U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-317/89-12
50-318/89-12

Docket No. 50-317
50-318

License No. DPR-53
DPR-69

Licensee: Baltimore Gas and Electric Company
P.O. Box 1475
Baltimore, Maryland 21203

Facility Name: Calvert Cliffs Units 1 & 2

Inspection At: Lusby, Maryland

Inspection Conducted: May 1-5, 1989

Inspectors: C J Anderson for 6/16/89
Roy R. Mathew, Reactor Engineer — date

Approved by: C J Anderson 6/16/89
C. J. Anderson, Chief, Plant Systems Section — date

Inspection Summary: Inspection on May 1-5, 1989 (Combined Inspection Report Nos. 50-317/89-12 and 50-318/89-12)

Areas Inspected: A special announced inspection was performed to review the corrective actions that resulted from IE Bulletin 85-03 regarding improper limit switch and torque switch settings in motor operatored valves. This inspection reviewed the licensee's engineering and maintenance activities to assure the operational readiness of the motor operated valves.

Results: The licensee had not addressed all the significant aspects of the bulletin. Two violations were identified regarding: (1) lack of procedures for setting the limit switches and providing stem lubrication; and, (2) the "as-left" Torque switch settings were different from the specified settings in the setpoint file. Three items remained unresolved at the end of the inspection.

DETAILS

1.0 Persons Contacted

1.1 Baltimore Gas and Electric Company

*G. Bell, Engineer, Licensing
*R. Bogin, AGS, Electrical Maintenance
*R. Branch, Senior Engineer, Environmental Qualification
S. Cowne, Senior Engineer, Licensing
R. E. Denton, Manager, Quality Assurance and Services Department
*M. J. Gahan III, Principal Engineer, Calvert Cliffs
*J. D. Hayden, Engineer, Mechanical Maintenance
P. Hebrank, Engineer, Electrical Modifications
*J. Jerald, Supervisor, Maintenance Training
T. Koneath, Mechanical Engineering Unit
B. Nelson, Training, Electrical and Instrumentation
*D. E. Nickerson, AGS, Mechanical Maintenance
*K. Nietman, General Supervisor, Nuclear Training
*W. H. Robinson, Project Manager, MOV Program
S. Rosenbach, Mechanical Engineering Unit
*L. Russell, Manager, Calvert Cliffs
*M. W. Taylor, Engineer
*A. Thornton, General Supervisor, Plant and Project Engineering
*L. L. Wackbaugh, General Supervisor, Electrical and Controls

1.2 United States Nuclear Regulatory Commission

*H. Eichenholz, Senior Resident Inspector
V. Pritchett, Resident Inspector

*Present at the exit meeting on May 5, 1989.

2.0 Purpose

The purpose of this inspection was to review the licensee's actions taken in response to IE Bulletin 85-03 regarding motor operated valve (MOV) common mode failures during plant transients due to improper switch settings and to review the licensee's program to assure the operational readiness of the motor operated valves covered under this bulletin.

3.0 Background

On June 9, 1985, the Davis-Besse Plant experienced a complete loss of main and auxiliary feedwater which was caused, in part, by MOV failures. This event resulted in IE Bulletin 85-03 that promulgated NRC requirements to assure the operational readiness of MOVs in the high pressure coolant injection, core spray and emergency feedwater systems. The bulletin specified that licensees take the following actions.

(a) Review and document the design basis for the operation of each valve, including the maximum differential pressure expected during normal and abnormal operation.

(b) Using the above data, establish the correct switch settings for torque, torque bypass, position limit and overload for each valve and perform modifications as needed.

(c) Individual valves should be demonstrated to be operable by testing the valve at the maximum differential pressure based on the performance requirements. In the absence of differential pressure testing, a justification should be provided.

(d) Prepare and revise procedures to ensure that correct switch settings are determined and maintained throughout the life of the plant.

(e) Submit a schedule to accomplish the above program including a final submittal with the results of (b) through (d).

Item (a) was reviewed by the NRC office of Nuclear Reactor Regulation (NRR). The scope of this inspection was to review items (b) through (d).

