Generic Letter 89-10
Design-Basis Closure

Northeast Nuclear Energy Company
Millstone Unit 3
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CLOSURE OF MP3 GL 89-10 PROGRAM

Executive Summary

This document describes the bases for Millstone Unit 3's closure of the design-basis verification phase of NRC Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance." This report was prepared to serve as a living document which controls the GL 89-10 design requirements, and provides in one place sufficient information to verify GL 89-10 closure. This has been accomplished by defining the Northeast Utilities Motor-Operated Valve Program as implemented at the Millstone Unit 3 Plant. Included in the report are actions taken to date, as well as descriptions of the longer-term program being implemented for on-going testing and surveillance of safety-related motor-operated valves (MOV's). This program verified and ensures MOV operability under design-basis differential pressure and flow conditions.

In November of 1985, the NRC issued Bulletin 85-03 recommending licensees develop and implement a program to ensure the reliability of MOV's in several safety-related systems. In June of 1989, the NRC issued Generic Letter (GL) 89-10 recommending licensees develop a comprehensive program to ensure MOV's in safety-related systems will operate under design-bases conditions and mispositioned conditions.

Northeast Utilities (NU) committed to develop a detailed program for addressing GL 89-10 at Connecticut Yankee , Millstone Unit No. 1, Millstone Unit No. 2, and Millstone Unit No. 3 nuclear power plants. All safety-related MOV's and position-changeable MOV's in safety-related piping systems are included in this program. This program includes demonstrating the operability of safety-related MOV's by analysis and in-situ flow tests at or near design-basis conditions, where practicable. The objectives of our program are to:

- Increase MOV operability assurance through a long-term preventive maintenance and trending program.
- Identify problem valves early (i.e., experience no failures during plant operation).
- Minimize extended outages due to MOV testing related activities.

The NU MOV Program Manual specifies criteria and requirements for NU's implementation of GL 89-10. The MOV Program Manual applies to the Connecticut Yankee , Millstone Unit No. 1, Millstone Unit No. 2, and Millstone Unit No. 3 nuclear power plants. It is the controlling document for Northeast Utilities Service Company (NUSCO), Northeast Nuclear Energy Company (NNECO), Connecticut Yankee Atomic Power Company (CYAPCO), and contractors performing MOV Program activities at Northeast Utilities. The MOV Program Manual consists of the following sections:

- **Introduction** — Objectives, purpose, scope and applicability.
- **Responsibilities** — Responsibilities of key individuals / groups.
- **Integration** — Interfaces with other groups and individuals.
- **Technical Requirements** — Technical Requirements of the MOV Program.

- **Instructions** Program Instructions (PIs) for implementation.
- **Figures** Organization and process flow charts.
- **References** Source / supporting documents, management commitments.
- **Definitions** Acronyms and terms.
- **Attachments** Attachments which are significant.

Millstone Unit 3 completed the design-basis phase of GL 89-10 on June 6, 1995, within the original NRC requested schedule, i.e., the third refueling outage after December 28, 1989.

1. Purpose

The purpose of this document is to summarize, in one place, closure of the design-basis phase of GL 89-10, and future changes which impact design-basis considerations. It also provides the bases for MOV settings and configuration. Finally, this report serves as a living document which will be periodically revised as one element in configuration control. This closure report will be maintained as a controlled document within the MOV Program Manual and updated as necessary.

It is currently envisioned that this document will be reviewed after each refueling outage if changes are made which impact MOV functionality or GL 89-10 MOV design compliance. This document will not control control-switch setpoints, future test data, or calculation numbers. These and other parameters are controlled by NU procedures. Tables 6, 7, 10, and 17 will not be maintained as living. An example of an item which will result in a revision is a design change requiring revalidating design-basis capability.

2. Introduction

On June 28, 1989, the NRC staff issued Generic Letter 89-10 , "Safety-Related Motor-Operated Valve Testing and Surveillance,"[1] which provided recommendations to the licensees for the development of adequate programs to ensure operability of safety-related MOV's during design-basis conditions. The generic letter recommended that each licensee with an operating license complete all design-basis reviews, analyses, verifications, tests and inspections that have been instituted within five years or three refueling outages, whichever is later, of the date of the generic letter (June 28, 1989).

The staff held public workshops to discuss the generic letter and to answer questions regarding its implementation. On June 13, 1990, the staff issued Supplement 1[2] to Generic Letter 89-10 to provide the results of the public workshops. In Supplement 2[3] to Generic Letter 89-10, issued on August 3, 1990, the staff stated that inspections of programs developed in response to the generic letter would not begin until January 1, 1991.

In response to concerns raised by the results of NRC-sponsored MOV tests, the staff issued Supplement 3[4] to Generic Letter 89-10 on October 25, 1990. This supplement requested that Boiling Water Reactor licensees evaluate the capability of MOV's used for containment isolation in the steam lines to the high pressure coolant injection system and reactor core isolation cooling system; in the supply line to the reactor water cleanup system; and in the lines to the isolation condenser, as applicable.

On February 12, 1992, the staff issued Supplement 4[5] to Generic Letter 89-10 excluding considerations for inadvertent operation of MOV's from the scope of Generic Letter 89-10 for Boiling Water Reactors. On June 28, 1993, the staff issued Supplement 5[6] to Generic Letter 89-10 which requested that licensees review their MOV programs and to identify measures taken or planned to account for uncertainties in properly setting valve operating thrust due to increased inaccuracy of MOV diagnostic equipment.

Supplement 6[7] to Generic Letter 89-10, issued March 8, 1994, further clarified NRC positions on the schedule for completing MOV testing to verify design-basis capability and grouping of MOV's to establish valve setup conditions. This supplement also provided staff responses to other general public questions.

3. Proactive Features of the MOV Program

- Used a 0.6 valve factor for non-testable gate valves based upon review of Electric Power Research Institute (EPRI) Performance Prediction Methodology (PPM) results.
- Use of the Kalsi Engineering Inc., KEI Gate Program for non-testable valves to validate our 0.6 valve factor assumption. In cases where the KEI Gate yields a value > than 0.6, the "bounding" KEI Gate value is used to define the thrust window. KEI Gate was performed for NNECO due to delayed issuance of the EPRI PPM.
- Developed a comprehensive structural analysis procedure and replaced diverse vendor seismic weak link calculations with consistent calculations for all GL 89-10 valves.
- Backfit ASME Code, stress-based requirements to Haddam Neck, Millstone Unit 1, and Millstone Unit 2.
- Determined acceptable pressure boundary integrity at actuator stall in cases where actuators have been modified and stall thrust increased significantly.
- Employ consistently determined results from three other nuclear units, thereby adding further validation to MOV program assumptions.
- Performed laboratory design-basis dynamic tests for selected replacement valves. This work was performed for Northeast Utilities by the broadly recognized Alden Research Laboratory in Massachusetts.
- Provided special treatment of Westinghouse gate valves in high differential pressure applications. Not yet published EPRI research was used to define a more conservative set of acceptance criteria for two Westinghouse MOV's in high pressure applications.
- Developed a more accurate model to evaluate stroke time for DC-powered actuators. A specific linkage was drawn between higher assumed valve factors and stroke time.
- Compiled digital photographs of MOV's for easy storage, retrieval and review.

4. Program Scope

The objective of the Millstone Unit 3 MOV Program is to ensure MOV operability under design-basis differential pressure and flow conditions. This entails several program elements to:

(1) determine the design-basis conditions,

(2) determine the physical limitations of the valve and actuator,

(3) perform the requisite testing and evaluate the data to determine the appropriate limit and / or torque switch settings, and

(4) ensure that operability is maintained throughout the life of the plant through on-going maintenance activities and design control measures.

Setup and testing of the valves is accomplished using the Liberty Technologies Valve Operation Test and Evaluation System (VOTES) and other state-of-the-art measurement techniques (e.g., QSS - Quick Stem Sensor and MPM - Motor Power Monitor).

Millstone Unit 3's administrative program is defined by Nuclear Group Procedure (NGP) 2.32, "Engineering Programs" with specific detailed procedural requirements contained in the Motor-Operated Valve Program Manual. Other ancillary procedures govern more specific aspects of the program such as use and calibration of test equipment and adjustment of switches. Finally, procedural interfaces exist with other programs governing routine maintenance, plant design changes and modifications, corrective action programs, and identification of non-conforming materials.

The Millstone Unit 3 MOV Program is based upon satisfying two key technical requirements. These are (1) the physical limitations of the valve and actuator based on allowable limits of subcomponents (e.g., torque limits on the actuator, thrust limits, valve component structural limits, etc.) and (2) the required differential pressure and flow environment in which the valve must function. Other effects such as operation at reduced voltage and elevated temperatures, use of proper stem factors, pressure locking and thermal binding have also been considered.

There are one hundred and forty three (143) motor-operated valves included in the Millstone Unit 3 MOV Program scope. A summary of valve types, disk type and valve manufacturer is defined in Table 1.

Table 1: Summary of MOV Types

Valve Type	Disk Type	Manufacturer
Butterfly (40)		(4) Contromatics (36) Henry Pratt
Gate (62)	Flex Wedge (34)	(12) Pacific (7) Walworth (15) Westinghouse
	Solid Wedge (28)	(21) Aloyco (3) Pacific (4) Walworth
Globe (35)		(4) Pacific (10) Velan (3) Walworth (18) Yarway
Plug (6)		(6) Xomox

All Millstone Unit 3 MOV's within the program scope utilize Limitorque operators.

5. Status of GL 89-10 Program MOV's

As of June 1995, all initial design reviews, valve set-up and static tests of the 143 valves in the Millstone Unit 3 GL 89-10 MOV Program were completed by the end of refueling outage RFO 5, the third refueling outage after the release of GL 89-10. Of the 143 MOV's in the program, 102 were statically tested during RFO 5. Of the 94 testable MOV's in the program; 35 MOV's were dynamically tested during RFO 5, 22 MOV's were tested the previous outage, for 6 MOV's the static test constituted the design-basis verification because the static breakaway torque requirements dominate the torque requirements, 14 MOV's were grouped with other tested MOV's, and 17 MOV's were not dynamically tested due to high calculated margin / capability.

Information about each MOV in the Millstone Unit 3 MOV Program is contained in numerous tables within this report. Table 2 contains the valve tag number and system label name along with the functional description of each valve.

Table 2: MOV -- System Name and Function

Valve Tag Number	System Name	Function
3CCP*MOV045A	Reactor Plant CCW	Train A RPCCW Supply Header Ctmt Penetration
3CCP*MOV045B	Reactor Plant CCW	Train B RPCCW Ctmt Supply Header Isolation
3CCP*MOV048A	Reactor Plant CCW	Train A RPCCW Ctmt Return Inner Isolation
3CCP*MOV048B	Reactor Plant CCW	Train B RPCCW Ctmt Return Inner Isolation
3CCP*MOV049A	Reactor Plant CCW	Train A RPCCW Ctmt Return Outer Isolation
3CCP*MOV049B	Reactor Plant CCW	Train B RPCCW Ctmt Return Outer Isolation
3CCP*MOV222	Reactor Plant CCW	Train A Chilled Water Supply
3CCP*MOV223	Reactor Plant CCW	Train A Chilled Water Return
3CCP*MOV224	Reactor Plant CCW	Train A Chilled Water Return
3CCP*MOV225	Reactor Plant CCW	Train A Chilled Water Return
3CCP*MOV226	Reactor Plant CCW	Train B Chilled Water Supply Isolation
3CCP*MOV227	Reactor Plant CCW	Train B Chilled Water Supply Isolation
3CCP*MOV228	Reactor Plant CCW	Train B Chilled Water Return Isolation
3CCP*MOV229	Reactor Plant CCW	Train B Chilled Water Return Isolation
3CHS*LCV112B	Charging	Volume Control Tank Outlet Isolation
3CHS*LCV112C	Charging	Volume Control Tank Outlet Isolation
3CHS*LCV112D	Charging	RWST Supply To Charging Pump Suction
3CHS*LCV112E	Charging	RWST Supply To Charging Pump Suction
3CHS*MV8100	Charging	Seal Water Return From RCP Ctmt Penetration
3CHS*MV8104	Charging	Emergency Boration
3CHS*MV8105	Charging	Charging Header Isolation
3CHS*MV8106	Charging	Charging Flow Controller Isolation
3CHS*MV8109A	Charging	RCP A Seal Supply Isolation Ctmt Penetration
3CHS*MV8109B	Charging	RCP B Seal Supply Isolation Ctmt Penetration
3CHS*MV8109C	Charging	RCP C Seal Supply Isolation Ctmt Penetration
3CHS*MV8109D	Charging	RCP D Seal Supply Isolation Ctmt Penetration
3CHS*MV8110	Charging	Charging Recirculation Isolation To Sealwater
3CHS*MV8111A	Charging	Charging Pump 3A Recirculation Isolation
3CHS*MV8111B	Charging	Charging Pump 3C Recirculation Isolation
3CHS*MV8111C	Charging	Charging Pump 3B Recirculation Isolation
3CHS*MV8112	Charging	Seal Water Return From RCP Ctmt Penetration
3CHS*MV8116	Charging	Bypass Control Valve
3CHS*MV8438A	Charging	Charging Pump A/C Discharge Isolation
3CHS*MV8438B	Charging	Charging Pump B/C Discharge Isolation
3CHS*MV8438C	Charging	Charging Header Cross Connection
3CHS*MV8468A	Charging	LPSI to Charging Pump Suction Isolation
3CHS*MV8468B	Charging	LPSI to Charging Pump Suction Isolation
3CHS*MV8507A	Charging	Bat A Gravity Boration
3CHS*MV8507B	Charging	Bat B Gravity Boration
3CHS*MV8511A	Charging	Charging Pump Relief Train A Isolation
3CHS*MV8511B	Charging	Charging Pump Relief Train B Isolation
3CHS*MV8512A	Charging	Charging Pump Relief Isolation Train B
3CHS*MV8512B	Charging	Charging Pump Relief Isolation Train A
3CMS*MOV24	Containment Atmosphere Monitor	Ctmt Atm Mntr Disch Ctmt Penetration
3CVS*MOV25	Containment Vacuum	Ctmt Vac Pump Disch Ctmt Penetration
3FWA*MOV35A	Aux. Feedwater	Auxiliary Feedwater Isolation Valve
3FWA*MOV35B	Aux. Feedwater	Auxiliary Feedwater Isolation Valve
3FWA*MOV35C	Aux. Feedwater	Auxiliary Feedwater Isolation Valve
3FWA*MOV35D	Aux. Feedwater	Auxiliary Feedwater Isolation Valve
3IAS*MOV72	Containment Instrument Air	Instrument Air Ctmt Penetration
3LMS*MOV40A	Containment Leakage Monitor	PT937 Containment Isolation
3LMS*MOV40B	Containment Leakage Monitor	PT936 Containment Isolation
3LMS*MOV40C	Containment Leakage Monitor	PT935 Containment Isolation
3LMS*MOV40D	Containment Leakage Monitor	PT934 Containment Isolation
3MSS*MOV17A	Main Steam	SG1 Terry Turbine Non-return Isolation
3MSS*MOV17B	Main Steam	SG2 Terry Turbine Non-return Isolation

Valve Tag Number	System Name	Function
3MSS*MOV17D	Main Steam	SG4 Terry Turbine Non-return Isolation
3MSS*MOV18A	Main Steam	Steam Generator 1 Pressure Relief Isolation
3MSS*MOV18B	Main Steam	Steam Generator 2 Pressure Relief Isolation
3MSS*MOV18C	Main Steam	Steam Generator 3 Pressure Relief Isolation
3MSS*MOV18D	Main Steam	Steam Generator 4 Pressure Relief Isolation
3MSS*MOV74A	Main Steam	Steam Generator 1 Pressure Relief Bypass
3MSS*MOV74B	Main Steam	Steam Generator 2 Pressure Relief Bypass
3MSS*MOV74C	Main Steam	Steam Generator 3 Pressure Relief Bypass
3MSS*MOV74D	Main Steam	Steam Generator 4 Pressure Relief Bypass
3QSS*MOV34A	Quench Spray	Quench Spray Pump Disch Ctmt Penetration
3QSS*MOV34B	Quench Spray	Quench Spray Pump Disch Ctmt Penetration
3RCS*MV8000A	Reactor Coolant	Pressurizer Power Relief Isolation
3RCS*MV8000B	Reactor Coolant	Pressurizer Power Relief Isolation
3RCS*MV8098	Reactor Coolant	Reactor Vessel To Excess Letdown
3RHS*FCV610	Residual Heat Removal	RHR Pump P1A Miniflow Recirculation
3RHS*FCV611	Residual Heat Removal	RHR Pump P1b Miniflow Recirculation
3RHS*MV8701A	Residual Heat Removal	RHR Loop A Outboard Isolation
3RHS*MV8701B	Residual Heat Removal	RHR Pump Suction From RCS
3RHS*MV8701C	Residual Heat Removal	RHR Loop A Inboard Isolation
3RHS*MV8702A	Residual Heat Removal	RHR Pump Suction From RCS
3RHS*MV8702B	Residual Heat Removal	RHR Loop B Outboard Isolation
3RHS*MV8702C	Residual Heat Removal	RHR Loop B Inboard Isolation
3RHS*MV8716A	Residual Heat Removal	RHR Train A to Hot Leg and RWST
3RHS*MV8716B	Residual Heat Removal	RHR Train B to Hot Leg and RWST
3RSS*MOV20A	Containment Recirculation	Ctmt Recirc Pump Disch Ctmt Penetration
3RSS*MOV20B	Containment Recirculation	Ctmt Recirc Pump Disch Ctmt Penetration
3RSS*MOV20C	Containment Recirculation	Ctmt Recirc Pump Disch Ctmt Penetration
3RSS*MOV20D	Containment Recirculation	Ctmt Recirc Pump Disch Ctmt Penetration
3RSS*MOV23A	Containment Recirculation	Ctmt Recirc Pump Suction Ctmt Penetration
3RSS*MOV23B	Containment Recirculation	Ctmt Recirc Pump Suction Ctmt Penetration
3RSS*MOV23C	Containment Recirculation	Ctmt Recirc Pump Suction Ctmt Penetration
3RSS*MOV23D	Containment Recirculation	Ctmt Recirc Pump Suction Ctmt Penetration
3RSS*MOV38A	Containment Recirculation	3RSS*P1A Miniflow Recirc
3RSS*MOV38B	Containment Recirculation	3RSS*P1A Miniflow Recirc
3RSS*MV8837A	Containment Recirculation	RSS To RHR Cross Connection
3RSS*MV8837B	Containment Recirculation	RSS To RHR Cross Connection
3RSS*MV8838A	Containment Recirculation	RSS To RHR Cross Connection
3RSS*MV8838B	Containment Recirculation	RSS To RHR Cross Connection
3SIH*MV8801A	High Head Safety Injection	Charging Pump SI Header Isolation
3SIH*MV8801B	High Head Safety Injection	Charging Pump SI Header Isolation
3SIH*MV8802A	High Head Safety Injection	SI Pump Disch Hot Leg Ctmt Penetration
3SIH*MV8802B	High Head Safety Injection	SI Pump Disch To Hot Leg Ctmt Penetration
3SIH*MV8806	High Head Safety Injection	Refueling Water Storage Tank To SI Pump
3SIH*MV8807A	High Head Safety Injection	LPSI Charging Pump Suction Cross Connect
3SIH*MV8807B	High Head Safety Injection	LPSI Charging Pump Suction Cross Connect
3SIH*MV8813	High Head Safety Injection	Safety Injection Pump Master Miniflow Isolation
3SIH*MV8814	High Head Safety Injection	Safety Injection System Pump Miniflow Isolation
3SIH*MV8821A	High Head Safety Injection	A Safety Injection Pump To Cold Leg Injection
3SIH*MV8821B	High Head Safety Injection	B Safety Injection Pump To Cold Leg Injection
3SIH*MV8835	High Head Safety Injection	SI Pump Disch To Cold Leg Ctmt Penetration
3SIH*MV8920	High Head Safety Injection	B Safety Injection Pump Miniflow Isolation
3SIH*MV8923A	High Head Safety Injection	A Safety Injection Pump Suction Isolation
3SIH*MV8923B	High Head Safety Injection	B Safety Injection Pump Suction Isolation
3SIH*MV8924	High Head Safety Injection	LPSI Charging Pump Suction
3SIL*MV8804A	Low Head Safety Injection	LPSI To Charging Pump Suction
3SIL*MV8804B	Low Head Safety Injection	LPSI To Charging Pump Suction
3SIL*MV8808A	Low Head Safety Injection	SI Accumulator Tank 1 Outlet Isolation

Valve Tag Number	System Name	Function
3SIL*MV8808B	Low Head Safety Injection	SI Accumulator Tank 2 Outlet Isolation
3SIL*MV8808C	Low Head Safety Injection	SI Accumulator Tank 3 Outlet Isolation
3SIL*MV8808D	Low Head Safety Injection	SI Accumulator Tank 4 Outlet Isolation
3SIL*MV8809A	Low Head Safety Injection	RHR Pump Discharge To Cold Leg Ctmt Penetration
3SIL*MV8809B	Low Head Safety Injection	RHR Pump Discharge To Cold Leg Ctmt Penetration
3SIL*MV8812A	Low Head Safety Injection	A RHR Pump Suction Isolation From RWST
3SIL*MV8812B	Low Head Safety Injection	B RHR Pump Suction Isolation From RWST
3SIL*MV8840	Low Head Safety Injection	RHR Pump Discharge To Hot Leg Ctmt Penetration
3SWP*MOV024A	Service Water	A Service Water Pump Disch Strnr Backwash
3SWP*MOV024B	Service Water	B Service Water Pump Disch Strnr Backwash
3SWP*MOV024C	Service Water	C Service Water Pump Disch Strnr Backwash
3SWP*MOV024D	Service Water	D Service Water Pump Disch Strnr Backwash
3SWP*MOV050A	Service Water	Train A Service Water Supply Reactor Plant CCW
3SWP*MOV050B	Service Water	Train B Service Water Supply Reactor Plant CCW
3SWP*MOV054A	Service Water	A Ctmt Recirc Cooler Inlet
3SWP*MOV054B	Service Water	B Ctmt Recirc Cooler Inlet
3SWP*MOV054C	Service Water	C Ctmt Recirc Cooler Inlet
3SWP*MOV054D	Service Water	D Ctmt Recirc Cooler Inlet
3SWP*MOV057A	Service Water	A Containment Recirculating Cooler Outlet
3SWP*MOV057B	Service Water	B Containment Recirculating Cooler Outlet
3SWP*MOV057C	Service Water	C Containment Recirculating Cooler Outlet
3SWP*MOV057D	Service Water	D Containment Recirculating Cooler Outlet
3SWP*MOV071A	Service Water	A Service Water Header Turbine Pump CCW Hx Supply
3SWP*MOV071B	Service Water	B Service Water Header Turbine Pump CCW Hx Supply
3SWP*MOV102A	Service Water	A Service Water Pump Discharge Valve
3SWP*MOV102B	Service Water	B Service Water Pump Discharge Valve
3SWP*MOV102C	Service Water	C Service Water Pump Discharge Valve
3SWP*MOV102D	Service Water	D Service Water Discharge Valve
3SWP*MOV115A	Service Water	Train A Circulating Pump Lube Water Supply
3SWP*MOV115B	Service Water	Train B Circulated Pump Lube Water Supply

Provided in Table 3 is the quantitative-based Probabilistic Risk Assessment (PRA) priority for each valve. All MOV's were reclassified[8] in 1995 using component risk achievement worth (RAW) importance parameters. The new prioritization scheme is based upon superior insights and state of the art knowledge in comparison to the previous MOV prioritization schemes. The 143 valves in the Millstone Unit 3 MOV Program include 13 valves with a very high PRA rank, 27 valves with high, and 99 valves with a medium PRA rank, and 4 valves with a low PRA rank.

