ENCLOSURE 2

The Southern California Edison Company (SCE)
Risk-Informed Inservice Testing Program
Revised Program Pages

component failure history on the whole is consistent with failure data reported to NPRDS. Generic data (and indeed, most interpretations of plant-specific data) considers components in groups. But ranking was done on a component basis. Consequently, the Expert Panel considered whether or not plant-specific operational insights indicated component reliability problems that might affect the ranking of an individual component or small group of components. Components with operational concerns were considered more risk significant by the Expert Panel.

Finally, the completeness of the models, assumptions and input data was tested by sensitivity studies. The sensitivity studies performed for the SONGS RI-IST component categorization considered both the issues addressed by the ASME Code Case and the Comanche Peak RI-IST pilot project.

The sensitivity studies addressed specific attributes of four general topic areas:

- Operator actions
- Common cause failure (CCF)
- Maintenance unavailabilities
- Uncertainty in component failure probabilities

Each of these issues was judged to be of sufficient significance to affect component categorization. For operator actions, two general types of studies were performed, giving no credit to operators and increasing low human error probabilities (HEPs) to nominal values. For the first type, operator actions were considered in two groups, namely recovery actions and post-accident actions. Because there were so many post-accident operator actions, assuming no credit did not yield meaningful results from the sensitivity case. However, assuming no credit for just recovery actions identified two valves (HV4714 and HV4731, AFW Discharge to Steam Generator Isolation Valves) with potentially unique importance. For the second type of HRA sensitivity study, increasing low HEPs, no new components became important.

The Expert Panel reviewed these results. The Panel concluded that no change in categorization was required for the two valves. While the Panel acknowledged the logic of the sensitivity study, the study also showed that the HEP would have to increase to a very large value for the risk ranking of the two valves to change. Significant time and adequate procedure guidance was deemed to be available to perform the action. Therefore, the Expert Panel concluded that the original PRA ranking was reasonable and that uncertainty in HEPs did not impact the component categorization of these two valves. Further, the sensitivity study gave the Panel additional confidence that the categorization of IST components was not subject to the effects of uncertainty in HEPs.

For common cause failures (CCF), the sensitivity study considered two aspects of the influence of CCF on component categorization. First, because CCF can sometimes dominate risk, its contribution can mask individual component failure modes. No masking was found.

it exists). The codes utilized in this analysis are listed and described below in Table 2.4-1.

Table 2.4-1: Corrective Maintenance Classification

FAILURE?	REASON CODE	DESCRIPTION
NO	F3	Problem with component function, function is [illegible] an IST safety function, not an IST functional failure
	F4	Component performed as intended, satisfied IST objectives, not an IST functional failure
	L1	External leakage (packing, bonnet, boric acid accumulation on piece part), not an IST functional failure
	L2	Leak by (usually by valve seat), not an IST functional failure
	M1	Post maintenance test (PMT) failure, prior to valve return to service
	M2	Maintenance of valve or pump to prevent future functional failure
	M3	Maintenance-induced problem (programmatic, test-related, etc.), not an IST functional failure
	N1	Failure of component piece part, major component still operable
	N2	Procedural problem, not an IST functional failure
	N3	Other (often signifies that there was no work performed, no problem found)
	P1	Problem with local position indication gauge, or with position limit switch
	R1	Component or component piece part replaced, or is scheduled for replacement, not an IST functional failure
	T1	IST test reference value revised or acceptance criteria changed, IST failure negated
	T2	Improper test methodology (test procedure might require revision), IST failure negated
	T3	Stroked outside reference range, not a functional failure (valve stroked within Tech Spec limits)
YES	F1	IST failure (does not involve PMT, improper test method, or inaccurate test reference)
	F2	In-situ functional failure
PROBLEM WITH POSITION INDICATION	P2	Accurate position indication is not known in the control room

According to the screening criteria in the table, if the corrective maintenance event concerned non-critical leaking (e.g., packing leakage or the valve is not leak tight in the absence of IST leakage criteria), the reviewer classified the event as a non-failure with an assigned reason codes (for this example, L1) . This is an acceptable disposition, as the corrective maintenance did not involve a functional failure (e.g., failure to close). However, if the corrective maintenance event concerned leaking past the valve seat, the reviewer investigated the description of the work performed to determine whether or not the leaking was severe enough to prevent the valve from performing its safety function to close. If not, it was classified as a non-failure. If the corrective maintenance involved an IST failure related to the test procedure or test reference, one or both of which had been subsequently revised as part of the corrective maintenance, the maintenance-related event or precursor was classified as a non-failure. Additionally, if the component failed its IST following any type of maintenance (e.g., post-maintenance test) but before the component had been formally returned to service, it was classified as a non-failure.

Once the corrective maintenance history had been fully reviewed for a component, all failure events or particularly eventful corrective maintenance histories were reported to the Expert Panel for their consideration during the risk categorization process. This was useful in facilitating the determination of contentious performers (i.e., those valves for which the LSSC categorization merits assigning either a compensatory measure, retaining the current test interval, or changing the ranking to HSSC). Based on consideration of this evaluation, the Panel changed the rankings of the following components:

COMPONENT	DESCRIPTION	ORIGINAL RANKING	REVISED RANKING OR DISPOSITION[27]
PCV6358, PCV6361	CCW SURGE TANK NITROGEN BACKPRESSURE REGULATOR	LSSC	LSSC with assigned compensatory measure. Test interval not extended.
HV4714, HV4731	AFW DISCHARGE TO STEAM GENERATOR E/H ISOLATION VALVE	LSSC	LSSC with assigned compensatory measure
HV4762, HV4763	AFW PUMP TO DISCHARGE BYPASS VALVE	LSSC	Test interval not extended. Retained LSSC ranking because these valves can be isolated by manual block valves, isolation does not affect performance of key system safety function.
1201MU003, 1201MU005	MAIN STEAM SUPPLY TO AFWTD PUMP	LSSC	HSSC
1201MU976, 1201MU977	PRESSURIZER SPRAY LINE CHECK VALVES	LSSC	LSSC. Test interval not extended because test historically administered incorrectly.
1305MU496, 1305MU497, 1305MU498, 1305MU499, 1305MU539, 1305MU541	AFW CHEMICAL ADDITION VALVES	LSSC	Test interval not extended. Retained LSSC ranking because these valves can be isolated by manual block valves, isolation does not affect performance of key system safety function.
1413MU013, 1413MU016, 1413MU021, 1413MU024	EMERGENCY BEARING COOLING WATER CHECK VALVES	LSSC	LSSC. Test interval not extended. These valves exhibited a higher than expected failure rate in the past. Corrective actions were implemented, but insufficient history exists (after the corrections) to extend the interval.
1413MU047, 1413MU048, 1413MU049, 1413MU050	BEARING COOLING WATER CHECK VALVES	LSSC	LSSC. Test interval not extended. These valves exhibited a higher than expected failure rate in the past. Corrective actions were implemented, but insufficient history exists (after the corrections) to extend the interval.

2.4.2 Additional Expert Panel Inputs

In addition to the component corrective maintenance evaluation, the Expert Panel considered relevant plant licensing commitments for IST, generic Combustion Engineering design issues, plant procedures, and inservice testing performance.

Furthermore, the Panel considered the results of sensitivity studies performed to evaluate whether PRA assumptions mask the true importance of IST components. The sensitivity studies demonstrated the quality of SCE's PRA, as components shifted slightly within the bounds of their ranking category, but did not, in general, shift enough to merit a ranking change. The one exception involved the sensitivity study pertaining to the modeling of human actions. If the PRA assumes a human error probability (HEP) of 1.0 for

[27] Although the test interval for these components will not be extended initially due to specific performance issues, the PRA analysis for cumulative risk assumes the bounding values listed in the Table 3.2-1. The interval determined by the Integrated Decisionmaking Process can be no greater than this value for a given grouping without performing specific PRA analysis to support it.

3 IMPLEMENTATION AND MONITORING PROGRAM

3.1 Inservice Testing Program Changes

Testing for components in the current IST program classified as HSSCs continues per the current IST program, which meets the requirements of the 1989 Edition of the ASME Boiler and Pressure Vessel Code, Section XI, except where specific written relief has been granted. The SCE RI-IST evaluation process concluded that the monitoring mandated by the current IST program for all components ranked as HSSCs is adequate. Where the ASME Section XI testing is practical, HSSC ranked valves or pumps not in the current ASME Section XI IST Program Plan will be tested in accordance with OM-1 for safety relief valves, OM-10 for active valves and OM-6 for pumps. Where the ASME Section XI testing is not practical, alternative methods will be developed to ensure operational readiness.

Note that there are two distinct subgroups based on RAW ranking. Those components with a high RAW (>2) and a low Fussell-Vesely (< 0.001) are described as L-H (low Fussell-Vesely, high RAW) while those components with a low Fussell-Vesely and a low RAW (< 2) are described as LSSCs. For simplicity, the text in this section refers to both categories as LSSCs unless the topic refers to a specific subgroup.

As modified by the testing strategy described below, components in the current IST program which are determined to be LSSC will also be tested in accordance with the ASME Code, Section XI requirements, except that the test frequency will initially be extended from quarterly (or cold shutdown/refueling as applicable) to a maximum of once every 6 years (except for the refueling water storage tank outlet check valves and the emergency sump check valves which will be extended to a maximum of 8 years) plus a 25% margin, depending on the number of valves in the group and their design, service condition, risk insights and ranking, performance history, and any compensatory measures. The extended test frequency will be staggered up to 8 years as described in Section 3.2 below. All other Code testing methods, corrective actions, documentation, and other requirements will remain in effect. Note that a rank of LSSC is insufficient justification for removing a pump or valve from the ASME Code, Section XI IST program. Therefore, all components tested in SCE's current IST program remain in the RI-IST program. As is true with the current IST Program, RI-IST program selection criteria remains fundamentally based on the component safety function as defined in the applicable Code sections.

By using PRA methods, a maximum test interval was determined for LSSCs. This information was provided to the Expert Panel for their consideration during component categorization deliberations. During periodic reassessments, the maximum test interval will be verified or modified as dictated by the integrated decision-making process.

SCE will continue to consider other test methods, such as non-intrusive testing and disassembly/inspection.

3.1.1 Testing Strategy

SCE's proposed RI-IST testing strategy for each component group will ensure to the extent practicable that adequate component capability margin exists above that required during design basis conditions. As such, component operating characteristics will not be allowed to degrade to a point of insufficient margin before the next scheduled test activity. On this basis, the testing strategies were deemed acceptable.

SCE's proposed RI-IST program identifies components that are candidates for an improved test strategy (i.e., frequency, methods, or both) as well as components for which the test strategy may be relaxed. The information contained in and derived from the SONGS PRA was used to help construct the testing strategy for components. Components with high safety significance will be tested in ways that are at least as effective as the current Code-required test at detecting their risk-important failure modes and causes (e.g., at least as effective at detecting failure, detecting conditions that are precursors to failure, or predicting end of service life). Components categorized as L-Hs and LSSCs will generally be tested less rigorously than components categorized as HSSCs (e.g., less frequent tests).

The proposed component IST test intervals have not been extended beyond once every 6 years (approximately 3 refueling outages, plus a 25% margin), except for the refueling water storage tank outlet check valves and the emergency sump outlet check valves, which have not been extended beyond once every 8 years plus a 25% margin. With the exception of relief valves and check valves, IST components are scheduled to be exercised or operated at least once every refueling cycle.

Test strategies were essentially augmented by leaving them as-is for all HSSCs in the IST program and adding diagnostic methods where possible. In a number of cases, only one IST function was risk-significant; nevertheless, all component functions were conservatively maintained as HSSC although the PRA ranking indicated some of the test intervals for LSSC functions were eligible for extension.

SCE considered component design, service condition, and performance history, as well as risk insights, in establishing the technical basis for the test strategy and interval assigned to each component as illustrated by the following examples:

1. A component was considered HSSC if the component had, in the opinion of the Expert Panel, a poor performance record. By categorizing the component as HSSC, the test strategies were left as-is and the test intervals were not extended. In the case of insufficient history (i.e., new component, either new to the program or new style), the component ranking considered PRA risk metrics, component safety function redundancy, and other relevant inputs from the Expert Panel, but for these cases the Expert Panel opted to retain the current test frequency until sufficient performance history has accumulated to justify a future test interval extension.

2. The SONGS Expert Panel also considered the impact of service condition on component performance. If the service condition had no impact on performance, the PRA results were unchanged. In a few cases, such as the two steam supply check valves to the turbine driven AFW pump (1301MU003 and

1301MU005), the Expert Panel considered the component function critical to safety system performance. Due to severe service conditions, SCE decided to disassemble and inspect both steam supply check valves each refueling outage. Since the wear on these valves is significant, the Expert Panel decided to rank them HSSC and continue to disassemble and inspect these valves each refueling until their wear characteristics are fully resolved. Design changes to mitigate the effects of the service conditions are being reviewed.

SONGS has not submitted any Technical Specification amendments in conjunction with this risk-informed IST program submittal; therefore, all surveillance testing required by the technical specifications will continue to be conducted. Technical Specification surveillance testing is sometimes noted as a compensatory measure for the IST interval extensions associated with L-H and LSSC ranked components. An example is the subgroup relay testing which is performed semi-annually and exercises numerous LSSC components. Although there are other compensatory measures, such as exercising during plant scheduled activities such as circulating water system heat treatment, or periodic equipment rotation for equalizing run hours, SCE conservatively chose to use only compensatory measures with a regulatory basis (e.g., Technical Specification surveillances), such as the subgroup relay testing and MOV biennial strokes to support the calculation of cumulative risk.

Components that were the subject of a previously NRC-approved relief request are summarized in Section 2.1.2. As discussed therein, the current NRC-authorized relief (or alternative) remains appropriate and will continue in concert with this request. As Section 2.1.2 indicates, the two current program relief requests relate to pumps. There are no current relief requests for valves.

The following describes the proposed testing strategy for each group of components and is considered consistent with the existing NRC positions on component test strategies. The strategy also appears to agree with the general direction that the NRC is encouraging the ASME Code groups to take in defining test strategies for components categorized as being either high or low safety significant.