4.0 Baltimore Gas and Electric Company response to IE Bulletin 85-03

4.1 Status of Commitments

In a letter dated May 15, 1986 (Ref. 1, Attachment-1), the licensee provided their schedule for Item (e) of Bulletin 85-03, which requested a written report within 180 days of the date of this bulletin. The licensee completed documentation on May 15, 1986 of the maximum differential pressure expected across MOVs during normal and abnormal operation. Of the systems identified in the bulletin, only the High Pressure Safety Injection (HPSI) system motor operated valves are subject to the bulletin concerns. The motor operated valves identified for Calvert Cliffs 1&2 for IEB 85-03 consideration are listed in attachment 3 to this report. In the same letter, the licensee committed to complete item (b) of the bulletin by July 15, 1986, item (c) by December 1, 1986 for Unit 1 and June 1, 1987 for Unit 2, and item (d) by July 1, 1987.

An NRC letter to the licensee dated July 29, 1987 (Ref. 2, Attachment-1) requested additional information regarding the licensee's response dated May 15, 1986 (Ref. 1, Attachment-1). The licensee responded to this letter on September 21, 1987.

The NRC requested a written report within 60 days on completion of the program. In a letter dated January 28, 1988 (Ref. 4, Attachment 1), the licensee completed the final response to IE Bulletin 85-03.

4.2 Switch Settings

Item (b) of the bulletin requires that correct switch settings for torque, torque bypass, position limit and overload for each value be established. These items are addressed below.

Open Torque Switch and Open Bypass Limit Switch

This switch is normally used to limit the mechanical thrust applied to the valve in the open direction. This switch is usually bypassed during the initial valve unseating which is the most challenging portion of the open stroke. Failure to set this switch to the required valve, or, not bypassing this switch in the initial opening stroke, can cause valve failure.

At Calvert Cliffs Units 1&2, the torque switch is initially bypassed during the unseating of the valve. The MOV will then "ride on" the torque switch until the open limit switch contact opens. The licensee has elected to set the open torque switch to a conservative value based on the limitations of the actuator assembly and the valve operator manufacturer's (Limitorque) recommendations.

Close Torque Switch and Close Torque Bypass Limit Switch

The close torque switch bypass acts in a similar manner to the open torque switch bypass. This torque switch is bypassed during the lightest duty portion of the stroke, the beginning of the closing stroke. This torque switch should be set to assure that valve closure is not prevented by the torque switch.

At Calvert Cliffs Units 1 and 2, the close torque switch bypass switch is set to a percentage of the valve travel from the backseat position. For the remainder of the valve stroke, the torque switch is used in the control circuit, in series, with the close limit switch.

The licensee does not torque seat the subject MOVs in the closed direction. However, the torque switch acts as a secondary control device during the closing cycle. The limiting requirement of the close torque switch is at the end of the closure stroke when the thrust requirements are the highest. If the valve demands more thrust due to mechanical friction or binding of the valve during the valve travel between the open and close limits, the torque switch will trip the motor depending on the torque settings. The torque switch is set to protect the motor as well as to assure valve operability during a design bases accident. The licensee obtained Limitorque recommendations on required torque settings and the supporting data sheets. The torque switch trip set point was calculated based on the most limiting closure thrust requirement including the thrust needed to overcome the differential pressure across the valve.

Open Limit Switch/Close Limit Switch

Normal industry practice is to seat valves under torque switch control and backseat valves under limit switch control. This is to assure tight seating during closure and to provide a positive stop of the operator during valve opening.

At Calvert Cliffs Units 1 and 2, the licensee uses limit switch control for both opening and closing of valves. The open limit switch provides the control function for determining the upper limit of the valve stem travel in the open direction and stops motor rotation by opening the circuit. The setting of this switch must assure adequate valve opening and should prevent backseating. Valve backseats normally provide a seal that is redundant to the valve packing in order to allow valve packing replacement without the need to drain down the process system. Using the motor power to backseat can, and has, caused valve stem shearing and stem thread twisting. Therefore, it is important to set the open limit switch away from the backseat with enough margin to allow for motor deenergization and inertia.