Table 3: Probabilistic-Risk-Assessment (PRA) Priority

Valve Number	PRA Rank
3CCP*MOV045A	Medium
3CCP*MOV045B	Medium
3CCP*MOV048A	Medium
3CCP*MOV048B	Medium
3CCP*MOV049A	Medium
3CCP*MOV049B	Medium
3CCP*MOV222	Medium
3CCP*MOV223	Medium
3CCP*MOV224	Medium
3CCP*MOV225	Medium
3CCP*MOV226	Medium
3CCP*MOV227	Medium
3CCP*MOV228	Medium
3CCP*MOV229	Medium
3CHS*LCV112B	High
3CHS*LCV112C	High
3CHS*LCV112D	High
3CHS*LCV112E	High
3CHS*MV8100	Medium
3CHS*MV8104	Medium
3CHS*MV8105	High
3CHS*MV8106	High
3CHS*MV8109A	Medium
3CHS*MV8109B	Medium
3CHS*MV8109C	Medium
3CHS*MV8109D	Medium
3CHS*MV8110	Medium
3CHS*MV8111A	Medium
3CHS*MV8111B	Medium
3CHS*MV8111C	Medium
3CHS*MV8112	Medium
3CHS*MV8116	Low
3CHS*MV8438A	Medium
3CHS*MV8438B	Medium
3CHS*MV8438C	Medium
3CHS*MV8468A	Medium
3CHS*MV8468B	Medium
3CHS*MV8507A	Medium
3CHS*MV8507B	Medium
3CHS*MV8511A	High
3CHS*MV8511B	High
3CHS*MV8512A	High
3CHS*MV8512B	High
3CMS*MOV24	Medium
3CVS*MOV25	Low
3FWA*MOV35A	Medium
3FWA*MOV35B	Medium
3FWA*MOV35C	Medium
3FWA*MOV35D	Medium

Valve Number	PRA Rank
3IAS*MOV72	Medium
3LMS*MOV40A	Medium
3LMS*MOV40B	Medium
3LMS*MOV40C	Medium
3LMS*MOV40D	Medium
3MSS*MOV17A	Medium
3MSS*MOV17B	Medium
3MSS*MOV17D	Medium
3MSS*MOV18A	Medium
3MSS*MOV18B	Medium
3MSS*MOV18C	Medium
3MSS*MOV18D	Medium
3MSS*MOV74A	Medium
3MSS*MOV74B	Medium
3MSS*MOV74C	Medium
3MSS*MOV74D	Medium
3QSS*MOV34A	High
3QSS*MOV34B	High
3RCS*MV8000A	Medium
3RCS*MV8000B	Medium
3RCS*MV8098	Medium
3RHS*FCV610	Medium
3RHS*FCV611	Medium
3RHS*MV8701A	Medium
3RHS*MV8701B	Medium
3RHS*MV8701C	Medium
3RHS*MV8702A	Medium
3RHS*MV8702B	Medium
3RHS*MV8702C	Medium
3RHS*MV8716A	Medium
3RHS*MV8716B	Medium
3RSS*MOV20A	High
3RSS*MOV20B	High
3RSS*MOV20C	High
3RSS*MOV20D	High
3RSS*MOV23A	Medium
3RSS*MOV23B	Medium
3RSS*MOV23C	Medium
3RSS*MOV23D	Medium
3RSS*MOV38A	Medium
3RSS*MOV38B	Medium
3RSS*MV8837A	High
3RSS*MV8837B	High
3RSS*MV8838A	Medium
3RSS*MV8838B	Medium
3SIH*MV8801A	High
3SIH*MV8801B	High

Valve Number	PRA Rank
3SIH*MV8802A	Low
3SIH*MV8802B	Low
3SIH*MV8806	Medium
3SIH*MV8807A	Medium
3SIH*MV8807B	Medium
3SIH*MV8813	High
3SIH*MV8814	Medium
3SIH*MV8821A	Medium
3SIH*MV8821B	Medium
3SIH*MV8835	Medium
3SIH*MV8920	Very High
3SIH*MV8923A	Medium
3SIH*MV8923B	Medium
3SIH*MV8924	Medium
3SIL*MV8804A	Very High
3SIL*MV8804B	Very High
3SIL*MV8808A	Medium
3SIL*MV8808B	Medium
3SIL*MV8808C	Medium
3SIL*MV8808D	Medium
3SIL*MV8809A	High
3SIL*MV8809B	High
3SIL*MV8812A	Very High
3SIL*MV8812B	Very High
3SIL*MV8840	Medium
3SWP*MOV024A	Medium
3SWP*MOV024B	Medium
3SWP*MOV024C	Medium
3SWP*MOV024D	Medium
3SWP*MOV050A	Very High
3SWP*MOV050B	Very High
3SWP*MOV054A	Very High
3SWP*MOV054B	Very High
3SWP*MOV054C	Very High
3SWP*MOV054D	Very High
3SWP*MOV057A	Medium
3SWP*MOV057B	Medium
3SWP*MOV057C	Medium
3SWP*MOV057D	Medium
3SWP*MOV071A	Very High
3SWP*MOV071B	Very High
3SWP*MOV102A	High
3SWP*MOV102B	High
3SWP*MOV102C	High
3SWP*MOV102D	High
3SWP*MOV115A	Medium
3SWP*MOV115B	Medium

Table 4 lists the credited safety function strokes for each valve. The 143 valves in the Millstone Unit 3 MOV Program include 36 valves with an open safety function, 61 valves with a close safety function, and 46 valves with both an open and close safety function.

Table 4: Safety Strokes

Valve Number	Safety Stroke
3CCP*MOV045A	open/close
3CCP*MOV045B	open/close
3CCP*MOV048A	open/close
3CCP*MOV048B	open/close
3CCP*MOV049A	open/close
3CCP*MOV049B	open/close
3CCP*MOV222	open/close
3CCP*MOV223	open/close
3CCP*MOV224	open/close
3CCP*MOV225	open/close
3CCP*MOV226	open/close
3CCP*MOV227	open/close
3CCP*MOV228	open/close
3CCP*MOV229	open/close
3CHS*LCV112B	open/close
3CHS*LCV112C	open/close
3CHS*LCV112D	open/close
3CHS*LCV112E	open/close
3CHS*MV8100	open/close
3CHS*MV8104	open
3CHS*MV8105	close
3CHS*MV8106	close
3CHS*MV8109A	open/close
3CHS*MV8109B	open/close
3CHS*MV8109C	open/close
3CHS*MV8109D	open/close
3CHS*MV8110	close
3CHS*MV8111A	close
3CHS*MV8111B	close
3CHS*MV8111C	close
3CHS*MV8112	open/close
3CHS*MV8116	open
3CHS*MV8438A	close
3CHS*MV8438B	close
3CHS*MV8438C	close
3CHS*MV8468A	close
3CHS*MV8468B	close
3CHS*MV8507A	open
3CHS*MV8507B	open
3CHS*MV8511A	open/close
3CHS*MV8511B	open/close
3CHS*MV8512A	close
3CHS*MV8512B	close
3CMS*MOV24	close
3CVS*MOV25	open
3FWA*MOV35A	close
3FWA*MOV35B	close
3FWA*MOV35C	close
3FWA*MOV35D	close
3IAS*MOV72	close
3LMS*MOV40A	close
3LMS*MOV40B	close
3LMS*MOV40C	close
3LMS*MOV40D	close
3MSS*MOV17A	close
3MSS*MOV17B	close
3MSS*MOV17D	close
3MSS*MOV18A	close
3MSS*MOV18B	close
3MSS*MOV18C	close
3MSS*MOV18D	close
3MSS*MOV74A	open
3MSS*MOV74B	open
3MSS*MOV74C	open
3MSS*MOV74D	open
3QSS*MOV34A	open/close
3QSS*MOV34B	open/close
3RCS*MV8000A	open/close
3RCS*MV8000B	open/close
3RCS*MV8098	open
3RHS*FCV610	open/close
3RHS*FCV611	open/close
3RHS*MV8701A	open/close
3RHS*MV8701B	open/close
3RHS*MV8701C	open/close
3RHS*MV8702A	open/close
3RHS*MV8702B	open/close
3RHS*MV8702C	open/close
3RHS*MV8716A	open/close
3RHS*MV8716B	open/close
3RSS*MOV20A	close
3RSS*MOV20B	close
3RSS*MOV20C	close
3RSS*MOV20D	close
3RSS*MOV23A	close
3RSS*MOV23B	close
3RSS*MOV23C	close
3RSS*MOV23D	close
3RSS*MOV38A	open
3RSS*MOV38B	open
3RSS*MV8837A	open
3RSS*MV8837B	open
3RSS*MV8838A	open
3RSS*MV8838B	open
3SIH*MV8801A	open
3SIH*MV8801B	open
3SIH*MV8802A	open
3SIH*MV8802B	open
3SIH*MV8806	close
3SIH*MV8807A	open
3SIH*MV8807B	open
3SIH*MV8813	close
3SIH*MV8814	close
3SIH*MV8821A	close
3SIH*MV8821B	close
3SIH*MV8835	close
3SIH*MV8920	close
3SIH*MV8923A	close
3SIH*MV8923B	close
3SIH*MV8924	close
3SIL*MV8804A	open
3SIL*MV8804B	open
3SIL*MV8808A	open
3SIL*MV8808B	open
3SIL*MV8808C	open
3SIL*MV8808D	open
3SIL*MV8809A	close
3SIL*MV8809B	close
3SIL*MV8812A	close
3SIL*MV8812B	close
3SIL*MV8840	close
3SWP*MOV024A	open/close
3SWP*MOV024B	open/close
3SWP*MOV024C	open/close
3SWP*MOV024D	open/close
3SWP*MOV050A	open/close
3SWP*MOV050B	open/close
3SWP*MOV054A	open
3SWP*MOV054B	open
3SWP*MOV054C	open
3SWP*MOV054D	open
3SWP*MOV057A	close
3SWP*MOV057B	close
3SWP*MOV057C	close
3SWP*MOV057D	close
3SWP*MOV071A	close
3SWP*MOV071B	close
3SWP*MOV102A	open
3SWP*MOV102B	open
3SWP*MOV102C	open
3SWP*MOV102D	open
3SWP*MOV115A	close
3SWP*MOV115B	close

Table 5 lists the pertinent valve, actuator and motor information. The disc type is indicated for each valve as well as the size (diameter) of the valve in inches.

Table 5: Information on Valve, Actuator and Motor

Valve Number	Valve				Actuator		Motor	
	Company	Type	Disc Type	Size (in.)	Company	Type	Company	Size (ft-lb)
3CCP*MOV045A	Henry Pratt	Butterfly	Symmetric	10	Limitorque	SMB-00	Reliance	10
3CCP*MOV045B	Henry Pratt	Butterfly	Symmetric	10	Limitorque	SMB-00	Reliance	10
3CCP*MOV048A	Henry Pratt	Butterfly	Symmetric	10	Limitorque	SMB-00	Reliance	10
3CCP*MOV048B	Henry Pratt	Butterfly	Symmetric	10	Limitorque	SMB-00	Reliance	10
3CCP*MOV049A	Henry Pratt	Butterfly	Symmetric	10	Limitorque	SMB-00	Reliance	10
3CCP*MOV049B	Henry Pratt	Butterfly	Symmetric	10	Limitorque	SMB-00	Reliance	10
3CCP*MOV222	Henry Pratt	Butterfly	Symmetric	4	Limitorque	SMB-000	Reliance	2
3CCP*MOV223	Henry Pratt	Butterfly	Symmetric	4	Limitorque	SMB-000	Reliance	2
3CCP*MOV224	Henry Pratt	Butterfly	Symmetric	4	Limitorque	SMB-000	Reliance	2
3CCP*MOV225	Henry Pratt	Butterfly	Symmetric	4	Limitorque	SMB-000	Reliance	2
3CCP*MOV226	Henry Pratt	Butterfly	Symmetric	4	Limitorque	SMB-000	Reliance	2
3CCP*MOV227	Henry Pratt	Butterfly	Symmetric	4	Limitorque	SMB-000	Reliance	2
3CCP*MOV228	Henry Pratt	Butterfly	Symmetric	4	Limitorque	SMB-000	Reliance	2
3CCP*MOV229	Henry Pratt	Butterfly	Symmetric	4	Limitorque	SMB-000	Reliance	2
3CHS*LCV112B	Aloyco	Gate	Solid wedge	4	Limitorque	SB-000	Reliance	5
3CHS*LCV112C	Aloyco	Gate	Solid wedge	4	Limitorque	SB-000	Reliance	5
3CHS*LCV112D	Aloyco	Gate	Solid wedge	8	Limitorque	SB-00	Reliance	10
3CHS*LCV112E	Aloyco	Gate	Solid wedge	8	Limitorque	SB-00	Reliance	10
3CHS*MV8100	Yarway	Globe	Guided	2	Limitorque	SMB-00	Reliance	5
3CHS*MV8104	Yarway	Globe	Guided	2	Limitorque	SMB-00	Reliance	5
3CHS*MV8105	Aloyco	Gate	Solid wedge	3	Limitorque	SMB-00	Reliance	25
3CHS*MV8106	Aloyco	Gate	Solid wedge	3	Limitorque	SMB-00	Reliance	25
3CHS*MV8109A	Yarway	Globe	Guided	2	Limitorque	SMB-00	Reliance	10
3CHS*MV8109B	Yarway	Globe	Guided	2	Limitorque	SMB-00	Reliance	10
3CHS*MV8109C	Yarway	Globe	Guided	2	Limitorque	SMB-00	Reliance	10
3CHS*MV8109D	Yarway	Globe	Guided	2	Limitorque	SMB-00	Reliance	10
3CHS*MV8110	Velan	Globe	Standard	2	Limitorque	SMB-00	Reliance	10
3CHS*MV8111A	Velan	Globe	Standard	2	Limitorque	SMB-00	Reliance	10
3CHS*MV8111B	Velan	Globe	Standard	2	Limitorque	SMB-00	Reliance	10
3CHS*MV8111C	Velan	Globe	Standard	2	Limitorque	SMB-00	Reliance	10
3CHS*MV8112	Yarway	Globe	Guided	2	Limitorque	SMB-00	Reliance	5
3CHS*MV8116	Velan	Globe	Standard	1	Limitorque	SMB-00	Reliance	10
3CHS*MV8438A	Westinghouse	Gate	Flex wedge	4	Limitorque	SBD-00	Reliance	15
3CHS*MV8438B	Westinghouse	Gate	Flex wedge	4	Limitorque	SBD-00	Reliance	15
3CHS*MV8438C	Westinghouse	Gate	Flex wedge	4	Limitorque	SBD-00	Reliance	15
3CHS*MV8468A	Westinghouse	Gate	Flex wedge	8	Limitorque	SB-00	Reliance	15
3CHS*MV8468B	Westinghouse	Gate	Flex wedge	8	Limitorque	SB-00	Reliance	15
3CHS*MV8507A	Westinghouse	Gate	Flex wedge	3	Limitorque	SMB-000	Reliance	10
3CHS*MV8507B	Westinghouse	Gate	Flex wedge	3	Limitorque	SMB-000	Reliance	10
3CHS*MV8511A	Velan	Globe	Standard	2	Limitorque	SMB-00	Reliance	10
3CHS*MV8511B	Velan	Globe	Standard	2	Limitorque	SMB-00	Reliance	10
3CHS*MV8512A	Velan	Globe	Standard	2	Limitorque	SMB-00	Reliance	10
3CHS*MV8512B	Velan	Globe	Standard	2	Limitorque	SMB-00	Reliance	10
3CMS*MOV24	Yarway	Globe	Guided	1	Limitorque	SMB-000	Reliance	5
3CVS*MOV25	Yarway	Globe	Guided	2	Limitorque	SMB-00	Reliance	5
3FWA*MOV35A	Walworth	Gate	Solid wedge	3	Limitorque	SMB-000	Reliance	5
3FWA*MOV35B	Walworth	Gate	Solid wedge	3	Limitorque	SMB-000	Reliance	5
3FWA*MOV35C	Walworth	Gate	Solid wedge	3	Limitorque	SMB-000	Reliance	5
3FWA*MOV35D	Walworth	Gate	Solid wedge	3	Limitorque	SMB-000	Reliance	5
3IAS*MOV72	Yarway	Globe	Guided	2	Limitorque	SMB-00	Reliance	5

Valve Number	Valve				Actuator		Motor	
	Company	Type	Disc Type	Size (in.)	Company	Type	Company	Size (ft-lb)
3LMS*MOV40A	Yarway	Globe	Guided	1.50	Limitorque	SMB-00	Reliance	5
3LMS*MOV40B	Yarway	Globe	Guided	1.50	Limitorque	SMB-00	Reliance	5
3LMS*MOV40C	Yarway	Globe	Guided	1.50	Limitorque	SMB-00	Reliance	5
3LMS*MOV40D	Yarway	Globe	Guided	1.50	Limitorque	SMB-00	Reliance	5
3MSS*MOV17A	Walworth	Globe	Standard	3	Limitorque	SMB-00	Reliance	5
3MSS*MOV17B	Walworth	Globe	Standard	3	Limitorque	SMB-00	Reliance	5
3MSS*MOV17D	Walworth	Globe	Standard	3	Limitorque	SMB-00	Reliance	5
3MSS*MOV18A	Walworth	Gate	Flex wedge	8	Limitorque	SMB-0	Reliance	25
3MSS*MOV18B	Walworth	Gate	Flex wedge	8	Limitorque	SMB-0	Reliance	25
3MSS*MOV18C	Walworth	Gate	Flex wedge	8	Limitorque	SMB-0	Reliance	25
3MSS*MOV18D	Walworth	Gate	Flex wedge	8	Limitorque	SMB-0	Reliance	25
3MSS*MOV74A	Pacific	Globe	Standard	8	Limitorque	SMB-2	Reliance	60
3MSS*MOV74B	Pacific	Globe	Standard	8	Limitorque	SMB-2	Reliance	60
3MSS*MOV74C	Pacific	Globe	Standard	8	Limitorque	SMB-2	Reliance	60
3MSS*MOV74D	Pacific	Globe	Standard	8	Limitorque	SMB-2	Reliance	60
3QSS*MOV34A	Henry Pratt	Butterfly	Symmetric	12	Limitorque	SMB-000	Reliance	5
3QSS*MOV34B	Henry Pratt	Butterfly	Symmetric	12	Limitorque	SMB-000	Reliance	5
3RCS*MV8000A	Aloyco	Gate	Solid wedge	3	Limitorque	SMB-00	Reliance	25
3RCS*MV8000B	Aloyco	Gate	Solid wedge	3	Limitorque	SMB-00	Reliance	25
3RCS*MV8098	Velan	Globe	Standard	1	Limitorque	SMB-00	Reliance	10
3RHS*FCV610	Yarway	Globe	Guided	2	Limitorque	SMB-00	Reliance	5
3RHS*FCV611	Yarway	Globe	Guided	2	Limitorque	SMB-00	Reliance	5
3RHS*MV8701A	Westinghouse	Gate	Flex wedge	12	Limitorque	SBD-3	Reliance	175
3RHS*MV8701B	Pacific	Gate	Flex wedge	12	Limitorque	SMB-1	Reliance	25
3RHS*MV8701C	Westinghouse	Gate	Flex wedge	12	Limitorque	SBD-3	Reliance	200
3RHS*MV8702A	Pacific	Gate	Flex wedge	12	Limitorque	SMB-1	Reliance	25
3RHS*MV8702B	Westinghouse	Gate	Flex wedge	12	Limitorque	SBD-3	Reliance	175
3RHS*MV8702C	Westinghouse	Gate	Flex wedge	12	Limitorque	SBD-3	Reliance	200
3RHS*MV8716A	Pacific	Gate	Flex wedge	10	Limitorque	SB-1	Reliance	40
3RHS*MV8716B	Pacific	Gate	Flex wedge	10	Limitorque	SB-1	Reliance	40
3RSS*MOV20A	Henry Pratt	Butterfly	Symmetric	10	Limitorque	SMB-000	Reliance	5
3RSS*MOV20B	Henry Pratt	Butterfly	Symmetric	10	Limitorque	SMB-000	Reliance	5
3RSS*MOV20C	Henry Pratt	Butterfly	Symmetric	10	Limitorque	SMB-000	Reliance	5
3RSS*MOV20D	Henry Pratt	Butterfly	Symmetric	10	Limitorque	SMB-000	Reliance	5
3RSS*MOV23A	Henry Pratt	Butterfly	Offset	12	Limitorque	SMB-000	Reliance	2
3RSS*MOV23B	Henry Pratt	Butterfly	Offset	12	Limitorque	SMB-000	Reliance	2
3RSS*MOV23C	Henry Pratt	Butterfly	Offset	12	Limitorque	SMB-000	Reliance	2
3RSS*MOV23D	Henry Pratt	Butterfly	Offset	12	Limitorque	SMB-000	Reliance	2
3RSS*MOV38A	Pacific	Gate	Solid wedge	4	Limitorque	SMB-000	Reliance	5
3RSS*MOV38B	Pacific	Gate	Solid wedge	4	Limitorque	SMB-000	Reliance	5
3RSS*MV8837A	Pacific	Gate	Flex wedge	8	Limitorque	SB-0	Reliance	15
3RSS*MV8837B	Pacific	Gate	Flex wedge	8	Limitorque	SB-0	Reliance	15
3RSS*MV8838A	Pacific	Gate	Flex wedge	8	Limitorque	SB-0	Reliance	15
3RSS*MV8838B	Pacific	Gate	Flex wedge	8	Limitorque	SB-0	Reliance	15
3SIH*MV8801A	Aloyco	Gate	Solid wedge	4	Limitorque	SB-0	Reliance	40
3SIH*MV8801B	Aloyco	Gate	Solid wedge	4	Limitorque	SB-0	Reliance	40
3SIH*MV8802A	Aloyco	Gate	Solid wedge	4	Limitorque	SB-0	Reliance	40
3SIH*MV8802B	Aloyco	Gate	Solid wedge	4	Limitorque	SB-0	Reliance	40
3SIH*MV8806	Aloyco	Gate	Solid wedge	8	Limitorque	SB-0	Reliance	10
3SIH*MV8807A	Aloyco	Gate	Solid wedge	6	Limitorque	SB-00	Reliance	10
3SIH*MV8807B	Aloyco	Gate	Solid wedge	6	Limitorque	SB-00	Reliance	10
3SIH*MV8813	Pacific	Gate	Solid wedge	3	Limitorque	SB-00	Reliance	10
3SIH*MV8814	Yarway	Globe	Guided	1.50	Limitorque	SMB-00	Reliance	5
3SIH*MV8821A	Aloyco	Gate	Solid wedge	4	Limitorque	SB-0	Reliance	25
3SIH*MV8821B	Aloyco	Gate	Solid wedge	4	Limitorque	SB-0	Reliance	25

Valve Number	Valve				Actuator		Motor	
	Company	Type	Disc Type	Size (in.)	Company	Type	Company	Size (ft-lb)
3SIH*MV8835	Aloyco	Gate	Solid wedge	4	Limitorque	SB-0	Reliance	40
3SIH*MV8920	Yarway	Globe	Guided	1.50	Limitorque	SMB-00	Reliance	5
3SIH*MV8923A	Aloyco	Gate	Solid wedge	6	Limitorque	SB-00	Reliance	10
3SIH*MV8923B	Aloyco	Gate	Solid wedge	6	Limitorque	SB-00	Reliance	10
3SIH*MV8924	Aloyco	Gate	Solid wedge	6	Limitorque	SB-00	Reliance	10
3SIL*MV8804A	Pacific	Gate	Flex wedge	8	Limitorque	SB-0	Reliance	15
3SIL*MV8804B	Pacific	Gate	Flex wedge	8	Limitorque	SB-0	Reliance	15
3SIL*MV8808A	Westinghouse	Gate	Flex wedge	10	Limitorque	SBD-3	Reliance	150
3SIL*MV8808B	Westinghouse	Gate	Flex wedge	10	Limitorque	SBD-3	Reliance	150
3SIL*MV8808C	Westinghouse	Gate	Flex wedge	10	Limitorque	SBD-3	Reliance	150
3SIL*MV8808D	Westinghouse	Gate	Flex wedge	10	Limitorque	SBD-3	Reliance	150
3SIL*MV8809A	Walworth	Gate	Flex wedge	10	Limitorque	SB-3	Reliance	150
3SIL*MV8809B	Walworth	Gate	Flex wedge	10	Limitorque	SB-3	Reliance	150
3SIL*MV8812A	Pacific	Gate	Flex wedge	12	Limitorque	SB-1	Reliance	60
3SIL*MV8812B	Pacific	Gate	Flex wedge	12	Limitorque	SB-1	Reliance	60
3SIL*MV8840	Walworth	Gate	Flex wedge	8	Limitorque	SB-2	Elec. Apparatus	80
3SWP*MOV024A	Xomox	Plug	Plug	3	Limitorque	SMB-000	Reliance	2
3SWP*MOV024B	Xomox	Plug	Plug	3	Limitorque	SMB-000	Reliance	2
3SWP*MOV024C	Xomox	Plug	Plug	3	Limitorque	SMB-000	Reliance	2
3SWP*MOV024D	Xomox	Plug	Plug	3	Limitorque	SMB-000	Reliance	2
3SWP*MOV050A	Henry Pratt	Butterfly	Offset	30	Limitorque	SMB-00	Reliance	15
3SWP*MOV050B	Henry Pratt	Butterfly	Offset	30	Limitorque	SMB-00	Reliance	15
3SWP*MOV054A	Henry Pratt	Butterfly	Symmetric	18	Limitorque	SMB-000	Reliance	5
3SWP*MOV054B	Henry Pratt	Butterfly	Symmetric	18	Limitorque	SMB-000	Reliance	5
3SWP*MOV054C	Henry Pratt	Butterfly	Symmetric	18	Limitorque	SMB-000	Reliance	5
3SWP*MOV054D	Henry Pratt	Butterfly	Symmetric	18	Limitorque	SMB-000	Reliance	5
3SWP*MOV057A	Henry Pratt	Butterfly	Symmetric	18	Limitorque	SMB-000	Reliance	5
3SWP*MOV057B	Henry Pratt	Butterfly	Symmetric	18	Limitorque	SMB-000	Reliance	5
3SWP*MOV057C	Henry Pratt	Butterfly	Symmetric	18	Limitorque	SMB-000	Reliance	5
3SWP*MOV057D	Henry Pratt	Butterfly	Symmetric	18	Limitorque	SMB-000	Reliance	5
3SWP*MOV071A	Henry Pratt	Butterfly	Symmetric	18	Limitorque	SMB-000	Reliance	5
3SWP*MOV071B	Henry Pratt	Butterfly	Symmetric	18	Limitorque	SMB-000	Reliance	5
3SWP*MOV102A	Contromatics	Butterfly	Offset	30	Limitorque	SMB-00	Elec. Apparatus	15
3SWP*MOV102B	Contromatics	Butterfly	Offset	30	Limitorque	SMB-00	Elec. Apparatus	15
3SWP*MOV102C	Contromatics	Butterfly	Offset	30	Limitorque	SMB-00	Elec. Apparatus	15
3SWP*MOV102D	Contromatics	Butterfly	Offset	30	Limitorque	SMB-00	Elec. Apparatus	15
3SWP*MOV115A	Xomox	Plug	Plug	2	Limitorque	SMB-000	Reliance	2
3SWP*MOV115B	Xomox	Plug	Plug	2	Limitorque	SMB-000	Reliance	2

The control switch thrust versus calculated minimum and maximum thrust (torque for butterfly valves) is tabulated in Table 6. The information in the table is presented to demonstrate design-basis closure. Future changes will be controlled by existing NU procedures.