Motor-operated Valves (MOVs)

MOV testing will be in accordance with commitments to NRC Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," and GL 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves." Test frequency will be in accordance with the risk categorization defined below:

- **HSSC** Testing will be performed in accordance with Code CaseOMN-1, and NRC Generic Letter 89-10 and 96-05 commitments. MOV's with a passive function will be tested per the Code of Record as defined in 10CFR50.55a.
- **L-H** Testing will be performed in accordance with Code Case OMN-1 and NRC Generic Letter 89-10 and 96-05 commitments at an initial interval not to exceed 6 years until sufficient data exist to determine a more appropriate test frequency. MOV's with a passive function will be

tested per the Code of Record, except at a test frequency not to exceed 6 years (with a 25% margin) based on evaluation of design, service condition, performance history, and compensatory actions. Seat leakage testing, if required, will be per the Code of record, except at a test frequency not to exceed 6 years (with a 25% margin).

- **LSSC** Testing will be performed in accordance with Code Case OMN-1 and NRC Generic Letter 89-10 and 96-05 commitments. MOV's with a passive function will be tested per the Code of Record, except at a test frequency not to exceed 6 years (with a 25% margin). Seat leakage testing will per the Code of record, except at a test frequency not to exceed 6 years (with a 25% margin).

MOV performance will be verified in accordance with GL 96-05. The SONGS commitment for satisfying GL 96-05 is described in SCE's response to GL 96-05. Furthermore, SONGS MOV periodic verification testing will comply with the provisions of ASME Code Case OMN-1. This position is consistent with SCE's response to GL 96-05.

The motor-operated valve testing strategy described above is consistent with the guidance provided in Section 3.1 of RG1.175.

Relief Valves

Testing of relief valves will continue to be conducted in accordance with the Code of record (OM-1) with no change in test interval. SCE believes that relief valve performance as a whole does not warrant interval extension. In the future, should performance history change, SCE will rank valves per the Integrated Decision-making Process (IDP) described in Section 2.4 and extend intervals accordingly.

Check Valves (CVs)

Check valves will be tested in accordance with the Code of Record (OM-10) with the exception that the test frequency will be in accordance with the component risk categorization defined below:

- **HSSC** Testing will be performed in accordance with the ASME Code of Record as required by 10 CFR 50.55a.
- **L-H** Testing will be performed in accordance with the ASME Code of Record as required by 10 CFR 50.55a except based on evaluation of design, service condition, performance history, and compensatory actions, the test frequency may be extended not to exceed 6 years plus a 25% margin, except for the refueling water storage tank outlet check valves and the emergency sump outlet check valves which may be extended not to exceed 8 years plus a 25% margin.
- **LSSC** Testing will be performed in accordance with the ASME Code of Record as required by 10 CFR 50.55a except based on evaluation of design, service condition, and performance history, the test frequency may be extended not to exceed 6 years plus a 25% margin.

The refueling water storage tank (RWST) and emergency sump outlet check valves currently comprise 2 cross unit valve groups, 1) S2(3)1204MU001 and S2(3)1204MU002, and 2) S2(3)1204MU003, and S2(3)1204MU004. All eight valves are 24 inch Mission Duo-Check split disk check valves. Testing is currently scheduled on a 6 year stagger test interval consisting of a disassembly, inspection, and hand stroke. Extending the test interval to 8 years on these 2 valve groups is reasonable given the valve history, and does not result in an interval which would allow degradation without prior detection. The results of the inspections indicate there is little, if any, wear over the initial 15 years of operation. These inspections validate the wear predictions calculated using the CVAP wear analysis software developed by Kalsi Engineering. The process of draining the 350 feet of 24 inch header piping (~8000 gallons) through ¾ inch drain, removing the two valves (one from each group), and hand stroking requires several days. Once the header is re-filled, the venting operation requires multiple start-stop cycles on each of the high pressure injection, low pressure injection, and containment spray pumps on the particular train, and is extremely resource intensive. In addition, there is significant dose accumulation associated with disassembly, inspection and subsequent post maintenance test activities. To support a partial flow test of the sump check valves, the sump must be cleaned, then partially filled. The partial flow activity uses a low pressure injection pump for a short duration partial flow through the check valve. Due to the limited volume available in the sump, the pump run is very short in duration and requires exclusive attention in the control room during preparation and execution.

The RWST valves are partially opened for the quarterly pump inservice tests, and the sump valves are only exercised during the course of the hand stroke. A search of the NPRDS data archives shows there are no records of failures of this valve style (Mission check valves) in this application. The recorded NPRDS failures typically pertain to seat leakage increases, but do not involve failures to close. The NPRDS events primarily concern inservice water systems which have higher service duty than refueling water storage tank and emergency sump outlet check valves. Given this fact, coupled with the above discussion, extending the test interval to 8 years on these 2 valve groups is reasonable and does not result in an interval which would allow degradation without prior detection.

HSSC, L-H, and LSSC check valves at SONGS are candidates for inclusion in the Check Valve Program (CVP) which has been developed to provide confidence that check valves will perform as designed. Station procedure(s) establish test/exam frequencies, methods, and acceptance criteria and provide performance-monitoring requirements for check valves in the CVP. Check valves in the CVP include check valves that are in the IST program, check valves identified as susceptible to unusually high wear, fatigue, or corrosion, and special valves used for personnel safety such as those in the breathing air system. The CVP includes approaches for identification of existing and incipient check valve failures using non-intrusive (e.g., radiography, acoustic emission (AE), magnetic flux (MF), and/or ultrasonic examination (UE) testing methods) and disassembly examination. Test data will be used (e.g., trended as appropriate) to provide confidence that check valves in the CVP will be capable of performing their intended function until the next scheduled test activity. Check valves may be added to or deleted from the CVP based on non-intrusive testing, disassembly examination results, component replacement, or site maintenance history. Kalsi Engineering is nearing completion on a wear trending study for all check valves in the CVP. The results of this study will be factored in to the check valve test strategy using the Integrated Decision-making Process (IDP).

CVP check valve groups are based on common characteristics (manufacturer, style, application, etc.) and the check valves in any group may have the testing staggered over an extended period (e.g., up to 6 years, +25%) based on design, risk ranking, service condition, performance history, and compensatory actions. Testing may be scheduled in regular intervals up to an 6-year period to ensure that all check valves in the group are tested at least once during the 6-year test interval and that not all components are tested at one time. Testing will be scheduled/planned such that there is no more than one cycle between tests of components in a group. Finally, the CVP is assessed on a biennial frequency, updated as appropriate with new design and operational information, and incorporates any applicable site or industry lessons learned.

The check valve testing strategy described above is consistent with the guidance provided in Section 3.1 of RG1.175.

<u>Air-Operated Valves (AOVs)</u>

AOVs will be tested in accordance with the Code of Record (OM-10) with the exception that the test frequency will be in accordance with the component risk categorization defined below:

- **HSSC** Testing will be performed in accordance with the Code of Record as required by 10 CFR 50.55a.
- **L-H** Testing will be performed in accordance with the Code of Record as required by 10 CFR 50.55a except based on evaluation of design, service condition, performance history, and compensatory actions, the test frequency may be extended not to exceed 6 years plus a 25% margin. Additionally L-H AOVs will be stroked at least once during each operating cycle.
- **LSSC** Testing will be performed in accordance with the Code of Record as required by 10 CFR 50.55a) except based on evaluation of design, service condition, and performance, the test frequency may be extended not to exceed 6 years plus a 25% margin. Additionally, LSSC AOVs will be stroked at least once during each operating cycle.

In addition, all AOVs will be exercised at least once during each operating cycle.

SCE has committed to work with the Joint Owners Group for Air Operated Valves (JOG AOV) to develop an enhanced AOV testing program similar to the MOV test program established in response to GL 89-10 and GL 96-05 (described above). The intent of this program is to specify AOV Program requirements to provide assurance that AOVs are capable of performing their intended safety-significant or risk-significant functions. Elements of the proposed program include establishing a scope of applicability, a categorization methodology, validation of safety significant functions by performing design basis reviews, performing baseline testing, and identifying the types of periodic testing necessary to identify potential degradation in a timely manner. SCE's current testing program meets or exceeds the current JOG AOV testing requirements for components within the IST program. To date, the design basis evaluations of all AOVs have not been performed. These evaluations will check the availability capability margin versus the required design-bases conditions to ensure adequate margin does indeed exist.

The AOV program is assessed on a biennial frequency, updated as appropriate with new design and operational information, and incorporates any applicable site or industry lessons learned.

The proposed AOV testing program and planned test activities described above are consistent with the guidance provided in Sections 3.1 and 3.2 of RG1.175.

Hydraulic Valves (E/H), Solenoid Valves, and Others (Manual Valves, etc.)

SCE proposes to test these valves in accordance with the Code of Record (OM-10) with the exception that the test frequency will be in accordance with the component risk categorization defined below:

- **HSSC** Testing will be performed in accordance with the Code of Record as required by 10 CFR 50.55a.
- **L-H** Testing will be performed in accordance with the Code of Record as required by 10 CFR 50.55a except based on evaluation of design, service condition, performance history, and compensatory actions, the test frequency may be extended not to exceed 6 years plus a 25% margin.
- **LSSC** Testing will be performed in accordance with the Code of Record as required by 10 CFR 50.55a) except based on evaluation of design, service condition, and performance history, the test frequency may be extended not to exceed 6 years plus a 25% margin.

Hydraulic valves will be exercised at least once during each operating cycle.

The proposed testing program described above is consistent with the guidance provided in Section 3.1 of RG1.175.

Pumps

Pumps will be tested in accordance with the Code of Record (OM-6) with the exception that the test frequency may be in accordance with the component risk categorization defined below:

- **HSSC** Testing will be performed in accordance with the Code of Record as required by 10 CFR 50.55a. Additionally, Code testing will be augmented with periodic oil analysis and thermography. A motor current monitoring program is in the development stage. Once implemented, HSSC pumps will be included in the scope of that program.

- **L-H** Testing will be performed in accordance with the Code of Record as required by 10 CFR 50.55a except based on evaluation of design, service condition, performance history and compensatory actions, the test frequency may be extended not exceed 6 years plus a 25% margin.
- **LSSC** Testing will be performed in accordance with the Code of Record as required by 10 CFR 50.55a except the test frequency may be extended not to exceed 6 years plus a 25% margin.

At this point no test interval extension for pumps is planned, regardless of Expert Panel categorization as LSSCs for a few pumps in the RI-IST Program.

All pumps will receive periodic thermography of their driver, lube oil analysis, alignment checks performed following major pump maintenance (using vibration analysis methods to confirm alignment), motor current testing (when the motor current testing program is implemented), vibration monitoring (required by the current Code), and flange loading checks of connected piping (note that this flange loading test is not periodic, but is performed after major maintenance/overhauls that required the disassembly of any flange in a safety-related system). Additional tests (e.g., thermography of the driver, or motor current testing[28]) are predictive in nature and involve trending of parameters that need to be compared more frequently in order to provide meaningful results. This augmented testing program for pumps is consistent with the guidance provided in RG1.175, and provides reasonable assurance that adequate pump capacity margin exists such that pump operating characteristics over time do not degrade to a point of insufficient margin before the next scheduled test activity.

The above testing strategy is consistent with the guidance provided in Section 3.1 of RG1.175.

3.2 Program Implementation

Implementation of SCE's RI-IST Program consists of grouping components and then staggering the testing of the group over the extended test interval for those components ranked L-H or LSSC.

3.2.1 Grouping

SCE performed a rigorous grouping analysis that involved several component attributes. The results of the grouping analysis are presented in Table 3.2-1, located at the end of Section 3. The groups share the following distinct characteristics:

- System
- Component type (MOV, AOV, Check Valve, etc.)
- Manufacturer

[28] Both driver thermography and motor current testing are currently in the early stages of implementation at SCE.

- Size
- Style (globe, gate, swing check, tilt disk, etc.)
- Application (pump discharge, flow path, orientation, etc).

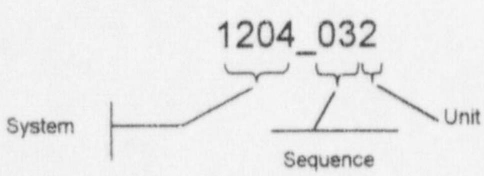
The grouping attributes selected and listed above satisfy NRC criteria provided in NUREG-1482. The required sampling techniques described in NUREG-1482/Generic Letter 89-04, Position 2 are design, service condition, and valve orientation.

Groups have been populated and testing has been scheduled such that the entire group will be tested over a range of quarterly to 6 years (except for the refueling water storage tank outlet check valves and the emergency sump check valves which will be extended to a maximum of 8 years) plus a 25% margin, depending on the size, safety and risk significance, and past performance of valves in the group. The population of the group proved to be dependent upon the total available population of the component, as well as consideration of the testing schedule that the program seeks to maintain.

The stagger test model allows trending and monitoring of the performance of components in the group to ensure that the selected test frequency is appropriate. Grouping components in this manner and testing on a staggered basis over the test frequency will reduce the importance of common cause failure modes, as selected components in the same staggered failure mode group are periodically tested over the group's extended test interval, ensuring that component capability will be maintained over the test interval. The sequence of testing will be repeated to ensure the maximum amount of time between testing of a component does not exceed the 6 year test interval (except for the refueling water storage tank outlet check valves and the emergency sump check valves which will not exceed an 8 year test interval) plus a 25% margin. Finally, SCE's RI-IST Program will incorporate the expansion criteria described in NUREG-1482, which states that if a potentially generic problem is identified during a test, all valves in the group in that unit must be inspected/tested during the refueling outage.

The valve group designators are composed of the system, a sequential number and a unit identifier, as illustrated below.

Group Identifier



Note: Consistent with plant convention, components common to both units or grouped across units display a unit "0" group identifier

In several cases the grouping spans two systems. In these cases, the component functions meet the grouping criteria and the system designation break is arbitrary. For example, for valve groups 1208_012 and 013, the charging system connects to the high pressure safety injection path through independent piping and manual isolation valves. The manual valves are identical in design and function, but they are arbitrarily designated as different systems (Safety Injection and Charging). Hence, combining these valves as a group does not violate the grouping criteria.

In summary, the L-H or LSSC valves in any group may have the testing staggered over an extended period (e.g., up to 6-years, except for the refueling water storage tank outlet check valves and the emergency sump check valves which will be extended to a maximum of 8 years, plus 25% margin) based on design, service condition, performance history, risk ranking, compensatory actions (for L-H valves), and the number of valves in a group. Testing will be scheduled on a stagger test basis to ensure:

- All valves in the group are tested at least once during the stagger test interval and,
- Not all components are tested at one time.

