. Shymlock — 8/25/95
M. Shymlock, Acting Chief
Test Program Section
Engineering Branch
Division of Reactor Safety — Date Signed

SUMMARY

Scope:

This special, announced inspection assessed the licensee's completion of implementation of commitments made for Unit 2 in response to Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance." In addition, the implementation of several GL 89-10 recommendations for Unit 3 were examined.

Results:

The inspectors concluded that the licensee's implementation of GL 89-10 for Unit 2 had been completed in a satisfactory manner. However, one inspector followup item (IFI) concerning the program scope reduction will remain open. A second inspector followup item was opened relating to repair of motor stator through bolts (Unit 3 Only). The scoping concern involved the reduction of

Enclosure

MOVs from 56 to 36 in the GL 89-10 program. Several work items remain to be completed for Unit 2 during the next two refueling outages. However, there were no operability concerns with these remaining work items.

For Unit 3, the MOVs had not been dynamically tested at the time of this inspection. However, the Unit 3 GL 89-10 MOV program reviewed was nearly identical to the Unit 2 GL 89-10 program. The results are summarized below:

Inspector Followup Items (IFI)

(Open): IFI 50-260,296/94-19-01, "Reduced Scope of Valves in GL 89-10 Program." Fifty-six MOVs were initially identified in the GL 89-10 scope. The program scope has been revised to re-classify 36 MOVs of the 56 MOVs as having an active safety function. The other 20 MOVs have been re-classified as having "system operational enhancement" (SOE) status and have been removed from the GL 89-10 program scope. [Section 2.1]

(Open): IFI 50-259,296/95-19-02, Failed Motor Stator Through Bolts. Verify that bolts have been inspected and modified for RHR valves. [Section 2.9]

(Closed): IFI 259/85-09-02, Failed Motor Stator Through Bolts. [Section 2.9]

(Closed): Unresolved Item 50-296/87-02-02, Wrong Gear Ratio in HPCI Valve. [Section 2.9]

Strengths

(1) The GL 89-10 Closure Book was thorough and identified the complete status of each MOV including the maintenance history. It contained tables to provide all the data from calculations and testing, valve grouping, and margins. It also provide the justification for closure of each MOV. [Section 2.1 & 2.2]

(2) The "calculations package" for each MOV was detailed and contained complete information that included actuator data, valve data, motor data, testing data, the design-basis differential pressure calculation, the thrust/torque calculations, maintenance data, and the reconciliation closure section. Open items were also included. [Section 2.1 & 2.3]

(3) Licensee personnel, including both engineering and maintenance, were very knowledgeable of the issues related to GL 89-10.

(4) The licensee had a strong program for identifying, evaluating, and implementing action to enhance or correct any concern associated with the MOVs. [All Sections]

Weaknesses

None were identified.

Remaining Items

The following remaining items were scheduled for the next refueling outage C8, Spring 1996, or the following refueling outage C9, Fall 1997. The inspectors verified there were no operability concerns and the schedule for implementation was satisfactory. [Section 2.2]

	Valve	Document	Modification or Work
1)	2-FCV-001-056,	DCN T36529,	Replace - new operator and valve stem. Installation C9.
2)	2-FCV-23-046,	PER 941202,	Replace - new stem nut and inspect. Installation C8.
3)	2-FCV-69-001,	DCN T36529,	Replace - new longer and stronger valve stem. Installation C8.
4)	2-FCV-69-002,	DCN T36529,	Replace - new operator and valve stem. Installation C9.
5)	2-FCV-73-002,	DCN W29666,	Replace - new stem roller screw/nut. Installation C8. [Section 2.3]
6)	2-FCV-73-003,	DCN T36529,	Replace - new yoke, operator, and stem. Installation C9.
7)	2-FCV-73-030,	DCN (not completed),	Replace - new actuator. Installation C9.
8)	2-FCV-74-057,	Nuclear Experience Review 940740001,	Develop resolution for roll pin failure on torque switch by December 31, 1995. [There is no information on this problem from vendor or other users]
9)	2-FCV-74-061,	Low margin -	inspect internals C8. [Section 2.3]
10)	2-FCV-74-071,	DCN T31884,	Replace - new spring pack. Installation C8.
11)	2-FCV-75-009,	TROI Seq. 7,	Inspect valve for high friction. (there is adequate margin and capability). Installation when available.
12)	2-FCV-75-025,	DCN T36529,	Reset Torque Switch. Installation C8.
13)	2-FCV-75-037,	TROI Seq. 8,	Inspect valve for high friction. (there is adequate margin and capability). Installation when available.

REPORT DETAILS

1.0 Persons Contacted

Licensee Employees

*I. Beltz, GL 89-10 Program Manager
*T. Chan, Corporate Engineering Specialist
*C. Crane, Assistant Plant Manager
*J. Davenport, Licensing Engineer
*B. Endsley, MOV Maintenance Engineer
*C. Galuska, MOV Engineer
*R. Golub, GL 89-10 Project Manager
*D. Gruber, Maintenance Manager
*J. Johnson, Site Quality Manager
*J. Maddox, Maintenance/Modification Manager
*J. McCarthy, Mechanical Engineering Manager
*G. Pierce, Technical Support Manager
*W. Pratt, Corporate Maintenance Valve Engineer
*G. Preston, Plant Manager
*P. Salas, Licensing Manager
*L. Turner, Technical Support Engineer
*H. Williams, Engineering Manager
*S. Wetzel, Compliance Manager

NRC Resident Inspectors

L. Wert, Senior Resident Inspector
J. Munday, Resident Inspector
*R. Musser, Resident Inspector

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)

On June 28, 1989, the NRC issued GL 89-10, which requested licensees and construction permit holders to establish a program to ensure that switch settings for safety-related MOVs were selected, set, and maintained properly. Subsequently, six supplements to the GL have been issued. NRC inspections of licensee actions implementing commitments to GL 89-10 and its supplements have been conducted based on guidance provided in Temporary Instruction (TI) 2515/109, "Inspection Requirements for Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance." TI 2515/109 is divided into Part 1, "Program Review," and Part 2, "Verification of Program Implementation."