Table 6: Control Switch Thrust (Torque for Butterfly Valves)

Valve Number	TSB or LS	Minimum Required	Calculated Maximum	As-Left CST
3CCP*MOV045A	LS	48.4	73	73
3CCP*MOV045B	LS	42.4	73	73
3CCP*MOV048A	LS	44.6	73	73
3CCP*MOV048B	LS	31.6	73	73
3CCP*MOV049A	LS	25.3	73	73
3CCP*MOV049B	LS	26.3	73	73
3CCP*MOV222	LS	35.7	73	73
3CCP*MOV223	LS	28.7	73	73
3CCP*MOV224	LS	324.9	470	470
3CCP*MOV225	LS	263.9	470	470
3CCP*MOV226	LS	403.5	470	470
3CCP*MOV227	LS	208.8	470	470
3CCP*MOV228	LS	369.4	470	470
3CCP*MOV229	LS	219.3	470	470
3CHS*LCV112B		2594	3276	3044
3CHS*LCV112C		2816	5527	3552
3CHS*LCV112D		9446	17404	9487
3CHS*LCV112E		9990	17404	10198
3CHS*MV8100		1824	14771	11977
3CHS*MV8104		1733	14771	11253
3CHS*MV8105		12745	19227	14762
3CHS*MV8106		11721	17547	12279
3CHS*MV8109A		1296	14771	7374
3CHS*MV8109B		1296	14771	9606
3CHS*MV8109C		1296	14771	8638
3CHS*MV8109D		1296	14771	7565
3CHS*MV8110		8385	11625	11291
3CHS*MV8111A		8934	13188	11434
3CHS*MV8111B		10648	15337	12763
3CHS*MV8111C		10796	15337	12548
3CHS*MV8112		1826	14170	10980
3CHS*MV8116		11202	14677	13686
3CHS*MV8438A		5293	17090	10960
3CHS*MV8438B		5663	17090	10372
3CHS*MV8438C		7516	17090	10054
3CHS*MV8468A		8696	9912	9174
3CHS*MV8468B		8696	9912	8720
3CHS*MV8507A		2796	9728	3330
3CHS*MV8507B		3717	9728	4297
3CHS*MV8511A		5827	15337	14675
3CHS*MV8511B		5435	14994	13381
3CHS*MV8512A		12497	15337	12718
3CHS*MV8512B		12728	14994	13848
3CMS*MOV24		1368	6461	3809
3CVS*MOV25		1263	13853	9497
3FWA*MOV35A	TSB	6238	10900	10900
3FWA*MOV35B	TSB	6698	10900	10900
3FWA*MOV35C	TSB	5763	10900	10900

Valve Number	TSB or LS	Minimum Required	Calculated Maximum	As-Left CST
3FWA*MOV35D	TSB	5143	10900	10900
3IAS*MOV72		1854	13467	8813
3LMS*MOV40A		1359	13971	5849
3LMS*MOV40B		1359	14291	5688
3LMS*MOV40C		1359	13971	8320
3LMS*MOV40D		1359	14291	9551
3MSS*MOV17A		5101	14142	13589
3MSS*MOV17B		5101	10707	8915
3MSS*MOV17D		5101	11890	10044
3MSS*MOV18A	TSB	24970	33132	33132
3MSS*MOV18B	TSB	26527	33132	33132
3MSS*MOV18C	TSB	25043	33132	33132
3MSS*MOV18D	TSB	26400	33132	33132
3MSS*MOV74A		16751	66162	54468
3MSS*MOV74B		17053	65331	55139
3MSS*MOV74C		17193	70278	65089
3MSS*MOV74D		16751	66162	62379
3QSS*MOV34A	LS	540	574	574
3QSS*MOV34B	LS	540	574	574
3RCS*MV8000A	TSB	16424	17580	17580
3RCS*MV8000B	TSB	15826	17580	17580
3RCS*MV8098		1296	12293	11010
3RHS*FCV610		1296	14771	11051
3RHS*FCV611		1296	16970	15224
3RHS*MV8701A		44991	72319	56803
3RHS*MV8701B		5963	20226	19458
3RHS*MV8701C		41533	63966	59811
3RHS*MV8702A		5963	20226	17322
3RHS*MV8702B		44991	72319	56332
3RHS*MV8702C		37776	88336	38228
3RHS*MV8716A		4415	13109	12482
3RHS*MV8716B		5708	27088	20481
3RSS*MOV20A	LS	468	543	543
3RSS*MOV20B	LS	468	543	543
3RSS*MOV20C	LS	468	543	543
3RSS*MOV20D	LS	468	543	543
3RSS*MOV23A	LS	364	726	726
3RSS*MOV23B	LS	364	709	709
3RSS*MOV23C	LS	364	726	726
3RSS*MOV23D	LS	364	709	709
3RSS*MOV38A		3001	3286	3216
3RSS*MOV38B		2392	3286	2600
3RSS*MV8837A		970	17255	10433
3RSS*MV8837B		1344	7937	7924
3RSS*MV8838A		4156	7937	7832
3RSS*MV8838B		4156	15942	8148
3SIH*MV8801A		11019	27339	24087
3SIH*MV8801B		10721	26903	20079
3SIH*MV8802A		5385	21050	18002
3SIH*MV8802B		5391	26903	21555
3SIH*MV8806		8486	12243	11969
3SIH*MV8807A		3385	7605	3947
3SIH*MV8807B		3385	6024	5802
3SIH*MV8813		5191	9156	8274
3SIH*MV8814		5436	12009	8912
3SIH*MV8821A		12249	24952	15216

Valve Number	TSB or LS	Minimum Required	Calculated Maximum	As-Left CST
3SIH*MV8821B		11689	18912	16096
3SIH*MV8835		13304	20124	17673
3SIH*MV8920		4920	16773	13522
3SIH*MV8923A		2181	3639	3372
3SIH*MV8923B		2181	3639	3282
3SIH*MV8924		2055	7605	4018
3SIL*MV8804A		3251	7937	6789
3SIL*MV8804B		3251	15585	8388
3SIL*MV8808A		18910	75409	58690
3SIL*MV8808B		18910	76806	47510
3SIL*MV8808C		18910	76806	50937
3SIL*MV8808D		18910	73602	46194
3SIL*MV8809A		8310	69775	23270
3SIL*MV8809B		7094	75106	32340
3SIL*MV8812A		3191	35751	17501
3SIL*MV8812B		3191	35751	17694
3SIL*MV8840		6354	38043	37780
3SWP*MOV024A	LS	67.2	109	109
3SWP*MOV024B	LS	67.2	109	109
3SWP*MOV024C	LS	67.2	109	109
3SWP*MOV024D	LS	67.2	109	109
3SWP*MOV050A	LS	2389	2738	2738
3SWP*MOV050B	LS	2180	2738	2738
3SWP*MOV054A	LS	1038.3	1195	1195
3SWP*MOV054B	LS	518.7	1195	1195
3SWP*MOV054C	LS	1050.1	1195	1195
3SWP*MOV054D	LS	715.6	1195	1195
3SWP*MOV057A	LS	788.1	1195	1195
3SWP*MOV057B	LS	827.9	1195	1195
3SWP*MOV057C	LS	800.3	1195	1195
3SWP*MOV057D	LS	634.1	1195	1195
3SWP*MOV071A	LS	285	1178	1178
3SWP*MOV071B	LS	779.1	1178	1178
3SWP*MOV102A	LS	3612	5250	5250
3SWP*MOV102B	LS	3612	5250	5250
3SWP*MOV102C	LS	3612	5250	5250
3SWP*MOV102D	LS	3612	5250	5250
3SWP*MOV115A	LS	55	100	100
3SWP*MOV115B	LS	50	100	100

TSB -- Torque Switch Bypass
LS -- Limit Switch

The type of test, either static or dynamic, and the date of the latest test is included in Table 7. The information in the table is presented to demonstrate design-basis closure. Future changes will be controlled by existing NU procedures.

Table 7: Test Data

Valve Number	Static Test Date	Dynamic Test Date	Open Test Pressure	Close Test Pressure	Open DB D/P	Close DB D/P	% DB D/P: Open Test	% DB D/P: Close Test
3CCP*MOV045A	4/27/95	Grouped			174	174		
3CCP*MOV045B	4/27/95	5/25/95	115.3	115.3	174	174	66%	66%
3CCP*MOV048A	5/3/95	Grouped			143	174		
3CCP*MOV048B	5/3/95	5/25/95	122.2	122.2	143	174	85%	70%
3CCP*MOV049A	4/27/95	Grouped			174	174		
3CCP*MOV049B	4/27/95	5/25/95	134.2	134.2	174	174	77%	77%
3CCP*MOV222	4/29/95	Grouped			143	143		
3CCP*MOV223	4/29/95	Grouped			143	143		
3CCP*MOV224	4/29/95	Grouped			143	143		
3CCP*MOV225	4/30/95	Grouped			143	143		
3CCP*MOV226	4/30/95	5/24/95	112.2	112.2	143	143	78%	78%
3CCP*MOV227	5/1/95	5/24/95	99.9	99.9	143	143	70%	70%
3CCP*MOV228	4/30/95	5/24/95	112.2	112.2	143	143	78%	78%
3CCP*MOV229	4/30/95	5/24/95	99.9	99.9	143	143	70%	70%
3CHS*LCV112B	5/3/95	Non-Testable			118	118		
3CHS*LCV112C	5/12/95	Non-Testable			118	118		
3CHS*LCV112D	5/9/95	Non-Testable			93	205		
3CHS*LCV112E	5/10/95	Non-Testable			93	205		
3CHS*MV8100	5/7/95	Non-Testable			133	133		
3CHS*MV8104	8/28/93	High Margin			134	111		
3CHS*MV8105	5/8/95	9/2/93	2556.6	2556.6	2597	2722	98%	94%
3CHS*MV8106	9/10/93	9/2/93	2554.8	2554.8	2597	2722	98%	94%
3CHS*MV8109A	5/4/95	High Margin			2739	0		
3CHS*MV8109B	5/11/95	High Margin			2739	0		
3CHS*MV8109C	5/8/95	High Margin			2739	0		
3CHS*MV8109D	5/2/95	High Margin			2739	0		
3CHS*MV8110	9/8/93	9/3/93	2290.7	2290.7	2673	2673	86%	86%
3CHS*MV8111A	5/11/95	9/3/93	2317.1	2317.1	2672	2672	87%	87%
3CHS*MV8111B	8/26/93	9/3/93	2308	2308	2672	2672	86%	86%
3CHS*MV8111C	8/23/93	9/4/93	2283.3	2283.3	2672	2672	85%	85%
3CHS*MV8112	5/3/95	Non-Testable			133	133		
3CHS*MV8116	9/3/93	9/2/93	2527.6	2527.6	790	2544	320%	99%
3CHS*MV8438A	9/9/93	9/2/93	2570.4	2563.6	2534	0	101%	N/A
3CHS*MV8438B	8/26/93	9/2/93	2495	N/A	2534	0	98%	N/A
3CHS*MV8438C	8/31/93	9/3/93	2510	N/A	2534	0	99%	N/A
3CHS*MV8468A	5/8/95	Non-Testable			220	220		
3CHS*MV8468B	5/8/95	Non-Testable			220	220		
3CHS*MV8507A	5/1/95	Non-Testable			146	216		
3CHS*MV8507B	5/1/95	Non-Testable			148	218		
3CHS*MV8511A	5/5/95	Non-Testable			2641	2619		
3CHS*MV8511B	5/4/95	Non-Testable			2641	2619		
3CHS*MV8512A	5/7/95	Non-Testable			419	2517		
3CHS*MV8512B	4/29/95	Non-Testable			419	2517		
3CMS*MOV24	9/12/93	High Margin			34	27		
3CVS*MOV25	9/7/93	High Margin			19	0		

Valve Number	Static Test Date	Dynamic Test Date	Open Test Pressure	Close Test Pressure	Open DB D/P	Close DB D/P	% DB D/P: Open Test	% DB D/P: Close Test
3FWA*MOV35A	10/4/93	10/4/93	1482.5	1482.5	1516	1516	98%	98%
3FWA*MOV35B	9/24/93	9/24/93	1495.8	1495.8	1516	1516	99%	99%
3FWA*MOV35C	9/25/93	9/28/93	1476.7	1476.7	1516	1516	97%	97%
3FWA*MOV35D	9/22/93	9/18/93	1486.5	1486.5	1515	1516	98%	98%
3IAS*MOV72	5/10/95	Non-Testable			129	129		
3LMS*MOV40A	5/8/95	High Margin			0	39		
3LMS*MOV40B	5/2/95	High Margin			0	39		
3LMS*MOV40C	5/9/95	High Margin			0	39		
3LMS*MOV40D	5/2/95	High Margin			0	39		
3MSS*MOV17A	5/29/95	4/14/95	1020	1020	1185	210	86%	486%
3MSS*MOV17B	4/18/95	4/14/95	1070	1070	1185	210	90%	510%
3MSS*MOV17D	5/30/95	4/14/95	1020	1020	1185	210	86%	486%
3MSS*MOV18A	4/25/95	Non-Testable			1185	1185		
3MSS*MOV18B	4/28/95	Non-Testable			1185	1185		
3MSS*MOV18C	4/25/95	Non-Testable			1185	1185		
3MSS*MOV18D	4/26/95	Non-Testable			1185	1185		
3MSS*MOV74A	5/16/95	Non-Testable			1185	260		
3MSS*MOV74B	5/18/95	Non-Testable			1185	260		
3MSS*MOV74C	10/6/93	Non-Testable			1185	260		
3MSS*MOV74D	10/6/93	Non-Testable			1185	260		
3QSS*MOV34A	4/27/95	Non-Testable			166	0		
3QSS*MOV34B	4/27/95	Non-Testable			166	0		
3RCS*MV8000A	5/10/95	Non-Testable			2485	2335		
3RCS*MV8000B	5/11/95	Non-Testable			2485	2335		
3RCS*MV8098	8/17/93	High Margin			2523	0		
3RHS*FCV610	8/29/93	High Margin			175	175		
3RHS*FCV611	8/28/93	High Margin			175	175		
3RHS*MV8701A	5/19/95	Grouped			2260	393		
3RHS*MV8701B	5/12/95	4/15/95	280.25	N/A	375	0	75%	N/A
3RHS*MV8701C	5/18/95	Grouped			1940	396		
3RHS*MV8702A	5/3/95	4/15/95	322	N/A	375	0	86%	N/A
3RHS*MV8702B	5/8/95	5/15/95	1500	N/A	2260	393	66%	N/A
3RHS*MV8702C	5/22/95	5/15/95	1788.5	N/A	1940	396	92%	N/A
3RHS*MV8716A	5/28/95	5/28/95	217.4	217.4	425	0	51%	N/A
3RHS*MV8716B	5/22/95	5/22/95	256.7	256.7	425	0	60%	N/A
3RSS*MOV20A	4/18/95	Non-Testable			261	261		
3RSS*MOV20B	4/20/95	Non-Testable			261	261		
3RSS*MOV20C	4/25/95	Non-Testable			261	261		
3RSS*MOV20D	4/26/95	Non-Testable			261	261		
3RSS*MOV23A	5/25/95	Non-Testable			48	49		
3RSS*MOV23B	5/25/95	Non-Testable			48	49		
3RSS*MOV23C	5/25/95	Non-Testable			48	49		
3RSS*MOV23D	4/19/95	Non-Testable			48	49		
3RSS*MOV38A	5/21/95	5/21/95	124.3	124.3	232	232	54%	54%
3RSS*MOV38B	5/22/95	5/22/95	130.3	130.3	232	232	56%	56%
3RSS*MV8837A	5/27/95	5/27/95	237.3	237.3	250	0	95%	N/A
3RSS*MV8837B	5/22/95	5/22/95	241.6	241.6	250	0	97%	N/A
3RSS*MV8838A	9/1/93	Non-Testable			250	0		
3RSS*MV8838B	9/3/93	Non-Testable			250	0		
3SIH*MV8801A	9/4/93	9/3/93	2595.1	2593.1	2759	707	94%	367%
3SIH*MV8801B	8/27/93	9/3/93	2571.6	2561.6	2759	707	93%	362%

Valve Number	Static Test Date	Dynamic Test Date	Open Test Pressure	Close Test Pressure	Open DB D/P	Close DB D/P	% DB D/P: Open Test	% DB D/P: Close Test
3SIH*MV8802A	8/14/93	9/2/93	1566.8	1566.8	1775	0	88%	N/A
3SIH*MV8802B	8/31/93	Grouped			1775	0		
3SIH*MV8806	5/6/95	Non-Testable			30	174		
3SIH*MV8807A	8/12/93	Non-Testable			213	54		
3SIH*MV8807B	8/20/93	Non-Testable			213	54		
3SIH*MV8813	8/19/93	9/2/93	1495	1495	1230	1230	123%	122%
3SIH*MV8814	8/15/93	9/2/93	1505	1505	1230	1230	122%	122%
3SIH*MV8821A	8/14/93	9/2/93	1567	1567	1775	1230	88%	127%
3SIH*MV8821B	8/23/93	9/2/93	1567	1567	1775	1230	88%	127%
3SIH*MV8835	8/31/93	9/2/93	1567	1567	1775	1401	88%	112%
3SIH*MV8920	5/27/95	5/13/95	742.6	742.6	1230	1230	60%	60%
3SIH*MV8923A	8/15/93	Non-Testable			25	0		
3SIH*MV8923B	8/29/93	Non-Testable			25	0		
3SIH*MV8924	8/27/93	Non-Testable			218	54		
3SIL*MV8804A	9/1/93	Non-Testable			256	0		
3SIL*MV8804B	8/25/93	Non-Testable			256	0		
3SIL*MV8808A	5/20/95	Non-Testable			686	246		
3SIL*MV8808B	5/6/95	Non-Testable			686	246		
3SIL*MV8808C	5/1/95	Non-Testable			686	246		
3SIL*MV8808D	5/19/95	Non-Testable			686	246		
3SIL*MV8809A	5/21/95	5/21/95	226.8	226.8	375	163	60%	139%
3SIL*MV8809B	5/21/95	5/22/95	233.3	233.3	375	163	62%	143%
3SIL*MV8812A	8/15/93	Non-Testable			419	0		
3SIL*MV8812B	8/30/93	Non-Testable			419	0		
3SIL*MV8840	8/30/93	High Margin			0	188		
3SWP*MOV024A	5/14/95	Static Bounds			98	78		
3SWP*MOV024B	5/2/95	Static Bounds			98	78		
3SWP*MOV024C	5/14/95	Static Bounds			98	78		
3SWP*MOV024D	5/4/95	Static Bounds			98	78		
3SWP*MOV050A	5/17/95	5/17/95	48.3	48.3	93	93	52%	52%
3SWP*MOV050B	4/28/95	4/23/95	49.3	49.3	93	93	53%	53%
3SWP*MOV054A	5/12/95	Grouped			94	94		
3SWP*MOV054B	4/28/95	4/22/95	64.1	64.1	94	94	68%	68%
3SWP*MOV054C	5/15/95	Grouped			94	94		
3SWP*MOV054D	5/28/95	4/23/95	64.1	64.1	94	94	68%	68%
3SWP*MOV057A	5/17/95	5/17/95	55.3	55.3	74	74	75%	75%
3SWP*MOV057B	4/28/95	4/23/95	64.1	64.1	74	74	87%	87%
3SWP*MOV057C	5/12/95	Grouped			74	74		
3SWP*MOV057D	4/28/95	4/23/95	64.1	64.1	74	74	87%	87%
3SWP*MOV071A	5/28/95	5/28/95	56.9	56.9	94	94	61%	61%
3SWP*MOV071B	5/6/95	5/6/95	60.9	60.9	94	94	65%	65%
3SWP*MOV102A	5/13/95	5/7/95	92	N/A	97	97	95%	N/A
3SWP*MOV102B	4/29/95	4/23/95	N/A	N/A	97	97	N/A	N/A
3SWP*MOV102C	5/10/95	Grouped			97	97		
3SWP*MOV102D	4/30/95	4/23/95	N/A	N/A	97	97	N/A	N/A
3SWP*MOV115A	5/13/95	Static Bounds			83	94		
3SWP*MOV115B	5/4/95	Static Bounds			83	94		

The basis used for closure of each MOV is depicted in Table 8.

Table 8: Basis For Closure

Valve Number	Full or Partial D/P Test	Group With D/P Tested Valves	KEI Gate (G) Butterfly (B)	Large Calculated Margin	Bounded by Static Test	Non-Testable Globe Valve
3CCP*MOV045A		G1				
3CCP*MOV045B	Partial					
3CCP*MOV048A		G1				
3CCP*MOV048B	Partial					
3CCP*MOV049A		G1				
3CCP*MOV049B	Partial					
3CCP*MOV222		G2				
3CCP*MOV223		G2				
3CCP*MOV224		G2				
3CCP*MOV225		G2				
3CCP*MOV226	Partial					
3CCP*MOV227	Partial					
3CCP*MOV228	Partial					
3CCP*MOV229	Partial					
3CHS*LCV112B			G			
3CHS*LCV112C			G			
3CHS*LCV112D			G			
3CHS*LCV112E			G			
3CHS*MV8100						X
3CHS*MV8104				X		
3CHS*MV8105	Partial					
3CHS*MV8106	Partial					
3CHS*MV8109A				X		
3CHS*MV8109B				X		
3CHS*MV8109C				X		
3CHS*MV8109D				X		
3CHS*MV8110	Partial					
3CHS*MV8111A	Partial					
3CHS*MV8111B	Partial					
3CHS*MV8111C	Partial					
3CHS*MV8112						X
3CHS*MV8116	Partial					
3CHS*MV8438A	Partial					
3CHS*MV8438B	Partial					
3CHS*MV8438C	Partial					
3CHS*MV8468A			G			
3CHS*MV8468B			G			
3CHS*MV8507A			G			
3CHS*MV8507B			G			
3CHS*MV8511A						X
3CHS*MV8511B						X
3CHS*MV8512A						X
3CHS*MV8512B						X
3CMS*MOV24				X		
3CVS*MOV25				X		
3FWA*MOV35A	Partial					
3FWA*MOV35B	Partial					
3FWA*MOV35C	Partial					
3FWA*MOV35D	Partial					
3IAS*MOV72						X
3LMS*MOV40A				X		
3LMS*MOV40B				X		
3LMS*MOV40C				X		
3LMS*MOV40D				X		

Valve Number	Full or Partial D/P Test	Group With D/P Tested Valves	KEI Gate (G) Butterfly (B)	Large Calculated Margin	Bounded by Static Test	Non-Testable Globe Valve
3MSS*MOV17A	Partial					
3MSS*MOV17B	Partial					
3MSS*MOV17D	Partial					
3MSS*MOV18A			G			
3MSS*MOV18B			G			
3MSS*MOV18C			G			
3MSS*MOV18D			G			
3MSS*MOV74A						X
3MSS*MOV74B						X
3MSS*MOV74C						X
3MSS*MOV74D						X
3QSS*MOV34A			G			
3QSS*MOV34B			G			
3RCS*MV8000A			G			
3RCS*MV8000B			G			
3RCS*MV8098				X		
3RHS*FCV610				X		
3RHS*FCV611				X		
3RHS*MV8701A		G3				
3RHS*MV8701B	Partial					
3RHS*MV8701C		G3				
3RHS*MV8702A	Partial					
3RHS*MV8702B	Partial					
3RHS*MV8702C	Partial					
3RHS*MV8716A	Partial					
3RHS*MV8716B	Partial					
3RSS*MOV20A			B			
3RSS*MOV20B			B			
3RSS*MOV20C			B			
3RSS*MOV20D			B			
3RSS*MOV23A			B			
3RSS*MOV23B			B			
3RSS*MOV23C			B			
3RSS*MOV23D			B			
3RSS*MOV38A	Partial					
3RSS*MOV38B	Partial					
3RSS*MV8837A	Partial					
3RSS*MV8837B	Partial					
3RSS*MV8838A			G			
3RSS*MV8838B			G			
3SIH*MV8801A	Partial					
3SIH*MV8801B	Partial					
3SIH*MV8802A	Partial					
3SIH*MV8802B		G4				
3SIH*MV8806			G			
3SIH*MV8807A			G			
3SIH*MV8807B			G			
3SIH*MV8813	Full					
3SIH*MV8814	Full					
3SIH*MV8821A	Partial					
3SIH*MV8821B	Partial					
3SIH*MV8835	Partial					
3SIH*MV8920	Partial					
3SIH*MV8923A			G			
3SIH*MV8923B			G			
3SIH*MV8924			G			
3SIL*MV8804A			G			
3SIL*MV8804B			G			

Valve Number	Full or Partial D/P Test	Group With D/P Tested Valves	KEI Gate (G) Butterfly (B)	Large Calculated Margin	Bounded by Static Test	Non-Testable Globe Valve
3SIL*MV8808A			G			
3SIL*MV8808B			G			
3SIL*MV8808C			G			
3SIL*MV8808D			G			
3SIL*MV8809A	Partial					
3SIL*MV8809B	Partial					
3SIL*MV8812A			G			
3SIL*MV8812B			G			
3SIL*MV8840				X		
3SWP*MOV024A					X	
3SWP*MOV024B					X	
3SWP*MOV024C					X	
3SWP*MOV024D					X	
3SWP*MOV050A	Partial					
3SWP*MOV050B	Partial					
3SWP*MOV054A		G5				
3SWP*MOV054B	Partial					
3SWP*MOV054C		G5				
3SWP*MOV054D	Partial					
3SWP*MOV057A	Partial					
3SWP*MOV057B	Partial					
3SWP*MOV057C		G5				
3SWP*MOV057D	Partial					
3SWP*MOV071A	Partial					
3SWP*MOV071B	Partial					
3SWP*MOV102A	Partial					
3SWP*MOV102B	Partial					
3SWP*MOV102C		G6				
3SWP*MOV102D	Partial					
3SWP*MOV115A					X	
3SWP*MOV115B					X	

X = Category Applicable
P = Partial
F = Full
G1 = Grouped with 3CCP*MOV045B, 048B, 049B
G2 = Grouped with 3CCP*MOV226, 227, 228, 229
G3 = Grouped with 3RHS*MV8702B, C
G4 = Grouped with 3SIH*MV8801A, 8801B, 8802A
G5 = Grouped with 3SWP*MOV054B, 054D, 057A, 057B, 057D
G6 = Grouped with 3SWP*MOV102A, 102B, 102D

6. Sheron Memo Cross Reference

Provided below is a quick cross reference of the section and page number for each of the items in the Sheron memo which required justification.