Generally, extensions for L-H and LSSC ranked components adhere to the following model (Table 3.2-1 contains the stagger test interval):

VALVES PER GROUP	FINAL TEST INTERVAL
1	2yr - 2A
2 (or multiples of 2)	4yr - 4A(S)
3 (or multiples of 3)	6yr - 6A(S)

Note: The "(S)" indicates a stagger test

This submittal does not change the current IST program alternate testing justifications, in that testing previously identified as cold shutdown or refueling remains in a "test at shutdown" classification. The alternate testing justifications are available for review, if required.

The performance history of the E/H valves on the AFW pump flow path (HV4762 and HV4763) is such that this valve group did not merit an increase in test frequency. In addition, some check valves were replaced with an improved design (1201MU019 and 1201MU021), but since they have not yet accumulated adequate performance history, their test frequency will remain at the cold shutdown interval. When adequate performance history is obtained, these valves will be re-evaluated and the interval will be extended as appropriate.

3.3 Performance Monitoring of IST Components

In addition to the specific inservice testing proposed for each component group discussed in Section 3.1.1 above, the RI-IST program will perform the following additional monitoring for each component group. The additional performance monitoring activities listed below by component type are applicable to all components within a given group regardless of individual ranking (HSSC, L-H, or LSSC).

The proposed monitoring plan is sufficient to detect component degradation in a timely manner. Further, the monitoring activities identified for each component group ensure that the following criteria are met:

- Sufficient tests are conducted to provide meaningful data.
- The inservice tests are conducted such that incipient degradation can reasonably be expected to be detected.
- Appropriate parameters are trended to provide reasonable assurance that the component will remain operable over the test interval.

The proposed performance monitoring plan is sufficient to ensure that degradation is not significant for components placed on an extended test interval, and that failure rates assumed for these components will not be significantly compromised. The proposed performance monitoring, when coupled with SCE's corrective action program (discussed in Section 2.4.1), ensures corrective actions are taken and timely adjustments are made to individual component test strategies where appropriate.

The SCE RI-IST Program will be reassessed at a frequency not to exceed once every other refueling outage, based on Unit 3, to reflect changes in plant configuration, component performance test results, industry experience, and other inputs to the process. Configuration changes will be assessed in concert with the current design change process. Therefore, the monitoring process for RI-IST is adequately coordinated with existing programs (e.g., Action Request program, Maintenance Rule monitoring, and design change process) for monitoring component performance and other operating experience on this site and, where appropriate, throughout the industry. Although the monitoring of reliability and unavailability goals for operating and standby systems/trains is required by the Maintenance Rule, it alone might not be sufficient to ensure operational readiness of components in the RI-IST program. The SONGS Action Request program requires timely operability assessment for component performance issues detected outside the auspices of the IST program. This process, coupled with the evaluations performed in Maintenance Rule space in concert with IST trending, ensures continued operational readiness of RI-IST components.

Motor-Operated Valves (MOVs)

- Actuator electrical inspections

    Limit switch assemblies

Torque switch assemblies

Leads, jumpers, lugs, caps, tape, space heaters, environmentally qualified (EQ) wire splices and cable ties

Inspect terminal blocks, motor T-drains

Assess motor overheating indication

Perform motor megger

- Actuator lubrication inspection

Inspect for weeping, grease relief for function, grease level in main gear and clutch housing, and grease quality

Add grease to stem reservoir

Lubricate upper drive sleeve bearing

Lubricate valve bushing via grease fitting, stem threads, and yoke legs/anti-rotation plate on WKM globes

- Inspect stem nut for tightness and staking, actuator type SB compensator spring housing for cracks, and stem protective cover
- Valve PM activities
- Other activities

Perform handwheel operation

Visual inspection for gross irregularities, upper bearing housing cover for warping on SMB-000,

Remove springpack/worm to inspect spring pack, worm, worm gear, torque switch roller, grease in main housing

Remove motor to inspect motor pinion, worm shaft gear, declutch mechanism, and grease in motor compartment

Verify/tighten actuator mounting bolts, anti-lock rotation plat jam nuts

Verify/adjust actuator stop nuts and monitor stem nut thread condition

Relief Valves

- Test results trended
- New valves tested prior to installation
- Valves set as close to nominal as practical

Check Valves

- Combination of acoustic, magnetic, and/or ultrasonic testing methods are used as appropriate
- Data retrieved from these methods will be compared with previous results and the differences evaluated

- Open and close testing
- Check valve disassembly inspections are performed where other testing is not practicable
- Leak rate testing is performed by 10 CFR 50, Appendix J program
- Leak testing for check valve closed exercise testing where appropriate

Air-Operated Valves (AOVs)

- Static diagnostic testing performed following valve or actuator overhaul or corrective maintenance that could impact valve function or as requested
- Routine overhauls
- Disassembly, cleaning, inspection
- Replacement of elastomers
- Re-assembly and testing
- Response time testing
- Valves exposed to extreme environmental conditions will have repetitive maintenance orders for actuator replacement
- Positioner PMs consist of the following:

  Removal disassembly, cleaning, inspection
  Parts replacement as required
  Reassembly and test
- Dynamic testing (the following testing parameters as applicable)
- Bench set, maximum pneumatic pressure, seat load, spring rate, stroke time, actual travel, total friction
- Setpoint of pressure switch(s) relief valve, regulator, etc.
- Minimum pneumatic pressure to accomplish safety function of valve assembly
- Pneumatic pressure at appropriate point in operation
- Others as applicable

Pumps

- Margin to safety limit deviations – head curves
- Lube oil analysis

- Alignment checks
- Motor current testing (recently initiated – program still developing)
- Vibration monitoring
- Flange loading checks of connected piping – (not periodic – only performed after disassembly)
- Thermography (recently initiated)

3.4 Feedback and Corrective Action Program

When a component with an extended test interval fails to meet established test criteria, corrective actions will be taken in accordance with the SONGS Action Request (AR) Program (the basic initiator for the corrective action program) as described below for the RI-IST program.

The SONGS AR program is initiated by component failures that are detected by the IST program, as well as by other mechanisms, such as normal plant operation, or inspections. For components not meeting any acceptance criteria, an AR is generated. This document initiates the corrective action process.

For example, during a "substantial flow" pump IST, the discharge check valve is effectively tested during the course of the pump test. Since the pump test can not be considered satisfactory if the check valve fails to perform its risk significant function (i.e., open), a test failure would be recorded and an AR would be initiated. The recorded information could then be used to assess whether a significant change in component reliability has occurred such that the component would merit a change in test interval.

Note, however, that the initiating AR event may be derived from causes other than an unacceptable IST test. In fact, the initiating event could be any other indication that the component is in a non-conforming condition. When an unsatisfactory condition occurs, it is evaluated to fulfill the following objectives:

(1) Determine the impact on system operability and take appropriate action;

(2) Review the previous test data for the component and all components in the group;

(3) Perform a root cause analysis, as appropriate;

(4) Determine if the event is a generic failure. If it is a generic failure whose implications affect a group of components, initiate corrective action for all components in the affected group.;

(5) Initiate corrective action for failed IST components; and

(6) Evaluate the adequacy of the test strategy. If a change is required, review the IST test schedule and change as appropriate.

As is apparent from the AR process outlined above, the SONGS corrective action guidance and procedures achieve the following objectives:

- The procedures comply with Criterion XVI, "Corrective Action" as specified by Appendix B to 10

CFR Part 50.

- The procedures institute a process that determines the impact of the failure or nonconforming condition on system/train operability. SCE refers to the appropriate Technical Specification when component capability cannot be demonstrated.
- The procedures determine and correct the apparent or root cause of the failure or nonconforming condition (e.g., improve testing practices, repair or replace the component).
- The procedures assess the applicability of the failure or nonconforming condition to other components in the IST program (including any test population expansion that may be required for grouped components such as relief valves).
- The procedures correct other susceptible similar IST components as necessary.
- The procedures consider the effectiveness of the component's test strategy (i.e., frequency and methods) in detecting the failure or nonconforming condition. They adjust the test frequency or methods or both, as appropriate, where the component (or group of components) experiences repeated or age-related failures or nonconforming conditions.

SCE's corrective action evaluations will periodically be given to the SONGS PRA group so that any necessary model changes and PRA component re-categorization will be incorporated as appropriate.

Performance history and data, including the adequacy of compensatory measures, will be fed back through the site processes to the IST Coordinator and the RI-IST Expert Panel. In this way, any unacceptable performance will be detected early and can be factored into the program. If an ineffective test interval is detected, it will be evaluated through the corrective action programs and resolved through appropriate changes to the IST Program.

Additionally, as part of the corrective action process, the IST Coordinator will evaluate the necessity of increasing the test frequency (i.e., decreasing the time between tests) of a component (or group of components) if the cause of failure is determined to be age-related. Furthermore, the SONGS Inservice Testing Coordination and Trending Program procedure will be modified to require the evaluation of the effects of a component failure or degradation for common causes across other plant systems. Therefore, the RI-IST feedback and corrective action process is consistent with the acceptance guidelines contained in Section 3.4 of RG1.175.

3.5 Periodic Reassessment

As a living process, components will be reassessed at a frequency not to exceed every other refueling outage (initiated based on Unit 3 refueling outages) to reflect changes in plant configuration, component performance test results, industry experience, and other inputs to the process. The RI-IST reassessment will be completed within 9 months of completion of the outage. Significant changes in plant configuration may require a more expedient assessment. One or more such emergent modifications resulting in significant changes in the PRA model is an example that would require a more expedient assessment.

Part of this periodic reassessment will involve feedback to the PRA group. This includes information such as components tested since the last reassessment, number and type of tests, number of failures, corrective actions taken including generic implication and changed test frequencies. Once the PRA has been reassessed, risk information will be re-introduced to the Integrated Decision-making Process (IDP) for Expert Panel deliberation and confirmation of the existing lists of HSSCs, L-Hs, and L-LSSCs or modification of these lists based on the new data. As part of the IDP, confirmatory measures previously used to categorize components as L-Hs or LSSCs will be validated. Additionally, the maximum test interval will be verified or modified as dictated by the IDP.

The risk analysis performed for the initial Risk-informed IST Program will be updated every other refueling outage. As part of the update, plant-specific performance histories will be analyzed by the PRA analysts and incorporated into the PRA models, then component importance will be recalculated. The Expert Panel will then review the performance histories and PRA inputs and determine if any L-Hs or LSSCs should be re-categorized as HSSCs because of plant-specific performance, or vice versa. This approach is considered to be both prudent and conservative, since it ensures that any new IST components will be evaluated by the RI-IST process before its ASME Code test requirements are relaxed.

For each L-H (LSSCs that have a high RAW), the Expert Panel either selected a compensatory measure or provided justification, based on model and performance considerations, why a compensatory measure was not required. Compensatory measures are tests and other activities that could be credited to reduce the increase in core damage frequency associated with test interval changes (e.g., pump operability test or pump IST for pump discharge check valves, slave relay test for MOVs, normal instrumentation monitoring, locked valve program, subgroup relay testing every 180 days per technical specifications). Compensatory measures which are used as part of the IDP process to qualitatively justify the extension of a test interval will be re-verified during the IDP process update.

Table 3.2-1 Inservice Testing Program Changes

IST Interval Legend					
QT	Quarterly	2A	Every two years	4AS	4 year stagger test
CS	Cold Shutdown	2AS	2 year stagger test	6AS	6 year stagger test
RR	Refueling	4A	Every 4 years	8AS	8 year stagger test
SP	Appendix J Opt B				

Risk Ranking Legend			
Low (LSSC)	Low FV, High RAW (LSSC)	High (HSSC)	Not Ranked

IST Test Type Legend					
AJ	Appendix J Seat Leakage	BTO	Stroke Test Open	CVTO	Check Valve Test Open
AT	Seat Leakage	BTC	Stroke Test Closed	FSTO	Fail Safe Test Open
BMO	Manual Stroke Open	BTPO	Partial Stroke Open	FSTC	Fail Safe Test Closed
BMC	Manual Stroke Closed	BTPC	Partial Stroke Closed Test	PIT	Position Indication Test
BMPO	Manual Partial Stroke Open	CVPO	Check Valve Partial Stroke Open	RVT	Relief Valve Test
BMPC	Manual Partial Stroke Closed	CVTC	Check Valve Test Closed		

RI-IST Test Interval	Bounding interval determined by PRA analysis. The interval determined by the Integrated Decisionmaking Process can be no greater than this value for a given grouping without performing specific PRA analysis to support it.
RI-IST Test Interval Factor	Multiplier proportional to the proposed change in test interval
RI-IST Interval Factor w/Comp Measure	Multiplier, considering compensatory measures, applied to PRA calculations for surveillance extensions.
Compensatory Measure	An activity that exercises a component more frequently than the proposed interval. Timing and/or other measurements are not required for compensatory measures. Only regulatory (Technical Specification) based activities were considered for compensatory measures

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Risk Ranking Legend

Low (LSSC)	Low FV, High RAW (LSSC)	High (HSSC)	Not Ranked

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BMC	Manual Stroke Closed	BTPC	Partial Stroke Closed Test	PIT	Position Indication Test
BMPO	Manual Partial Stroke Open	CVPO	Check Valve Partial Stroke Open	RVT	Relief Valve Test
BMPC	Manual Partial Stroke Closed	CVTC	Check Valve Test Closed		

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Compensatory Measure	An activity that exercises a component more frequently than the proposed interval. Timing and/or other measurements are not required for compensatory measures. Only regulatory (Technical Specification) based activities were considered for compensatory measures

Table 3.2-1 Program Changes

	TEST TYPE	CURRENT TEST INTERVAL	RI-IST TEST INTERVAL	RI-IST INTERVAL FACTOR	RI-ISTINTERVAL FACTOR w/COMP MEAS	COMPENSATORY MEASURE
VALVE GROUP: 1415_022						
	2HV7911	NUCL SERV WATER CONTAINMENT ISOL				**ACTUATOR:** PNEUMATIC
	AJ	SP	Test per Appendix J Option B	N/A		
	BTC	QT	2A	8	2	This valve is stroked as a part of the semi-annual sub-group relay testing per SO23-3-3.43.4
	FSTC	QT	2A	8	2	This valve is stroked as a part of the semi-annual sub-group relay testing per SO23-3-3.43.4
	PIT	RR	2A	1		
VALVE GROUP: 1415_032						
	2PSV9066	NUCLEAR SERVICE WATER INSIDE CNTMT PRESSURE SAFETY/RELIEF VALVE				**ACTUATOR:** SAFETY/RELIEF
	RVT	RR	RR	1		
SYSTEM: 1417 Demineralized Water						
VALVE GROUP: 1417_010						
	SA1417MU136	{ME335} CHECK VALVE TO PREVENT LEAKAGE & BACKFLOW ON NSW				**ACTUATOR:** CHECK
	AT	RR	4AS	2		
	CVTC	RR	4AS	2		
	SA1417MU138	{ME336} CHECK VALVE TO PR[illegible]VENT LEAKAGE & BACKFLOW ON NSW				**ACTUATOR:** CHECK
	AT	RR	4AS	2		
	CVTC	RR	4AS	2		
VALVE GROUP: 1417_022						
	S21417MU230	COND STORAGE TANK 2T-121 2LV-4355 BYPASS				**ACTUATOR:** MANUAL
	BMO	N/A	2A	1		

ENCLOSURE 3

The Southern California Edison Company (SCE)
Risk-Informed Inservice Testing
Program Description

RISK-INFORMED INSERVICE TESTING

PROGRAM DESCRIPTION

The proposed alternative is a risk informed process to determine the safety significance and testing strategy of components in the ASME Section XI Inservice Testing (IST) Program, and identify non-ASME IST components (pumps & valves) modeled in the Probabilistic Risk Assessment (PRA) that are determined to be High Safety Significant Components (HSSCs). The process consists of the following elements.