In a letter to the NRC dated January 9, 1995, the licensee provided notification that the committed programmatic actions to address the GL 89-10 guidance have been implemented for Browns Ferry Unit 2. The current inspection assessed that completion. In addition, the

licensee's progress towards implementing the recommendations of GL 89-10 for Unit 3 were also examined using the guidance of TI 2515/109, Part 2.

The assessment was conducted utilizing 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 and its implementation were previously examined and documented in NRC Inspection Reports 50-259, 260, 296/92-04 and 94-03. Details of this inspection and findings are described below.

2.1 Design-Basis Reviews

For Unit 2, the inspectors examined the licensee's design-basis documentation used in the implementation of their GL-89-10 Motor Operated Valve Plant Program for diagnostic testing of MOVs. This examination included review of mechanical flow diagrams (piping and instrumentation); design-basis calculation results of the expected differential pressures; the sizing and switch setting calculations; and diagnostic test data. The inspectors also conducted a walkdown of selected MOVs.

The inspectors reviewed the licensee's design-basis documentation (DBD) to determine and verify its adequacy in general for all MOVs in the program and specifically for the five sampled Unit 2 MOVs examined during this inspection. In addition, the recommended action "a" of GL 89-10 that requested licensees determine the maximum differential pressure and flow expected for both normal and abnormal (accident) conditions was examined to verify that maximum parameters were used.

The licensee had one MOV calculation package (included closure package) for each valve which included 1) design data for the valve, operator, and motor; 2) design-basis calculation; 3) pressure locking/thermal binding evaluation; 4) electrical data; 5) thrust/torque calculations; 6) weak link analysis; 7) testing results including diagnostic traces; and 8) closure package. The MOV packages included the calculations for differential pressure, electrical degraded grid voltage, flow, temperature, design thrust, and torque. The documents and calculations were reviewed to determine if the design-basis differential pressure and flow conditions, design temperature, and other design parameters for each MOV selected met the recommendations of GL 89-10. The inspectors verified that degraded grid calculations were included to ensure that the lowest motor terminal voltage commensurate with design-basis conditions was factored into the determination of maximum thrust ratings. The inspectors also verified that the licensee satisfactorily addressed the Limitorque Part 21 high temperature motor concern.

The closure package included 1) design-basis overview, 2) maintenance history, 3) static test results, 4) dynamic test results (for MOVs DP tested), 5) closing evaluation, 6) valve opening methodology calculation for extrapolation, 7) opening capability and structural evaluation, 8)

conclusions, 9) recommendations, 10) open items (work orders or modifications needed), 11) definitions and references for valve. The closure package was also considered the "reconciliation package" that engineering addressed to ensure all items were completed or in the process of being completed. All 36 closure packages were examined by the inspectors.

The MOV documentation was reviewed in detail for the Unit 2 sampled valves identified below:

Valve No.	Function, Vendor, Size, Type and MOV DBD and Engineering Thrust Calculations
2-FCV-73-16	HPCI Turbine Steam Supply, Crane 10-inch pressure seal gate
	Calculation MD-Q2073-910095, Revision 4
2-FCV-74-57	RHR Suppression Pool Spray/RHR Test Return, Walworth 18-inch solid wedge
	Calculation MD-Q20743-910119, Revision 5
2-FCV-74-73	RHR Suppression Pool Cooling/RHR Test Return, Walworth 12 inch globe
	Calculation MD-Q2074-910128
2-FCV-75-09	Core Spray Minimum Flow for Pumps 2A and 2C, Velan 3-inch flex wedge gate
	Calculation MD-Q2075-910138, Revision 4
2-FCV-75-37	Core Spray Minimum Flow for Pumps 2B and 2D, Velan 3-inch flex wedge gate
	Calculation MD-Q2075-910144, Revision 4

The system documentation review included the "System Design Criteria" for the Residual Heat Removal System (RHR), the High Pressure Coolant Injection System and the Core Spray Coolant System. The "System Design Criteria" included the system description, operation, and design-basis documentation. The system flow (P&ID) drawings were used to verify the location of the MOVs in the piping systems and the design safety function. These documents were examined to verify that the MOV design-basis calculations included all necessary parameters.