Table 9: Sheron Memo Items - Cross Reference

Section	Page	Sheron Memo Item
10.5	38	Valve factor (including area assumption)
10.6	40	Stem friction coefficient
11.3	48	Load sensitive behavior
10.8	44	Margins for stem lubrication degradation and springpack relaxation
10.3.1	36	Motor performance factors
11.2	48	Basis for extrapolation method of partial d/p thrust measurements
12.2.3	54	Torque switch repeatability
10.2	35	Use of Limitorque, Kalsi, or other sources for increasing thrust/torque allowable limits
12	51	Equipment error
11.4	50	Post-maintenance testing, especially valve packing adjustments
13	54	Grouping of MOVs
15	58	Trending of MOV problems

7. Valve Mispositioning

Millstone Unit 3 has deferred consideration of valve mispositioning in our GL 89-10 program in accordance with guidance provided in NRR memo of July 12, 1994 (the "Sheron memo").[9] The NRC staff is evaluating the request by the Westinghouse Owners' Group that the recommendation in GL 89-10 to consider valve mispositioning be removed. The NRC Staff is preparing a Supplement 7 to GL 89-10 on the need to consider valve mispositioning as part of GL 89-10 programs at Pressurized Water Reactor (PWR) plants.[9] If ongoing staff analyses provide adequate justification, the supplement will eliminate the recommendation for PWR licensees to consider valve mispositioning as part of their GL 89-10 programs.

During the time while the staff is preparing the proposed supplement to GL 89-10, the staff stated that a PWR licensee may defer consideration of valve mispositioning in its GL 89-10 program.[9] Where a PWR licensee has completed its GL 89-10 program with the exception of the consideration of valve mispositioning, the staff may close its review of the licensee's design-basis capability verification of MOV's within the GL 89-10 program provided the licensee commits to consider valve mispositioning if the staff determines that this recommendation in GL 89-10 remains appropriate.

Millstone Unit 3 committed in a memo[10] dated June 16, 1995, that they would consider valve mispositioning if the NRC Staff determines that the recommendation, to consider mispositioning, in GL 89-10 remains appropriate. Only two MOV's were removed from the program since they were in the program only to support mispositioning strokes: 3SWP*MOV130A and 3SWP*MOV130B.

8. MOV Program Scope Criteria

Program Instruction (PI)-1, "MOV Program Scope Determination," establishes the criteria for determining which MOV's are included in the MOV Program. PI-1 provides the methodology for

performing and documenting this process, and establishes the criteria to identify other MOV's in the balance of plant, commensurate with their importance to safety, to be included in the MOV Program. In addition, it provides methods for determining the position-changeability of MOV's. Millstone Unit 3 has deferred consideration of valve mispositioning pending the results of the final NRC position on mispositioning.[9] The Millstone Unit 3 MOV Program scope is defined in the "Millstone Unit 3 MOV Program Scope Determination," Calculation 89-094-939ES, Revision 1, CCN 01, August 18, 1995.

9. Design Basis Reviews

PI-2, "MOV System and Functional Design Basis Review," defines the methodology and requirements for performing system and design-basis reviews under the scope of GL 89-10. PI-2 requires that the following key elements be identified:

1. All active safety-related functions for each MOV by reviewing all normal operating and abnormal valve line-ups.
2. The maximum bounding system parameters corresponding to each normal operating and abnormal condition valve line-up, to include:
    - **Line Pressure (Upstream and Downstream)**

      Head differences due to elevation between the pump and the valve will, in general, be included in line pressure and differential pressure calculations (e.g. the pressure downstream of a pump during flowing conditions should be assumed to be equal to the pump discharge pressure plus any elevation difference). This assumption does not preclude the incorporation of dynamic piping losses in future analyses as a means of justifying reduced line pressure or differential pressure.

      Equation 1: $P_{upstream/downstream} = P_{source} + H_{pump} \pm H_{elevation}$

      Source Pressure (P_{Source}) can include any combination of the following:

        - reactor coolant system pressure
        - inter-connecting fluid system pressure
        - tank pressure
        - atmospheric pressure
        - containment pressure
        - pressure contained in sections of pipe that could be pressurized; sources such as leakage past other valves or thermal expansion of the fluid.
        - safety valve set point; nominal set pressure should be used for consistency. Use of set pressure tolerance is not required.

Pump Head (H_{Pump}) is the available head of any operating pump at the appropriate flow rate converted to psig by an appropriate conversion factor. If the subject valve's close stroke reduces the source pump flow rate to zero under its design-basis conditions, then the Pump Head is the Shutoff Head at the valve's full closed position. The nominal or design pump head curve should be used for the calculation of pump head.

Elevation Head ($H_{Elevation}$) results from elevation differences between the valve elevation and any higher or lower elevation of piping / components / tank water levels, etc., converted to psig by an appropriate conversion factor.

- **Maximum Line Pressure**

  Maximum Line Pressure is the greater of the upstream and downstream line pressures.

- **Differential Pressure**

  The maximum differential pressure (psid) exists when the valve is in its fully closed position. Throttling valves are assumed to fully close in order to obtain a bounding differential pressure.

- **Process Fluid Temperature and Flow**

  Process fluid temperature and flow values shall be determined and correspond to the highest postulated temperature and flow for the line pressure / differential pressure case listed.

- **Flow Direction (forward and reverse)**

  The flow direction shall be determined for each MOV operation. In general, the normal flow direction for the valve will establish the upstream and downstream side of the valve.

- **Ambient Environment Temperature**

  The ambient environment temperature shall be determined for each MOV (i.e. normal operation temperature, accident and post-accident conditions). For post-accident conditions, the ambient temperature based on the EEQ Profile should be used.

- **Degraded Voltage at Design Basis Conditions**

  The effects of degraded voltage at design-basis conditions on MOV performance shall be determined in accordance with PI-4, "AC and DC Motor Terminal Voltage Evaluation."

- **Process Fluid and Phase**

  The process fluid conditions (water, steam or two-phase) shall be determined for each identified MOV operation.

3. The maximum cases for both open and close operations.

The Millstone Unit 3 MOV Program design-basis review is contained in the Design Basis Review Calculations which are listed in Table 10. Also provided in Table 10 is a listing of the Electrical Calculations, Weak Link Calculations, and Target Thrust Calculations for each MOV. The information in the table is presented to demonstrate design-basis closure. Future changes will be controlled by existing NU procedures.

Table 10: Calculation Listing

Valve Number	DBR	Rev	Electrical	Rev	Weak Link	Rev	Target Thrust	Rev
3CCP*MOV045A	NUC-035	01	89-094-119E3	00	94103-C-01	00	89-094-1070M3	00
3CCP*MOV045B	NUC-035	01	89-094-119E3	00	94103-C-01	00	89-094-1070M3	00
3CCP*MOV048A	NUC-044	01	89-094-119E3	00	94103-C-01	00	89-094-1026ES	00
3CCP*MOV048B	NUC-044	01	89-094-119E3	00	94103-C-01	00	89-094-1026ES	00
3CCP*MOV049A	NUC-047	01	89[illegible]19E3	00	94103-C-01	00	89-094-1071M3	00
3CCP*MOV049B	NUC-047	01	8[illegible]119E3	00	94103-C-01	00	89-094-1071M3	00
3CCP*MOV222	NUC-048	01	89-094-119E3	00	94103-C-02	00	89-094-1031ES	00
3CCP*MOV223	NUC-048	01	89-094-119E3	00	94103-C-02	00	89-094-1031ES	00
3CCP*MOV224	NUC-048	01	89-094-119E3	00	94103-C-02	00	89-094-1032ES	00
3CCP*MOV225	NUC-048	01	89-094-119E3	00	94103-C-02	00	89-094-1032ES	00
3CCP*MOV226	NUC-048	01	89-094-119E3	00	94103-C-02	00	89-094-1031ES	00
3CCP*MOV227	NUC-048	01	89-094-119E3	00	94103-C-02	00	89-094-1031ES	00
3CCP*MOV228	NUC-048	01	89-094-119E3	00	94103-C-02	00	89-094-1032ES	00
3CCP*MOV229	NUC-048	01	89-094-119E3	00	94103-C-02	00	89-094-1032ES	00
3CHS*LCV112B	89-094-0896ES	00	89-094-112E3	00	94103-C-12	00	89-094-0897ES	02
3CHS*LCV112C	89-094-0896ES	00	89-094-112E3	00	94103-C-12	00	89-094-0897ES	02
3CHS*LCV112D	NUC-039	00	89-094-115E3	00	94103-C-03	02	89-094-0993ES	01
3CHS*LCV112E	NUC-039	00	89-094-115E3	00	94103-C-03	02	89-094-0993ES	01
3CHS*MV8100	NUC-025	00	89-094-123E3	00	94103-C-05	01	89-094-0983ES	01
3CHS*MV8104	NUC-033	00	89-094-332E3	00	94103-C-05	01	89-094-0995ES	01
3CHS*MV8105	NUC-043	00	89-094-113E3	00	94103-C-13	01	89-094-0886ES	02
3CHS*MV8106	NUC-043	00	89-094-113E3	00	94103-C-13	01	89-094-0886ES	02
3CHS*MV8109A	NUC-030	00	89-094-123E3	00	94103-C-05	01	89-094-1072M3	01
3CHS*MV8109B	NUC-030	00	89-094-123E3	00	94103-C-05	01	89-094-1072M3	01
3CHS*MV8109C	NUC-030	00	89-094-123E3	00	94103-C-05	01	89-094-1072M3	01
3CHS*MV8109D	NUC-030	00	89-094-123E3	00	94103-C-05	01	89-094-1072M3	01
3CHS*MV8110	NUC-042	00	89-094-128E3	00	94103-C-41	00	89-094-1006ES	01
3CHS*MV8111A	NUC-042	00	89-094-128E3	00	94103-C-41	00	89-094-1006ES	01
3CHS*MV8111B	NUC-042	00	89-094-128E3	00	94103-C-06	00	89-094-1006ES	01
3CHS*MV8111C	NUC-042	00	89-094-128E3	00	94103-C-06	00	89-094-1006ES	01
3CHS*MV8112	NUC-025	00	89-094-123E3	00	94103-C-05	01	89-094-0983ES	01
3CHS*MV8116	NUC-036	00	89-094-123E3	00	94103-C-18	01	89-094-0986ES	01
3CHS*MV8438A	NUC-029	01	89-094-128E3	00	94103-C-33	00	89-094-0985ES	01
3CHS*MV8438B	NUC-029	01	89-094-128E3	00	94103-C-33	00	89-094-0985ES	01
3CHS*MV8438C	NUC-029	01	89-094-128E3	00	94103-C-33	00	89-094-0985ES	01
3CHS*MV8468A	NUC-029	01	89-094-115E3	00	94103-C-35	00	89-094-0984ES	01
3CHS*MV8468B	NUC-029	01	89-094-115E3	00	94103-C-35	00	89-094-0984ES	01
3CHS*MV8507A	NUC-034	00	89-094-123E3	00	94103-C-34	00	89-094-0989ES	01
3CHS*MV8507B	NUC-034	00	89-094-116E3	00	94103-C-34	00	89-094-0989ES	01
3CHS*MV8511A	NUC-051	00	89-094-123E3	00	94103-C-38	00	89-094-0990ES	02
3CHS*MV8511B	NUC-051	00	89-094-123E3	00	94103-C-38	00	89-094-0990ES	02
3CHS*MV8512A	NUC-051	00	89-094-123E3	00	94103-C-38	00	89-094-0990ES	02
3CHS*MV8512B	NUC-051	00	89-094-123E3	00	94103-C-38	00	89-094-0990ES	[illegible]
3CMS*MOV24	89-094-1004ES	00	89-094-124E3	00	94103-C-07	01	89-094-1013ES	01
3CVS*MOV25	89-094-0982ES	00	89-094-124E3	00	94103-C-05	01	89-094-0863ES	02
3FWA*MOV35A	89-094-0962ES	00	89-094-113E3	00	94103-C-08	00	89-094-0885ES	03
3FWA*MOV35B	89-094-0962ES	00	89-094-113E3	00	94103-C-08	00	89-094-0885ES	03
3FWA*MOV35C	89-094-0962ES	00	89-094-113E3	00	94103-C-08	00	89-094-0885ES	03

Valve Number	DBR	Rev	Electrical	Rev	Weak Link	Rev	Target Thrust	Rev
3FWA*MOV35D	89-094-0962ES	00	89-094-113E3	00	94103-C-08	00	89-094-0885ES	03
3IAS*MOV72	89-094-0996ES	00	89-094-127E3	00	94103-C-05	01	89-094-0946ES	02
3LMS*MOV40A	89-094-1021M3	00	89-094-127E3	00	94103-C-14	00	89-094-1059M3	00
3LMS*MOV40B	89-094-1021M3	00	89-094-127E3	00	94103-C-14	00	89-094-1059M3	00
3LMS*MOV40C	89-094-1021M3	00	89-094-127E3	00	94103-C-14	00	89-094-1059M3	00
3LMS*MOV40D	89-094-1021M3	00	89-094-127E3	00	94103-C-14	00	89-094-1059M3	00
3MSS*MOV17A	89-094-0977ES	00	89-094-126E3	00	94103-C-09	01	89-094-1016ES	01
3MSS*MOV17B	89-094-0977ES	00	89-094-126E3	00	94103-C-09	01	89-094-1016ES	01
3MSS*MOV17D	89-094-0977ES	00	89-094-126E3	00	94103-C-09	01	89-094-1016ES	01
3MSS*MOV18A	89-094-0977ES	00	89-094-126E3	00	94103-C-10	01	89-094-1015ES	02
3MSS*MOV18B	89-094-0977ES	00	89-094-126E3	00	94103-C-10	01	89-094-1015ES	02
3MSS*MOV18C	89-094-0977ES	00	89-094-126E3	00	94103-C-10	01	89-094-1015ES	02
3MSS*MOV18D	89-094-0977ES	00	89-094-126E3	00	94103-C-10	01	89-094-1015ES	02
3MSS*MOV74A	89-094-0977ES	00	89-094-115E3	00	94103-C-15	00	89-094-1018ES	01
3MSS*MOV74B	89-094-0977ES	00	89-094-115E3	00	94103-C-15	00	89-094-1018ES	01
3MSS*MOV74C	89-094-0977ES	00	89-094-115E3	00	94103-C-15	00	89-094-1018ES	01
3MSS*MOV74D	89-094-0977ES	00	89-094-115E3	00	94103-C-15	00	89-094-1018ES	01
3QSS*MOV34A	NUC-041	00	89-094-120E3	00	94103-C-40	01	89-094-1027ES	00
3QSS*MOV34B	NUC-041	00	89-094-120E3	00	94103-C-40	01	89-094-1027ES	00
3RCS*MV8000A	NUC-040	00	89-094-113E3	00	94103-C-04	01	89-094-0887ES	02
3RCS*MV8000B	NUC-040	00	89-094-113E3	00	94103-C-04	01	89-094-0887ES	02
3RCS*MV8098	NUC-045	00	89-094-116E3	00	94103-C-18	01	89-094-1001ES	01
3RHS*FCV610	89-094-0956ES	00	89-094-332E3	00	94103-C-05	01	89-094-1009ES	01
3RHS*FCV611	89-094-0956ES	00	89-094-332E3	00	94103-C-05	01	89-094-1009ES	01
3RHS*MV8701A	89-094-0956ES	00	89-094-116E3	00	94103-C-36	01	89-094-1005ES	01
3RHS*MV8701B	89-094-0956ES	00	89-094-117E3	00	94103-C-19	00	89-094-1000ES	02
3RHS*MV8701C	89-094-0956ES	00	89-094-116E3	00	94103-C-36	01	89-094-1005ES	01
3RHS*MV8702A	89-094-0956ES	00	89-094-117E3	00	94103-C-19	00	89-094-1000ES	02
3RHS*MV8702B	89-094-0956ES	00	89-094-116E3	00	94103-C-36	01	89-094-1005ES	01
3RHS*MV8702C	89-094-0956ES	00	89-094-116E3	00	94103-C-36	01	89-094-1005ES	01
3RHS*MV8716A	89-094-0956ES	00	89-094-116E3	00	94103-C-20	00	89-094-1011ES	01
3RHS*MV8716B	89-094-0956ES	00	89-094-116E3	00	94103-C-20	00	89-094-1011ES	01
3RSS*MOV20A	NUC-028	00	89-094-120E3	00	94103-C-21	01	89-094-1030ES	00
3RSS*MOV20B	NUC-028	00	89-094-120E3	00	94103-C-21	01	89-094-1030ES	00
3RSS*MOV20C	NUC-028	00	89-094-120E3	00	94103-C-21	01	89-094-1030ES	00
3RSS*MOV20D	NUC-028	00	89-094-120E3	00	94103-C-21	01	89-094-1030ES	00
3RSS*MOV23A	NUC-031	00	89-094-120E3	00	94103-C-16	00	89-094-1028ES	00
3RSS*MOV23B	NUC-031	00	89-094-120E3	00	94103-C-16	00	89-094-1028ES	00
3RSS*MOV23C	NUC-031	00	89-094-120E3	00	94103-C-16	00	89-094-1028ES	00
3RSS*MOV23D	NUC-031	00	89-094-120E3	00	94103-C-16	00	89-094-1028ES	00
3RSS*MOV38A	NUC-038	00	89-094-117E3	00	94103-C-22	00	89-094-0987ES	01
3RSS*MOV38B	NUC-038	00	89-094-117E3	00	94103-C-22	00	89-094-0987ES	01
3RSS*MV8837A	NUC-026	00	89-094-332E3	00	94103-C-24	00	89-094-0899ES	03
3RSS*MV8837B	NUC-026	00	89-094-332E3	00	94103-C-24	00	89-094-0899ES	03
3RSS*MV8838A	NUC-026	00	89-094-112E3	00	94103-C-24	00	89-094-0899ES	03
3RSS*MV8838B	NUC-026	00	89-094-112E3	00	94103-C-24	00	89-094-0899ES	03
3SIH*MV8801A	89-094-0964ES	00	89-094-128E3	00	94103-C-39	01	89-094-1007ES	01
3SIH*MV8801B	89-094-0964ES	00	89-094-124E3	00	94103-C-39	01	89-094-1007ES	01
3SIH*MV8802A	89-094-0964ES	00	89-094-128E3	00	94103-C-39	01	89-094-1008ES	01
3SIH*MV8802B	89-094-0964ES	00	89-094-128E3	00	94103-C-39	01	89-094-1008ES	01
3SIH*MV8806	89-094-0964ES	00	89-094-128E3	00	94103-C-31	01	89-094-1019ES	02
3SIH*MV8807A	89-094-0964ES	00	89-094-112E3	00	94103-C-17	01	89-094-0898ES	02
3SIH*MV8807B	89-094-0964ES	00	89-094-112E3	00	94103-C-17	01	89-094-0898ES	02
3SIH*MV8813	89-094-0964ES	00	89-094-128E3	00	94103-C-23	00	89-094-0991ES	01
3SIH*MV8814	89-094-0964ES	00	89-094-128E3	00	94103-C-14	00	89-094-0999ES	01
3SIH*MV8821A	89-094-0964ES	00	89-094-118E3	00	94103-C-32	00	89-094-0997ES	02
3SIH*MV8821B	89-094-0964ES	00	89-094-118E3	00	94103-C-32	00	89-094-0997ES	02

Valve Number	DBR	Rev	Electrical	Rev	Weak Link	Rev	Target Thrust	Rev
3SIH*MV8835	89-094-0964ES	00	89-094-128E3	00	94103-C-39	01	89-094-1010ES	01
3SIH*MV8920	89-094-0964ES	00	89-094-124E3	00	94103-C-14	00	89-094-0999ES	01
3SIH*MV8923A	89-094-0964ES	00	89-094-124E3	00	94103-C-17	01	89-094-1002ES	01
3SIH*MV8923B	89-094-0964ES	00	89-094-118E3	00	94103-C-17	01	89-094-1002ES	01
3SIH*MV8924	89-094-0964ES	00	89-094-124E3	00	94103-C-17	01	89-094-1003ES	01
3SIL*MV8804A	89-094-0972ES	00	89-094-112E3	00	94103-C-24	00	89-094-0900ES	03
3SIL*MV8804B	89-094-0972ES	00	89-094-112E3	00	94103-C-24	00	89-094-0900ES	03
3SIL*MV8808A	89-094-0972ES	00	89-094-118E3	00	94103-C-37	00	89-094-1017ES	02
3SIL*MV8808B	89-094-0972ES	00	89-094-118E3	00	94103-C-37	00	89-094-1017ES	02
3SIL*MV8808C	89-094-0972ES	00	89-094-118E3	00	94103-C-37	00	89-094-1017ES	02
3SIL*MV8808D	89-094-0972ES	00	89-094-118E3	00	94103-C-37	00	89-094-1017ES	02
3SIL*MV8809A	89-094-0972ES	00	89-094-116E3	00	94103-C-11	01	89-094-1012ES	02
3SIL*MV8809B	89-094-0972ES	00	89-094-116E3	00	94103-C-11	01	89-094-1012ES	02
3SIL*MV8812A	89-094-0972ES	00	89-094-118E3	00	94103-C-25	02	89-094-0992ES	01
3SIL*MV8812B	89-094-0972ES	00	89-094-118E3	00	94103-C-25	02	89-094-0992ES	01
3SIL*MV8840	89-094-0972ES	00	89-094-125E3	00	94103-C-26	00	89-094-0998ES	01
3SWP*MOV024A	NUC-049	01	89-094-121E3	00	94103-C-27	01	89-094-1073M3	00
3SWP*MOV024B	NUC-049	01	89-094-121E3	00	94103-C-27	01	89-094-1073M3	00
3SWP*MOV024C	NUC-049	01	89-094-121E3	00	94103-C-27	01	89-094-1073M3	00
3SWP*MOV024D	NUC-049	01	89-094-121E3	00	94103-C-27	01	89-094-1073M3	00
3SWP*MOV050A	NUC-052	00	89-094-121E3	00	94103-C-28	01	89-094-1029ES	00
3SWP*MOV050B	NUC-052	00	89-094-121E3	00	94103-C-28	01	89-094-1029ES	00
3SWP*MOV054A	NUC-062	00	89-094-121E3	00	94103-C-29	00	89-094-1074M3	00
3SWP*MOV054B	NUC-062	00	89-094-121E3	00	94103-C-29	00	89-094-1074M3	00
3SWP*MOV054C	NUC-062	00	89-094-121E3	00	94103-C-29	00	89-094-1074M3	00
3SWP*MOV054D	NUC-062	00	89-094-121E3	00	94103-C-29	00	89-094-1074M3	00
3SWP*MOV057A	NUC-062	00	89-094-121E3	00	94103-C-29	00	89-094-1075M3	00
3SWP*MOV057B	NUC-062	00	89-094-121E3	00	94103-C-29	00	89-094-1075M3	00
3SWP*MOV057C	NUC-062	00	89-094-121E3	00	94103-C-29	00	89-094-1075M3	00
3SWP*MOV057D	NUC-062	00	89-094-121E3	00	94103-C-29	00	89-094-1075M3	00
3SWP*MOV071A	NUC-054	00	89-094-122E3	00	94103-C-30	00	89-094-1076M3	00
3SWP*MOV071B	NUC-054	00	89-094-122E3	00	94103-C-30	00	89-094-1076M3	00
3SWP*MOV102A	NUC-053	00	89-094-122E3	00	94103-C-42	00	89-094-1069M3	01
3SWP*MOV102B	NUC-053	00	89-094-122E3	00	94103-C-42	00	89-094-1069M3	01
3SWP*MOV102C	NUC-053	00	89-094-122E3	00	94103-C-42	00	89-094-1069M3	01
3SWP*MOV102D	NUC-053	00	89-094-122E3	00	94103-C-42	00	89-094-1069M3	01
3SWP*MOV115A	NUC-064	00	89-094-122E3	00	94103-C-27	01	89-094-1077M3	00
3SWP*MOV115B	NUC-064	00	89-094-122E3	00	94103-C-27	01	89-094-1077M3	00

10. MOV Sizing and Switch Settings

10.1 Valve Weak Link Analysis

NU has performed weak link analyses for all MOV's in the GL 89-10 Program. The weak link analyses have determined the thrust or torque structural capacity of each component involved in supporting the MOV opening and closing strokes.