1. Categorize components by Fussell-Vesely (FV) and Risk Achievement Worth (RAW) importance measures based on the San Onofre Nuclear Generating Station (SONGS) 2/3 Living PRA. (PRA Process)

2. Blend deterministic and probabilistic data to perform a final importance categorization of components as either Low Safety Significant Component (LSSC), Potentially High (LH) or High Safety Significant Component (HSSC). (Integrated Decision Process - IDP)

3. Develop/Determine Test Frequencies and Test Methodologies for the ranked components. (Testing Philosophy)

4. Evaluate cumulative risk impact of new test frequencies and test methodologies to ensure risk reduction or risk neutrality. (Cumulative Risk Impact)

5. Develop an implementation plan. (Implementation)

6. Develop a Corrective Action plan. (Corrective Action)

7. Perform periodic reassessments. (Periodic Reassessments)

8. Develop a methodology for making changes to the Risk Informed – Inservice Testing (RI-IST) program. (Changes to RI-IST)

With these elements and their implementation, the key safety principle discussed in the Basis for Acceptance are maintained.

1. PRA Process

PRA methodology facilitates determination of the risk significance of components based on end states of interest, such as core damage frequency (CDF) and release of radioactivity (e.g., large early release frequency (LERF)).

The full scope (internal and external events, and shutdown) PRA used to develop the importance measures is adequate for this application, and is complemented by the Integrated Decision Process (IDP). Evaluation of initiating events also includes loss of support systems and other special events such as Loss of Coolant Accident (LOCA), Steam Generator Tube Rupture (STGR), station blackout, and Anticipated Transient without Scram (ATWS).

The PRA model used for the development of importance measures for the RI-IST was independently reviewed to ensure completeness and accuracy. Additionally, all changes to the model are formally tracked and reviewed to ensure the change is complete, accurate, appropriately implemented in the computer model, and documented.

The PRA will be periodically updated (See Section 7) to reflect the current plant design, procedures, and programs.

2. Component Ranking

Two figures of merit will be used to initially categorize components: Fussell-Vesely (FV) and Risk Achievement Worth (RAW). For the RI-IST Program, the following criteria will be used to initially rank components for review by the Integrated Decision Process (IDP).

Category	Criteria
High (HSSC)	FV>0.001
Potentially High (LH)	FV < 0.001 and RAW> 2
Low (LSSC)	FV<0.001 and RAW<2

These CDF and LERF thresholds ensure that the cumulative risk impact due to changes in test frequencies are within the acceptance guidelines of Regulatory Guides 1.174.

Methodology/Decision Criteria for PRA

The following describes a methodology that may be used to categorize components in the RI-IST when the program is reassessed. However, only those elements that are significantly affected by the model changes (e.g., design modifications or procedural changes) need to be reviewed in detail using this process. The scope of the review and the justification for it will be documented as part of the IDP. The following steps will be applied by the IDP:

a) Review FV and RAW importance measures for pumps and valves considered in the PRA against the classification criteria.

b) Review component importance measures to ensure that their bases are well understood and are consistent with the SONGS specific levels of redundancy, diversity, and reliability.

PRA Limitations

a) Address the sensitivity of the results to common cause failures (CCF), assuming all/none of the CCF importance is assigned to the associated component.

b) Evaluate the sensitivity due to human action modeling. Identify/evaluate proceduralized operator recovery actions omitted by the PRA that can reduce the ranking of a component.

c) Consider industry history for particular IST components. Review such sources as NRC Generic Letters, Significant Operating Event Report (SOERs), and Technical Bulletins and rank accordingly.

d) For components with high RAW/ low FV, ensure that other compensatory measures are available to maintain the reliability of the component.

e) Identify and evaluate components whose performance shows a history of causing entry into LCO conditions. To ensure that safety margins are maintained, consider retaining the ASME test frequency for these components.

Level II (LERF)

Consider components/systems that are potential contributors to large, early release. Determine LERF FV and RAW for components and/or determine which would have the equivalent of a high FV or low FV /high RAW with respect to LERF and rank accordingly.

IST Components Not in PRA

Review scenarios involving the "not-modeled" IST components to validate that the components are in fact low risk.

High-Risk PRA Components Not in the IST Program

- Identify, if any, other high risk pumps and valves in the PRA that are not in the IST program but should be tested commensurate with their importance.

- Determine whether current plant testing is commensurate with the importance of these valves. If not, determine what test, e.g., the IST test, would be the most appropriate

Other Considerations

Review the PRA to determine that sensitivity studies for cumulative effects and defense in depth have been adequately addressed in the determination of component importance factors.

3. Integrated Decision Process

The purpose of using the Integrated Decision Process (IDP) is to confirm or adjust the initial risk ranking developed from the PRA results, and to provide a qualitative assessment based on engineering judgement and expert experience. This qualitative assessment compensates for limitations of the PRA, including cases where adequate quantitative data is not available.

The IDP uses deterministic insights, engineering judgement, experience, and regulatory requirements as described above in Section 2. The IDP will review the initial PRA risk ranking, evaluate applicable deterministic information, and determine the final safety significance categories. The IDP considerations will be documented for each individual component to allow for future repeatability and scrutiny of the categorization process.

The scope of the IDP includes both categorization and application. The IDP is to provide deterministic insights that might influence categorization. The IDP will identify components whose performance justifies a higher categorization.

The IDP will determine appropriate changes to testing strategies. The IDP will identify compensatory measures for potentially HCCSs or justify the final categorization. The IDP will also concur on the test interval for components categorized as a Low Safety Significant Component (LSSC) .

The end product of the IDP will be components categorized as LSSC, Potentially High Safety Significant (LH) or High Safety Significant Component (HSSC).

In making these determinations, the Integrated Decision Process (IDP) ensures that key safety principles (namely defense-in-depth and safety margins), are maintained. It also ensures the changes in risk for both CDF and LERF are acceptable per the guidelines discussed in Section 2 above. The key safety principles are described below.

Defense in Depth

The SONGS RI-IST program ensures consistent defense in depth by maintaining strict adherence to seven objectives of the defense in depth philosophy described in Regulatory Guides 1.174 and 1.175. The review and documentation of these objectives are an integral feature of the IDP for future changes to the program. Those objectives are:

1) A reasonable balance is preserved among prevention of core damage, prevention of containment failure, and consequence mitigation. Multiple risk metrics, including core damage frequency (CDF) and large early release frequency (LERF), will be used to ensure reasonable balance between risk end states (Objective 1).

2) No changes to the plant design or operations procedures will be made as part of the RI-IST program which either significantly reduces defense-in-depth, barrier independence or places strong reliance on any particular plant feature, human action, or programmatic activity (Objective 2, 5).

3) The methodology for component categorization, namely the selection of importance measures and how they are applied and understanding the basic reasons why components are categorized HSSC or LSSC, will be reviewed to ensure that redundancy and diversity are preserved as the more important principles. Component reliability can be used to categorize a component LSSC only when:

    1) plant performance has been good, and

    2) a compensatory measure or feedback mechanism is available to ensure adverse trends in equipment performance can be detected in a timely manner.

   A review will ensure that test frequency relaxation in the RI-IST program occurs only when the level of redundancy or diversity in the plant design or operation supports it. In this regard, all components that have significant contributions to common cause failure will be reviewed to avoid relaxation of requirements on those components with the lowest level of diversity within the system (Objective 3, 4)

4) Defenses against human errors are preserved by performing sensitivity studies. Sensitivity studies will be performed for human actions to ensure that components which mitigate the spectrum of accidents are not ranked low solely because of the reliability of a human action (Objective 6).

5) The intent of the General Design Criteria in 10CFRPart 50, Appendix A will be maintained (Objective 7).

Other Considerations Related To Defense-In-Depth.

When the PRA does not explicitly model a component, function, or mode of operation, a qualitative method may be used to classify the component HSSC, LH, or LSSC and to determine whether a compensatory measure is required. The qualitative method is consistent with the principles of defense in depth because it preserves the distinction between those components which have high relative redundancy and those which have only high relative reliability.

Maintain Sufficient Safety Margin

The IDP will perform reviews consistent with Regulatory Guides 1.174 and 1.175 to ensure that sufficient safety margin is maintained when compared to the deterministic IST program. In performing this review, the IDP will consider such things as proposed changes to test intervals and, where appropriate, test methods. The IDP will ensure that the proposed compensatory measures, when required by the program, are effective in maintaining adequate safety margin. To enhance the safety margin, the IDP will also review PRA important components not in the current IST program for potential inclusion in the RI-IST program.

Categorization Guidelines

Modeled Components/Functions

For modeled components/functions with a FV >0.001 the IDP either confirms the component categorization is HSSC or a justification of conservatism in the PRA model will be developed.

For modeled components/functions with a FV <0.001, but a RAW >2.0, the component will be categorized LH. The component may be considered LSSC provided a compensatory measure exists that ensures operational readiness and the component's performance is acceptable. If a compensatory measure is not available or the component has a history of poor performance, the component will not be considered for test interval extension and will be considered for potential test method enhancement.

For modeled components/functions with a FV <0.001 and a RAW <2.0, the component will be categorized as LSSC provided the component's performance has been acceptable. For those components with performance problems, a compensatory measure will be identified to ensure operational readiness or the component will be categorized as HSSC.

Non-Modeled Components/Functions

For components not modeled or the safety function not modeled in the PRA, the categorization is as follows:

If the sister train is modeled then the component takes that final categorization.

If the component is implicitly modeled in the PRA, the FV and RAW are estimated and the deliberation is as discussed for modeled components/functions.

If the component is not implicitly modeled, the component performance history will be reviewed. For acceptable performance history the component will be categorized as LSSC. For poor performance history, a compensatory measure will be identified to ensure operational readiness and the component categorized as LSSC, or if no compensatory measures are available, categorize the component as HSSC.

Documentation

Documentation of the IDP will be available for review at the plant site. The basis for risk ranking and component grouping will be entered in the IST data system.

4. Testing Philosophy

Motor Operated Valves (MOVs)

HSSC Testing will be performed in accordance with Code Case OMN-1, and NRC Generic Letter 89-10 and 96-05 commitments. MOV's with a passive function will be tested per the Code of Record as defined in 10CFR50.55a. Seat leakage testing, if required, will be per the Code of record.

LH Testing will be performed in accordance with Code Case OMN-1 and NRC Generic Letter 89-10 and 96-05 commitments at an initial interval not to exceed 6 years until sufficient data exist to determine a more appropriate test frequency. MOV's with a passive function will be tested per the Code of

Record, except at a test frequency not to exceed 6 years (with a 25% margin) based on evaluation of design, service condition, performance history, and compensatory actions. Seat leakage testing, if required, will be per the Code of record, except at a test frequency not to exceed 6 years (with a 25% margin).

LSSC Testing will be performed in accordance with Code Case OMN-1, and NRC Generic Letter 89-10 and 96-05 commitments at an initial interval not to exceed 6 years until sufficient data exist to determine a more appropriate test frequency. MOV's with a passive function will be tested per the Code of Record, except at a test frequency not to exceed 6 years (with a 25% margin). Seat leakage testing, if required, will be per the Code of record, except at a test frequency not to exceed 6 years (with a 25% margin).

Relief Valves

Testing of relief valves will continue to be conducted in accordance with the Code of record (OM-1) with no change in test interval. The Southern California Edison Company (SCE) believes that relief valve performance as a whole does not warrant interval extension. In the future, should performance history change, SCE will rank valves per the Integrated Decision-making Process (IDP) and extend intervals accordingly. The initial testing strategy will be:

HSSC Testing will be performed in accordance with the Code of Record as defined in 1OCFR5O.55a.

LH Testing will be performed in accordance with the Code of Record as defined in 1OCFR5O.55a.

LSSC Testing will be performed in accordance with the Code of Record as defined in 1OCFR5O.55a

Check Valves

HSSC Testing will be performed in accordance with the ASME Code of Record as defined by 1OCFR50.55a.

LH Testing will be performed in accordance with the ASME Code of Record as required by 10 CFR 50.55a except, based on evaluation of design, service condition, performance history, and compensatory actions, the test frequency may be extended not to exceed 6 years plus a 25% margin, except for the refueling water storage tank outlet check valves and the emergency sump outlet check valves which may be extended not to exceed 8 years plus a 25% margin.[i]

LSSC Testing will be performed in accordance with the ASME Code of Record as defined by 1OCFR5O.55a except at a test frequency not to exceed 6 years(with 25% margin).

In addition, the interval for exercise testing for certain check valves with Appendix J local leak rate testing requirements will be assigned consistent with Appendix J, Option B criteria.

Air Operated Valves (AOVs)

HSSC Testing will be performed in accordance with the Code of Record as defined by 1OCFR5O.55a.

LH Testing will be performed in accordance with the Code of Record as required by 10CFR50.55a except based on evaluation of design, service condition, performance history, and compensatory actions, the test frequency may be extended not to exceed 6 years plus a 25% margin. Additionally L-H AOVs will be stroked at least once during each operating cycle.