The MOV design-basis documentation (DBD) included calculations, drawings, engineering reports, and engineering standards. The MOV documentation package for each valve included both the "design-basis" calculations and the "engineering thrust" calculations. The DBD documents reviewed are listed as follows:

1. System Design Criteria BFN-50-7073, Revision 6, High Pressure Coolant Injection System (HPCI) - Unit 2 & 3

   HPCI Pump Curves - General Electric Co. - C.O No. 205-H-0457

   Flow Diagram 2-47E812-1, Revision 31, High Pressure Coolant Injection System

2. System Design Criteria BFN-50-7074, Revision 7, Residual Heat Removal System (RHR) - Unit 2 & 3

   RHR Pump Curves - Bingham Pump Co. 18 X 24 X 28 CVIC, per General Electric Co. P.O. No. 205-H0627

   Flow Diagram 2-47E811-1, Revision 38, Residual Heat Removal System

3. System Design Criteria BFN-50-7075, Revision 5, Core Spray System - Unit 2 & 3

   Core Spray Pump Manual for Curves - Bingham-Willamette 12 X 16 X 14 1/2 CVDS, per General Electric Co. C.O. No. 205-H0592

   Flow Diagram 2-47E813-1, Revision 31, Core Spray System

In the areas inspected the inspectors concluded the licensee had adequately addressed the design-basis as recommended in GL 89-10.

The inspectors concluded that the MOV packages were very thorough and contained all the necessary data, calculations, and reviews to ensure each MOV has been adequately evaluated by engineering. The MOV packages were considered a strength in the GL 89-10 program.

Motor Brakes

During the design-basis review, the inspectors verified that none of the Unit 2 MOVs had motor brakes. The brakes for 2-FCV-73-34, 2-FCV-73-40, and 2-FCV-73-44 were removed and documented by DCN W29831.

For Unit 3 MOVs, the brakes (same system valves as Unit 2) had not been removed. DCN F29369 had been initiated for the removal of the Unit 3 MOV brakes.

Conclusions

The inspectors concluded the licensee had implemented the recommendations of GL 89-10 for design-basis reviews in Unit 2.

Scope Change

Initially, the licensee had identified 56 MOVs in their GL 89-10 program during the Part 1 GL 89-10 inspection conducted February 1992. Since that time, the scope of MOVs had been reduced to 36 MOVs. The licensee

had revised the scope of MOVs after the GL 89-10 Part 2 inspection conducted February 1994. GL 89-10 Scope Calculation MD-Q0999-910034 had been revised reducing the MOVs to 36 MOVs. The MOVs had been re-evaluated and the results are documented in report "Assessment Of Browns Ferry Units 2 And 3 Motor Operated Valves," dated November 11, 1994, by the contractor S. LEVY Incorporated. Thirty-six of the MOVs had been classified as having an "active" safety function and remain in the GL 89-10 program. The remaining 20 MOVs had been re-classified as "system operation enhancement" (S.O.E.) valves and have been removed from the GL 89-10 program. All 20 S.O.E. MOVs had their thrust limits calculated and were statically tested and met the recommendations in GL 89-10. However, the licensee's GL 89-10 program requirements would no longer be applicable to these valves. The MOVs removed from the scope of the GL 89-10 program for Units 2 and 3 were:

FCV-70-47 Reactor Building Close Cooling Water Containment Outlet Isolation Valve

FCV-71-08 Reactor Core Isolation Cooling (RCIC) Turbine Steam Supply Valve

FCV-71-19 RCIC Condensate Storage Tank Suction Valve

FCV-71-25 RCIC Lube Oil Cooling Water Valve

FCV-71-34 RCIC Pump Minimum Flow Valve

FCV-71-39 RCIC Injection Valve

FCV-73-35 High Pressure Coolant Injection (HPCI) Pump Test Return Valve

FCV-73-36 HPCI/RCIC Pump Test Return Valve

FCV-73-81 HPCI Isolation Valve Bypass Valve

FCV-74-07 Residual Heat Removal (RHR) Minimum Flow Valve

FCV-74-30 RHR Minimum Flow Valve

FCV-74-47 RHR Shutdown Cooling Outboard Isolation Valve

FCV-74-48 RHR Shutdown Cooling Inboard Isolation Valve

FCV-74-52 RHR Low Pressure Coolant Injection (LPCI) Injection Throttling Valve

FCV-74-66 RHR LPCI Injection Throttling Valve

FCV-75-22 Core Spray Test Return Valve

FCV-75-23 Core Spray Injection Valve

FCV-75-50 Core Spray Test Return Valve

FCV-75-51 Core Spray Injection Valve

FCV-78-68 Fuel Pool Cooling Connection To Reactor Well Valve

The reduction of MOVs from the GL 89-10 scope was identified as Inspector Followup Item IFI 50-260,296/95-19-01, Reduced Scope of Valves in GL 89-10 Program. Further review of this issue will be required by the NRC staff.

2.2 Establishing MOV Settings

The inspectors reviewed the following documentation to determine and assess the licensee's general requirements for switch settings and the specific practices applied to the selected sample of MOVs.

Summary Status of Generic Letter 89-10 Motor-Operated Valves

The inspectors reviewed maintenance testing procedure ECI-0-000-MOV008, "Testing of Motor Operated Valves Using 3000 MOVATS Signature Analysis System," Revision 2; corporate MOV procedures DS-M18.2.21, "MOV Thrust and Torque Calculations," Revision 7; and DS-M18.2.22, "MOV Design Basis Review Methodology," Revision 1. Other documents pertaining to the licensee's GL 89-10 program including evaluations on MOV valve factor, stem friction coefficient (SFC) and load sensitive behavior were also reviewed. The licensee's engineering personnel provided a detailed presentation on program methodology and closure at the entrance interview. The inspectors selected a GL 89-10 program valve sample to verify design-basis capability. These methods included verification by: 1) valve specific dynamic test at, or near, design-basis conditions; 2) valve specific test, linearly extrapolated to design-basis conditions; and 3) plant specific data or industry data applied via grouping to MOVs that were not practicable to test. The inspectors reviewed the documentation for the five sampled MOVs listed in Section 2.1.