These analyses evaluated all structural components of each MOV which typically included the valve body, bonnet, yoke, stem, disk and appropriate flanges including bolted interfaces as a minimum. The allowable thrust or torque capacity of each MOV was developed using the valve vendor's weak link analysis which have been independently reviewed and in most cases supplemented by Altran Corporation of Boston, MA. Completion of the weak link analysis results in identification of the

weakest component of the MOV as well as the limiting thrust or torque load which could be accommodated by the valve for the given conditions.

The formulae employed in the weak link analyses are those traditionally used for determining stress and consider the appropriate temperatures and pressures along with other plant specific design loads applied as required. The weak link evaluation and acceptance criteria are governed by a detailed and rigorous program instruction entitled, PI-3, "MOV Structural Evaluation". PI-3 criteria were based on the original valve design requirements as specified in the plant final safety analysis report, original construction valve specifications and subsequent plant licensing items, such as the SEP and GL 89-10.

With the exception of Millstone Unit 3, the original design code requirements were not stress (i.e., thrust) based criteria. The lack of thrust based limits would have precluded comparison with as-left and design-basis thrust values. With the exception of the valve actuator and stem nut, pressure and non-pressure boundary components of valves were evaluated to Section III of the ASME B&PV Code in accordance with PI-3 instructions. This in effect constituted a voluntary Backfit for Haddam Neck, Millstone Unit 1, and Millstone Unit 2.

Once the allowable stress was identified, the maximum thrust capacity of each structural element was solved for and tabulated in the weak link analysis. Additional thrust or torque limits were also developed which defined the threshold that, if exceeded during testing / set-up, would require engineering evaluation through more refined analysis techniques for potential corrective actions including inspection and / or replacement of weak link parts.

Included in the weak link analyses described above, NU has also evaluated the structural effects of motor actuator stall loads on the pressure boundary parts of MOV's for actuators which have been modified such that the resultant thrust output of the actuator at stall has been significantly increased.[11] Part of the structural limits developed in the weak link analyses have included allowable thrust or torque under motor actuator stall conditions.

The purpose of this additional evaluation was to ensure the resultant increase in stall thrust output of the modified actuator would not introduce a malfunction of the MOV different than any evaluated previously in the safety analysis report. The analysis compared the thrust or torque output at stall to the MOV's pressure boundary structural capacity and confirmed the valve's pressure boundary integrity was maintained. NU believes this analysis provided assurance that if a modified actuator developed stall thrust, the pressure boundary of the MOV would not be breached.

Conformance to the ASME B&PV Code allowable stress criteria and PI-3 requirements as well as meeting the analytical and testing acceptance criterion of all other applicable Project Instructions in NU's MOV Program Manual have confirmed both the integrity of the pressure boundary as well as the functionality of the MOV.

10.1.1 Load Cases and Combinations

The valve components were evaluated for the following loading combinations for the valve opening and closing directions. Loads due to pressure, deadweight, seismic, other occasional loads (such as water hammer, blowdown and other hydrodynamic loads, if applicable), and thrust / torque were included in the weak link analysis.

10.1.1.1 As-Left Load Combinations (Design Basis)

Table 11: As-Left Load Combination (Design Basis)

Condition	Load Combination
Normal	Pa + DW + Thrust/Torque
OBE	Pa + OBE + DW + Thrust/Torque
SSE	Pa + SSE + DW + Thrust/Torque

where:

DW = Loads due to dead weight of the valve components including the operator.
Pa = Loads due to the maximum pressure of: design, operating, design accident or a valve mispositioning event (as applicable) per GL 89-10.
OBE = Loads due to the operating basis earthquake.
SSE = Loads due to the safe shutdown earthquake.
Thrust/Torque = Operational loads due to simultaneous seating stem thrust and torque loads acting on the valve components. For purposes of this evaluation the torque shall be taken as the stem thrust load times the stem factor.

10.1.1.2 Non-As-Left Load Combinations

The valve components are also evaluated for the following MOV Program test (i.e., set-up) conditions for the appropriate valve direction (opening, closing).

Table 12: Non-As-Left Load Combinations

Condition	Load Combination
Static Test:	DW + P_t + Thrust/Torque
Dynamic Test:	DW + P_t + Thrust/Torque

where:

DW and Thrust/Torque as defined above
P_t = Loads due to actual operating line / dynamic pressure during valve test.

10.1.1.3 Stall Load Combination

For MOV's which needed to be evaluated for stall in accordance with NU's position on stall evaluations discussed above or, when the valve had been stroked in a manner which resulted in a stall event, the valve components were evaluated for the following motor stall conditions for the appropriate valve direction.

Table 13: Stall Load Combination

Condition	Load Combination
Stall:	DW + P_a + Thrust/Torque

where:

DW and P_a as defined above
Thrust/Torque = Stall load as determined in accordance with Appendix E of PI-3.

10.1.2 Use of EPRI MOV Stem Thrust Prediction Method for Westinghouse Flexible Wedge Gate Valves, TR-103233 - Draft - December 1994

Westinghouse flexible wedge gate valves employ a unique stem-to-disk assembly and disc guiderail design. Due to this unique design, during high differential pressure closing strokes, the disk is free to translate relative to the stem in a direction parallel to fluid flow. Under these conditions the translation of the disk imparts an added bending moment on the stem which has the potential of being significant and reduces the structural capacity of the valve stem in the closed stroke direction.

Kalsi Engineering has developed a draft methodology for EPRI (TR-103233) which evaluates the effects on the stress in the valve stem resultant from this added bending moment. Recognize that the reduction in valve stem closing allowable thrust could potentially affect the function of these Westinghouse flexible wedge gate valves . NU acted pro-actively, employing an as yet unpublished methodology in addition to our traditional analyses per PI-3. There are no MOV's in the MP3 MOV Program which meet the criteria of this valve design in conjunction with a design basis requirement to close under high differential pressure conditions.

10.2 Valve Operator Limits

Similar to the "weak link" analysis for the valve, the operator's manufacturer (i.e., Limitorque) established limiting operating parameters for the operator. Situations occurred across the industry where the operator's limits would not allow attainment of the forces required to ensure the associated valve's operation under design-basis conditions. Thus, several utilities combined resources to fund a study by Kalsi Engineering to justify increasing the published limits.

Northeast Utilities became an active participant in the Limitorque Phase I and II Overload Testing Program being conducted by Kalsi Engineering, Inc. The Phase I portion of this program provided the necessary testing and analysis to substantially increase the published thrust rating for Limitorque operator sizes SMB-000 through 1. The thrust rating for each size operator was increased to 162% of the published thrust rating for 2000 cycles or 200% of the published rating for 763 cycles. This report was reviewed and approved by the NU MOV Engineering group for use at Millstone Unit 3. Applicable Target Thrust Calculations incorporate the Limitorque Technical Update 92-01 (use of 140% thrust rating). On a case basis, Kalsi reports are also utilized, as appropriate, in accordance with PI-9, "Determination of Stem Thrust Requirements".

As an extension to the Phase I thrust overload test results, the Phase II program was initiated in March 1992 to qualify the SMB-2 and the SB-000 through 2 operator design to larger thrust ratings. In addition, the torque carrying capabilities of the H0BC and the SMB-000 through SMB-2 operators were chosen for further study. The results provide additional margin and extend the results of the Phase I study to a broader population of motor operated valves at Millstone Unit 3. We also have the software for determining fatigue life for greater than rated torque.

We have extended the rating of SB operators based on Kalsi Engineering's Phase II report, "Thrust Rating Increase of Limitorque SB-00 Through SB-2 Spring Compensator Assemblies and SB-00 Through SB-1 Operators," Document No. 1799C, Rev. 0, October 7, 1994. On January 30 ,1995, Limitorque issued a letter to Kalsi Engineering concurring with the conclusions of the Kalsi Phase II Report.

10.3 Electrical

Calculations were performed to determine the motor-operated valve minimum terminal voltage using locked rotor current and to use the appropriate Limitorque operator factors and design thrust values in the Limitorque sizing equations to determine correct operator motor sizing.

For alternating current (AC) MOV's, a motor control center (MCC) voltage corresponding to the minimum degraded bus voltage was used to supply the motor-operated valve feeder cables. This degraded voltage was based on load flow calculations assuming a hypothetical minimum switchyard grid voltage and accident (LOCA) bus loadings in accordance with PI-4, "AC and DC Motor Terminal Voltage Evaluation."

The cable voltage drop is developed using a constant impedance motor model for a given ambient temperature (90°C). The model was developed from the locked rotor current and the nameplate voltage. In response to Limitorque Part 21, Reliance actuator motors were derated due to ambient operating temperature in accordance with PI-4. Additionally, Millstone Unit 3 calculations applied this derate to the five actuators with non-Reliance motors in accordance with recent non-Reliance motor studies.[12] For valves located in areas where the maximum design-basis accident (DBA) temperature exceeded 40°C, the derating was applied to the starting current for that valve motor at the maximum DBA temperature. The derate accounts for the resistive rise in the motor at elevated temperatures.

The cable size, cable lengths, and thermal overload and magnetic coil resistances were obtained for all of the listed 460V AC motor operated valves. Power factors for locked rotor torque conditions were obtained from Limitorque. The cables were derated to elevated temperatures, and the cable voltage drop / motor terminal voltage was calculated for each MOV. These motor terminal voltages were then used to determine appropriate motor sizing using the Limitorque sizing equation.

10.3.1 Motor Performance Factors

Defined below are the values used for various motor performance factors:

- Motor rating

  We use 100 percent of nameplate rating for the motor.

- Efficiencies used in open and close directions

  The source for open and close efficiencies is the Limitorque Sizing and Selection Procedure dated November 9, 1990. For AC motors we use pullout efficiency in the open direction, running efficiency in the closed direction, and stall efficiency for stall calculations. For DC motors we use pullout efficiency in both the open and closed direction. Millstone Unit 3 does not have any DC motor MOV's in the GL 89-10 program.

- Application factor

  We use an application factor of 1.0 to determine motor capability for target thrust / torque calculations.

- Power factor used in degraded voltage calculations

  PI-4, "AC and DC Motor Terminal Voltage Evaluation," requires the use of the power factor supplied by the motor operator manufacturers for the

specific motor at Locked Rotor Current. If the value is not available from the manufacturer, we assume a 0.8 power factor.

10.3.2 Effects of Design-Basis Degraded Voltage on MOV Performance

PI-4, "AC and DC Motor Terminal Voltage Evaluation," provides instructions for performing minimal terminal voltage evaluations for AC and DC powered MOV's. This evaluation provides direct input to the motor derate output torque evaluation which is then input to PI-9, "Determination of Stem Thrust Requirements," for evaluating the effects of degraded voltage at design-basis conditions.

PI-4 uses locked rotor current at degraded voltage conditions to determine motor terminal voltage. Because this is beyond the current licensing basis of the Millstone Unit 3 and Millstone nuclear units, when operability issues arise, (e.g., when inadequate motor terminal voltage is predicted during the course of a degraded voltage calculation), additional MOV specific calculations will be performed with less restrictive assumptions (e.g., use of starting current).

10.4 Design Thrust

The following equation is used for design set-up with gate and globe valves.

Equation 2: $\text{Design Thrust} = (DP \times A_{SEAT} \times VF) + PL \pm PE$

DP = Differential Pressure for the open or close stroke.

A_{SEAT} = valve seat area = $(3.14159 * D^2) / 4$, where D is the mean seat diameter that most closely reflects the contact surface at the seat to disc interface. For plug-in-cage globe valves with piston / guide rings on the plug, the guide rings determine the D_p area rather than the seating diameter.

VF = Refer to Table 14 for the valve factor selection criteria for gate valves.
= 1.1 for globe valves.

PL = Packing Loads are assumed as follows:

Packing Load	Valve Stem Diameter
1000 lb.	$\leq$ 1.0 in.
1500 lb.	> 1.0 in. $\leq$ 1.5 in.
2500 lb.	> 1.5 in. $\leq$ 2.5 in.
4000 lb.	> 2.5 in. $\leq$ 4.0 in.
5000 lb.	> 4.0 in.

PE = Piston Effect (PE) is calculated as follows:

(1) Gate Valve: PE = Valve Stem Area x Line Pressure (LP)
(2) Globe Valve: PE = Valve Stem Area x (LP - DP)

Post set-up, static and dynamic testing valve factors, packing loads, and rate of loading (ROL) values are revised appropriately, if measured values exceed design set-up values.

10.5 Valve Factor

NU's technical position on gate valve, valve factors (Vf's) reflects the "best available knowledge." Actions taken by NU in response to the November 30, 1993, NRC Information Notice,[13] addressing valve factor data, are contained in a memo[14] in the MOV Program Manual. The MOV Program Manual provides the criteria used to choose Vf for gate valves in the GL 89-10 program for operability, design set-up and for GL 89-10 closure.

"Best available data" was derived from quality assurance (QA) reviewed EPRI Performance Prediction Program (PPP) valve test results,[15] other industry testing, and guidance contained in Reference 16. EPRI results confirm 1.1 is an appropriate value for globe valve design set-up. However, evaluation of this information prompted the adoption of increased valve factors for gate valves in many cases. Prior to this change NU had used vendor supplied valve factors or had assumed a 0.3 Vf for gate valves. A comparison of NU GL 89-10 MOV's was made to the valves tested in the EPRI program. The results of this comparison[17] revealed no matches between EPRI valves and NU non-dynamically testable MOV's.

Table 14 summarizes the criteria used by NU for different categories of gate valve Vf's under varying plant conditions and for different phases of the MOV Program.[14] These values are used to achieve flow isolation in the close direction and are assumed to be applicable in the open direction. The "Design Set-up" values were used in conjunction with PI-9 during the preparation of target thrust calculations.

Table 14: Gate Valve Vf Criteria

Category	Operability	Design Set-up	GL 89-10 Closure	Comment
Dynamically Testable	Dynamic Test	≥ 0.4 (Note 1)	Measured Vf or 0.3: Whichever is Greater	Adjust for Design Basis Conditions (Notes 2 and 3)
Non-Testable: Wedge Gate	Interim: ≥ 0.4 After 1st RFO: PPM or Other	≥ 0.6 (Notes 4 and 5)	EPRI PPM or Other	Interim Operability (Note 6) Other (Note 7)
Non-Testable: Parallel Disc	Interim: ≥ 0.4 After 1st RFO: PPM or Other	≥ 0.4 (Note 8)	EPRI PPM or Other	Note 8
Testable: NOT Planned for Dynamic Test	EPRI PPM, or Grouping, or Other	≥ 0.9 or Grouping Vf	EPRI PPM or Grouping Vf or Other	Vf ≥ 0.9 (Note 9)

Notes:[14] (1) This value includes margin for "preconditioning or aging" effects. NU will continue to monitor this effect during testing and through industry data, making adjustments as necessary.

(2) Definitive determination of Vf and operability will be provided by dynamic testing properly adjusted to Design Basis conditions.

(3) A Vf lower than 0.3 may be used if justified by test results.

(4) EPRI data indicates a Vf of 0.4 is a bounding value for stellite surfaces under high contact stress, flat-on-flat disc-to-seat contact, at temperatures above 350°F. An allowance of 0.2 is provided to allow for "poor geometry" and the differences between mu and Vf.

(5) With the torque switch bypassed until flow isolation, the thrust at this Vf constitutes the design-basis thrust due to dynamic conditions to be used for structural evaluation.

(6) Use of a Vf ≥ 0.4 is an interim operability screening value for use at each unit until their first refueling after December 4, 1993. This is a more realistic number than the 0.3 Vf previously used in NU's MOV Program Manual. A 0.4 Vf bounds about 50% of EPRI blowdown tests; is the minimum value stated in Reference[16]; and is a "good geometry" bounding value for high contact stress, flat-on-flat disc-to-seat contact, at temperatures above 350^0F. It is not considered a conservative value.

(7) "Other" includes technically justifiable approaches, e.g. special tests, analysis, etc.

(8) A 0.4 Vf bounds the limited EPRI PPP test data for parallel-disc Anchor-Darling gate valves at temperatures > 350^0F. This is also consistent with the results of blowdown testing performed by Anchor-Darling. EPRI testing also indicates 0.4 is a bounding value for high contact stress, flat-on-flat disc-to-seat contact, at temperatures above 350^0F.

(9) A 0.9 Vf bounds virtually all empirical data for gate valves.

Valve factors and measured rate of loading values for each MOV are provided in Table 15. The shaded areas represent MOV's set-up on limit switch or torque switch bypass control.

Table 15: Valve Factors and Rate of Loading

Valve Number	Valve Factor		Rate of Loading
	Close	Open	
3CCP*MOV045A	N/A	N/A	
3CCP*MOV045B	N/A	N/A	
3CCP*MOV048A	N/A	N/A	
3CCP*MOV048B	N/A	N/A	
3CCP*MOV049A	N/A	N/A	
3CCP*MOV049B	N/A	N/A	
3CCP*MOV222	N/A	N/A	
3CCP*MOV223	N/A	N/A	
3CCP*MOV224	N/A	N/A	
3CCP*MOV225	N/A	N/A	
3CCP*MOV226	N/A	N/A	
3CCP*MOV227	N/A	N/A	
3CCP*MOV228	N/A	N/A	
3CCP*MOV229	N/A	N/A	
3CHS*LCV112B	0.6*	0.6*	
3CHS*LCV112C	0.6*	0.6*	
3CHS*LCV112D	0.6	0.6	
3CHS*LCV112E	0.6	0.6	
3CHS*MV8100	1.1	1.1	
3CHS*MV8104	1.1	1.1	
3CHS*MV8105	0.341	0.218	-5.6
3CHS*MV8106	0.097	0.167	4.2
3CHS*MV8109A	1.1	1.1	
3CHS*MV8109B	1.1	1.1	
3CHS*MV8109C	1.1	1.1	
3CHS*MV8109D	1.1	1.1	
3CHS*MV8110	0.47	N/A	-25.7

Valve Number	Valve Factor		Rate of Loading
	Close	Open	
3RHS*MV8701A	0.6	0.33	
3RHS*MV8701B	0.6	0.585	
3RHS*MV8701C	0.6	0.33	
3RHS*MV8702A	0.6	0.6	
3RHS*MV8702B	0.6	0.329	
3RHS*MV8702C	0.6	0.159	
3RHS*MV8716A	0.4	0.508	
3RHS*MV8716B	0.554	0.574	
3RSS*MOV20A	N/A	N/A	
3RSS*MOV20B	N/A	N/A	
3RSS*MOV20C	N/A	N/A	
3RSS*MOV20D	N/A	N/A	
3RSS*MOV23A	N/A	N/A	
3RSS*MOV23B	N/A	N/A	
3RSS*MOV23C	N/A	N/A	
3RSS*MOV23D	N/A	N/A	
3RSS*MOV38A	0.4	0.399	20.7
3RSS*MOV38B	0.4	0.571	
3RSS*MV8837A	0.521	0.44	-3.0
3RSS*MV8837B	0.341	0.183	-21.0
3RSS*MV8838A	0.6	0.6	
3RSS*MV8838B	0.6	0.6	
3SIH*MV8801A	0.4	0.367	6.8
3SIH*MV8801B	0.4	0.326	2.4
3SIH*MV8802A	0.25	0.327	-0.7
3SIH*MV8802B	0.4	0.4	
3SIH*MV8806	0.6*	0.6	

Valve Number	Valve Factor		Rate of Loading
	Close	Open	
3CHS*MV8111A	1.1	N/A	-1.1
3CHS*MV8111B	0.838	N/A	9.4
3CHS*MV8111C	1.06	N/A	8.2
3CHS*MV8112	1.1	1.1	
3CHS*MV8116	1.08	N/A	5.4
3CHS*MV8438A	0.163	0.142	-0.4
3CHS*MV8438B	0.3	0.226	6.9
3CHS*MV8438C	0.3	0.158	
3CHS*MV8468A	0.6*	0.6	
3CHS*MV8468B	0.6*	0.6	
3CHS*MV8507A	0.6	0.6	
3CHS*MV8507B	0.6	0.6	
3CHS*MV8511A	1.1	1.1	
3CHS*MV8511B	1.1	1.1	
3CHS*MV8512A	1.1	1.1	
3CHS*MV8512B	1.1	1.1	
3CMS*MOV24	1.1	1.1	
3CVS*MOV25	1.1	1.1	
3FWA*MOV35A	0.208	0.252	4.7
3FWA*MOV35B	0.458	0.366	9.7
3FWA*MOV35C	0.363	0.286	-0.5
3FWA*MOV35D	0.29	0.16	-1.6
3IAS*MOV72	1.1	1.1	
3LMS*MOV40A	1.1	1.1	
3LMS*MOV40B	1.1	1.1	
3LMS*MOV40C	1.1	1.1	
3LMS*MOV40D	1.1	1.1	
3MSS*MOV17A	1.1	1.1	
3MSS*MOV17B	1.1	1.1	
3MSS*MOV17D	1.1	1.1	
3MSS*MOV18A	0.6	0.6	
3MSS*MOV18B	0.6	0.6	
3MSS*MOV18C	0.6	0.6	
3MSS*MOV18D	0.6	0.6	
3MSS*MOV74A	1.1	1.1	
3MSS*MOV74B	1.1	1.1	
3MSS*MOV74C	1.1	1.1	
3MSS*MOV74D	1.1	1.1	
3QSS*MOV34A	N/A	N/A	
3QSS*MOV34B	N/A	N/A	
3RCS*MV8000A	0.6	0.6	
3RCS*MV8000B	0.6	0.6	
3RCS*MV8098	1.1	1.1	
3RHS*FCV610	1.1	1.1	
3RHS*FCV611	1.1	1.1	

Valve Number	Valve Factor		Rate of Loading
	Close	Open	
3SIH*MV8807A	0.6	0.6	
3SIH*MV8807B	0.6	0.6	
3SIH*MV8813	0.18	0.18	1.7
3SIH*MV8814	1.25	1.1	-22.9
3SIH*MV8821A	0.44	0.21	-2.0
3SIH*MV8821B	0.41	0.357	-6.7
3SIH*MV8835	0.436	0.178	-4.6
3SIH*MV8920	1.1	1.1	
3SIH*MV8923A	0.6	0.6	
3SIH*MV8923B	0.6	0.6	
3SIH*MV8924	0.6*	0.6	
3SIL*MV8804A	0.6	0.6	
3SIL*MV8804B	0.6	0.6	
3SIL*MV8808A	0.6	0.6	
3SIL*MV8808B	0.6	0.6	
3SIL*MV8808C	0.6	0.6	
3SIL*MV8808D	0.6	0.6	
3SIL*MV8809A	0.51	0.642	-0.03
3SIL*MV8809B	0.4	0.4	-10.3
3SIL*MV8812A	0.6	0.6	
3SIL*MV8812B	0.6	0.6	
3SIL*MV8840	0.4	0.4	
3SWP*MOV024A	N/A	N/A	
3SWP*MOV024B	N/A	N/A	
3SWP*MOV024C	N/A	N/A	
3SWP*MOV024D	N/A	N/A	
3SWP*MOV050A	N/A	N/A	
3SWP*MOV050B	N/A	N/A	
3SWP*MOV054A	N/A	N/A	
3SWP*MOV054B	N/A	N/A	
3SWP*MOV054C	N/A	N/A	
3SWP*MOV054D	N/A	N/A	
3SWP*MOV057A	N/A	N/A	
3SWP*MOV057B	N/A	N/A	
3SWP*MOV057C	N/A	N/A	
3SWP*MOV057D	N/A	N/A	
3SWP*MOV071A	N/A	N/A	
3SWP*MOV071B	N/A	N/A	
3SWP*MOV102A	N/A	N/A	
3SWP*MOV102B	N/A	N/A	
3SWP*MOV102C	N/A	N/A	
3SWP*MOV102D	N/A	N/A	
3SWP*MOV115A	N/A	N/A	
3SWP*MOV115B	N/A	N/A	

* Our standard non-testable, "default" valve factor of 0.6 has been used for these valves while KEI Gate calculations are being finalized. Any final valve factors above 0.6 will require a revision to this report.