LSSC Testing will be performed in accordance with the Code of Record as defined by 1OCFR5O.55a except with a test frequency not to exceed 6 years (with 25% margin). Additionally, LSSC AOVs will be stroked once during the operating cycle.

Note: Currently certain AOVs are tested using diagnostic equipment. SONGS is participating in a Joint Owners Group effort to develop an AOV program similar to the MOV Program mandated by GL 89-10 and 96-05. This program will evaluate the valve/operator characteristics/capabilities and the design conditions under which the valve is expected to operate. Once this information is developed it will be evaluated and implemented as appropriate.

Hydraulic Valves (E/H), Solenoid Valves, and Others (Manual Valves, etc.)

SCE proposes to test these valves in accordance with the Code of Record (OM-10) with the exception that the test frequency will be in accordance with the component risk categorization defined below:

HSSC Testing will be performed in accordance with the Code of Record as required by 10CFR50.55a.

LH Testing will be performed in accordance with the Code of Record as required by 10 CFR 50.55a except based on evaluation of design, service condition, performance history, and compensatory actions, the test frequency may be extended not to exceed 6 years plus a 25% margin.

LSSC Testing will be performed in accordance with the Code of Record as required by 10 CFR 50.55a except based on evaluation of design, service condition, and performance history, the test frequency may be extended not to exceed 6 years plus a 25% margin.

Pumps

Pumps will be tested in accordance with the Code of Record (OM-6) with the exception that the test frequency may be in accordance with the component risk categorization defined below:

HSSC Testing will be performed in accordance with the Code of Record as required by 10 CFR 50.55a. Additionally, Code testing will be augmented with periodic oil analysis and thermography. A motor current monitoring program is in the development stage. Once implemented, HSSC pumps will be included in the scope of that program.

LH Testing will be performed in accordance with the Code of Record as required by 10 CFR 50.55a except based on evaluation of design, service condition, performance history, and compensatory actions, the test frequency may be extended not exceed 6 years plus a 25% margin.

LSSC Testing will be performed in accordance with the Code of Record as required by 10 CFR 50.55a except the test frequency may be extended not to exceed 6 years plus a 25% margin.

5. Implementation

Implementation of the RI-IST to LSSC will consist of grouping components and then staggering the testing of the group over the test frequency.

Grouping:

Components will generally be grouped based on:

- System
- Component type (MOV, AOV, Check Valve, etc.)
- Manufacturer
- Size
- Style (globe, gate, swing check, tilt disk, etc.)
- Application (pump discharge, flow path, orientation, etc).

The population of the group will be dependent on:

- total population available
- maintaining current testing schedule

Grouping components in this manner and testing on a staggered basis over the test interval reduces the importance of common cause failure modes since at least one valve in the group is tested during each cycle.

Testing of components within the defined group will be staggered over the test interval, typically 6 years. Testing will be scheduled on regular intervals over the test interval to ensure all components in the group are tested at least once during the interval, the same component is not tested repeatedly, while deferring others in the group, and not all components are tested at one time. The staggering allows the trending of components in the group to ensure the test frequency selected is appropriate.

Testing will be scheduled / planned such that there is no more than one cycle between tests of components in a group.

6. Corrective Action

When an LSSC (including L,H) on the extended test interval fails to meet established test criteria, corrective actions will be taken in accordance with the SONGS corrective action program as described below for the RI-IST.

For all components not meeting the acceptance criteria, an Action Request (AR) will be generated. This document initiates the corrective action process. An AR may result from activities other than IST that identify a degradation in performance.

The initiating event could be any other indications that the component is in a non-conforming condition. The unsatisfactory condition will be evaluated to:

a) Determine the impact on system operability since the previous test.

b) Review the previous test data for the component and all components in the group.

c) Perform a root cause analysis.

d) Determine if this is a generic failure. If it is a generic failure whose implications affect a group of components, initiate corrective action for all components in the affected group.

e) Initiate corrective action for failed IST components.

f) Evaluate the adequacy of the test interval. If a change is required, review the IST test schedule and change as appropriate.

The results of component testing will be provided to and reviewed by the PRA group for potential impact to a PRA model update. The PRA model will be updated as necessary with changes tracked and documented per the PRA Change Process Program.

For an emergent plant modification, any new IST component added will initially be included at the current Code of Record test frequency. Only after evaluation of the component through the RI-IST Program (i.e., PRA model update if applicable and IDP review) will this be considered LSSC with an extended test interval..

7. Periodic Reassessment

As a living process, components will be reassessed at a frequency not to exceed every other refueling outage (based on Unit 3 refueling outages) to reflect changes in plant configuration, component performance test results, industry experience, and other inputs to the process. The RI-IST reassessment will be completed within 9 months of completion of the outage.

Part of this periodic reassessment will be a feedback loop of information to the PRA. This will include information such as components tested since the last reassessment, number and type of tests, number of failures, corrective actions taken including generic implication, and changed test frequencies. Once the PRA has been reassessed, the information will be brought back to the IDP for deliberation and confirmation of the existing lists of HSSCs and LCCSs or modification of these lists based on the new data, if required. As part of the IDP, confirmatory measures previously used to categorize components as LSSC as well as compensatory measures used to justify the extension of LH components will be validated. Additionally, the maximum test interval will be verified or modified as dictated by the IDP.

8. Changes to RI-IST

Changes to the process described above (such as acceptance guidelines used for the IDP) as well as changes in test methodology issues that involve deviation from NRC endorsed Code requirements, NRC endorsed Code Case, or published NRC guidance are subject to NRC review and approval prior to implementation. Other changes using the process detailed above (such as relative ranking, risk categorization, and grouping) are subject to site procedures and the associated change process pursuant to 10CFR50.59.

SONGS will periodically submit changes to the NRC for their information.

Notes:

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[i] The refueling water storage tank (RWST) and emergency sump outlet check valves currently comprise 2 cross unit valve groups: 1) S2(3)1204MU001 and S2(3)1204MU002, and 2) S2(3)1204MU003, and S2(3)1204MU004. All eight valves are 24 inch Mission Duo-Check split disk check valves. Testing is currently scheduled on a 6 year staggered test interval consisting of a disassembly, inspection, and hand stroke. Extending the test interval to 8 years on these 2 valve groups is reasonable given the valve history, and does not result in an interval which would allow degradation without prior detection. The results of the inspections indicate there is little, if any, wear over the initial 15 years of operation. These inspections validate the wear predictions calculated using the CVAP wear analysis software developed by Kalsi Engineering. The process of draining the 350 feet of 24 inch header piping (~8000 gallons) through ¾ inch drain, removing the two valves (one from each group), and hand stroking requires several days. Once the header is re-filled, the venting operation requires multiple start-stop cycles on each of the high pressure injection, low pressure injection, and containment spray pumps on the particular train, and is extremely resource intensive. In addition, there is significant dose accumulation associated with disassembly, inspection, and subsequent post maintenance test activities. To support a partial flow test of the sump check valves, the sump must be cleaned, then partially filled. The partial flow activity uses a low pressure injection pump for a short duration partial flow through the check valve. Due to the limited volume available in the sump, the pump run is very short in duration and requires exclusive attention in the control room during preparation and execution.

The RWST valves are partially opened for the quarterly pump inservice tests, and the sump valves are only exercised during the course of the hand stroke. A search of the Nuclear Plant Reliability Data System (NPRDS) data archives shows there are no records of failures of this valve style (Mission check valves) in this application. The recorded

NPRDS failures typically pertain to seat leakage increases, but do not involve failures to close. The NPRDS events primarily concern inservice water systems which have higher service duty than refueling water storage tank and emergency sump outlet check valves. Given this fact, coupled with the above discussion, extending the test interval to 8 years on these 2 valve groups is reasonable and does not result in an interval which would allow degradation without prior detection.

ENCLOSURE 4

The Southern California Edison Company (SCE)
Risk-Informed Inservice Testing Program
Valve Design Basis Margin Tables

ENCLOSURE 4

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TABLE 1A: THRUST MARGIN ASSESSMENT FOR UNIT 2 GATE VALVES (Page 1 of 3)

VALVE INFO					SETPOINT CALCULATION INPUTS																	
Valve I.D.	GPA No.	Valve Size (in)	Disc Type	Mfg	Design Basis Open Valve Factor VFo	Design Basis Close Valve Factor VFc	As-Left Stem Factor at CST (adj) SF'al	Stem Factor Degrade Allow SFD (%)	Rate of Load ROL (%)	As-Left Average Static Packing Load Fapl,al (lbs)	Valve Seat Area Ast (in2)	Valve Lower Stem Area Asml (in2)	Valve Stem and Disc Weight Wsd (lbs)	Max O to C Line Press MELPoc (psi)	Max C to O Line Press MELPco (psi)	Max O to C Diff Press MEDPoc (psid)	Max C to O Diff Press MEDPco (psid)	Closing Seat Control Logic	Seismic Force Fse (lbs)	Avail Open Torque at DV Tavo (ft-lbs)	Avail Close Torque at DV Tavc (ft-lbs)
2HV5686	9	3	SPLIT	WKM	0.60	0.60	0.01130	5.0	10	876	8.621	0.785	39	160	160	160	160	TS	195	35	44
2HV5803	9	3	SPLIT	WKM	0.60	0.60	0.01300	5.0	10	750	8.631	0.785	35	26	0	30	0	TS	35	48	60
2HV6366	8	8	SPLIT	WKM	0.65	0.60	0.01760	5.0	10	842	51.849	2.405	283	119	119	95	87	BS	1041	140	209
2HV6367	8	8	SPLIT	WKM	0.65	0.60	0.01600	5.0	10	315	51.849	2.405	283	119	119	97	87	BS	328	124	186
2HV6368	8	8	SPLIT	WKM	0.65	0.60	0.01450	5.0	10	371	51.849	2.405	283	119	119	96	87	BS	328	134	201
2HV6369	8	8	SPLIT	WKM	0.65	0.60	0.01470	5.0	10	1598	51.849	2.405	283	119	119	95	87	BS	470	116	175
2HV6370	8	8	SPLIT	WKM	0.65	0.60	0.01390	5.0	10	392	51.849	2.405	283	119	119	93	87	BS	838	139	208
2HV6371	8	8	SPLIT	WKM	0.65	0.60	0.01680	5.0	10	509	51.849	2.405	283	119	119	94	87	BS	320	124	186
2HV6372	8	8	SPLIT	WKM	0.65	0.60	0.01800	5.0	10	735	51.849	2.405	283	119	119	98	87	BS	262	132	199
2HV6373	8	8	SPLIT	WKM	0.65	0.60	0.01800	5.0	10	593	51.849	2.405	283	119	119	97	87	BS	275	115	172
2HV7258	9	3	SPLIT	WKM	0.60	0.60	0.01141	5.0	10	815	8.621	0.785	44	135	105	135	30	TS	42	42	52
2HV7512	9	3	SPLIT	WKM	0.60	0.60	0.01218	5.0	10	231	8.621	0.785	14	236	182	216	179	TS	13	42	53
2HV8152	7	12	SLD	WLWTH	0.55	0.60	0.02710	5.0	10	1205	125.185	2.074	291	427	262	0	249	TS	652	850	850
2HV8153	7	12	SLD	WLWTH	0.55	0.60	0.02410	5.0	10	646	125.185	2.074	291	428	263	0	249	TS	762	850	850
2HV8161	7	14	SLD	WLWTH	0.65	0.65	0.02220	5.0	10	401	147.411	2.405	179	234	0	206	0	TS	399	582	727
2HV8162	12	3	FLX	WEST	0.45	0.40	0.01120	5.0	10	918	7.211	0.994	20	34	392	14	359	TS	36	90	90
2HV8163	12	3	FLX	WEST	0.45	0.40	0.01450	5.0	10	1243	7.211	0.994	20	34	392	14	359	TS	36	87	87
2HV9235	4	3	DBL	T-RCK	0.45	0.45	***0.01892***	5.0	10	***1800***	6.353	1.767	21	13	87	0	81	LS	84	104	151
2HV9240	4	3	DBL	T-RCK	0.45	0.45	***0.01892***	5.0	10	***1800***	6.353	1.767	21	13	87	0	81	LS	84	104	150
2HV9247	4	3	DBL	T-RCK	0.45	0.45	***0.01892***	5.0	10	***1800***	6.353	1.767	21	130	130	114	120	LS	105	113	149
2HV9300	7	24	SLD	WLWTH	0.65	0.65	0.02918	5.0	10	1420	445.255	3.976	481	13	13	4	13	TS	1395	520	715
2HV9301	7	24	SLD	WLWTH	0.65	0.65	0.02600	5.0	10	1817	445.255	3.976	481	13	13	4	13	TS	1395	520	715
2HV9306	9	3	SPLIT	WKM	0.60	0.65	0.01400	5.0	10	953	8.621	0.785	35	1641	1641	1480	1618	BS	107	146	183
2HV9307	9	3	SPLIT	WKM	0.60	0.65	0.01330	5.0	10	623	8.621	0.785	35	1641	1641	1480	1430	BS	107	146	183
2HV9336	8	16	SPLIT	WKM	0.65	0.60	0.02971	5.0	10	1342	185.661	5.940	1186	416	416	0	401	TS	1575	3514	3514
2HV9337	8	16	SPLIT	WKM	0.65	0.60	0.04460	5.0	10	6865	135.297	11.045	1290	417	405	2	389	TS	1329	4549	6255
2HV9339	8	16	SPLIT	WKM	0.65	0.60	0.04179	5.0	10	***1800***	135.297	11.045	1290	417	399	2	383	TS	1329	4049	5567
2HV9340	8	8	SPLIT	WKM	0.65	0.60	0.02330	5.0	10	2514	39.871	3.142	300	515	1451	0	655	TS	563	491	675
2HV9347	9	3	SPLIT	WKM	0.60	0.65	0.01210	5.0	10	1335	8.621	0.785	35	1641	1641	1480	1618	BS	107	148	185
2HV9348	9	3	SPLIT	WKM	0.60	0.65	0.01430	5.0	10	1359	8.621	0.785	35	1641	1641	1480	1430	BS	107	148	185
2HV9350	8	8	SPLIT	WKM	0.65	0.60	0.02210	5.0	10	3411	39.871	3.142	300	515	1451	0	655	TS	1500	847	847
2HV9360	8	8	SPLIT	WKM	0.65	0.60	0.02610	5.0	10	3570	39.871	3.142	300	515	1451	0	655	TS	562	697	850
2HV9367	4	8	DBL	T-RCK	0.45	0.45	***0.01892***	5.0	10	1926	11.419	1.767	35	56	263	47	201	LS	63	146	230
2HV9368	4	8	DBL	T-RCK	0.45	0.45	***0.01892***	5.0	10	1246	11.419	1.767	35	58	263	49	198	LS	63	141	222
2HV9370	8	8	SPLIT	WKM	0.65	0.60	0.02191	5.0	10	1938	39.871	3.142	300	515	1451	0	655	TS	1500	669	669
2HV9377	8	8	SPLIT	WKM	0.65	0.60	0.02780	5.0	10	3445	39.871	3.142	311	420	408	0	389	BS	336	498	640
2HV9378	8	8	SPLIT	WKM	0.65	0.60	0.02150	5.0	10	2311	39.871	3.142	311	417	399	0	383	BS	323	498	640
2HV9379	8	8	SPLIT	WKM	0.65	0.60	0.02160	5.0	10	1837	51.849	2.405	289	416	416	6	401	TS	514	469	500
2LV0227B	4	3	DBL	T-RCK	0.45	0.45	***0.01892***	5.0	10	***1800***	6.353	1.767	25	87	117	88	111	LS	26	103	135
2LV0227C	4	3	DBL	T-RCK	0.45	0.45	0.02810	5.0	10	723	6.353	1.767	21	22	129	25	129	LS	22	100	132
2TV9267	12	3	FLX	WEST	0.45	0.40	0.01000	5.0	10	832	7.306	0.994	16	2505	0	2514	0	LS	4	192	250