Unit 2 had 12 MOVs which were differentially pressure (d/p) tested. The licensee determined that the other 24 MOVs were non-d/p testable. The thrust and torque calculations utilized the standard industry equations with the exception of including the disc seating angle in the calculation for the differential pressure force. Valve mean seat diameter was used to calculate valve seat area. A stem friction coefficient of 0.15 was used to convert thrust to torque. Dynamically tested MOVs used the valve factor determined from the testing. MOVs which were not practicable to test used valve factors from other TVA valve groups first (Watts Bar and Sequoyah), and then used industry data if no TVA data was available. The minimum required thrust and torque was adjusted for diagnostic system inaccuracies and torque switch repeatability. A margin of 20% was included in the minimum required thrust to account for valve and lubrication degradation and rate of loading. If the MOV had been tested or was grouped with other MOVs, then the amount of rate of loading that was calculated from the test or

the group was applied to that particular MOV. The maximum thrust and torque was adjusted for torque switch repeatability and diagnostic system inaccuracies.

The inspectors discussed the added 20% margin with licensee personnel to determine if it was adequate to account for the various effects. These included load sensitive behavior, valve factor variation, and other effects which had not received a specific value during performance of the calculation. The licensee had collected data from their in-plant differential pressure testing and other testing performed at Watts Bar and Sequoyah. Load sensitive behavior for gate valves, from the combined TVA units, was approximately 10%. However, three groups of valves indicated load sensitive behavior higher than 10%. These valve groups were: 1) Velan gate valves, 2) 4" 1500# parallel disc Anchor Darling gate valves, and 3) 4" 300# Powell flex wedge gate valves. Engineering intends to address these groups separately by identifying the root cause of the load sensitive behavior, reducing it (if practicable), and reconciling the differences by using similar valve comparison, or other methods, and raising the amount of margin for load sensitive behavior of non-tested valves as appropriate. Further, TVA testing showed load sensitive behavior for globe valves to be 15% or less. The licensee intends to identify and correct any globe valve load sensitive behavior greater than 15% similar to the method used for gate valves. Engineering used EPRI data and other utilities' data for their Crane gate valves. With continued testing at other TVA sites and other industry data being revised, the licensee plans to update their data and make adjustments to their MOV settings, where appropriate, to ensure their MOVs are set-up using the correct data.

The licensee used procedure DS-M18.2.21, "MOV Thrust and Torque Calculations," Revision 7, to justify their position on rate of loading, valve factor, stem friction coefficient, and extrapolations of dynamic testing to design basis differential pressure. The rate of loading justification was discussed in the previous paragraph. Valve factor justification used data from all three TVA sites (Watts Bar, Sequoyah, and Browns Ferry). This data was grouped according to valve manufacturer, type, and pressure class rating, but not valve size. The inspectors discussed with engineering personnel the concern that all three sites used the combined TVA data and that an adverse condition or new data found at one plant would affect the program and MOVs at the other plants. Engineering personnel indicated their awareness of this fact and stated that the TVA corrective action program required them and the other sites to notify each other of new or adverse data. The inspectors noted that engineering plans to update their data and make adjustments to their MOV settings, when and where appropriate, to ensure their MOVs are set-up using the correct data.

Similarly, stem friction coefficient information was collected from all three sites and compiled for justification of using a stem friction coefficient of 0.15. The stem friction coefficient data separated valves by the above criteria and by valve size. Further, TVA used GP-1 as a stem lubricant at all sites and reviewed the stem to stem nut

materials, geometry, and condition of threads. Unit 2 had a group of valves, Walworth, 12", 300#, globe valves, where four out of six valves consistently showed stem friction coefficient's higher than 0.15. These valves were considered separately and were being monitored for adverse trends. The inspectors concluded that the licensee was adequately addressing this concern.

The program used for extrapolation of differential pressure to design basis conditions for gate valves was a flow chart that asked specific questions. These questions reviewed the test results by verifying that the differential pressure force was measurable and that the MOV had predictable behavior. The next check required the test to be at least 90% of design basis conditions. If this criteria was not met, then the differential pressure was reviewed (a low value differential pressure) and flow was checked (fluid type: steam or water, and velocity: moderate, etc). The testing performed by Siemans for TVA showed gate valves with a low differential pressure tended to have higher valve factors (called "friction factor" by TVA) under lower disc-seat or disc-guide/body-guide bearing stress. This criteria was used to determine if extrapolation of the test differential pressure to design basis conditions was acceptable. TVA based this criteria on a study performed for them by Siemens and the EPRI separate effects tests for standard design gate valves with stellite seat surfaces. Extrapolation of globe valves to design basis differential pressure required further review of the globe valves design requirements. Some of these requirements were flow over or under the seat, valve safety function to open or close, presence of anti-rotation device, and if the valve had a rotating rising stem.

The gate valves were separated into 15 valve groups. Each valve group was based on valve manufacturer, type and pressure class rating, however, valve size could vary within a particular group. To evaluate the licensee's program closure methods, the inspectors reviewed the margin for all 36 "Active" GL 89-10 valves. The method "for closure" of these valves was discussed in detail with engineering personnel. The inspectors identified two valves which needed further review.