10.6 Stem Factor / Stem Friction Coefficient

Millstone Unit 3 calculations use a stem factor based on a friction coefficient of $\mu = 0.18$ or greater for all valves unless justification is provided. This assumption is based on information and experience from the following sources:

- Industry experience
- Testing performed by Northeast Utilities
- Limitorque sizing procedures
- Millstone Unit 3 NCR 393-438, "MOV Stem / Stem Nut Coefficient of Friction," dated September 25, 1993.
- NMAC Application Guide for Motor Operated Valves in Nuclear Power Plants, NP-6660-D
- EPRI Stem/Stem-Nut Lubrication Test Report, TR-102135

The actuator of an MOV produces torque. For rising stem valves, the torque produced is converted to thrust at the stem and stem-nut interface, or yoke-nut for rising rotating MOV's. The stem and stem-nut / yoke nut is a power screw which in most cases uses ACME threads. The efficiency of conversion of torque to thrust by the stem and stem-nut / yoke-nut is called the "Stem Factor." The stem factor is determined by stem geometry and the coefficient of friction between the stem and the stem-nut / yoke-nut. Since the geometry of a given stem is fixed, any change in coefficient of friction will change the stem factor.

Industry testing has shown that the coefficient of friction can vary over a range of about 0.08 to 0.20. This range of friction coefficient can change the output thrust for a given torque input by 250%, thereby potentially effecting its ability to perform its intended function. Determining and maintaining a stem to stem-nut coefficient of friction is dependent upon mechanical condition, lubricant used, lubricant condition, and preventive maintenance practices.

Measurement of torque and thrust under static conditions may not provide an accurate representation of coefficient of friction for the design-basis condition. Under static running load conditions, the load on the stem to stem-nut is not high enough to maintain even contact loads between the stem and stem-nut, causing the two to "float". This produces large swings in the measured coefficient of friction. Measurements taken at static torque switch trip can also be misleading, since at this point in the valve stroke there is little or no actual rotational movement. Under this condition, the measured coefficient of friction although consistent, will usually be lower than the actual value under design-basis conditions.

Northeast Utilities has validated the assumed $\mu = 0.15$ by monitoring torque and thrust during selective dynamic tests for Haddam Neck, Millstone Unit 1, and Millstone Unit 2 for valves with similar lubrication practices. Millstone Unit 3 testing indicated that $\mu = 0.18$ would bound data obtained. The disposition of NCR 393-438 identified past lubrication practices as the root cause for higher coefficient of friction. Table 16 provides the results of all applicable valid stem coefficient data measured in NU's MOV Program to date. As can be seen, $\mu = 0.15$ bounds 100 percent of the data for Haddam Neck, Millstone Unit 1, and Millstone Unit 2. For Millstone Unit 3, $\mu = 0.18$ bounds 100 percent of the test data.

A review of EPRI PPP data at flow cutoff shows >> 99% of the data being below 0.15. This review covered in excess of 800 strokes. This adds significant credibility to NU's use of 0.15 as a bounding value.

Table 16: Measured Stem to Stem-Nut Coefficient of Friction (μ)

Valve	Dynamic COF	
	Close	Open
BA-MOV-373	0.046	
CH-MOV-257	0.103	0.119
CH-MOV-257B	0.103	0.119
CH-MOV-292B	0.031	0.063
CH-MOV-292C	0.068	
SI-MOV-861C	0.120	
SI-MOV-871B	0.133	0.085
1-CS-21B	0.106	
1-LP-7A	0.096	
2-FW-44	0.150	
2-MS-201	0.068	
2-MS-202	0.091	
3CHS*MV8106	0.179	
3CHS*MV8116	0.153	
3CHS*MV8438A	0.146	
3FWA*MOV35A ('93)	0.100	
3FWA*MOV35A ('93)	0.135	
3FWA*MOV35B	0.156	
3FWA*MOV35D	0.103	
3RHS*MV8702B		0.093
3RHS*MV8702C		0.091
3RHS*MV8716A	0.109	
3RSS*MV8837A	0.155	
3RSS*MV8837B	0.125	
3SIH*MV8801A	0.153	

Where possible, NU's MOV's were tested using the VOTES Torque Cartridge / Quick Stem Sensor (VTC / QSS) to validate our selection of friction coefficient. Currently we have obtained 29 data points for coefficient of friction for the four Connecticut units. These data points were obtained under dynamic (i.e., flow and differential pressure) conditions, to best represent design-basis conditions. As noted, all data points are below 0.15 for Haddam Neck, Millstone Unit 1, and Millstone Unit 2, and below 0.18 for Millstone Unit 3; therefore validating our assumption. To add further rigor to NU's MOV Program, we are assessing the use of statistical analysis of our final data set (post Millstone Unit 1 completion) as a validation methodology. This will require additional data to permit meaningful statistical analysis.

10.7 Margin

The definition of margin varies from one licensee to another. Making simple comparisons of the numerical value is an unreliable indication. For example, NU's quoted margin is approximately 20 percent greater than a licensee who uses 0.5 for a non-testable gate valve factor, if all other parameters are the same. The definition of margin is provided below:

$$\text{Equation 3: } Margin = \left(\frac{Thrust_{available} - Thrust_{required}}{Thrust_{required}} \right) \times 100\%$$

Listed in Table 17 is the margin for the safety stroke for each valve. Also included is the periodic testing priority for each MOV (see Section 14.3). Open margin was not calculated for globe valves which have flow under the seat, and is indicated in the table by FUS (flow under seat). The flow would assist in opening the valve and the resulting open margin values would be very large. The information in the table is presented to demonstrate design-basis closure. Future changes will be controlled by existing NU procedures.

Table 17: Margin

Valve Number	Periodic Testing Priority	Close Margin (%)	Open Margin (%)	Valve Number	Periodic Testing Priority	Close Margin (%)	Open Margin (%)
3CCP*MOV045A	2	31	32	3RHS*MV8701A	2	26	57
3CCP*MOV045B	2	61	119	3RHS*MV8701B	2	226	49
3CCP*MOV048A	2	6	32	3RHS*MV8701C	2	44	89
3CCP*MOV048B	2	104	144	3RHS*MV8702A	2	190	55
3CCP*MOV049A	2	15	23	3RHS*MV8702B	2	25	57
3CCP*MOV049B	2	94	47	3RHS*MV8702C	2	1	206
3CCP*MOV222	2	34	61	3RHS*MV8716A	2	183	100
3CCP*MOV223	2	53	84	3RHS*MV8716B	2	259	96
3CCP*MOV224	2	46	84	3RSS*MOV20A	1	16	
3CCP*MOV225	2	106	84	3RSS*MOV20B	1	16	
3CCP*MOV226	2	157	171	3RSS*MOV20C	1	16	
3CCP*MOV227	2	147	84	3RSS*MOV20D	1	16	
3CCP*MOV228	2	82	99	3RSS*MOV23A	2	100	
3CCP*MOV229	2	126	157	3RSS*MOV23B	2	95	
3CHS*LCV112B	1	17	111	3RSS*MOV23C	2	100	
3CHS*LCV112C	1	26	167	3RSS*MOV23D	2	95	
3CHS*LCV112D	1	0	72	3RSS*MOV38A	2		136
3CHS*LCV112E	1	2	75	3RSS*MOV38B	2		136
3CHS*MV8100	1	557	FUS	3RSS*MV8837A	1		160
3CHS*MV8104	2		FUS	3RSS*MV8837B	1		160
3CHS*MV8105	1	16		3RSS*MV8838A	2		102
3CHS*MV8106	1	5		3RSS*MV8838B	2		60
3CHS*MV8109A	2	469	FUS	3SIH*MV8801A	1	119	46
3CHS*MV8109B	2	641	FUS	3SIH*MV8801B	1	41	70
3CHS*MV8109C	2	566	FUS	3SIH*MV8802A	2		142
3CHS*MV8109D	2	484	FUS	3SIH*MV8802B	2		92
3CHS*MV8110	1	39		3SIH*MV8806	2	47	
3CHS*MV8111A	1	28		3SIH*MV8807A	1		49
3CHS*MV8111B	1	20		3SIH*MV8807B	1		29
3CHS*MV8111C	1	16		3SIH*MV8813	1	59	
3CHS*MV8112	1	501	FUS	3SIH*MV8814	1	64	
3CHS*MV8116	2		FUS	3SIH*MV8821A	2	24	
3CHS*MV8438A	2	107		3SIH*MV8821B	2	38	
3CHS*MV8438B	2	83		3SIH*MV8835	2	33	
3CHS*MV8438C	2	34		3SIH*MV8920	1	175	
3CHS*MV8468A	2	5		3SIH*MV8923A	2	55	
3CHS*MV8468B	2	0		3SIH*MV8923B	2	50	

Valve Number	Periodic Testing Priority	Close Margin (%)	Open Margin (%)
3CHS*MV8507A	2		186
3CHS*MV8507B	2		184
3CHS*MV8511A	1	152	FUS
3CHS*MV8511B	1	146	FUS
3CHS*MV8512A	1	2	
3CHS*MV8512B	1	9	
3CMS*MOV24	2	179	
3CVS*MOV25	2		FUS
3FWA*MOV35A	2	7	
3FWA*MOV35B	2	52	
3FWA*MOV35C	2	82	
3FWA*MOV35D	2	104	
3IAS*MOV72	2	375	
3LMS*MOV40A	2	330	
3LMS*MOV40B	2	319	
3LMS*MOV40C	2	512	
3LMS*MOV40D	2	603	
3MSS*MOV17A	2	166	
3MSS*MOV17B	2	75	
3MSS*MOV17D	2	97	
3MSS*MOV18A	2	33	
3MSS*MOV18B	2	25	
3MSS*MOV18C	2	32	
3MSS*MOV18D	2	26	
3MSS*MOV74A	2		FUS
3MSS*MOV74B	2		FUS
3MSS*MOV74C	2		FUS
3MSS*MOV74D	2		FUS
3QSS*MOV34A	1	52	6
3QSS*MOV34B	1	52	6
3RCS*MV8000A	1	1	16
3RCS*MV8000B	1	1	16
3RCS*MV8098	2		FUS
3RHS*FCV610	2	753	FUS
3RHS*FCV611	2	1075	FUS

Valve Number	Periodic Testing Priority	Close Margin (%)	Open Margin (%)
3SIH*MV8924	2	96	
3SIL*MV8804A	1		58
3SIL*MV8804B	1		54
3SIL*MV8808A	2		100
3SIL*MV8808B	2		102
3SIL*MV8808C	2		102
3SIL*MV8808D	2		95
3SIL*MV8809A	1	180	
3SIL*MV8809B	1	356	
3SIL*MV8812A	1	448	
3SIL*MV8812B	1	454	
3SIL*MV8840	2	495	
3SWP*MOV024A	2	79	79
3SWP*MOV024B	2	79	79
3SWP*MOV024C	2	79	79
3SWP*MOV024D	2	79	79
3SWP*MOV050A	1	15	43
3SWP*MOV050B	1	26	12
3SWP*MOV054A	1		15
3SWP*MOV054B	1		128
3SWP*MOV054C	1		15
3SWP*MOV054D	1		73
3SWP*MOV057A	2	52	
3SWP*MOV057B	2	44	
3SWP*MOV057C	2	49	
3SWP*MOV057D	2	88	
3SWP*MOV071A	1	313	
3SWP*MOV071B	1	51	
3SWP*MOV102A	1		45
3SWP*MOV102B	1		45
3SWP*MOV102C	1		45
3SWP*MOV102D	1		16
3SWP*MOV115A	2	81	
3SWP*MOV115B	2	100	

10.8 Stem Lubrication and Springpack Relaxation

The MOV Program assumes little or no degradation of stem lubricant will occur between maintenance intervals. This is based on a preventive maintenance program, and using the "reservoir method" of stem lubrication, which limits degradation of stem lubricant. To validate this assumption, "as-found" dynamic tests may need to be performed unless another means of monitoring stem lubrication effectiveness statically can be developed. Currently, use of motor power to provide this capability without further dynamic testing is being evaluated. The small number of as-found tests conducted to date indicate that there is no lubrication degradation using the reservoir method, therefore validating our assumption that additional margin is not required. However, for those MOV's with small overall margin, we will continue to closely monitor for changes.

10.9 Selection of MOV Switch Settings

Item b. of GL 89-10 requires that methods exist for selecting and setting MOV switches (i.e., switch settings) to ensure high reliability of safety-related MOV's. MOV sizing calculations and methods for determining switch setting are described in PI-9, "Determination of Stem Thrust Requirements," memorandum MOV-RTH-93-034, "NU MOV Program: Acceptance Criteria for Gate Valve, Valve Factors (Vf),"[14] and target thrust calculations. PI-9 establishes the methodology for determining the target torque and thrust values for globe, gate, and ¼-turn valves, and the corresponding control switch settings. In addition, it provides instructions for determining a MOV's capability. The appropriate limit and torque switch settings are determined following the valve capability analysis. MOV limiter plate sizing to prevent exceeding torque based limits is also included in PI-9. It is conservative to use the motor pull-out efficiency to calculate valve thrust requirements for the open and closed cases, however it is also permissible to use the motor running efficiencies for closed cases, for AC actuators.

Design set-up calculations for determining thrust requirements and actuator capability assume the following: a valve factor of 0.4 for rising stem gate valves that will be dynamically tested; 0.6 for non-testable wedge gate valves; and 0.4 for non-testable parallel disc gate valves. For the non-testable valves or where representative dynamic conditions cannot be reasonably created, NU plans to use "best available data" in determining valve factors (e.g., the EPRI Performance Prediction Program, Kalsi Engineering evaluation, or from grouping of data from other dynamic tests). We reviewed preliminary information provided by EPRI's Performance Prediction Program and used this information as a basis for raising our valve factor assumptions from the previous standard assumption of 0.3 for wedge gate valves. For Millstone Unit 3 a stem friction coefficient of 0.18 is used for determination of actuator output thrust capability. Thrust requirements for setting of actuator torque switches are adjusted to account for diagnostic equipment inaccuracy and torque switch repeatability.

The design-basis thrust calculations specify a 1.1 margin for non-testable gate / globe valves to account for load-sensitive behavior (also known as "rate of loading"), unless the valve is on torque switch bypass (see Section 10.10). Load sensitive behavior data obtained from dynamic tests (i.e., testable gate / globe valves) is incorporated into target thrust calculations. Load sensitive behavior can reduce the thrust delivered by the motor operator under high differential pressure and flow conditions from the amount delivered under static conditions. The MOV Program allowance of 1.1 is based upon NU specific measurements statistically analyzed as a truncated normal distribution to exclude negative values (see Section 11.3). We will continue to monitor industry development of increased understanding of this phenomenon and make changes to our analysis results[18] to account for load sensitive behavior.

Four-rotor limit switches are installed on all actuators in the Millstone Unit 3 GL 89-10 program. Actual limit switch settings are in the MOV schematic diagram or ESK drawings. The following limit switch settings apply to all MOV's, unless justified for a different setup, and are documented in accordance with PI-8, "Control of MOV Settings":

> **Open Limit** - shall be set to 5% (nominally) from the full open valve position. The exact set point shall be determined on a case by case basis in order to ensure the valve does not torque into the backseat, coast into the backseat or adversely effect the stroke time of the MOV. The open limit shall be adjusted for the additional coast due to the piston effect of line pressure. The setting shall also be selected such that the valve disc does not excessively protrude into the flow stream.

Close Limit - shall be set 0 to 10% from the valve full closed position (hard seat contact / flow isolation) on limit closed valves. This setting is only applicable if the original plant design-basis utilizes the close limit switch in its control circuit and the actuator speed requires closing on limit.

Open-to-Close Bypass - shall be set greater than 5% from the full open valve position on MOV's designed to backseat only. Otherwise, there are no requirements. The "97% nominal close torque switch bypass" (CTSB) may be used. In this application the close torque switch is bypassed until flow cut off is ensured. Once the port is covered the torque switch comes back in the circuit and controls closure. A limit switch repeatability of $\pm$ 1 % shall be applied to CTSB setpoint to ensure the port is covered and the motor is cut off before hard seat contact. Use of a limit switch repeatability less than $\pm$ 1% may be justified by performing limit switch repeatability tests or via correlation to existing NU limit switch repeatability data. All limit switch repeatability data must be statistically analyzed to ensure proper sample size and to confirm the actual limit switch repeatability is within a 95% confidence range[20].

Close-to-Open Bypass - shall be set greater than 45% from the full closed valve position. This setting is critical to ensure operability of the valve. (Note: Some valves have interlocks which required setting at 20% from full closed.)

Open position indicator (green light off) - shall be set to trip within ±0% to -2% (of full stroke) of open control switch trip, for MOV's which open on limit. For MOV's which intentionally backseat, the switch shall be set in accordance with Unit Engineering requirements.

Close position indicator (red light off) - when MOV is torque closed then light shall be set no greater than 3% (of full stroke) before hard seat contact and no greater than 15% (of the distance between hard seat contact and CST) after hard seat contact. If limit switch controlled, the switch is set in accordance with an approved set-up procedure.

Intermediate Limits - Limits providing interlocks, status inputs, and special signals must be set so the limit switch at least changes state prior to the valve control switch.

For gate valves, limit control in the closing direction may be used in lieu of torque switch control, as appropriate. The limit switches associated with Limitorque actuators are used for various functions including interlocks, position indication and controlling valve position. The limit switches are gear-driven directly off the drive sleeve for models SMB-000 and SMB-00 or the worm shaft for models SMB-0 through SMB-5. With this arrangement, it is possible to adjust a limit switch to control valve position within a few hundredths of an inch. For the normal uses the limit switch is put to, this fine control is not necessary, and therefore has not been evaluated.

Control of motor-operated gate and globe valves in the closing direction is normally performed by the torque switch. In certain cases, control by use of the limit switch is desirable. These cases include high inertia, bypassing the close torque switch until flow isolation is achieved, and butterfly / plug (quarter-turn) valves. In all cases the valve is being controlled by stem position rather than

output torque. The allowable band of stem position in these situations is very small, sometimes as little a one quarter inch, so the ability to set the limit switch to control in these regions is critical.[19]

In addition to the ability to set the limit switch, some determination of the ability of the switch to trip at the same point each time must be made. The repeatability of the limit switches for Limitorque actuators is commonly reported at 2 to 3%. There has been no industry documentation of any testing or evaluation of limit switch repeatability. The purpose for which we use limit switch control of valve closure on a gate valve requires better repeatability than 2 to 3%. NU has determined limit switch repeatability for particular applications based upon statistical analysis of multiple valve strokes[20] (see Section 12.2.3).

At Millstone Unit 3, only the 46 butterfly /plug valves are set-up on limit switch control.

10.10 Torque Switch Bypass Methodology

NU has implemented a methodology of bypassing the torque switch until flow cutoff. This control configuration is similar to limit-closed configuration because the full capability of the motor actuator is available to close the valve. However, NU's torque switch bypass configuration differs because the limit switch removes the torque switch bypass until flow cutoff and not the motor power. This allows the motor to ensure the disk covers the flow path then fully seat the disk based on torque switch trip. The torque switch setting is adjusted as high as possible to provide the greatest assurance of proper valve seating under a static condition.

Using this control configuration, a possibility exists during a close stroke under dynamic conditions for the motor torque to exceed the torque switch trip setpoint, which is bypassed. As a result, when the torque switch bypass is removed (after flow cutoff), motor power will be cut off after flow is stopped and, possibly, prior to hard seat contact. NU uses information contained in EPRI's NUMAC, "Application Guide for Motor-Operated Valves in Nuclear Power Plants," as guidance on the sealing contact force required to obtain a leak-tight seal.

Torque switches are generally bypassed in the opening direction for approximately the first 45 - 65% of the stroke. The open limit switch is used to control termination of the open stroke for rising stem and rising / rotating stem valves to prevent backseating of the valve. The torque switch is bypassed in the closing direction except for the last 5-20% of the stroke. For butterfly valves, open and close torque switches are bypassed 100% of open and close travel.

11. Design-Basis Capability

11.1 In-situ Design Basis Verification Testing

Item c. of GL 89-10 requires that each MOV be tested in-situ at design-basis conditions, if practicable, to demonstrate that it is capable of performing its intended function. In addition, Item c. requires that each MOV be stroke tested at no-pressure or no-flow conditions (static testing) to verify that the MOV is operable even if testing with a differential pressure or flow cannot be performed.

PI-10, "Static Testing," establishes guidelines for developing unit-specific test procedures for performing static condition testing of MOV's.

PI-11, "Determination of In-Situ Test Capability," establishes the methodology and requirements for determining in-situ testability of MOV's at design-basis conditions. In addition, it establishes the

requirements for documenting and justifying those cases where in-situ testing cannot be practicably performed at design-basis conditions (see Calculation 89-094-1017M3, Rev. 0, dated June 27, 1995, "Determination of In-Situ Test Capability of Millstone Unit 3 MOV's."

Test procedures for in-situ design-basis verification testing are developed using established unit and station procedures and guidelines. PI-12, "Requirements for Design Basis Verification Testing," lists parameters which must be measured during the performance of in-situ tests.

The test procedures contain the test methodology, controls, and specifications for initial system conditions, test limitations, necessary differential pressures and flows, and appropriate test acceptance criteria. MOV and system parameters such as motor voltage, upstream and downstream pressure, flow, and ambient temperature are documented in pre- and post-test data sheets.

11.2 Extrapolation of Partial d/p Thrust Measurements

Uncertainty in predicting thrust required at design-basis d/p increases as one departs from testing at 100% d/p. This is a generic issue for gate valves, and to a lesser degree globe valves. Virtually all licensees have used extrapolation, typically from 50% of design-basis d/p. The NRC has reviewed and found this practice acceptable for GL 89-10 closure.[21] NU has also reviewed an evaluation of the extensive EPRI test results for gate and globe valves which validated linear extrapolation.[22]

Published EPRI results demonstrate that the friction coefficient for stellite-on-stellite *decreases* with increasing disc-to-seat contact pressure, i.e., increasing d/p. Thus, extrapolation from low d/p should be conservative. It is possible that contact stresses become so low that data scatter becomes significant.

We are using extrapolation approaches identical to that reviewed and accepted by NRC for other licensees. The approach is incorporated in a dynamic test methodology in accordance with PI-13, "Evaluation of Dynamic Test Results."

11.3 Load Sensitive Behavior

Rate of Loading (ROL) or load-sensitive behavior, as it is also called, is the condition where torque switch trip occurs at a <u>different</u> thrust under dynamic conditions than during static conditions for the same torque switch setting. For example, an MOV that achieved 20,000 lbs. of thrust at torque switch trip during a static test delivers only 17,000 lbs. under dynamic conditions. This effect is normally considered as "positive" ROL, since a positive allowance is needed to ensure sufficient thrust under dynamic conditions. "Negative" ROL has also been observed, where <u>more</u> thrust is delivered under dynamic conditions than static conditions. Some changes in torque as a function of loading profile may also occur. Equation 4 is used to determine ROL:

$$\text{Equation 4:}\quad ROL = \frac{Thrust_{(CSTStatic)} - Thrust_{(CSTDynamic)}}{Thrust_{(CSTStatic)}}$$

The mechanism that produces ROL is not well understood in the industry. It appears to be related to a change in stem factor brought about by changes in stem coefficient of friction as a result of stem lubrication. During gradual loading (dynamic conditions) stem lubrication is mostly in a boundary regime. During a rapid load increase (static test) some hydrodynamic lubrication appears to exist which decreases the coefficient of friction. During the past several years ROL has been the subject

of numerous industry presentations, discussions, and experiments. ROL was examined during the EPRI Performance Prediction Program in an attempt to quantify it. EPRI concluded that ROL was not analytically predictable.

ROL is accounted for by two methodologies, dependent upon control circuit logic. Testable MOV's are evaluated for ROL as a part of the PI-13 dynamic test evaluation. If present, the ROL will be incorporated in a revision to the thrust calculation. Both positive and negative ROL are considered. Positive ROL increases the minimum required thrust to close the valve while negative ROL decreases the maximum allowable control switch trip values.

More consideration must be given to those MOV's which are not dynamically testable. Millstone Unit 3 has 49 MOV's in this category. Of these, 10 are controlled by limit switches and require no separate specific margin for ROL. The remaining 39 MOV's all have a specific 10% margin for ROL added to their required thrust. Table 15 above (see page 39) provides the measured rate of loading values.

For non-dynamically testable torque switch controlled valves, an additional margin (e.g., the 10% noted above) is added to the calculated required thrust. Rather than use a representative but arbitrary margin allowance of 10%, we have validated this assumption by the use of ROL data obtained from Millstone Unit 3 dynamic test results. We have not chosen to use multi-plant data because our testing has shown that ROL is affected by the base oil viscosity of the grease used for stem lubrication and lubrication practices. A statistical analysis[18] was performed of this data. To provide a conservative evaluation of this data, a "truncated" normal distribution was used (see Figure 1, page 49). The method is well described in statistical literature.[23] This method eliminates all negative ROL values. This will result in a higher mean and a lower standard deviation than the use of a normal distribution.