TABLE 1A: THRUST MARGIN ASSESSMENT FOR UNIT 2 GATE VALVES (Page 2 of 3)

	AS-LEFT TEST DATA AND MARGIN ASSESSMENT																	
Valve I.D.	As-Left Static Torque at CST	As-Left Static Thrust at CST	Torque Switch Repeat	Spring Pack Relax	Max Strain Gage Error	Torque Curve Error	TMD Read Error	Dam Signal Error	As-Left Static Torque at CST (adj)	As-Left Static Thrust at CST (adj)	Min Req DB Opening Thrust	Min Req DB Closing Thrust	Avail DB Opening Thrust (adj)	Avail DB Closing Thrust (adj)	Limiting Allowable In-Situ Open Valve Factor	Limiting Allowable In-Situ Close Valve Factor	Opening DB Thrust Margin	Closing DB Thrust Margin
	Tcst,al (ft-lbs)	Fcst,al (lbs)	TSR	SPR	Ef	Et	Etmd	Edam	T'cst,al (ft-lbs)	F'cst,al (lbs)	Fmino(DB) (lbs)	Fminc(DB) (lbs)	F'avo(DB) (lbs)	F'avc(DB) (lbs)	VFlimo(IS)	VFlimc(IS)	Fmargo(DB) (%)	Fmargc(DB) (%)	NOTES
2HV5686	33	3830	0.10	0.032	0.16	1.50	0.025	0.02	29	3097	2084	2283	3097	3097	1.24	1.06	49	36	
2HV5803	32	3246	0.10	0.032	0.16	1.50	0.025	0.02	28	2625	944	1065	3692	2625	2769.90	5.57	291	147	
2HV6366	115	10035	0.00	0.000	0.11	2.00	0.025	0.02	111	8931	5534	5568	7955	11875	1.12	1.60	44	113	
2HV6367	110	9490	0.00	0.000	0.11	2.00	0.025	0.02	106	8446	4108	4213	7750	11625	1.35	1.77	89	176	
2HV6368	96	7015	0.00	0.000	0.11	2.00	0.025	0.02	92	6243	4172	4242	9241	13862	1.63	2.17	122	227	
2HV6369	121	9466	0.00	0.000	0.11	2.00	0.025	0.02	117	8425	5746	5781	7891	11905	1.06	1.57	37	106	
2HV6370	88	7341	0.00	0.000	0.11	2.00	0.025	0.02	85	6533	4783	4745	10000	14964	1.66	2.33	109	215	
2HV6371	115	10100	0.00	0.000	0.11	2.00	0.025	0.02	111	8989	4322	4320	7381	11071	1.24	1.69	71	156	
2HV6372	114	7286	0.00	0.000	0.11	2.00	0.025	0.02	110	6485	4515	4656	7333	11056	1.19	1.58	62	137	
2HV6373	102	6529	0.00	0.000	0.11	2.00	0.025	0.02	98	5811	4366	4472	6389	9556	1.04	1.37	46	114	
2HV7258	42	4821	0.10	0.032	0.16	1.50	0.025	0.02	37	3898	1120	1860	3681	3898	9.21	2.05	229	110	
2HV7512	39	4192	0.10	0.032	0.16	1.50	0.025	0.02	34	3390	1197	1762	3448	3390	1.87	1.34	188	92	
2HV8152	155	7496	0.05	0.032	0.16	3.25	0.025	0.02	144	6217	21561	2828	31365	6217	0.82	189.50	45	120	
2HV8153	144	7469	0.05	0.032	0.16	3.25	0.025	0.02	134	6194	21042	2314	35270	6194	0.95	223.65	68	168	
2HV8161	545	32178	0.05	0.032	0.11	3.25	0.025	0.02	508	28156	1126	24060	26216	28156	148005.98	0.76	2228	17	1
2HV8162	37	4069	0.20	0.032	0.11	1.50	0.025	0.02	29	3131	2012	1159	8036	3131	2.47	16.99	299	170	
2HV8163	40	2946	0.10	0.032	0.11	1.50	0.025	0.02	35	2498	2385	1533	6000	2498	1.66	8.31	152	63	
2HV9235	43	***1800***	0.00	0.000	0.16	2.00	0.025	0.02	41	***1512***	2280	2169	5497	7981	5.89	7889.19	141	268	
2HV9240	38	***1800***	0.00	0.000	0.16	2.00	0.025	0.02	36	***1512***	2280	2169	5497	7928	5.89	7816.85	141	265	
2HV9247	29	1800	0.00	0.000	0.11	2.00	0.025	0.02	27	1602	2345	2806	5973	7875	4.59	6.48	155	181	
2HV9300	220	9319	0.10	0.032	0.11	3.25	0.025	0.02	196	7902	8058	4075	17820	7902	2.12	1.98	121	94	
2HV9301	460	21589	0.05	0.032	0.11	3.25	0.025	0.02	429	18890	8514	4531	20000	18890	2.38	7.12	135	317	
2HV9306	107	9363	0.00	0.000	0.11	2.00	0.025	0.02	103	8333	9402	12198	10429	13071	0.66	0.70	11	7	1
2HV9307	137	12580	0.00	0.000	0.11	2.00	0.025	0.02	132	11196	7905	11818	10977	13759	0.82	0.78	39	16	1
2HV9336	1370	57000	0.10	0.032	0.11	3.25	0.025	0.02	1220	48332	57528	4845	118277	48332	1.36	1909.61	106	898	
2HV9337	1591	44133	0.05	0.032	0.11	6.50	0.025	0.02	1483	38617	45104	13423	101996	38617	1.59	72.03	126	188	
2HV9339	1847	55295	0.05	0.032	0.16	6.50	0.025	0.02	1722	45858	38748	7598	96889	45858	1.63	114.02	150	504	
2HV9340	426	20988	0.05	0.032	0.11	3.25	0.025	0.02	397	18365	18162	5057	21073	18365	0.75	2752.39	16	263	2
2HV9347	90	9104	0.00	0.000	0.11	2.00	0.025	0.02	86	8103	9842	12637	12231	15289	0.75	0.83	24	21	1
2HV9348	135	11562	0.00	0.000	0.11	2.00	0.025	0.02	130	10290	8751	12664	10350	12937	0.71	0.66	18	2	1
2HV9350	388	21682	0.05	0.032	0.11	3.25	0.025	0.02	362	18972	20271	7166	38326	18972	1.25	2424.85	89	165	
2HV9360	491	22968	0.05	0.032	0.11	3.25	0.025	0.02	458	20097	19375	6270	26705	20097	0.89	2865.64	38	221	
2HV9367	91	2224	0.00	0.000	0.16	2.00	0.025	0.02	87	1868	2981	2639	7717	12156	2.24	15.74	159	361	
2HV9368	94	1651	0.00	0.000	0.16	2.00	0.025	0.02	90	1387	2181	1873	7452	11734	2.48	15.65	242	527	
2HV9370	358	19972	0.05	0.032	0.11	3.25	0.025	0.02	334	17476	18577	5472	30534	17476	1.05	2467.97	64	219	
2HV9377	529	22712	0.00	0.000	0.11	3.25	0.025	0.02	512	20214	14825	5511	17914	23022	0.82	3663.60	21	318	
2HV9378	170	9782	0.00	0.000	0.11	3.25	0.025	0.02	164	8706	13360	4181	23163	29767	1.21	5424.87	73	612	
2HV9379	161	9205	0.05	0.032	0.11	2.70	0.025	0.02	150	8054	17427	3737	21713	8054	0.83	10.81	25	116	
2LV0227B	36	4176	0.00	0.000	0.16	2.00	0.025	0.02	34	3508	2256	2537	5444	7135	4.38	7.51	141	181	
2LV0227C	26	723	0.00	0.000	0.16	2.00	0.025	0.02	24	607	1043	959	3559	4698	3.12	20.65	241	390	
2TV9267	119	14734	0.00	0.000	0.11	2.00	0.025	0.02	115	13113	980	12255	19200	25000	21685.81	1.00	1859	104	

TABLE 1A: THRUST MARGIN ASSESSMENT FOR UNIT 2 GATE VALVES (Page 3 of 3)

Summary of Table Equations

1) T'cst,al = (Tcst,al * (1 - ((TSR)^2 + (Et/Tcst,al)^2 + (Edam)^2 + (SPR)^2 + (Etmd)^2)^0.5))

2) F'cst,al = (Fcst,al * (1-((TSR)^2 + (Ef)^2 + (SPR)^2)^0.5))

3) Fmino(DB) = (((Ast * VFo * MEDPco) + Fse + Wsd - (Asml * MELPco) + Fapl.al) * (1+(ROL/100) + (SFD/100)))

4) Fminc(DB) = (((Ast * VFc * MEDPoc) + Fse - Wsd + (Asml * MELPoc) + Fapl,al) * (1+(ROL/100) + (SFD/100)))

5) F'avo(DB) = (Tavo / SF'al)

6) F'avc(DB) = (F'cst,al if Control Switch Logic is TS) or (Tavc / SF'al if Control Switch Logic is BS or LS)

7) VFlimo(IS) = ((F'avo / (1 + (ROL/100) + (SFD/100))) + (Asml * MELPco) - Fse - Wsd - Fapl,al) / (Ast * MEDPco)

8) VFlimc(IS) = ((F'avc / (1 + (ROL/100) + (SFD/100))) - (Asml * MELPoc) - Fse - Wsd - Fapl,al) / (Ast * MEDPoc)

9) Fmargo(DB) = (((F'avo(DB) / Fmino(DB))-1) * 100)

10) Fmargc(DB) = (((F'avc(DB) / Fminc(DB))-1) * 100)

Table Notes

1) These valves are defined as low margin in accordance with GL 96-05 program response.

2) Valve is not considered low margin because it is normally locked open and its safety function is to close (i.e. SIT isolation).

Additional Notes

Test data from recently completed Cycle 10 Refuel Outage has not been fully incorporated to date.

TABLE 2A: THRUST MARGIN ASSESSMENT FOR UNIT 3 GATE VALVES (Page 1 of 3)