1) 2-FCV-73-02 was a Crane, 10", 900#, solid wedge gate valve. This valve was statically tested using the stem strain ring (SSR) because the torque thrust cell (TTC) did not fit. Data was obtained from another similar valve that was dynamically tested. By using the similar valve data (rate of loading and valve factor) and the inaccuracies of the SSR (including torque switch repeatability), this valve had a 2.0% margin in the closed direction. The licensee initiated a design change notice (DCN) for valve 73-02 to improve its' margin. The modification includes the installation of a smart stem to increase the accuracy of their thrust and torque measurements. In addition, the stem/nut will be replaced with a roller screw stem to stem nut configuration to increase the thrust output for the same given torque. The modification is scheduled during the upcoming outage

U2C8. The inspectors concluded there was no operability concern with this valve and the modification planned was adequate to provide sufficient increased margin for future operation.

2) 2-FCV-74-61 was a Walworth, 12", 300#, solid wedge gate valve. This valve was statically tested and used data from a similar dynamically tested valve. The margin was 2% in the closed direction. The valve performed a throttling function in the closed direction. Engineering used pull out efficiency to calculate the closed operator capability including degraded voltage and high ambient temperature. The licensee plans to inspect the valve internals during the upcoming outage to determine if there is disc wear/rolling. The inspectors concluded there was no operability concern and the licensee has addressed this concern.

Both of these items are identified as "remaining items" that the licensee has reviewed and scheduled to implement appropriate corrective action. The other "Remaining Items" are listed in the Results Section at the beginning of this report. The inspectors reviewed each item in detail to ensure there was no operability concern. In addition, the inspectors verified the licensee addressed every PER (deficiency) regardless of what it was or its significance. The inspectors concluded the licensee identification and evaluation of deficiencies was a strength in the MOV program.

Conclusion

The inspectors concluded the licensee had satisfactorily implemented the recommendations in GL 89-10 for switch settings for Unit 2.

2.3 Design-Basis Capabilities

The inspectors reviewed procedure ECI-0-000-MOV008, "Testing of Motor Operated Valves Using 3000 MOVATS Signature Analysis System," Revision 2, to determine its adequacy for testing. In addition, Appendices C and D of each valve "calculation package" were reviewed. These appendices contained the "reconciliation" and "closure" sections for the MOV. The inspectors noted that only 11 MOVs were dynamically tested. The twelfth test did not provide accurate data. Since only 12 MOVs were practical to test the licensee relied heavily on testing at other TVA sites. As stated in TVA corporate programs (DS-M18.2.21), if new data is obtained from testing at other sites, or from other industry sources, the licensee would incorporate the findings, where appropriate, into their MOV program.

The inspectors noted a deficiency in procedure ECI-0-000-MOV008, Attachment 12, sections B, D, H, and I. These sections provided instruction for performing the immediate operability checks prior to returning the valve to service by comparing the thrust at torque switch trip, in the closing direction, to the required closing thrust, and in

the opening direction comparing the operator capability to the peak unseating thrust or required closing thrust (which ever was greater). These checks included torque switch repeatability and diagnostic system inaccuracies, however, no margin for degradation was included in the immediate operability check. While the MOV's "reconciliation package" included the review for margin for each valve and the determination of sufficient margin was available for degradation based on engineering judgement, no exact amount was stated. Further, the inspectors noted that the "reconciliation package" could be completed after the valve was returned to service. Licensee personnel stated that "reconciliation packages" were completed prior to returning the MOV to service. However, licensee personnel agreed that it could be possible for a MOV to be returned to service prior to completion of the "reconciliation package". The inspectors verified that the licensee revised procedure ECI-0-000-MOV008 to prevent any possible concern with margin or operability. Steps B, D, H and I were revised to require a minimum 5% margin for valve/actuator degradation as an immediate operability check before returning the MOV to service. The inspectors concluded the added margin in the revised procedure was appropriate to ensure valve operability.

Previous Inspection Open Items.

During the GL 89-10 Part 2 inspection, several items were identified as a weakness or were incomplete. Since that inspection, the inspectors verified that the licensee had implemented appropriate corrective action. The items were:

1. During the Part 2 inspection of the diagnostic test traces, the licensee's personnel were not marking the traces for torque switch trip, flow cutoff, and other necessary points used to evaluate the MOVs thrust and torque requirements. The inspectors reviewed the traces from the test packages and discussed the marking of these traces with the MOV Maintenance Coordinator. The inspectors verified the traces had been marked correctly and conservatively.

2. During the Part 2 inspection, the "reconciliation packages" were not completed for all the MOVs. The inspectors reviewed the 36 "Active" GL 89-10 program valves and verified that all "reconciliation packages" were completed.

Conclusions

The inspectors concluded that the licensee has satisfactorily implemented the recommendations of GL 89-10 for addressing design-basis capability for Unit 2.

2.4 Periodic Verification of MOV Capability

Recommended action "d" of Generic Letter (GL) 89-10 requested 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 the surveillance is to be based on the safety importance of the MOV as well as its maintenance and performance history, but 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 an extent that the existing test results are not representative of the MOV.

Periodic Testing (Re-verification)

The licensee revised SSP-6.51, Program Plan For Generic Letter 89-10, Section 3.14, Periodic Monitoring of MOVs, Step B. Step B has been revised to state, "The frequency for periodic monitoring shall be set not to exceed three refueling outages or five years.... All MOVs identified as 89-10 shall be retested as a minimum under static conditions and where possible under differential pressure (Dp) conditions.... Currently, for BFN Unit 2, 36 MOVs are in the 89-10 program with 24 static and 12 Dp testable MOVs...."