The close limit switch is usually used with the close torque switch in series for over torque protection. For high speed operators, where torque switches cannot react in sufficient time, the close limit switch deenergizes the motor and the remaining inertia force is used to seat the valve.

At Calvert Cliffs Units 1 and 2, the licensee has set both the open and close limit switches to position valves a sufficient distance from the backseat/seat to deenergize the motor. The remaining inertia forces are used to open/close the valve. The inspector noticed that the licensee is relying on the electrician's expertise to set the limit switches. Since the limit switch is the primary control for opening/closing the valve, the valve will operate per the limit switch setting, unless, there is a mechanical failure of the valve which demands excessive thrust causing the torque switch to operate. Incorrect limit switch settings could lead to damage to the valve, valve operator and related components. See section 4.4 for a further discussion of this issue.

Another related concern regarding limit switch control for controlling valve closure is the influence of wear on the valve seat. The motor will get a signal to shut off the limit switch at a definite point during the closing stroke based on the limit switch setpoint. If the valve seat suffers erosion or other wear, the inertia force available after the motor shuts off may not be sufficient to fully seat the valve. The inspector noted that the licensee does not perform surveillance checks or leak rate tests to assure proper closing of the bulletin valves. This is an unresolved item pending NRC review of the licensee action to assure proper setting of the close limit switch considering the influence of seatwear on valve closure for valves that are closed using the limit switches. 50-317/89-12-03; 50-318/89-12-03.

Open/Close Indication

A red light indicates a valve open signal. This light is taken from the close rotor limit switch which is set to actuate very close to the end of valve closure. A green light provides a valve closed signal and is taken from the open rotor limit switch actuation. The green light will turn off when the MOV is in the full open position, and the red light will turn off when the MOV is in the full closed position. When both lights are on, the valve is in an intermediate position.

At Calvert Cliffs Units 1 and 2, the licensee uses a 2 rotor limit switch assembly for controlling MOV operation. The torque bypass switch and the indication light signals are taken from the same rotors. Any adjustment to the torque bypass switch will affect the indication. In a similar manner limit switch adjustment to get the correct indication will change the bypass switch settings. Operators rely on the indication lights to determine the valve status. Any change in limit switch setting can influence MOV stroke time testing as well as valve position dependent interlocks and permissives. This is an unresolved item pending NRC review of the licensee's actions to assure that changes to bypass switch settings do not adversely affect indication and limit switch settings. (50-317/89-12-04; 50-318/89-12-04).

Thermal Overload Relay

Thermal overload relays are used to protect motor winding insulation from breakdown during overload conditions. Devices used consist of heaters at the motor control center which trip a heat sensitive relay, the contacts of which either interrupt current to the contactor closure or open the coil (which stops the motor) or initiate an overload alarm, or both. Where thermal overload relays stop operator motor rotation on tripping, the heaters must either be sized to prevent inadvertently stopping the motor or the overload relays must be bypassed when motor operation is important to safety. They should also be sized to protect the motor windings from thermal damage. Regulatory Guide 1.106, thermal overload protection for electric motors on motor operated valves provides guidelines on the design criteria for thermal overloads.

Designs that are being used at this time to eliminate the threat of inadvertent motor trips include: (1) removing the heaters or relay contacts from use; (2) using the relay contacts for alarm only; (3) bypassing the relay contacts during all operating modes except when a valve is being exercised for testing; (4) bypassing the relay contacts only during the presence of an automatic safety actuation signal; and, (5) oversizing the thermal overloads.

At Calvert Cliffs Units 1 and 2, the licensee utilizes the following general criteria for sizing the overload relays that are used in the control circuit of all bulletin valves to protect the motor without compromising the safety function.

1. A minimum of twenty minutes trip time at full load current.

2. A maximum of fifteen seconds and minimum of two seconds trip time at locked rotor current. This allows at least 2 seconds to unseat the valve and a maximum of fifteen seconds to operate the valve under locked rotor condition.