The results of this evaluation provided a mean of 6.7% and a standard deviation of 5.1%, for a 95% confidence level that the ROL is less than 16.6%. This ROL value is combined with other sources of uncertainty using the methods outlined in Reference 24. This method uses the mean as a margin in addition to all other margins, and two standard deviations are combined with the existing errors of diagnostic system accuracy and torque switch repeatability using the Square Root Sum of Squares (SRSS) method. The result is the equivalent of a "margin multiplier" slightly less than 10%, validating our previous 10% margin allowance.

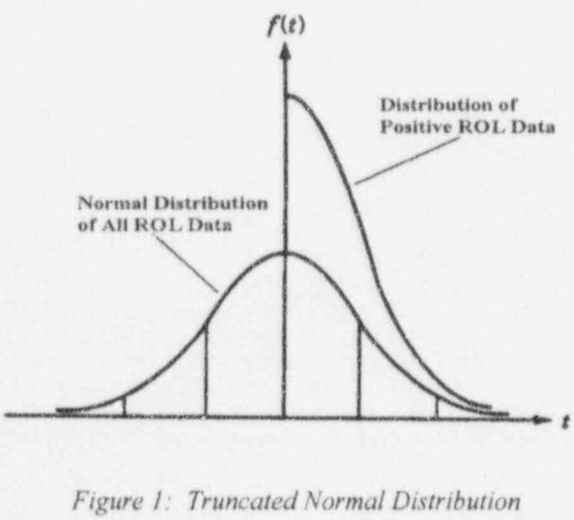

Figure 1: Truncated Normal Distribution

For MOV's that are controlled by limit switches, e.g., open direction, limit seating, and close torque switch bypass schemes, ROL is accounted for by the assumed stem-to-stem nut coefficient of friction. In this case, a separate margin is not added to the calculated minimum required, the margin is included in the assumption for coefficient of friction. In this case, the validity of the assumption is verified along with the validation of coefficient of friction.

It is felt that current setup practices are sufficient to provide assurance of the ability of non-testable valves to perform their intended safety function. Conservatisms are already included in the calculation of minimum required thrusts. These include conservative valve factors, diagnostic system inaccuracy, torque switch repeatability, worst case differential pressure, derated motor torque, theoretical packing loads, actuator application factors, worst case undervoltage factors, and stem-to-stem nut coefficient of friction.

11.4 Post-Maintenance Testing

Post-maintenance testing and lubrication requirements are defined in PI-14, "Post-Maintenance Testing and Lubrication Requirements," for MOV's which have completed a baseline set-up with diagnostic test equipment. Maintenance or modifications that affect the ability of an MOV to perform its design-basis function must be followed by a new baseline static test in accordance with GL 89-10 requirements. Listed in Table 18 are the retest requirements for various maintenance items. The Unit MOV Coordinator may modify these requirements when written justification is provided to demonstrate the activity does not effect the ability of the MOV to perform it's design-basis function.

For testable valves, a dynamic test is performed at greater than or equal to 50% of design-basis differential pressure and 80% of design-basis flow conditions, following any modification which could affect the valve factor. Machining of the seat, disc or disc guiding surfaces, when not per the original design, is evaluated by engineering to determine if the baseline dynamic test is required. If plant or system conditions do not allow a dynamic test to be performed, an analytical justification is provided which verifies the ability of the MOV to continue to perform its required functions.

Table 18: Post-Maintenance Retest Requirements

Maintenance Activity	Test	Comments
Packing Replacement	X	A P3500 test, complete VOTES Test, calculation, or other means.
Packing Adjustment	X	A P3500 test, complete VOTES Test, calculation, or other means.
Valve Disassembly	X	Dynamic test should be performed following maintenance or modification of the disk, seats, or guides. If plant or system conditions do not allow a dynamic test to be performed, provide an analytical justification to verify the ability of the MOV to continue to perform its required functions.
Cleaning and Re-lubricating Valve Stem		Grease or other approved lubricant shall be applied so that all stem surfaces that come in contact with the stem nut are well coated.
Replace Valve	X	
Torque Switch Removal	X	
Torque Switch Adjustment	X	
Motor Operator Disassembly	X	
Spring Pack Removal	X	
Spring Pack Replacement	X	
Spring Pack Adjustment	X	
Stem-Nut Removal	X	
Stem-Nut Replacement	X	

Maintenance Activity	Test	Comments
Motor Starter Contactor Replacement	X	VOTES test is not required if contactor dropout time can be shown to be at or below that determined from the previous VOTES test.
Motor Replacement (i.e. new motor)	X	Verify correct wiring and motor rotation.
Motor Rebuild	X	
Limit Switch Removal		Correct wiring must be verified and limit switch settings adjusted in accordance with approved procedures.
Limit Switch Replacement		
Limit Switch Adjustment		
Clutch Lever Removal or Replacement		
Replace any Gears	X	Baseline test for gear ratio changes or springpack removal. Static retest not required if gear ratio unchanged and only motor pinion / worm shaft gears were removed and replaced with identical parts.
Replace any Bearings	X	
Replace Declutch Shaft	X	
Handwheel Assembly Removed (SMB-00 and SMB-000 only)	X	
Motor Removal (gear box not removed)		Verify correct wiring and motor rotation.
Motor Pinion Gear and Key Removal		
Replace actuator-to-yoke or yoke-to-bonnet bolts / studs	X	Retest not required if replaced one at a time in accordance with published guidance.[25]

12. Diagnostic Test Equipment Accuracy

12.1 GL 89-10 Supplement 5

On October 2, 1992, Liberty Technologies, manufacturer of the VOTES system used at NU, issued a 10 CFR Part 21 notification regarding potential inaccuracies in thrust measurements made with VOTES. On June 28, 1993, the NRC issued Supplement 5 to inform licensees of a generic concern regarding the accuracy of MOV diagnostic equipment. Liberty Technologies determined that two new factors can affect the thrust values obtained with its VOTES equipment. Those factors involve: (1) the stem material constants, and (2) the failure to account for a torque effect when the equipment is calibrated by measuring strain of the threaded portion of a valve stem. The Supplement requested that the licensee evaluate this new information and any other information reasonably available to them and provide a written response to two requests for additional information. NU provided the additional information in a letter dated October 14, 1993.[26]

NU uses Liberty Technologies VOTES diagnostic test equipment to confirm and maintain GL 89-10 MOV torque switch and / or limit switch settings. NU also uses VOTES 2.31 software, which automatically calculates the torque correction factor (TCF), which accounts for the VOTES Part 21 thrust under-prediction measurement inaccuracy. The following is a summary of the actions taken to address the diagnostic test equipment accuracy concern:

(1) The Millstone Unit 3 performed VOTES thrust underprediction evaluations on July 12, 1993. This effort corrected as-left measured thrust values. Internal reportability evaluations were issued to address potential valve structural over-thrusts which were successfully resolved and the valves were deemed operable.

(2) NU's Engineering Department verified that all MOV measured thrust values were proper and valid.

(3) CYAPCO and NNECO's Engineering Department instituted VOTES Part 21 thrust under-prediction corrections for all MOV thrust window calculations

completed after January 1, 1993. Thrust windows incorporate the Liberty Technologies VOTES accuracy adjustment or TCF in their combined accuracy determinations. All VOTES diagnostic test systems now utilize Version 2.31 software, which automatically determines TCF. All VOTES test personnel are properly trained in the use of the 2.31 software.

(4) CYAPCO and NNECO revised the MOV Program Manual stem thrust procedure to incorporate Liberty Technologies VOTES system TCF accuracy corrections. All program thrust calculations automatically address VOTES measurement and system accuracies.

(5) During Millstone Unit 3 refueling outage 4 (1993) those valves exhibiting an over-thrust condition, due to the application of the VOTES Part 21 correction, were retested and their thrusts reduced to acceptable levels.

(6) NNECO identified and evaluated historical VOTES tests to determine if previous operating thrust setups were higher and determine if cumulative fatigue is a concern. Our evaluation corrected as-left thrust values and resulted in further evaluations to address potential valve structural over-thrusts. A detailed structural analysis was used to increase the valve's nominal thrust to greater than the over-thrust value and, subsequently, the valves were deemed operable. Detailed structural analysis for the over-thrusted valves revised the allowable design thrust. The revised thrust value for unlimited cycles exceeds the maximum thrust developed during past operation, when the thrust was under-predicted.

12.2 Diagnostic Test Equipment Requirements

PI-15, "Requirements for Test Equipment," establishes the requirements and optional parameters to be measured by MOV diagnostic test equipment. As a minimum, diagnostic test equipment will have the capability of measuring and recording the following parameters:

- Stem Thrust - measured or calculated in both the opening and closing directions.
- Stem Torque - measured in both the opening and closing directions (VTC is closed only).
- Limit, Bypass, and Torque Switch Actuation
- Motor Current
- Voltage

PI-15 specifies diagnostic test equipment calibration and system accuracy requirements. In addition, it provides general guidelines for test equipment associated with the NU MOV Program. Typically, systems and components are used from Teledyne Brown Engineering (QSS), Liberty Technologies (VOTES, STS - stem torque sensors), and calibrated strain gages. Millstone Unit 3 uses the VOTES diagnostic equipment to set the torque switches and perform diagnostic evaluations for MOV's in the GL 89-10 program.

12.2.1 Determining Accuracies

Minimum and maximum thrust requirements include margin for MOV test equipment accuracies as summarized in Table 19, with additional discussion below. These margins are combined using the square root of the sum of the squares method.

Table 19: Test Equipment Accuracy Matrix

Parameter	Accuracy
VOTES Diagnostic Test Equipment	Close: ±9% x TCF Open: ±10% x TCF
Teledyne Quick Stem Sensor (Torque and Thrust)	±9.8%
Limitorque Torque Switch Settings **above** #1 and ≤ 50 ft-lbs at TST	± 10%
Limitorque Torque Switch Settings **above** #1 and > 50 ft-lbs at TST	± 5%
Limitorque Torque Switch Settings **at** #1 and > 50 ft-lbs at TST	± 10%
Limitorque Torque Switch Settings **at** #1 and ≤ 50 ft-lbs at TST	± 20%

A diagnostic test equipment (e.g., VOTES) closed accuracy of 9% x Torque Correction Factor (TCF) and open accuracy of 10% x TCF is assumed for the purpose of target thrust calculations based on Curve Fit Accuracy (CFA) calibration for the VOTES software,[27] unless the testing is done outside the bounds of the Liberty assumptions. If outside the bounds, we contact Liberty to obtain the correct values. In cases where Best Fit Straight Line (BFSL) calibrations must be utilized, if the RSQ value is less than 0.997, the target thrust is recalculated to account for the difference in accuracy obtained via the CFA and BFSL methods.

The actual diagnostic test equipment accuracy used in post-diagnostic test analysis is taken from the calibration results obtained during performance of station specific procedures and / or the test equipment vendor manual, as appropriate. The calibration process may require technical guidance from the test equipment manufacturer to account for local physical variations or particular valve installations.

Any pressure measuring devices, permanent or temporary, used for determining system differential or line pressure during diagnostic testing have a minimum accuracy of ± 2% of the full scale reading. The pre-diagnostic test analysis assumes a ± 2% pressure instrument accuracy.

Based upon Limitorque specifications, the actual torque output for a given torque switch setting is repeatable within the values specified in Table 19. This repeatability of actuator output is applied to the allowable thrust / torque at torque switch trip as well as to the total allowable torque / thrust value which includes inertial effects after contactor dropout and minimum available thrust. The measured test values are compared to these adjusted limits.

12.2.2 Applying Accuracies

Diagnostic and test equipment accuracy factors are applied in a conservative manner to the calculated allowables and / or measured torque and thrust values, as appropriate. The overall accuracy which is applied to the MOV thrust and torque values will be the square root of the sum of the squares of the torque switch repeatability accuracy and diagnostic equipment accuracy.

Pressure instrument (gages or transducers) accuracy factors are applied directly to the appropriate calibration range of the pressure instrument (e.g., percentage of full scale reading, percentage of reading, etc.) and added or subtracted to the measured test pressure in accordance with PI-13. It is

important to note that pressure instrument accuracies are independent of the actual reading since they are a function of the full scale reading for a given instrument, unless the accuracy is expressed as a percent of reading. If pressure transducers are used it is important to use the total loop accuracy to the point where the data is being used. Corrections for elevation-head differences between installed or temporary pressure instruments and the valve are applied in accordance with PI-13 for dynamic test evaluations.

Any other combination of independent accuracy factors will be compiled using the square root of the sum of the squares method.

12.2.3 Limit Switch Repeatability

The objective of the analysis "Millstone Unit 2 Repeatability Statistical Evaluation,"[20] was to determine, at the 95 / 95 probability / confidence level, the repeatability of the limit switches for the Millstone Unit Two feedwater valve's closure from tests conducted at the site on October 6, 1993. The time from applying power to the motor on the MOV to the time when the limit switch was activated was measured on all four valves: 2-FW-38A, 2-FW-38B, 2-FW-42A and 2-FW-42B. In addition, valve closure tests were performed on 1-MS-5 at Millstone Unit One on March 16, 1994.

Each of the four feedwater (FW) valves were subjected to five test runs of the valve motor until the limit switch was activated. The results of these tests consisted of times to closure and were recorded. In addition, ten test runs of the valve motor were performed on 1-MS-5. The test results were recorded.

It is assumed that each measured valve closure time constitutes a random value from the population of all measurements. Sequential measurements on a valve are also assumed to be statistically independent and unbiased. The calculation method consisted of a sequence of steps:

1. The measurements for each valve were adjusted (transformed) by their respective mean values.
2. Basic statistics were determined for the adjusted data.
3. The W-test was applied to verify that the data can be characterized by a normal distribution (Millstone Unit 2 data only).
4. Two-sided 95/95 probability / confidence values for the adjusted valve closure times were determined.
5. The repeatability error for motor-operated valve closure times was then established by transforming the 95/95 values for adjusted valve closure times back to the original (pre-adjusted) times.

The most adverse 95/95 closure time for the five valves was used to specify the repeatability error as a percent of average closure time. The calculation concluded that the Millstone Unit One valve was bounded by a limit switch repeatability ±0.2% and the Millstone Unit Two valves were bounded by a ±0.5% limit switch repeatability.

13. Grouping

In GL 89-10 and its supplements, the NRC staff requested that licensees test each MOV under design-basis differential pressure and flow conditions where practicable. However, the staff recognized that it is not practicable to test each MOV within the scope of GL 89-10 in-situ dynamic

conditions. Therefore, if a licensee does not perform prototype testing at a test facility for each MOV that is not practicable to test in situ, the licensee will have to group MOV's that are not practicable to test in a manner that provides adequate confidence that the MOV's are capable of performing their design-basis function.

The staff continues to recommend testing MOV's under design-basis conditions where practicable. Paragraph 1 of GL 89-10 allows licensees to propose alternatives to the recommendations of the generic letter where justification is provided. Grouping data from design-basis differential pressure testing of similar MOV's at or near design-basis test conditions is an acceptable option to establish design-basis valve setup conditions.

Grouping of MOV's is performed in accordance with the requirements of GL 89-10 Supplement 6 as summarized below: identical valve design (the valves must either be of identical design or justified identical in design by performing a detailed analysis including consideration of internal dimensions and clearances), representative (but not similar) operating conditions, the MOV's have similar installation conditions and orientation, the adequacy of the valve design has been verified through review of industry and plant specific data, and number of times the valve is stroked during an operating cycle.

Dynamic testing shall be performed on at least two MOV's from a group or 30% of the group (round up to the next high number of valves when taking percentages), whichever is greater. Dynamic testing need not be performed on the remaining MOV's in the group for GL 89-10 closure. Grouping analysis methodology is contained in PI-11. The valves exempted from dynamic testing meet the requirements of PI-11, Section 3.4; GL 89-10, Supplement 6 for excluding testable valves from dynamic testing; and the following guidelines for grouped valves:

- Industry or plant specific data shows that valves in this group can perform their intended function.
- At least two (2) and no less than 30% of the number of valves in the group will be tested at or near DB conditions.
- All valves in the group have been statically tested.
- Valves in same group with higher priority, least margin, or greatest safety significance have been dynamically tested.
- The MOV's have similar installation conditions and orientations.
- Valve designs are the same or similar.
- Adverse performance results were reviewed for applicability to all MOV's in the group.
- Valve maintenance histories were reviewed to determine if valve internals are in the same condition.

Millstone Unit 3 MOV's which were grouped are indicated in Table 8.

14. Periodic Verification

14.1 Philosophy

The purpose of GL 89-10 was to ensure that safety-related MOV's are *operable*, and to the extent practical this has been verified by testing the MOV's at conditions representative of their design-basis function. The unit's licensing basis requires that these valves are operable and be maintained as operable after the *closure* of the design-basis verification phase of GL 89-10. There needs to be high confidence that *degradation* will not occur so as to erode margin or in some way render the MOV inoperable.

Item j. of GL 89-10 speaks of the need to verify "MOV switch settings because of the effects of wear or aging" (Item d.). In Item j., the licensee is requested to perform periodic testing with surveillance intervals "based upon the licensee's evaluation of the safety importance of each MOV as well as its maintenance and performance history. The surveillance interval should not exceed five years or three outages, whichever is longer, unless a longer interval can be justified for any particular MOV."

Milistone Unit 3, through implementation of the NU MOV Program, is committed to maintaining these safety-related MOV's operable in accordance with our MOV Program requirements as specified in our MOV Program Manual. Periodic testing can include static, dynamic, and motor current tests, or other acceptable diagnostic test methods. NU believes that static tests are fully effective in detecting degradation, except where valve internals have been modified or somehow degraded. We are aware that issues still exist as to the need to periodically dynamically test GL 89-10 MOV's. This was responsively considered in our approach to periodic testing (see Section 14.3).

14.2 Determination and Maintenance of Correct Switch Settings

Item d. of GL 89-10 requires licensees to prepare or revise procedures to ensure that correct switch settings are determined and maintained throughout the life of the plant. PI-8, "Control of MOV Settings," establishes the methodology for controlling changes to maximum and minimum thrust and torque settings, limiter plate sizes, limit switch setpoints, and thermal overload heater settings.

NGP 6.10, "Use of the PMMS Data Base to Indicate Quality Assurance or Special Program Applicability," provides methods for identifying which nuclear plant components have special program requirements. All MOV's within the scope of the MP3 MOV Program are included in a "special programs" PMMS screen. This action will provide a mechanism for identifying components which have special MOV Program requirements during the generation of Automated Work Orders or system reviews. This effort integrates the MOV Program as an element of the NU Configuration Management Program to help maintain the configuration management of MOV switch settings.

PEP Action Plan 2.3.2, "Design Control Manual," has been established to redesign the design control process at Northeast Utilities. This effort is integrated with PEP Action Plans 2.3.1, "Configuration Management," and 2.3.3, "Engineering Programs." The Design Control Manual will provide a mechanism for ensuring that MOV design requirements are maintained.

14.3 Position on Periodic Testing (Post Closure)

The MOV Program approach to periodic testing of GL 89-10 MOV's is as follows:

1. Post-Maintenance Testing

   This will be performed as required by PI-14, "Post-Maintenance Testing Requirements," which addresses the need for both static and dynamic testing.

2. Trending

   This is described in PI-16, "MOV Tracking and Trending Program." This PI will be enhanced by a revision to specify trending requirements in even greater detail. We consider the use of static diagnostic testing to be the core of an effective periodic testing program. It allows detection of anomalies and / or early indication of degradation. Periodic static testing will be performed on all GL 89-10 MOV's.

   - Frequency of periodic static testing will be based on the PRA ranking, with the MOV's being divided into two groups. Priority 1 will consist of MOV's with a "very high" or "high" PRA ranking; and
   - Priority 2 will consist of MOV's with a "medium" or "low" PRA ranking. The definition of "very high", "high", etc. is as defined by NU's Safety Analysis Branch. The frequency of testing will be:
     - Priority 1: Every three outages or five years, whichever is greater.
     - Priority 2: Every six outages or ten years, whichever is greater.
   - Grouping will also be employed to optimize the tested population.

3. Periodic Dynamic Testing

   Plans currently call for six supplemental dynamic tests to be performed over the next three fuel cycles to verify that design-basis capability is being maintained. MOV's will be selected with consideration of margin, safety importance, maintenance history, and other relevant considerations. The figure of six tests was determined independent of the number of GL 89-10 MOV's for the nuclear unit. These tests will be evaluated, along with other industry data which is then available to determine whether degradation, not detectable with static testing, is occurring.

These plans will be reassessed when the recently announced NRC generic letter on periodic verification is issued, and changes made if deemed appropriate.

Millstone Unit 3 will be reviewing valves with low (but acceptable) margin as potential candidates for either reclassification from periodic testing category Priority 2 to 1, or to have their torque switch settings increased at the next convenient opportunity, as appropriate.

15. Trend and Analyze MOV Failures

15.1 Tracking and Trending Requirements

Item h. of GL 89-10 requires that each MOV failure and corrective action taken, including repair, alteration, analysis, test, and surveillance, should be analyzed or justified and documented. The documentation should include the results and history of each as-found deteriorated condition, malfunction, test, inspection, analysis, repair, or alteration. PI-16, "MOV Tracking and Trending Program," establishes the tracking and trending requirements for the NU MOV Program. PI-16 requires that each MOV failure and corrective action taken, including any repair or alteration, shall be entered into the NPRDS data for their units to identify any trends.

All corrective work on MOV's is performed through the work request process. Procedures describe the method for documenting failures or nonconforming conditions that occur during operation, testing, or maintenance. Depending on the particular failure or deteriorated condition, follow-up action may include:

- Generation of a Adverse Condition Report (ACR), which replaced Plant Incident Report (PIR).
- Performance of a Root Cause Determination (RCD).
- Notification under the Nuclear Plant Reliability Data System (NPRDS).
- Generation of an additional work package(s) for follow-up or corrective maintenance.

15.2 Diagnostic Parameter Trending

MOV performance is trended to ensure that switch settings remain adequate for a given MOV throughout the life of the unit. PI-16 provides guidance on the collection of as-found testing and the collection of diagnostic test data for trending. The following performance parameters shall be trended:

- Motor running current and supply voltage at the MCC or at the motor.
- Measured maximum thrust or torque (whichever parameter is used for "baseline") at close torque switch trip and running average.
- Power factor (if found to be a quantitative parameter, otherwise motor power should be trended).
- Torque switch settings.

Valve stroke time is monitored and trended by existing nuclear unit In-Service Test (IST) Programs and will not be trended by the NU MOV Program. Our program should provide sufficient data to identify degraded MOV performance. During this RFO (1995) and last RFO (1993), 143 valves had baseline static tests performed and, effectively, 71 valves had baseline dynamic tests performed, including grouped valves.

15.3 MOV Failure Trending Using NPRDS

The NPRDS system will be used to assist in root cause investigations of MOV failures. At least once every refueling cycle (i.e., every two years or after each refueling outage), a Component Failure Analysis Report (CFAR) will be generated from the NPRDS data on record for Millstone Unit 3 to identify trends related to MOV operability as a function of the failures reported in the nuclear industry. This effort will assist in determining areas for programmatic improvement.

16. Pressure Locking and Thermal Binding

16.1 NRC Position

The NRC Office for Analysis and Evaluation of Operational Data (AEOD) completed AEOD Special Study AEOD/S92-07 (December 1992), "Pressure Locking and Thermal Binding of Gate Valves." The staff issued the AEOD report in NUREG-1275, Volume 9 (March 1993), "Operating Experience Feedback Report Pressure Locking and Thermal Binding of Gate Valves." In its report, AEOD concluded that licensees had not taken sufficient action to provide assurance that pressure locking and thermal binding will not prevent a gate valve from performing its safety function.

A memorandum dated December 20, 1993, from James T. Wiggins, Acting Director, Division of Engineering, NRR, to the Regions provided guidance on the *evaluation* of licensee activities to address pressure locking and thermal binding of gate valves. Supplement 6 to GL 89-10, dated March 4, 1994, provided information on the *consideration* of pressure locking and thermal binding of gate valves. Finally, on August 17, 1995, NRR issued GL 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves."

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 bases of their safety-related MOV's. In complying with the NRC regulations, "... licensees are expected to have evaluated the potential for pressure locking and thermal binding of gate valves and taken action to ensure that these phenomena do not affect the capability of MOV's to perform their safety-related functions. If a licensee identifies a potential for pressure locking and thermal binding of gate valves, the NRC regulations require that the licensee take action to resolve that problem."[7]

16.2 PLTB Evaluation

The initial review of the potential for pressure locking and thermal binding of gate valves at Millstone Unit 3 was performed by Stone and Webster Engineering Corporation (SWEC) in 1990.[28] Stone and Webster performed similar evaluations for the other Millstone Units and Haddam Neck. During an NRC evaluation of the GL 89-10 Program at Millstone Unit 1, the NRC reviewed the SWEC report, and identified potential deficiencies with the evaluation[29] and questioned the following assumptions:

- Excluding steam system valves from the evaluation for pressure locking,
- Excluding valves below 200°F for thermal binding and below 150 psi for pressure locking.