Conclusion

The inspector concluded that the licensee has agreed to meet the recommended actions "a" and "j" in GL 89-10 for periodic monitoring of MOVs to ensure the MOVs capabilities and switch settings for Unit 2.

However, the NRC Staff is preparing a generic letter on the periodic verification of MOV design-basis capability. Consequently, the inspectors cannot determine the acceptability of the licensee's long-term periodic verification plans. The Staff will review the licensee's MOV periodic verification program following issuance of the new generic letter. The licensee should review its periodic verification program in light of the new generic letter and consider any appropriate adjustments. For example, the licensee should consider the benefits (such as identification of decreased thrust and increased requirements) and potential adverse effects (such as accelerated aging or valve damage) when determining appropriate periodic verification testing for each GL 89-10 MOV.

2.5 Post Maintenance and Post Modification Testing

The inspectors found that the post maintenance and post modification test (PMT) requirements for GL 89-10 MOVs were specified in Appendix B of the Site Standard Practice Procedure SSP-6.51," Program Plan For Generic Letter 89-10," Revision 2. Table 1 of Appendix B to SSP-6.51 listed the test requirements and guidelines for 21 maintenance and modification activities. These activities were placed in three categories, Minor, Intermediate, and Major. The "Intermediate" category

included stem packing replacement/adjustment and actuator removal/installation. The testing requirement was to re-verify the running load by thrust measurement (MOVATS Testing). The "Major" category included actuator/gearbox rebuild, torque switch adjustment, valve disassembly, stem/nut replacement, spring pack adjustment, motor replacement, and upper housing cover bolt tightening or gasket replacement. New baseline testing (MOVATS Testing) was required for all Major items.

In addition, the inspectors reviewed the electrical and mechanical maintenance procedures for PMT requirements. The Maintenance Management System Procedure SSP-6.2 established that PMT requirements are listed on all work orders. The inspectors reviewed the recent corrective work orders to verify that PMT requirements were included.

Conclusion

The inspectors concluded that the licensee has satisfactorily addressed post maintenance testing and post modification testing requirements for Unit 2.

2.6 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.

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

The inspectors assessed the adequacy of the licensee's documentation, analyses, and corrective actions for MOV degradation and failures through a review of MOV discrepancies selected from a database listing for the period since January 1994. The discrepancies were identified through Problem Evaluation Reports (PER) and corrective actions were typically completed through Maintenance Work Orders (MWOs). The discrepancies selected and reviewed by the inspectors were as follows:

PER No.	Discrepant Condition Reported
BFPER950023 (1/18/95)	Closure package for 2-FCV-69-01 recommends resetting torque switch. DCN T36529 initiated for longer stem to be installed Spring 1996. No operability concern.
BFPER950187 (2/21/95)	2-FCV-73-27, 34, 35 were overthrust. The overthrust was within the limits allowed by Limitorque Technical Update 92-01. 2-FCV-74-66 thrust was low due to equipment accuracies. Thrust Calculation MD-Q2073-950034 was performed satisfactory for 74-66 (Not 89-10 MOV).
BFPER950190 (2/22/95)	"Run" efficiency used for DC powered MOVs. "Run" efficiency was used in closing direction only. New calculations were performed using "pull out" efficiency.
BFPER940970 (10/30/94)	2-FCV-68-079 was overthrust during static test. The overthrust condition was within the guidelines of Limitorque Update 92-01.
BFPER941131 (11/30/94)	2 FCV-75-09 failed to meet acceptance criteria during DP test. The 5 ft.lb.motor was replaced with a 10 ft.lb. motor.
BFPER95-023 (1/18/95)	2-FCV-73-016 needs to be replaced with a better sealing valve to stop steam leakage. To be completed cycle C9. No operability concern.

In addition to the above PERs listed, the inspectors reviewed all the Unit 2 MOV PERs generated since the Part 2 inspection conducted in February 1994. The inspectors concluded from the PERs reviewed that the licensee's staff was proficient in identifying all potential problems. Engineering provided appropriate timely evaluations for these potential problems.

In the Summary Section at the beginning of this report is a list of "Remaining Open Items" for the GL 89-10 MOVs. The inspectors reviewed in detail each item to assure there was no operability concern with any of the MOVs.

In the "Maintenance History" Section of the Closure Package for 2-FCV-73-16 several problems were identified. The torque switch roll pin sheared causing valve failure to close and valve leakage. The roll pin problem is being investigated for 2-FCV-74-057 (See Open Item No. 8 in the Summary Section of report). The 2-FCV-73-16 valve, which was repaired and returned to service, is scheduled for replacement by a different type of valve during the cycle 9 refueling outage in the Fall 1997. The inspector concluded this was acceptable since there was no operability concern.

Conclusions

Based on their review of the documented resolution of the above discrepancies, the inspectors concluded that the licensee's analyses and corrective actions for MOV degradation and failures were satisfactory for Unit 2. The inspectors concluded this area was a strength in the MOV program.