During the review of the overload heater calculations, the inspector observed that the licensee sized the overload relays to trip between a band of approximately 4.5 seconds minimum to a 15 seconds maximum locked rotor current range. Limitorque requires its motor manufacturers to provide a minimum of 10-15 seconds allowable stall time. According to Limitorque, 10 seconds locked rotor time for overload selection gives the highest degree of motor protection, even though, 15 seconds locked rotor time is considered adequate protection for the motor. The licensee selected the overload relay such that motor protection and availability of the MOV is not compromised. During the field walkdown, the inspector verified thermal overloads for four HPSI valves for Unit 1. The installation agreed with the required ratings established in the calculation.

The licensee determined that control room indication is not provided to identify tripped overload relays. The licensee is reviewing this issue to determine the need for control room indication of tripped overload relays.

4.3 Demonstration of Operability

This involves demonstrating the valve to be operable by testing the valve under maximum differential pressure (ΔP) after changing the individual valve settings, as appropriate, based on the design bases. In the absence of testing with full differential pressure across the valve, a justification is to be provided. The use of a Limitorque/MOVATS data base to set the torque switches for a particular type of valve is considered an acceptable alternative to differential pressure testing, provided this type of valve has sufficient test data to establish similarity.

The inspector noted that the licensee has not used signature tracing methods to determine the traces of motor current, torque and limit switch actuations and axial motion of the worm gear. Lacking this information the licensee cannot determine the actual available thrust developed by the motor at the maximum design bases differential pressure. However, the licensee uses Limitorque information to calculate the stem thrust and the required torque settings to seat and unseat the valve.

The MOVs subject to the requirements of the bulletin were tested at the maximum Δp and at full flow for both units. The valves were stroke tested using the "as found" switch settings with the maximum differential pressure (Δp). Additionally, the Unit 1 MOVs were tested at a reduced voltage of 432 volts (minimum 480V bus voltage allowed by tech specifications). Unit 1 completed the differential pressure test twice and the second test for Unit 2 is scheduled for this outage. The full Δp test is scheduled every refueling outage. The inspector verified the test records. All MOVs operated properly in both the open and shut directions with the maximum design bases differential pressure across the valve. In five cases the HPSI system was not capable of producing maximum design Δp. (1310 psid vs. 1313 psid required). For these cases, the difference in Δp was minimal. During the test, the licensee took opening/closing time and starting and running current to establish the operability of the MOVs.

No changes to the switch settings were required as a result of the testing. However, some torque switch settings were changed, either to increase the conservatism in the settings or, to standardize settings on similar MOVs in order to assist in long-term valve trending. The inspector noted that the licensee performs a quarterly valve operability verification test consisting of valve cycling to provide additional confidence of valve operability. The list of the bulletin valves and their torque and thrust values are shown in attachment 3.

4.4 Maintenance and Procedures

The bulletin requires that licensees prepare or revise procedures to ensure that correct switch settings are maintained throughout the life of the plant and also to ensure that applicable industry recommendations are considered in the preparation of the procedure.

The inspector reviewed the procedures and documents listed in Attachments 1 and 2. The licensee had revised existing procedures for maintaining the limit and torque switch settings. The procedure addressed the details on installing torque switches with the spring pack in the relaxed condition. However, procedures were not provided to specify the greasing levels and acceptable level/quantity of grease for the limit switch gear assembly.

A walkdown was conducted to assess the adequacy of MOV maintenance and to verify torque switch and limit switch settings. As Unit 1 was operating at full power, access to these valves was limited. However, the inspector inspected three valves (MOV 653, 654 and 655) in the HPSI system. The torque and the limit switch contacts appeared to be set correctly, aligned, clean, and free from corrosion and pitting. The inspector verified the control wiring to be in conformance with the licensee documents listed in Attachment 2.

During the procedure review, the inspector noted that no specific criteria were provided to specify limit switch and bypass switch settings to cut off the motor circuit. Industry practice is to use either the stem measurement or the hand wheel movement method to get the desired limit switch setting. Industry analysis indicated that the lack of information of proper limit switch settings and torque switches was one of the causes of failures of MOVs.