Since the same assumptions were used in the Millstone Unit 3 evaluation, the SWEC evaluation was revisited. During the re-evaluation, the following Adverse Condition Reports (ACR's) were initiated when there were indications of PLTB concerns with GL 89-10 MOVs: ACR's 00220 (2/27/95), 00288 (3/10/95), 00290 (3/14/95), 00935 (3/17/95), 00302 (3/25/95), 00300 (4/17/95), and 03624 (6/14/95).

All ACRs were dispositioned with all of the subject valves found to be operable. Final evaluations were performed in accordance with PI-20, "MOV Program Pressure Locking and Thermal Binding Evaluation", and documented in calculation 95-ENG-1129M3, "MP3 - MOV Pressure Locking and Thermal Binding - PI-20 Evaluations", Rev. 0 with Calculation Change Notices 1, 2, and 3, June 16, 1995.

16.2.1 Evaluation Criteria

The following criteria were used to determine if a GL 89-10 valve is susceptible to either pressure locking or thermal binding:[30]

- Pressure locking and thermal binding is only applicable to gate valves. Any valve that is not a gate valve is excluded from any further evaluation for susceptibility to pressure locking or thermal binding.
- Pressure locking and / or thermal binding of a gate valve is only a safety concern when the valve is closed and the valve is required to open to perform its safety function. Valves that are normally open and must only be closed to perform their safety function are not required to be evaluated for pressure locking or thermal binding.
- Double-disc parallel-seat gate valves are not subject to thermal binding due to their disc design. The wedging mechanism between the double discs collapses as the stem rises. This permits the parallel discs to move inward and be raised regardless of the change in system temperature.
- Solid wedge gate valves are not subject to pressure locking since the disc does not contain a cavity at the seating surfaces that can be pressurized, and simultaneous leak tightness of both disc sealing surfaces cannot be reliably achieved.
- Gate valves that perform non-design-basis event opening for recovery from mispositioning only are excluded from this evaluation.

16.2.2 Evaluation Method

Utilizing the above criteria, each of the valves in the GL 89-10 program have been screened for susceptibility to pressure locking and thermal binding. No further evaluation was required for valves eliminated based on one of the above screening criteria. For each valve that was not eliminated as a result of the screening, the following evaluation method was used:

- The expected range of upstream and downstream operating conditions was established.
- Each stroke in the Design Basis Review (DBR) calculation where the valve is required to open from the full closed position was reviewed to determine if the

conditions necessary to cause pressure locking or thermal binding of the disc exist during that stroke. Recovery from mispositioning strokes were not included in this review.

- The surveillance procedures that affect these valves were reviewed to determine if the surveillance procedure established the conditions that could result in pressure locking or thermal binding of the valve.

The following are the conditions that must occur before the valve is required to open for pressure locking or thermal binding to potentially exist:

- Thermal binding of a valve could occur if a valve is closed when hot and then cools down appreciably before it is required to open. PI-20, "MOV Program Pressure Locking and Thermal Binding Evaluation," provided the temperature changes for evaluation. The valve body and seats contract a greater amount than the disc causing the seats to bind the disc more tightly, increasing the force required to open the valve, possibly exceeding the capabilities of the motor operator.
- Pressure locking could occur if a valve is closed in a system that operates at pressure or is pressurized. The bonnet cavity and the area between the valve discs fill with pressurized water, equalizing with system pressure over time. Subsequently, before the valve is required to open, the system pressure drops and the higher pressure fluid is trapped in the bonnet area and the area between the valve discs. The pressurized fluid forces the discs closed even tighter, trapping the pressurized fluid and preventing it from leaking by the discs. When the valve is required to open, the extra force required to open the valve due to the discs being pressed against the valve seats could potentially exceed the capability of the motor operator.
- Pressure locking could occur if a valve is closed in a system that is normally filled and slightly pressurized. The bonnet cavity and the area between the valve discs fill with water, equalizing with line pressure over time. (Note that the head of water from a filled tank can provide enough pressure to fill the valve internals.) Subsequently, before opening, the valve is heated by hotter fluid on either side of the valve disc or by an external heat source. Heating of the water in the bonnet and disc cavity results in the thermal expansion of the trapped fluid, increasing the pressure seating the valve discs against the seats. When the valve is required to open, the extra force required to open the valve due to the discs being pressed against the valve seats could potentially exceed the capability of the motor operator.

16.3 Evaluation Results

For each valve opening stroke or surveillance procedure where the potential for either pressure locking or thermal binding exists, the corrective actions taken to preclude it from occurring are identified. The results / conclusions and corrective actions are summarized in Table 20.

Table 20: Pressure Locking (PL) / Thermal Binding (TB) Summary

Valve	Valve Type	Wedge Design	Susceptible PL	Susceptible TB	Action
3CCP*MOV045A	Butterfly	Symmetric			
3CCP*MOV045B	Butterfly	Symmetric			
3CCP*MOV048A	Butterfly	Symmetric			
3CCP*MOV048B	Butterfly	Symmetric			
3CCP*MOV049A	Butterfly	Symmetric			
3CCP*MOV049B	Butterfly	Symmetric			
3CCP*MOV222	Butterfly	Symmetric			
3CCP*MOV223	Butterfly	Symmetric			
3CCP*MOV224	Butterfly	Symmetric			
3CCP*MOV225	Butterfly	Symmetric			
3CCP*MOV226	Butterfly	Symmetric			
3CCP*MOV227	Butterfly	Symmetric			
3CCP*MOV228	Butterfly	Symmetric			
3CCP*MOV229	Butterfly	Symmetric			
3CHS*LCV112B	Gate	Solid	No	No	
3CHS*LCV112C	Gate	Solid	No	No	
3CHS*LCV112D	Gate	Solid	No	No	
3CHS*LCV112E	Gate	Solid	No	No	
3CHS*MV8100	Globe	Guided			
3CHS*MV8104	Globe	Guided			
3CHS*MV8105	Gate	Solid	No	No	
3CHS*MV8106	Gate	Solid	No	No	
3CHS*MV8109A	Globe	Guided			
3CHS*MV8109B	Globe	Guided			
3CHS*MV8109C	Globe	Guided			
3CHS*MV8109D	Globe	Guided			
3CHS*MV8110	Globe	Standard			
3CHS*MV8111A	Globe	Standard			
3CHS*MV8111B	Globe	Standard			
3CHS*MV8111C	Globe	Standard			
3CHS*MV8112	Globe	Guided			
3CHS*MV8116	Globe	Standard			
3CHS*MV8438A	Gate	Flex	No	No	
3CHS*MV8438B	Gate	Flex	No	No	
3CHS*MV8438C	Gate	Flex	No	No	
3CHS*MV8468A	Gate	Flex	No	No	
3CHS*MV8468B	Gate	Flex	No	No	
3CHS*MV8507A	Gate	Flex	Yes	No	Drilled Disc[34]
3CHS*MV8507B	Gate	Flex	Yes	No	Drilled Disc[34]
3CHS*MV8511A	Globe	Standard			
3CHS*MV8511B	Globe	Standard			
3CHS*MV8512A	Globe	Standard			
3CHS*MV8512B	Globe	Standard			
3CMS*MOV24	Globe	Guided			
3CVS*MOV25	Globe	Guided			
3FWA*MOV35A	Gate	Solid	No	No	
3FWA*MOV35B	Gate	Solid	No	No	
3FWA*MOV35C	Gate	Solid	No	No	
3FWA*MOV35D	Gate	Solid	No	No	
3IAS*MOV72	Globe	Guided			
3LMS*MOV40A	Globe	Guided			
3LMS*MOV40B	Globe	Guided			
3LMS*MOV40C	Globe	Guided			
3LMS*MOV40D	Globe	Guided			

Valve	Valve Type	Wedge Design	Susceptible PL	Susceptible TB	Action
3MSS*MOV17A	Globe	Stop Check			
3MSS*MOV17B	Globe	Stop Check			
3MSS*MOV17D	Globe	Stop Check			
3MSS*MOV18A	Gate	Flex	Yes	Yes	Drill Disc[31] - RFO 6
3MSS*MOV18B	Gate	Flex	Yes	Yes	Drill Disc[31] - RFO 6
3MSS*MOV18C	Gate	Flex	Yes	Yes	Drill Disc[31] - RFO 6
3MSS*MOV18D	Gate	Flex	Yes	Yes	Drill Disc[31] - RFO 6
3MSS*MOV74A	Globe	Standard			
3MSS*MOV74B	Globe	Standard			
3MSS*MOV74C	Globe	Standard			
3MSS*MOV74D	Globe	Standard			
3QSS*MOV34A	Butterfly	Symmetric			
3QSS*MOV34B	Butterfly	Symmetric			
3RCS*MV8000A	Gate	Solid	No	No	
3RCS*MV8000B	Gate	Solid	No	No	
3RCS*MV8098	Globe	Standard			
3RHS*FCV610	Globe	Guided			
3RHS*FCV611	Globe	Guided			
3RHS*MV8701A	Gate	Flex	Yes	No	Open TS Bypass[32] - RFO 5 Connect Bonnet Bypass[33] - RFO 6
3RHS*MV8701B	Gate	Flex	No	No	
3RHS*MV8701C	Gate	Flex	Yes	No	Bonnet Leakoff Connected[33]
3RHS*MV8702A	Gate	Flex	No	No	
3RHS*MV8702B	Gate	Flex	Yes	No	Open TS Bypass[32] - RFO 5 Connect Bonnet Bypass[33] - RFO 6
3RHS*MV8702C	Gate	Flex	Yes	No	Bonnet Leakoff Connected[33]
3RHS*MV8716A	Gate	Flex	No	No	
3RHS*MV8716B	Gate	Flex	No	No	
3RSS*MOV20A	Butterfly	Symmetric			
3RSS*MOV20B	Butterfly	Symmetric			
3RSS*MOV20C	Butterfly	Symmetric			
3RSS*MOV20D	Butterfly	Symmetric			
3RSS*MOV23A	Butterfly	Offset			
3RSS*MOV23B	Butterfly	Offset			
3RSS*MOV23C	Butterfly	Offset			
3RSS*MOV23D	Butterfly	Offset			
3RSS*MOV38A	Gate	Solid	No	No	
3RSS*MOV38B	Gate	Solid	No	No	
3RSS*MV8837A	Gate	Flex	No	No	
3RSS*MV8837B	Gate	Flex	No	No	
3RSS*MV8838A	Gate	Flex	No	No	
3RSS*MV8838B	Gate	Flex	No	No	
3SIH*MV8801A	Gate	Solid	No	No	
3SIH*MV8801B	Gate	Solid	No	No	
3SIH*MV8802A	Gate	Solid	No	No	
3SIH*MV8802B	Gate	Solid	No	No	
3SIH*MV8806	Gate	Solid	No	No	
3SIH*MV8807A	Gate	Solid	No	No	
3SIH*MV8807B	Gate	Solid	No	No	
3SIH*MV8813	Gate	Solid	No	No	
3SIH*MV8814	Globe	Guided			
3SIH*MV8821A	Gate	Solid	No	No	
3SIH*MV8821B	Gate	Solid	No	No	
3SIH*MV8835	Gate	Solid	No	No	
3SIH*MV8920	Globe	Guided			
3SIH*MV8923A	Gate	Solid	No	No	

Valve	Valve Type	Wedge Design	Susceptible		Action
			PL	TB	
3SIH*MV8923B	Gate	Solid	No	No	
3SIH*MV8924	Gate	Solid	No	No	
3SIL*MV8804A	Gate	Flex	No	No	
3SIL*MV8804B	Gate	Flex	No	No	
3SIL*MV8808A	Gate	Flex	No	No	
3SIL*MV8808B	Gate	Flex	No	No	
3SIL*MV8808C	Gate	Flex	No	No	
3SIL*MV8808D	Gate	Flex	No	No	
3SIL*MV8809A	Gate	Flex	No	No	
3SIL*MV8809B	Gate	Flex	No	No	
3SIL*MV8812A	Gate	Flex	No	No	
3SIL*MV8812B	Gate	Flex	No	No	
3SIL*MV8840	Gate	Flex	No	No	
3SWP*MOV024A	Plug				
3SWP*MOV024B	Plug				
3SWP*MOV024C	Plug				
3SWP*MOV024D	Plug				
3SWP*MOV050A	Butterfly	Offset			
3SWP*MOV050B	Butterfly	Offset			
3SWP*MOV054A	Butterfly	Symmetric			
3SWP*MOV054B	Butterfly	Symmetric			
3SWP*MOV054C	Butterfly	Symmetric			
3SWP*MOV054D	Butterfly	Symmetric			
3SWP*MOV057A	Butterfly	Symmetric			
3SWP*MOV057B	Butterfly	Symmetric			
3SWP*MOV057C	Butterfly	Symmetric			
3SWP*MOV057D	Butterfly	Symmetric			
3SWP*MOV071A	Butterfly	Symmetric			
3SWP*MOV071B	Butterfly	Symmetric			
3SWP*MOV102A	Butterfly	Offset			
3SWP*MOV102B	Butterfly	Offset			
3SWP*MOV102C	Butterfly	Offset			
3SWP*MOV102D	Butterfly	Offset			
3SWP*MOV115A	Plug				
3SWP*MOV115B	Plug				

The NRC regulations require an analysis under 10 CFR 50.59 for any valve modifications and establishment of adequate post-modification and in-service testing of any valves installed as part of the modification. For example, the licensee would have to evaluate the effects of drilling the hole in the disk if used to resolve a pressure locking concern. One consideration in this evaluation is the fact that the MOV will be leaktight in only one direction. The Millstone Unit 3 Safety Analysis was documented in Millstone Unit 3 PDCR MP3-95-020.[34]

If an MOV is found to be susceptible to pressure locking or thermal binding and the licensee relies on the capability of the MOV to overcome pressure locking or thermal binding, the staff will review the licensee justification during inspections in consideration of the uncertainties surrounding the prediction of the required thrust to overcome these phenomena. If the staff finds that a licensee has not adequately addressed the potential for pressure locking and thermal binding of gate valves, enforcement actions and schedules for response will depend on the safety significance of the issue at the plant. At Millstone Unit 3 modifications were made to four valves: 3CHS*MV8507A/B, 3RHS*MV8701C, and 3RHS*MV8702C, we did not have to rely on MOV capability calculations to overcome pressure locking or thermal binding. Acceptable to the NRC,[35] two valves

(3RHS*MV8701A and 3RHS*MV8702B) are currently relying on MOV capability to overcome a pressure locking condition, i.e. operable.[32] This operability condition is until an acceptable physical modification will be performed during RFO 6. Four valves, 3MSS*MOV18A/B/C/D, are currently relying on a procedure change to prevent pressure locking and thermal binding. A physical modification will be performed during RFO 6 for these valves.

17. Industry Information

NRC information notices, industry technical and maintenance updates, and 10 CFR Part 21 notices are entered into our mainframe-based Action Item Tracking and Trending System (AITTS) computer database. The assignments, due dates, required response, and resultant action can be reviewed by any individual with access to a computer.

18. Program Schedule

In a letter dated June 28, 1989,[1] the NRC Staff issued Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance." The letter required each licensee with an operating license to complete all design-basis reviews, analyses, verifications, tests, and inspections instituted to comply with GL 89-10 within five years or three refueling outages of the date of the letter, whichever was later. The required documentation had to be available within one year or one refueling outage of the date of the letter, whichever was later. The documents should include the description and schedule for the design-basis review recommended in item a. (including guidance from item e.) for all safety-related MOV's and position-changeable MOV's as described, and the program description and schedule for items b. through h. for all safety-related MOV's and position-changeable MOV's.

Northeast Utilities certified in a letter dated December 15, 1989,[36] that they were "...developing detailed programs for addressing Generic Letter 89-10 at the Millstone Unit 3 Plant...", and that the "...programs will encompass the guidance as detailed in the Generic Letter." The proposed schedule for Millstone Unit 3, with the program defined by January 1991 and the program completed within three refueling outages (1994).

In a letter dated August 3, 1990[3], the NRC Staff issued Supplement 2 to GL 89-10. In this letter, the NRC staff stated that licensees were not required to have their respective program descriptions in place until at least January 1, 1991. Northeast Utilities informed the NRC in a letter dated May 4, 1992[37], that they did not fully comply with their commitments to develop program descriptions by April 1991. This conclusion was based upon an audit, part of a routine in-house Quality Services self-assessment, which determined that in-place program descriptions for addressing GL 89-10 did not contain all of the necessary technical elements specified in GL 89-10. Northeast Utilities then stated that they "...plan to have the program descriptions completed by the end of 1992." This commitment was met with the release of the Motor Operated Valve Program Manual on December 18, 1992.

In a letter dated December 13, 1993,[38] Northeast Utilities provided the NRC with an updated schedule for completion of testing at the third refueling outage (1995). This change represented a change in the Millstone Unit 3 date for the third refueling. The GL 89-10 MOV Program was completed at Millstone Unit 3 within three refueling outages after the date of the GL 89-10 letter. Additionally, documentation was provided to the NRC Staff within 30 days following the completion

of the third refueling outage. Therefore, Millstone Unit 3 has met all schedule commitments with respect to GL 89-10 requirements.

19. Quality Assurance

Item f. of GL 89-10 requires that documentation of explanations and a description of the actual test methods used for accomplishing design-basis verification testing be retained. Calculations associated with design-basis reviews and development of in-situ testing are performed in accordance with Nuclear Group Procedures (NGP) 5.05, "Design Inputs, Design Verification, and Design Interface Reviews," and NGP 5.06, "Design Analyses and Calculations." All MOV Program records and test procedures are retained in accordance with NGP 2.13, "Nuclear Plant Records Program."

NU developed Motor-Operated Valve Engineering Program Plan, Revision 1, dated July 16, 1992, to address the recommended actions of GL 89-10. The documents that implement this plan are the Motor-Operated Valve Program Manual and its Program Instructions. Based on the results of an internal audit, NU recognized that they were behind schedule in meeting their prior commitment to develop a GL 89-10 MOV Program Description for Millstone Unit 3 by April 1991. Management took action to correct this problem by assigning lead responsibility for MOV program development to the systems engineering group. To complete this effort, NU used contractor assistance to prepare the MOV Program Instructions, differential pressure test procedures and other related documents. Northeast Utilities committed to have the Motor-Operated Valve Program Manual in place by December 31, 1992, and they completed this effort on December 18, 1992.

20. Audits / Inspections

We performed a self-assessment of our MOV Program from June 14-25, 1993, following a meeting with Region I and NRR staff on May 20, 1993, where we proposed our plan to do a self-assessment at the Millstone Nuclear Power Station and documented by letter, dated June 4, 1993. Region I authorized our self-assessment in lieu of the NRC inspection mandated by NRC Temporary Instruction 2515/109. NRC inspectors monitored the self-assessment and found that the findings were equivalent to those that would have been identified by an NRC team. The self-assessment was conducted for the three Millstone units. The findings were significant, proper emphasis was placed on the importance of the items, and disposition of each finding was adequately addressed.

Additionally, an internal audit was conducted during RFO 5 by Quality Assessment Services personnel. The audit covered outage activities, including MOV testing, design changes, maintenance, procedure use, organization, and engineering calculations. The results of the Millstone Unit 3 Audit A30345[39] identified six concerns that were transferred to six Adverse Condition Reports (ACR's), in accordance with a revised QAS reporting procedure, and two recommendations for the MOV Program.

21. Training

PI-17, "Qualification of Personnel," establishes MOV Program training and personnel qualification requirements based on position and functional assignments. Departmental training requirements for Nuclear Group personnel are governed by NGP 2.26, "Departmental Training." All personnel performing maintenance and / or testing on MOV's are required to attend and satisfactorily complete the necessary training courses. Supervisors evaluate each individual's competence and previous

MOV experience to determine an individual's qualification to perform work. The Nuclear Training Department provides VOTES and MOV technical training for nuclear unit department personnel.

Millstone Unit 3's MOV training program has been accredited by the Institute of Nuclear Power Operations. It outlines the specific requirements as well as continuing and refresher training for various technicians and engineers. This program includes both classroom knowledge and hands-on laboratory skill development. Numerous types of MOV hardware are used as training aids at the NU training facility. VOTES equipment is borrowed from Generation Test Services for training and returned for actual work at the unit.

Each instructor has an individual training folder which contains qualifying documentation covering the background and qualifications of the instructor. NRC discussions with the training staff regarding MOV issues verified that they were knowledgeable and experienced. The Nuclear Training Department staff check and validate contractor training by examination requiring an 80% on a written test and a display of proficiency in the laboratory before being allowed to assist qualified personnel from Millstone Unit 3 or Generation Test Services.

The Nuclear Training Department maintains a matrix of all qualified personnel in each department and distributes this information to department heads periodically. After completion of the required MOV training, the department head qualifies the trainee with applicable job related training. The completed training information is sent to the Nuclear Training Department to update the matrix with a qualification status and a date for requalification. Required training updates are designated on the matrix to signify when new elements of training are required.

The Training Program Control Committee reviews regulatory and industry documents to determine their applicability to the licensee's MOV program. Representatives from training and maintenance meet periodically to discuss the need to modify training as a result of any new industry or vendor information.

22. Future Planned MOV Enhancements

Table 21 provides work items in the Cycle 6 planning / review process for Millstone Unit 3 to provide enhancements of GL 89-10 MOV's.

Table 21: Future MOV Enhancements

Valve	Work Item
3CHS*LCV112E	Spring pack change/upgrade - Inspection URI 95-17-08
3CHS*MV8109B	Adjust packing, replace spring pack
3RHS*MV8701A	Add pressure locking bypass, re-establish conventional open torque switch bypass
3RHS*MV8702B	Add pressure locking bypass, re-establish conventional open torque switch bypass
3RSS*MV8837A	Spring pack change/upgrade
3SIH*MV8806	Stem nut replacement & stem inspection
3SIH*MV8923B	Adjust packing, inspect stem for galling
3SIL*MV8804A	Spring pack change/upgrade - Inspection URI 95-17-08
3SIL*MV8808A	Spring pack change/upgrade - Inspection URI 95-17-08
3SIL*MV8808C	Spring pack change/upgrade - Inspection URI 95-17-08
3SIL*MV8808D	Spring pack change/upgrade - Inspection URI 95-17-08
3SIL*MV8809A	Spring pack change/upgrade - Inspection URI 95-17-08
3SIL*MV8812A	Spring pack change/upgrade - Inspection URI 95-17-08
3SIL*MV8812B	Spring pack change/upgrade - Inspection URI 95-17-08

23. MP3 Cycle 6 Test Scope (Preliminary)

Provided in Table 22 is a preliminary summary of future MOV monitoring activities and retests in addition to periodic testing.

Table 22: Cycle 6 Monitoring / Test Scope

Valve	Static Test	Dynamic Test	Comments
3SIH*MV8801B	X	X	Partial disposition to NCR 395-408
3CHS*LCV112C	X		

24. Status of GL 89-10 Inspection Findings

NU extensively modified its position on gate valve factors in December, 1993 in response to the release of the EPRI PPM test data and the issuance of NRC Information Notice 93-88.[13] This position which was documented in January 1994 has remained unchanged.[14] The memo provided requirements for operability and design-setup for both testable and non-testable gate valves. Validation of these valve factor criteria is required as part of design-basis closure of GL 89-10. The need to justify these values was reaffirmed in the July 12, 1994, "Sheron memo".

The approach for dynamically testable valves has been to validate Vf's used for design setup by dynamic testing with appropriate allowances for uncertainties and extrapolation. For non-testable valves, validation is provided using the EPRI developed Performance Prediction Methodology (PPM).[24] Due to the extensive delay in the release of PPM to the industry, NU took the pro-active step to hire Kalsi Engineering Inc. to provide validation using their KEI Gate program under their QA Program. KEI Gate is the functional equivalent of the gate valve model in the EPRI PPM program. Kalsi Engineering Inc. was the developer of the gate valve model under contract to EPRI.

NU recognizes that the NRC Staff intends to formally review PPM and issue a Safety Evaluation Report (SER). NU will examine the NRC SER when issued and reconcile any differences with KEI Gate. The schedule for resolution is dependent upon the significance of the change, and in no case would it be later than RFO 6. This recognizes that control switch settings may have to be adjusted if significant changes were made which would involve static diagnostic testing. Subsequent calculations for new valves, new conditions, or for those previous KEI Gate calculations which require revision will all be analyzed using the NRC reviewed version of EPRI PPM.

Results of a NRC inspection of the Millstone Unit 3 MOV program on June 19-30, 1995, were issued in a report dated September 11, 1995. The inspection report, which included one unresolved item and several inspector follow items, is under review by Millstone Unit 3 staff to determine the appropriate actions. The inspector follow items covered the same MOV Programmatic issues which were reviewed and accepted by the NRC during their closure of the Haddam Neck MOV Program[40].

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[6] James G. Partlow letter to All Licensees of Operating Nuclear Power Plants and Holders of Construction Permits for Nuclear Power Plants, "Generic Letter 89-10, Supplement 5, 'Inaccuracy of Motor-Operated Valve Diagnostic Equipment'," June 28, 1993.

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