Trending

The inspectors examined the licensee's implementation of the data base that was set up to maintain and trend MOV data. The trending program for MOV performance was established in the licensee's Site Standard Practice (SSP) 6.51, "Program Plan For Generic Letter 89-10," Revision 2, which stated that a data base for MOV testing, failure and degradation would be maintained and a trend analysis and report performed every 18 months or after refueling outages. The MOV Coordinator was responsible for issuing the Trend report. MOV static and dynamic test results were trended on a computer using the ITI MOVATS INC. Motor Operated Valve Data Base (MOVDB) Software. This trending program interfaces with established plant equipment monitoring programs such as SSP 6.4, "Equipment History And Failure Trending," Revision 7, the Nuclear Power Reliability Data System (NPRDS), the Equipment Management System (EMS),etc.... The database for trending GL 89-10 MOVs includes MOV Signature Analysis, Maintenance History (Preventive and Corrective), Component Failure Analysis Reports (CFAR), Semi-annual Generic Trending Reports (MPAC), NPRDS Semi-annual Generic Trending Reports and Monthly Repetitive Trending Reports (MPAC). These programs consider the analysis of motor/actuator/valve degradations as well as failures.

The inspectors observed that GL 89-10 MOV data was input in the MOVDB computer trending program and that appropriate parameters were trended. The inspectors also reviewed print outs from the maintenance history and repetitive failure programs to verify the accessibility of these programs for trend analysis.

Conclusions

The inspectors concluded that the trending program for MOVs was capable of trending the parameters necessary for test performance analysis and component degradation/failure evaluations in maintenance activities. The licensee had implemented the recommendations of GL 89-10 for trending MOVs in Unit 2 and Unit 3.

2.7 Pressure Locking and Thermal Binding

The Office for Analysis and Evaluation of Operational Data has 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 inspectors reviewed the licensee's actions taken to evaluate thermal binding and pressure locking. In accordance with recommendation from INPO's SOER 84-7 and GE SIL 368 Revision 1 and Supplement, the licensee performed a design review of safety related valves that were susceptible to pressure locking or thermal binding. These valves were required to operate in the event of an accident. The evaluations considered flow, temperature, operational conditions, sequence of events, physical orientation, and disc configuration. Four MOVs in the Emergency Core Cooling Systems for both Units 2 and 3 were identified as being susceptible to pressure locking. The valves were:

2(3)-FCV-74-53	Inboard RHR Loop I Low Pressure Coolant Injection (LPCI) Injection Valve
2(3)-FCV-74-67	Inboard RHR Loop II Low Pressure Coolant Injection (LPCI) Injection Valve
2(3)-FCV-75-25	Inboard Loop I Core Spray Injection Valve
2(3)-FCV-75-53	Inboard Loop II Core Spray Injection Valve

The licensee's engineering evaluation concluded that these four valves were susceptible to pressure locking and should be vented to the high pressure side. Accordingly, DCN W18895A and DCN W21711, Rev. A (design change modifications for Unit 2 and Unit 3 respectively) were issued for drilling a 1/4 inch hole in each valve to provide a vent path for the body cavity. The inspectors verified that DCN W18895A and DCN W21711, Rev. A were closed out for Units 2 and 3.

For thermal binding, the licensee included a step in each operating procedure warning the operators that the potential for thermal binding existed. For example, Operating Instruction 2-OI-73, High Pressure Coolant Injection System, Revision 36, Step 3.29 for 2-FCV-73-16 states this MOV is susceptible to thermal binding. The condition could occur after the valve has been heated.... The inspectors verified that the "Closure Package" for each MOV had addressed pressure locking and thermal binding as recommended in GL 89-10.

Conclusions

The inspectors concluded that the licensee had adequately addressed pressure locking and thermal binding to meet the intent of the recommendation in GL 89-10 at the present time for Units 2 and 3. However, the licensee was aware that further re-evaluation of PL and TB may be required pending the issue of a new NRC generic letter. Pressure locking and thermal binding are currently under NRC review and the issue has not been resolved.

2.8 Quality Assurance Program Implementation

The inspectors reviewed the licensee's implementation of quality assurance (QA) function for the GL 89-10 MOV Program. A Self Assessment of the MOV program was performed and a report (RIMS 92 940131 805) issued on January 26 1994. Attachment 4 to that report provided a summary of required actions resulting from the audit. That assessment report was reviewed in NRC Inspection Report 94-03. An additional assessment, NA-BF-94-095, "Assessment Of NRC Generic Letter 89-10 Motor Operated Valve Program," was performed in November 1994 by the Nuclear Assurance And Licensing group with assistance from site engineering. The assessment report was issued January 18, 1995.

The purpose of the assessment was to evaluate the effectiveness of MOV program development and implementation, in accordance with the recommendations and guidelines of GL 89-10, at Browns Ferry Nuclear Plant. The assessment team focused their review on documentation and implementation of program aspects identified as open items in the previous assessment of January 1994 and in NRC Part I and Part II MOV inspection reports. In the assessment report, issued January 18, 1995, the licensee concluded that the major elements of the MOV program were in place and implementation was in progress. However, the assessment team could not reach a final conclusion on the effectiveness of the program since several aspects of the program were incomplete and/or not updated.

The assessment team identified ten areas which had multiple open items in each area that needed revision, updating, or completion. A written formal response to the QA findings was provided by engineering in a letter dated January 27, 1995. QA in the interim had reviewed the open items with engineering personnel and concurred that no items were open which impacted the program. QA signed off on program implementation and subsequently concurred on the formal response.

The inspectors verified that all of these open items were either closed or were adequately addressed and in the process of being closed. No operability concerns were identified with these items.