VALVE INFO					SETPOINT CALCULATION INPUTS																
Valve I.D.	GPA No.	Valve Size (in)	Disc Type	Mfg	Design Basis Open Valve Factor VFo	Design Basis Close Valve Factor VFc	As-Left Stem Factor at CST (adj) SF'al	Stem Factor Degrade Allow SFD (%)	Rate of Load ROL (%)	As-Left Average Static Packing Load Fapl,al (lbs)	Valve Seat Area Ast (in2)	Valve Lower Stem Area Asml (in2)	Valve Stem and Disc Weight Wsd (lbs)	Max O to C Line Press MELPoc (psi)	Max C to O Line Press MELPco (psi)	Max O to C Diff Press MEDPoc (psid)	Max C to O Diff Press MEDPco (psid)	Closing Seat Control Logic	Seismic Force Fse (lbs)	Avail Open Torque at DV Tavo (ft-lbs)	Avail Close Torque at DV Tavc (ft-lbs)
3HV5686	9	3	SPLIT	WKM	0.60	0.60	0.01410	5.0	10	378	8.621	0.785	39	160	160	179	160	TS	195	43	53
3HV5803	9	3	SPLIT	WKM	0.60	0.60	0.02250	5.0	10	96	8.631	0.785	35	26	0	30	0	TS	35	48	60
3HV6366	8	8	SPLIT	WKM	0.65	0.60	0.01380	5.0	10	488	51.849	2.405	283	119	119	95	87	BS	1041	140	209
3HV6367	8	8	SPLIT	WKM	0.65	0.60	0.01320	5.0	10	311	51.849	2.405	283	119	119	97	87	BS	275	124	187
3HV6368	8	8	SPLIT	WKM	0.65	0.60	0.01623	5.0	10	574	51.849	2.405	283	119	119	96	87	BS	385	130	194
3HV6369	8	8	SPLIT	WKM	0.65	0.60	0.01190	5.0	10	764	51.849	2.405	283	119	119	95	87	BS	470	111	167
3HV6370	8	8	SPLIT	WKM	0.65	0.60	0.00990	5.0	10	939	51.849	2.405	283	119	119	93	87	BS	838	138	207
3HV6371	8	8	SPLIT	WKM	0.65	0.60	0.01350	5.0	10	792	51.849	2.405	283	119	119	94	87	BS	267	123	185
3HV6372	8	8	SPLIT	WKM	0.65	0.60	0.01100	5.0	10	409	51.849	2.405	283	119	119	98	87	BS	262	126	189
3HV6373	8	8	SPLIT	WKM	0.65	0.60	0.01250	5.0	10	606	51.849	2.405	283	119	119	97	87	BS	275	111	166
3HV7258	9	3	SPLIT	WKM	0.60	0.60	0.01160	5.0	10	633	8.621	0.785	46	135	105	135	30	TS	44	41	51
3HV7512	9	3	SPLIT	WKM	0.60	0.60	0.01130	5.0	10	605	8.621	0.785	14	236	182	216	179	TS	13	42	53
3HV8152	7	12	SLD	WLWTH	0.55	0.60	0.01995	5.0	10	1357	125.185	2.074	291	427	262	0	249	TS	652	850	850
3HV8153	7	12	SLD	WLWTH	0.55	0.60	0.01740	5.0	10	1514	125.185	2.074	291	428	263	0	249	TS	762	850	850
3HV8161	7	14	SLD	WLWTH	0.65	0.65	0.02110	5.0	10	1331	147.411	2.405	179	234	0	206	0	TS	399	560	700
3HV8162	12	3	FLX	WEST	0.45	0.40	0.01100	5.0	10	315	7.211	0.994	20	34	392	14	359	TS	36	90	90
3HV8163	12	3	FLX	WEST	0.45	0.40	0.00960	5.0	10	353	7.211	0.994	20	34	392	14	359	TS	36	90	90
3HV9235	4	3	DBL	T-RCK	0.45	0.45	***0.01892***	5.0	10	***1800***	6.353	1.767	21	13	87	0	81	LS	84	102	148
3HV9240	4	3	DBL	T-RCK	0.45	0.45	***0.01892***	5.0	10	***1800***	6.353	1.767	21	13	87	0	81	LS	84	102	148
3HV9247	4	3	DBL	T-RCK	0.45	0.45	***0.01892***	5.0	10	***1800***	6.353	1.767	21	130	130	114	120	LS	105	113	149
3HV9300	7	24	SLD	WLWTH	0.65	0.65	0.01841	5.0	10	1620	445.255	3.976	481	13	13	4	13	TS	722	520	715
3HV9301	7	24	SLD	WLWTH	0.65	0.65	0.02380	5.0	10	1048	445.255	3.976	481	13	13	4	13	TS	818	520	715
3HV9306	9	3	SPLIT	WKM	0.60	0.65	0.01460	5.0	10	1150	8.621	0.785	35	1641	1641	1480	1618	BS	107	147	183
3HV9307	9	3	SPLIT	WKM	0.60	0.65	0.01400	5.0	10	1320	8.621	0.785	35	1641	1641	1480	1430	BS	107	147	183
3HV9336	8	16	SPLIT	WKM	0.65	0.60	0.03290	5.0	10	2028	185.661	5.940	1186	416	416	0	401	TS	1575	3507	3507
3HV9337	8	16	SPLIT	WKM	0.65	0.60	0.03950	5.0	10	5922	135.297	11.045	1290	417	405	2	389	TS	1329	4427	6087
3HV9339	8	16	SPLIT	WKM	0.65	0.60	0.04273	5.0	10	4520	135.297	11.045	1290	417	399	2	383	TS	1329	3954	5437
3HV9340	8	8	SPLIT	WKM	0.65	0.60	0.02230	5.0	10	2751	39.871	3.142	300	515	1451	0	655	TS	543	630	850
3HV9347	9	3	SPLIT	WKM	0.60	0.65	0.01200	5.0	10	438	8.621	0.785	35	1641	1641	1480	1618	BS	107	147	184
3HV9348	9	3	SPLIT	WKM	0.60	0.65	0.01070	5.0	10	980	8.621	0.785	35	1641	1641	1480	1430	BS	107	147	184
3HV9350	8	8	SPLIT	WKM	0.65	0.60	0.01930	5.0	10	2195	39.871	3.142	300	515	1451	0	655	TS	1500	762	850
3HV9360	8	8	SPLIT	WKM	0.65	0.60	0.01910	5.0	10	2820	39.871	3.142	300	515	1451	0	655	TS	323	667	850
3HV9367	4	8	DBL	T-RCK	0.45	0.45	***0.01892***	5.0	10	1681	11.419	1.767	35	56	263	47	201	LS	63	146	229
3HV9368	4	8	DBL	T-RCK	0.45	0.45	***0.01892***	5.0	10	1545	11.419	1.767	35	58	263	49	198	LS	63	138	216
3HV9370	8	8	SPLIT	WKM	0.65	0.60	0.02320	5.0	10	2899	39.871	3.142	300	515	1451	0	655	TS	1500	682	682
3HV9377	8	8	SPLIT	WKM	0.65	0.60	0.02470	5.0	10	3290	39.871	3.142	311	420	408	0	389	BS	336	622	800
3HV9378	8	8	SPLIT	WKM	0.65	0.60	0.02620	5.0	10	4220	39.871	3.142	311	417	399	0	383	BS	323	622	800
3HV9379	8	8	SPLIT	WKM	0.65	0.60	0.01790	5.0	10	1208	51.849	2.405	289	416	416	6	401	TS	514	467	500
3LV0227B	4	3	DBL	T-RCK	0.45	0.45	0.03700	5.0	10	700	6.353	1.767	25	87	117	88	111	LS	27	101	133
3LV0227C	4	3	DBL	T-RCK	0.45	0.45	***0.01892***	5.0	10	368	6.353	1.767	21	22	129	25	129	LS	22	99	131
3TV9267	12	3	FLX	WEST	0.45	0.40	0.01120	5.0	10	855	7.306	0.994	16	2505	0	2514	0	LS	4	187	250

TABLE 2A: THRUST MARGIN ASSESSMENT FOR UNIT 3 GATE VALVES (Page 2 of 3)

AS-LEFT TEST DATA AND MARGIN ASSESSMENT																			
Valve I.D.	As-Left Static Torque at CST	As-Left Static Thrust at CST	Torque Switch Repeat	Spring Pack Relax	Max Strain Gage Error	Torque Curve Error	TMD Read Error	Dam Signal Error	As-Left Static Torque at CST (adj)	As-Left Static Thrust at CST (adj)	Min Req DB Opening Thrust	Min Req DB Closing Thrust	Avail DB Opening Thrust (adj)	Avail DB Closing Thrust (adj)	Limiting Allowable In-Situ Open Valve Factor	Limiting Allowable In-Situ Close Valve Factor	Opening DB Thrust Margin	Closing DB Thrust Margin	
	Tcst,al (ft-lbs)	Fcst,al (lbs)	TSR	SPR	Ef	Et	Etmd	Edam	T'cst,al (ft-lbs)	F'cst,al (lbs)	Fmino(DB) (lbs)	Fminc(DB) (lbs)	F'avo(DB) (lbs)	F'avc(DB) (lbs)	VFlimo(IS)	VFlimc(IS)	Fmargo(DB) (%)	Fmargc(DB) (%)	NOTES
3HV5686	35	3244	0.10	0.032	0.16	1.50	0.025	0.02	31	2623	1511	1823	3050	2623	1.57	1.00	102	44	
3HV5803	44	2559	0.10	0.032	0.16	1.50	0.025	0.02	39	2069	191	313	2133	2069	1956.98	6.23	1014	562	
3HV6366	70	5893	0.00	0.000	0.11	2.00	0.025	0.02	67	5245	5127	5161	10145	15145	1.62	2.25	98	193	
3HV6367	99	8591	0.00	0.000	0.11	2.00	0.025	0.02	95	7646	4042	4148	9394	14167	1.68	2.22	132	242	
3HV6368	124	9441	0.00	0.000	0.11	2.00	0.025	0.02	120	8402	4471	4541	8010	11953	1.33	1.78	79	163	
3HV6369	89	10786	0.00	0.000	0.11	2.00	0.025	0.02	86	9600	4787	4821	9328	14034	1.53	2.11	95	191	
3HV6370	82	9336	0.00	0.000	0.11	2.00	0.025	0.02	79	8309	5412	5374	13939	20909	2.29	3.28	158	289	
3HV6371	85	7153	0.00	0.000	0.11	2.00	0.025	0.02	82	6366	4586	4584	9111	13704	1.52	2.11	99	199	
3HV6372	98	9014	0.00	0.000	0.11	2.00	0.025	0.02	94	8022	4140	4281	11455	17182	2.06	2.70	177	301	
3HV6373	95	8822	0.00	0.000	0.11	2.00	0.025	0.02	91	7852	4381	4487	8880	13280	1.52	2.01	103	196	
3HV7258	40	4521	0.10	0.032	0.16	1.50	0.025	0.02	35	3656	915	1651	3534	3656	9.4[illegible]	2.02	286	121	
3HV7512	38	4407	0.10	0.032	0.16	1.50	0.025	0.02	34	3564	1627	2193	3717	3564	1.78	1.23	128	63	
3HV8152	112	7018	0.05	0.032	0.16	3.25	0.025	0.02	104	5820	21736	3003	42607	5820	1.13	149.82	96	94	
3HV8153	148	11130	0.10	0.032	0.16	3.25	0.025	0.02	131	9000	22040	3312	48851	9000	1.30	349.20	122	172	
3HV8161	612	35827	0.05	0.032	0.11	7.00	0.025	0.02	570	31349	2195	25130	26540	31349	143608.76	0.82	1109	25	
3HV8162	37	4115	0.20	0.032	0.11	1.50	0.025	0.02	29	3167	1318	466	8182	3167	2.76	23.27	521	580	
3HV8163	31	3999	0.10	0.032	0.11	1.50	0.025	0.02	27	3391	1362	510	9375	3391	3.14	24.82	588	565	
3HV9235	27	1800	0.00	0.000	0.16	2.00	0.025	0.02	25	1512	2280	2169	5391	7822	5.71	7672.16	136	261	
3HV9240	21	1800	0.00	0.000	0.16	2.00	0.025	0.02	19	1512	2280	2169	5391	7822	5.71	7672.16	136	261	
3HV9247	26.5	1800	0.00	0.000	0.16	2.00	0.025	0.02	24	1512	2345	2806	5973	7875	4.59	6.48	155	181	
3HV9300	305	20252	0.05	0.032	0.11	3.25	0.025	0.02	284	17721	7514	3531	28246	17721	3.76	7.04	276	402	
3HV9301	450	23114	0.05	0.032	0.11	3.25	0.025	0.02	419	20225	6966	2984	21849	20225	2.89	8.53	214	578	
3HV9306	137	12275	0.00	0.000	0.11	2.00	0.025	0.02	132	10925	9629	12424	10068	12534	0.63	0.65	5	1	1
3HV9307	124	11621	0.00	0.000	0.11	2.00	0.025	0.02	120	10343	8706	12620	10500	13071	0.73	0.68	21	4	1
3HV9336	1079	40535	0.05	0.032	0.11	6.50	0.025	0.02	1006	35468	58317	5634	106596	35468	1.21	1270.16	83	530	
3HV9337	2210	69089	0.05	0.032	0.11	6.50	0.025	0.02	2061	60453	44019	12338	112076	60453	1.77	145.68	155	390	
3HV9339	2292	66296	0.05	0.032	0.11	6.50	0.025	0.02	2137	58009	41876	10726	92535	58009	1.50	143.01	121	441	
3HV9340	388	20113	0.05	0.032	0.11	3.25	0.025	0.02	362	17599	18412	5307	28251	17599	0.98	2530.99	53	232	
3HV9347	99	10786	0.00	0.000	0.11	2.00	0.025	0.02	95	9600	8810	11605	12250	15333	0.81	0.90	39	32	
3HV9348	93	11406	0.00	0.000	0.11	2.00	0.025	0.02	89	10151	8315	12229	13738	17196	0.98	0.98	65	41	
3HV9350	320	19004	0.05	0.032	0.11	3.25	0.025	0.02	298	16629	18873	5768	39482	16629	1.34	2218.78	109	188	
3HV9360	360	21531	0.05	0.032	0.11	8.00	0.025	0.02	334	18840	18238	5133	34921	18840	1.21	2839.46	91	267	
3HV9367	96	1681	0.00	0.000	0.11	2.00	0.025	0.02	92	1496	2699	2357	7717	12104	2.35	16.11	186	414	
3HV9368	93	1545	0.00	0.000	0.11	2.00	0.025	0.02	89	1375	2525	2216	7294	11416	2.28	14.62	189	415	
3HV9370	432	20808	0.05	0.032	0.11	3.25	0.025	0.02	403	18207	19682	6577	29397	18207	0.97	2386.48	49	177	
3HV9377	595	29750	0.00	0.000	0.11	3.25	0.025	0.02	576	26478	14647	5333	25182	32389	1.24	5745.38	72	507	
3HV9378	307	14464	0.00	0.000	0.11	7.00	0.025	0.02	295	12873	15555	6376	23740	30534	1.12	5113.34	53	379	
3HV9379	186	12837	0.05	0.032	0.11	2.70	0.025	0.02	173	11232	16704	3013	26089	11232	1.04	21.72	56	273	
3LV0227B	27	957	0.00	0.000	0.16	2.00	0.025	0.02	25	804	992	1273	2730	3595	2.59	3.97	175	182	
3LV0227C	21	368	0.00	0.000	0.16	2.00	0.025	0.02	19	309	635	551	5233	6924	5.33	35.08	725	1156	
3TV9267	151	16711	0.00	0.000	0.11	2.00	0.025	0.02	146	14873	1007	12282	16696	22321	18674.56	0.87	1559	82	

TABLE 2A: THRUST MARGIN ASSESSMENT FOR UNIT 3 GATE VALVES (Page 3 of 3)

Summary of Table Equations

1)	T'cst,al	= (Tcst,al * (1 - ((TSR)^2 + (Et/Tcst,al)^2 + (Edam)^2 + (SPR)^2 + (Etmd)^2)^0.5))
2)	F'cst,al	= (Fcst,al * (1-((TSR)^2 + (Ef)^2 + (SPR)^2)^0.5))
3)	Fmino(DB)	= (((Ast * VFo * MEDPco) + Fse + Wsd - (Asml * MELPco) + Fapl.al) * (1+(ROL/100) + (SFD/100)))
4)	Fminc(DB)	= (((Ast * VFc * MEDPoc) + Fse - Wsd + (Asml * MELPoc) + Fapl,al) * (1+(ROL/100) + (SFD/100)))
5)	F'avo(DB)	= (Tavo / SF'al)
6)	F'avc(DB)	= (F'cst,al if Control Switch Logic is TS) or (Tavc / SF'al if Control Switch Logic is BS or LS)
7)	VFlimo(IS)	= ((F'avo / (1 + (ROL/100) + (SFD/100))) + (Asml * MELPco) - Fse - Wsd - Fapl,al) / (Ast * MEDPco)
8)	VFlimc(IS)	= ((F'avc / (1 + (ROL/100) + (SFD/100))) - (Asml * MELPoc) - Fse - Wsd - Fapl,al) / (Ast * MEDPoc)
9)	Fmargo(DB)	= (((F'avo(DB) / Fmino(DB))-1) * 100)
10)	Fmargc(DB)	= (((F'avc(DB) / Fminc(DB))-1) * 100)

Table Notes

1) These valves are defined as low margin in accordance with GL 96-05 program response.