During the walkdown, the inspector noted that the 2MOV653, 654 and 655 valve stems were without a trace of lubrication. No procedural requirements exist for SMB-00 and SMB-3 MOV actuators to specify the frequency of inspections or to specify the criteria for stem lubrication of the actuators to assure proper MOV operation. Industry experience indicates that a lack of adequate lubrication of valve stem leads to premature tripping of the operator because of excessive torque requirements. The above two examples constitute a violation of Baltimore Gas and Electric Company Technical Specification, section 6.8.1, in that no procedures were provided for these important maintenance activities that can affect the performance of safety related equipment (50-317/89-12-01; 50-318/89-12-01).

During the review of the test records, the inspector noted that at the last refueling outage, several MOVs in Unit 1 exhibited potential lubrication deficiencies for the main gear box assembly (such as potential degradation of grease and using different grease). Preventive maintenance records, PM 2-52-MR8 thru 15 for the last outage for Unit 2 indicated discoloration of the grease. This is an indication of potential grease degradation. During the current Unit 2 outage, the licensee stated that ten out of 12 Bulletin valves exhibited similar lubrication deficiencies.

This issue of potential lubrication deficiencies for the main gear box assembly is an unresolved item pending the licensee establishing clear acceptance criteria for the lubricant, licensee determination of the acceptability of the main gear box lubricant; and the licensee's actions to correct unacceptable lubricant conditions (50-317/89-12-02; 50-318/89-12-02).

During the walkdown, the inspector noticed that the torque switch settings were nonconservatively set at 1.0 for both opening and closing valve 2MOV653. The setpoint file manual and the licensee's final response to the Bulletin specifies 1.5 for both opening and closing the valve. This discrepancy was brought to the attention of the licensee during the inspection and at the exit meeting.

The Baltimore Gas and Electric Company Quality Assurance policy, Revision 19, Section 1B.5 requires that activities affecting quality shall be prescribed by procedures and shall be accomplished in accordance with these procedures. This finding constitutes a violation of 10 CFR 50 Appendix B Criterion V, failure to follow procedures (50-317/89-12-05; 50-318/89-12-05).

The inspector reviewed the licensee's training program. The maintenance personnel have attended the Limitorque training presented by power safety international and also undergo in-house training. The training consists of operation, disassembly and assembly of MOV, setting torque and limit switches and hands on training. Since the licensee did not have any diagnostic equipment, technicians are not trained in this area. The inspector interviewed an electrician who was responsible for the MOV maintenance. He was determined to be knowledgeable in the maintenance aspects of MOVs. The inspector observed that the existing training requalification interval is three years.

The inspector reviewed the post maintenance testing of MOVs. The licensee is currently timing the valve stroke and monitoring the current reading to establish the operability of MOVs after minor and mid-level maintenance. Following major maintenance, full Δp stroke testing is performed to establish MOV operability. The licensee is currently reviewing their valve testing program to determine if there is a need for full Δp stroke testing after mid-level maintenance.

5.0 Conclusions

The licensee has not addressed all of the significant aspects of the bulletin. A deficiency was noted during the walkdown regarding a torque switch setting. Maintenance procedures were not provided to specify the limit switch settings. Maintenance deficiencies were observed in the lubrication area. Surveillance, preventive, and post maintenance procedures were not descriptive.

During the inspection, the inspector observed that the licensee lacked dedicated MOV maintenance personnel to address the MOV program. They now have a dedicated project manager to oversee the program. The licensee stated that they are in the process of implementing an extensive plan that should address concerns regarding the existing MOV maintenance program.

The inspector concluded that since all the bulletin valves were tested with full differential pressure across the valve, there is reasonable assurance that these valves can perform their safety function. Based on the review of the licensee's LER's and PM's, no MOV failures were observed during the past two years.

6.0 Unresolved Items

Unresolved items are matters for which more information is required in order to ascertain whether they are acceptable, violations, or deviations. Three unresolved items are discussed in sections 4.2 and 4.4 of this report.

7.0 Exit Interview

At the conclusion of the inspection on May 5, 1989, the inspectors met with the licensee representatives, denoted in section 1.0. The inspector summarized the scope and findings of the inspection at that time. No written material was given to the licensee during this inspection.