Conclusions

The inspectors concluded that the licensee had adequately implemented the QA functions recommended in GL 89-10 for Units 2 and 3.

2.9 Followup of Previous Items (92701)

(Closed) Unresolved Item (URI) 50-296/87-02-02, Wrong Gear Ratio In HPCI Isolation Valve.

While working the program for IE Bulletin 85-03, Motor Operated Valve Common Mode Failures During Plant Transients Due To Improper Switch Settings, the licensee determined that HPCI isolation valve 2-FCV-73-2 may not open against design differential pressure. The problem was

determined to be an incorrect worm gear installed in the initial installation of the actuator. The licensee found that the stroke time of 2-FCV-73-2 differed from similar valves and actuators. In a comparison of stroke times the licensee identified three other valves with potential incorrect gear ratios. The four valves (1-FCV-69-1, 3-FCV-69-2, 3-FCV-69-12 and 2-FCV-73-2) were identified as Unresolved Item 87-02-02 pending further evaluation. In NRC Inspection Report 88-16, Unresolved Item 260/87-02-02 was closed for 2-FCV-73-2 (Unit 2 only). Unresolved Items 259/87-02-02 (Unit 1) and 296/87-02-02 (Unit 3) remained open.

The inspector reviewed the licensee's actions to correct the condition for Unit 3 valves 3-FCV-69-2 and 3-FCV-69-12. In the case of MOV 3-FCV-69-12, an engineering evaluation was performed in response to Site-Licensing-Tracking item SLT870049011 which indicated that the stroke time of this valve was acceptable. Additionally, Calculation MD-Q0999-910034, NRC Generic Letter 89-10-Motor Operated Valve Evaluation, showed that this valve does not have an active safety function. Specifically, the valve is not required to function for the mitigation of a design basis event. In the case of 3-FCV-69-2, the valve is included in the GL 89-10 program and will be modified prior to the Unit 3 restart by DCN W20897A by replacing the operator. DCN W20897A was in the process of being worked at the time of this inspection. The inspector considered URI 50-296/87-02-02 closed for Unit 3. URI 50-259/87-02-02 remains open for Unit 1.

(Closed) Inspector Followup Item (IFI) 259/85-09-02, Failed motor stator through bolts.

This item related to all three units and concerned the failure of MOV 3-FCV-74-73 motor stator through bolts which rendered the valve inoperable. The licensee determined that the combination of low strength bolts and the bolts becoming loose resulted in failed bolts due to high valve vibrations. To prevent recurrence the licensee installed larger high strength bolts and installed locking devices on the bolts on Unit 2 system 74 (RHR) high vibration valves which included 74-52, 53, 57, 58, 59, 66, 67, 71, 72, and 73. This concern was closed for Unit 2 in NRC Report 88-28 but remained open for Unit 3 and Unit 1.

To update this item the inspector closed IFI 259/85-09-02 in its entirety and opened IFI 50-259, 296/95-19-01 as follows:

(Open) Inspector Followup Item (IFI) 50-259, 296/95-19-02, Verify that valve motor stator through bolts have been inspected and modified as appropriate to prevent failures from RHR system vibrations prior to startup for Unit 3 or Unit 1. Valves included are FCV-74-52, 53, 57, 58, 59, 66, 67, 71, 72, and 73.

2.10 Walkdown

The inspectors conducted a walkdown of MOVs in Unit 2. The inspection of MOVs was conducted to observe the general condition of the MOVs and the lubrication of the valve stems. The general condition of the MOVs and the stem lubrication was found to be satisfactory. The valves were also examined to identify any MOVs that were horizontally installed and if this position was addressed by the licensee. This issue was discussed in NRC Information Notice IN 92-59. The inspectors verified that the licensee adequately addressed the concern of horizontally installed MOV gate valves in their GL 89-10 MOV program.

The inspectors concluded that the condition of Unit 2 GL 89-10 MOVs was satisfactory.

3.0 Exit Interview

The inspection scope and results were summarized on July 28, 1995, with those persons indicated in paragraph 1. These issues are listed in the Summary at the beginning of this report. No proprietary information was reviewed or contained in this report. Dissenting comments were not received from the licensee.

4.0 Acronyms and Intialisms

DBD	-	Design Basis Document
DCN	-	Design Change Notice
DP	-	Differential Pressure
EMS	-	Equipment Management System
EPRI	-	Electric Power Research Institute
FCV	-	Flow Control Valve (MOV)
GL	-	Generic Letter
HPCI	-	High Pressure Coolant Injection
IFI	-	Inspector Followup Item
INPO	-	Institute for Nuclear Power Operation
LPCI	-	Low Pressure Coolant Injection
LSB	-	Load Sensitive Behavior
MOV	-	Motor Operated Valve
MWO	-	Maintenance Work Order
NPRDS	-	Nuclear Plant Reliability Data System
NRC	-	Nuclear Regulatory Commission
NRR	-	NRC Office of Nuclear Reactor Regulation
PER	-	Problem Evaluation Report
QA	-	Quality Assurance
RHR	-	Residual Heat Removal
SFC	-	Stem Friction Coefficient
S.O.E.	-	System Operation Enhancement
SOER	-	Significant Operating Event Report
SSR	-	Stem Strain Ring
TI	-	Temporary Instruction
TROI	-	Tracking/Reporting of Open Items
TTC	-	Torque Thrust Cell
TVA	-	Tennessee Valley Authority