REFERENCES

1. Letter from Mr. J. A. Tiernan (BG&E) to Dr. T. E. Murley (NRC), dated May 15, 1986.

2. Letter from Mr. E. C. Wenzinger (NRC) to Mr. J. A. Tiernan (BG&E), dated July 29, 1987, Request for Additional Information

3. Letter from Mr. J. A. Tiernan (BG&E) to NRC Document Control Desk dated September 1, 1987

4. Letter from Mr. J. A. Tiernan (BG&E) to NRC Document Control Desk dated January 28, 1988.

PROCEDURES

Procedure No. FTE-41, Rev 6. Insulation Resistance Testing

Calvert Cliffs Instruction 2051, Rev 0 - Setpoint Control Procedure

STP No. 066-2 Rev 0 - Quarterly Valve Operability Verification - Shutdown

GEN-19, Rev 5 - Disassembly and assembly of limitorque actuators SMB-0, SMB-1, SMB-2 and SMB-3

065-1, Rev 32 - Quarterly Valve Operability Verification.

GNE-18, Rev 1 - Instruction and Maintenance of Limitorque Actuator SMB-00

FTE-47, Rev 6 - Functional Test Procedures - Electrical Motor Operated Valve Test Procedure

Quality Assurance Policy Rev 19

STP No. 0-103-1 (Unit 1) - Surveillance Test Procedure - HPSI MOV Maximum Differential Pressure

STP No. 0-103-2 (Unit 2) - Surveillance Test Procedure - HPSI MOV Maximum Differential Pressure

Documents Reviewed

STP-066-1 - Maximum Differential Pressure Test Record

Maintenance Order No. 206-294-277A - Perform Testing on SI MOV

Manual #14 - Set point file for MOV torque switch settings

Calculation No. E-81-1 - Overload heater selection

Bechtel File No. 1475/2703 - MOV overload relay calculations

BG&E Drawing No. 61-014B Shet 4 Rev 23 - Relay Settings, MCC 104R

BG&E Drawing No. 61-014B Sht 4B, Rev 25 - Relay setting, MCC 114R

BG&E Drawing No. 63-014-B, Sht 4, Rev 24 - Relay settings, MCC 204R

BG&E Drawing No. 063-014B, Sht 4B, Rev 22 - Relay settings, MCC 214R

BG&E Drawing No., 61-076-B Sht 23, Rev 10 - Reactor Safeguards MOVs 616, 626 636, 646

BG&E, Drawing No. 61-076B, Sht 22, Rev 10 - Reactor Safeguards MOVs 615, 625, 635, 645, 617, 627, 637 and 647

BG&E, Drawing No. 61-076-B, Reactor Safeguards MOV 656 Sht 21, Rev 7

BG&E, Drawing No. 61-076-B, Sht 19, Rev 10 - Reactor Safeguards, MOVs 653, 654, 655

BG&E, Drawing No. 63-076-B, Sht 23A, Rev 0 - Reactor Safeguards MOVs 616, 626, 636, 646

Motor Operated Valve Safety Data

PM No. 1-52-E-2R-3, Safety Injection MOVs

FCR No. 89-10 - Limitorque Motor Operators

PM No. 1-52-M-R-16, 18 - SI, 1-MOV-653, 654

PM No. 2-52-M-R-8 thru 18 and 21 - Safety Injection MOVs

PM No. 1-52-E-2R-6 - Preventive Maintenance for Valves 653, 654, 658, 659, 660, 662

PM No. 1-52-E-2R-7 - Preventive Maintenance for Valves 665, 656, 663

PM No. 2-52-E-2R-6 - Preventive Maintenance Safety Injection MOVs

Attachment-2

Documents Reviewed (Continued)

LERs

LER 79-11/3L, 2 LER 7787

LER 79-44/3L, 1 LER 8416

LER 77-87/3L, 1 LER 7911

LER 80-01/3L

ATTACHMENT 3

VALVE						VALVE OPERATOR			DVF	BASIS Δ		TEST ΔP	T/S @ TEST		T/S FINAL		Recom. Seating	Recom. Min.	Recom. Max. Torque
COMP ID	M	T	MDL	S	R	M	RPM	GR	FUNC	O	C	O/C	O	C	O	C	Thrust	Torque Setting	Settings
1MOV616	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1295	1295	1340	1.0	2.25	1.5	1.5*	7905	1½	3
1MOV627	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1295	1295	1320	2.25	1.75	1.5	1.5*	7905	1½	3
1MOV626	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1295	1295	1340	2.0	2.25	1.5	1.5*	7905	1½	3
1MOV627	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1295	1295	1320	1.5	1.75	1.5	1.75	7905	1½	3
1MOV636	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1295	1295	1330	2.5	2.5	1.5	1.5*	7905	1½	3
1MOV637	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1295	1295	1310	1.5	1.5	1.5	1.5	7905	1½	3
1MOV646	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1294	1294	1330	1.75	2.75	1.5	1.5*	7905	1½	3
1MOV647	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1294	1294	1310	2.5	1.5	1.5	1.5*	7905	1½	3
1MOV653	V	GA	P 34658	4	900	-0025	1700	36.2:1	PDIV	1313	1313	1310	1.0	1.0	1.5	1.5	9827	1	2
1MOV654	V	GA	P 34658	6	900	-040	1700	35.4:1	TIV	1313	1313	1330	2.25	2.5	3.0	3.0	24710	2¼	4½
1MOV655	V	GA	P 34658	4	900	-0025	1700	36.2:1	PDIV	1313	1313	1310	1.0	1.0	1.5	1.5	9827	1	2
1MOV656	V	GA	P 34658	6	1500	-160	3405	35.4:1	TIV	1313	1313	1310	2.25	2.25	2.25	2.25	24710	2¼	4½
2MOV616	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1295	1295	1325	1.5	1.5	1.5	1.5	7905	1½	3
2MOV617	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1295	1295	1320	1.5	1.5	1.5	1.5	7905	1½	3
2MOV626	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1295	1295	1325	1.5	1.5	1.5	1.5	7905	1½	3
2MOV627	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1295	1295	1320	1.5	1.5	1.5	1.5	7905	1½	3
2MOV636	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1295	1295	1325	1.5	1.25	1.5	1.25	7905	1½	3
2MOV637	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1295	1295	1310	1.5	1.5	1.5	1.5	7905	1½	3
2MOV646	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1294	1294	1320	1.0	2.0	1.5	1.5+	9905	1½	3
2MOV647	V	GL	P 34657	2	1500	-0025	1700	38.6:1	LIV	1294	1294	1310	1.0	2.0	1.5	1.5+	9905	1½	3
2MOV653	V	GA	P 34658	4	900	-0025	1700	36.2:1	PDIV	1313	1313	1325	1.5	1.5	1.5	1.5	9827	1	2
2MOV654	V	GA	P 34658	6	900	-040	1700	35.4:1	TIV	1313	1313	1340	2.25	2.25	3.0	3.0	24710	2¼	4½
2MOV655	V	GA	P 34658	4	900	-0025	1700	36.2:1	PDIV	1313	1313	1310	1.5	1.5	1.5	1.5	9827	1	2
2MOV656	V	GA	P 34658	6	1500	-160	1720	35.4:1	TIV	1313	1313	1310	2.25	2.25	2.25	2.25	24710	2¼	4½

VALVE

M = Manufact.
V = VELAN
T = Type
GL = Globe
GA = Gate
S = Size in inches
R = Primary rating in lbs.
MDL = Model

VALVE OPERATOR

M = Manufact.
ALL are Limitorque SMB
RPM = Motor
GR = Gear Ratio

DVF

DVF = Design Valve Func.
LIV = Loop Isolation Valve
PDIV = Pump Downstream Isolation Valve
TIV = Train Isolation Valve
All valves are in the High Pressure Safety Injection System

TEST DELTA P

O = Closed to Open
C = Open to Close
All pressures in psig.
Valve Closing Pressures are with flow during last outage

T/S FINAL

T/S = Torque Switch
O = Open
C = Close
* = T/S Adjusted/Tested at Full Delta P during last outage
+ = Operability established by testing Unit 1 Valve (Full ΔP test for Unit 2 is scheduled for this outage)