Additional Notes

Test data from recently completed Cycle 10 Refuel Outage has not been fully incorporated to date.

TABLE 3A: THRUST MARGIN ASSESSMENT FOR UNIT 2 GLOBE VALVES (Page 1 of 3)

VALVE INFO				SETPOINT CALCULATION INPUTS																		
Valve I.D.	Valve Size (in)	Disc Type	Mfg	Effective DP Disk Area Aeff (in2)	As-Left Stem Factor at CST (adj) SF'al	Stem Factor Degrade Allow SFD (%)	Rate of Load ROL (%)	As-Left Average Static Packing Load Fapl,al (lbs)	Req Disc Sealing Force Fsf (lbs)	Valve Stem Weight Wstem (lbs)	Valve Disc Weight Wdisk (lbs)	Valve Lower Stem Area Asml (in2)	Max O to C Line Press MELPoc (psi)	Max C to O Line Press MELPco (psi)	Max O to C Diff Press MEDPoc (psid)	Max C to O Diff Press MEDPco (psid)	Req DP Force Open Fdpo (lbs)	Req DP Force Close Fdpc (lbs)	Closing Seat Control Logic	Seismic Force Fse (lbs)	Avail Open Torque at DV Tavo (ft-lbs)	Avail Close Torque at DV Tavc (ft-lbs)
2HV0396	10	UNB/FUS	BG-WARN	65.039	0.01800	5.0	25.00	1954	0	19	79	1.767	234	234	206	204	0	13398	TS	230	578	743
2HV0508	0.75	UNB/FUS	WKM	0.785	0.00840	5.0	10.00	336	117	10	5	0.307	2391	2391	702	2391	0	551	TS	21	71	71
2HV0510	0.75	UNB/FUS	WKM	0.785	0.00900	5.0	10.00	411	235	10	5	0.307	2391	2391	2373	2391	0	1864	TS	26	71	71
2HV0512	0.75	UNB/FUS	WKM	0.785	0.00860	5.0	10.00	261	117	10	5	0.307	2391	2391	122	2391	0	96	TS	20	74	74
2HV0514	0.75	UNB/FUS	WKM	0.785	0.00630	5.0	10.00	265	58	10	5	0.307	60	110	71	110	0	56	TS	15	32	40
2HV0516	0.75	UNB/FUS	WKM	0.785	0.00900	5.0	10.00	197	58	10	5	0.307	60	110	71	110	0	56	TS	15	32	40
2HV0517	0.75	UNB/FUS	WKM	0.785	0.01030	5.0	10.00	243	117	10	5	0.307	2391	2391	702	2391	0	551	TS	21	71	71
2HV4705	4	BAL/FOS	WKM	0.571	0.00830	5.0	10.00	413	41	3	15	0.307	0	2099	2099	2032	0	1197	TS	41	44	44
2HV4706	4	BAL/FOS	WKM	0.571	0.01054	5.0	10.00	223	0	3	15	0.307	0	2099	2099	2032	0	1197	TS	41	43	43
2HV4712	4	BAL/FUS	WKM	0.571	0.00894	5.0	10.00	458	0	5	15	0.307	1423	1423	1423	1423	0	812	TS	40	40	50
2HV4713	4	BAL/FUS	WKM	0.571	0.00900	5.0	10.00	115	0	5	15	0.307	1423	1423	1423	1423	0	812	TS	40	39	49
2HV4715	6	BAL/FOS	WKM	0.738	0.01483	5.0	10.00	831	0	11	36	1.227	2099	2099	0	2032	0	0	TS	94	147	147
2HV4716	4	UNB/FOS	GIMPEL	1.208	0.00840	5.0	10.00	30.5	0	10	33	0.369	985	1157	985	1157	1397	0	TS	86	51	59
2HV4730	6	BAL/FOS	WKM	0.738	0.01400	5.0	10.00	483	0	11	36	1.227	2099	2099	0	2032	0	0	TS	94	129	129
2HV8150	10	UNB/FUS	BG-WARN	65.039	0.01630	5.0	25.00	1272	0	19	179	1.767	213	256	208	249	0	13528	TS	465	717	922
2HV8151	10	UNB/FUS	BG-WARN	65.039	0.01430	5.0	25.00	970	0	19	179	1.767	213	256	208	249	0	13528	TS	465	737	850
2HV8160	10	UNB/FUS	BG-WARN	65.039	***0.01892***	5.0	25.00	***1800***	0	19	179	1.767	234	234	206	204	0	13398	TS	230	595	765
2HV9201	2	UNB/FUS	WKM	2.074	0.01220	5.0	10.00	412	0	10	5	0.307	2515	0	7	0	0	15	TS	26	70	87
2HV9217	0.75	UNB/FUS	WKM	0.785	0.00880	5.0	10.00	577	176	10	5	0.307	145	145	142	136	0	112	TS	18	26	32
2HV9322	8	UNB/FOS	T-ROCK	16.873	0.01492	5.0	25.00	2902	0	20	30	2.405	676	211	0	211	3560	0	TS	148	378	472
2HV9325	8	UNB/FOS	T-ROCK	16.873	0.02070	5.0	25.00	2998	0	20	30	2.405	676	211	0	211	3560	0	TS	148	381	476
2HV9328	8	UNB/FOS	T-ROCK	16.873	0.01664	5.0	25.00	1764	0	20	30	2.405	676	211	0	211	3560	0	TS	148	322	403
2HV9331	8	UNB/FOS	T-ROCK	16.873	0.01276	5.0	25.00	3409	0	20	30	2.405	676	211	0	211	3560	0	TS	148	362	453
2HV9334	2	UNB/FUC	WKM	4.468	0.01050	5.0	10.00	1042	2156	10	5	0.601	1433	1433	1405	1405	0	6277	TS	15	122	192

TABLE 3A: THRUST MARGIN ASSESSMENT FOR UNIT 2 GLOBE VALVES (Page 2 of 3)

AS-LEFT TEST DATA AND MARGIN ASSESSMENT																	
Valve I.D.	As-Left Static Torque at CST	As-Left Static Thrust at CST	Torque Switch Repeat	Spring Pack Relax	Max Strain Gage Error	Torque Curve Error	TMD Read Error	Dam Signal Error	As-Left Static Torque at CST (adj)	As-Left Static Thrust at CST (adj)	Min Required DB Opening Thrust	Min Required DB Closing Thrust	Avail DB Opening Thrust (adj)	Avail DB Closing Thrust (adj)	Opening DB Thrust Margin	Closing DB Thrust Margin	NOTES
	Tcst,al (ft-lbs)	**Fcst,al** (lbs)	**TSR**	**SPR**	**Ef**	**Et**	**Etmd**	**Edam**	**T'cst,al** (ft-lbs)	**F'cst,al** (lbs)	**Fmino(DB)** (lbs)	**Fminc(DB)** (lbs)	**F'avo(DB)** (lbs)	**F'avc(DB)** (lbs)	**Fmargo(DB)** (%)	**Fmargc(DB)** (%)	
2HV0396	485	35362	0.05	0.032	0.16	8.00	0.025	0.02	451	29327	19677	20667	32111	29327	63	42	
2HV0508	32	5281	0.20	0.032	0.11	1.50	0.025	0.02	25	4064	1742	2006	8452	4064	385	103	
2HV0510	45	6313	0.10	0.032	0.11	1.50	0.025	0.02	40	5353	1834	3742	7889	5353	330	43	
2HV0512	33	4730	0.10	0.032	0.11	1.50	0.025	0.02	29	4011	1655	1395	8605	4011	420	188	
2HV0514	16	3126	0.20	0.032	0.11	1.50	0.025	0.02	12	2405	400	457	5079	2405	1171	427	
2HV0516	21	2799	0.20	0.032	0.11	1.50	0.025	0.02	16	2154	322	379	3556	2154	1006	469	
2HV0517	27	3226	0.20	0.032	0.11	1.50	0.025	0.02	21	2482	1635	1899	6893	2482	322	31	
2HV4705	24	3589	0.20	0.032	0.11	1.50	0.025	0.02	19	2762	1136	1927	5301	2762	367	43	
2HV4706	29	3363	0.10	0.032	0.11	1.50	0.025	0.02	25	2852	918	1661	4080	2852	345	72	
2HV4712	34	4646	0.10	0.032	0.11	1.50	0.025	0.02	30	3940	1028	1987	4474	3940	335	98	
2HV4713	30	4062	0.20	0.032	0.11	1.50	0.025	0.02	24	3126	633	1592	4333	3126	584	96	
2HV4715	95	7917	0.10	0.032	0.11	2.00	0.025	0.02	84	6713	0	3971	9912	6713	9912240	69	1
2HV4716	33	5165	0.20	0.032	0.16	1.50	0.025	0.02	26	3832	1300	1871	6071	3832	367	105	
2HV4730	100	8481	0.10	0.032	0.11	2.00	0.025	0.02	89	7191	0	3571	9214	7191	9214186	101	1
2HV8150	454	32153	0.05	0.032	0.11	8.00	0.025	0.02	422	28134	22981	20077	43988	28134	91	40	
2HV8151	422	33895	0.05	0.032	0.16	8.00	0.025	0.02	392	28111	22588	19684	51538	28111	128	43	
2HV8160	450	***22125***	0.05	0.032	0.11	8.00	0.025	0.02	419	***22125***	19607	20337	31448	***22125***	60	9	2
2HV9201	50	5018	0.10	0.032	0.11	1.50	0.025	0.02	44	4255	521	1391	5738	4255	1001	206	
2HV9217	20	2784	0.20	0.032	0.11	1.50	0.025	0.02	16	2142	773	1049	2955	2142	282	104	
2HV9322	154	13521	0.05	0.032	0.11	8.00	0.025	0.02	141	11831	7999	6014	25335	11831	217	97	
2HV9325	155	9814	0.05	0.032	0.11	8.00	0.025	0.02	142	8587	8123	6138	18406	8587	127	40	
2HV9328	200	15744	0.05	0.032	0.11	8.00	0.025	0.02	184	13776	6519	4534	19351	13776	197	204	
2HV9331	165	16938	0.05	0.032	0.11	8.00	0.025	0.02	151	14821	8658	6673	28370	14821	228	122	
2HV9334	124	14474	0.05	0.032	0.11	2.00	0.025	0.02	115	12665	7462	11887	11619	12665	56	7	

TABLE 3A: THRUST MARGIN ASSESSMENT FOR UNIT 2 GLOBE VALVES (Page 3 of 3)

Summary of Table Equations

1)	T'cst,al	= (Tcst,al * (1 - ((TSR)^2 + ((Et/Tcst,al)^2) + (SPR)^2 + (Etmd)^2 + (Edam)^2)^0.5))
2)	F'cst,al	= (Fcst,al * (1- ((TSR)^2 + (Ef)^2 + (SPR)^2)^0.5))
3)	Fmino(DB)	= (((Aeff * MEDPco) - (Asml * MELPoc) + Fapl,al + Wstem + Wdisk + Fse) * (1 + (ROL/100) + (SFD/100)))
4)	Fminc(DB)	= (((Aeff * MEDPoc) + (Asml * MELPoc) + Fsf - (Wstem + Wdisk) + Fapl,al + Fse) * (1+(ROL/100) + (SFD/100)))
5)	F'avo(DB)	= (Tavo / SF'al)
6)	F'avc(DB)	= F'cst,al
8)	Fmargo(DB)	= (((F'avo(DB) / Fmino(DB))-1) * 100)
9)	Fmargc(DB)	= (((F'avc(DB) / Fminc(DB))-1) * 100)

Table Notes

1) Valves HV4715 & 4730 are balanced globe valves, flow tends to open these valves. Net required open forces are less than zero.

2) Strain gage data unavailable. Forces at CST estimated from torque at CST and design basis stem factor.

Additional Notes

Test data from recently completed Cycle 10 Refuel Outage has not been fully incorporated to date.

TABLE 4A: THRUST MARGIN ASSESSMENT FOR UNIT 3 GLOBE VALVES (Page 1 of 3)

VALVE INFO				SETPOINT CALCULATION INPUTS																			
Valve I.D.	Valve Size	Disc Type	Mfg	Effective DP Disk Area	As-Left Stem Factor at CST (adj)	Stem Factor Degrade Allow	Rate of Load	As-Left Average Static Packing Load	Req Disc Sealing Force	Valve Stem Weight	Valve Disc Weight	Valve Lower Stem Area	Max O to C Line Press	Max C to O Line Press	Max O to C Diff Press	Max C to O Diff Press	Req DP Force Open	Req DP Force Close	Closing Seat Control Logic	Seismic Force	Avail Open Torque at DV	Avail Close Torque at DV
				Aeff	**SFal**	**SFD**	**ROL**	**Fspl,al**	**Fsf**	**Wstem**	**Wdisk**	**Asml**	**MELPoc**	**MELPco**	**MEDPoc**	**MEDPco**	**Fdpo**	**Fdpc**		**Fse**	**Tavo**	**Tavc**
	(in)			(in2)		(%)	(%)	(lbs)	(lbs)	(lbs)	(lbs)	(in2)	(psi)	(psi)	(psid)	(psid)	(lbs)	(lbs)		(lbs)	(ft-lbs)	(ft-lbs)
3HV0396	10	UNB/FUS	BG-WARN	65.039	0.01520	5.0	25.00	1250	0	19	79	1.767	234	234	206	204	0	13398	TS	230	577	742
3HV0508	0.75	UNB/FUS	WKM	0.785	0.00800	5.0	10.00	336	117	10	5	0.307	1622	2391	1344	2391	0	1056	TS	75	47	51
3HV0510	0.75	UNB/FUS	WKM	0.785	0.00830	5.0	10.00	457	234	10	5	0.307	0	2391	2988	2391	0	2347	TS	75	86	93
3HV0512	0.75	UNB/FUS	WKM	0.785	0.00750	5.0	10.00	520	117	10	5	0.307	2050	2391	956	2391	0	751	TS	75	69	75
3HV0514	0.75	UNB/FUS	WKM	0.785	0.01110	5.0	10.00	553	58	10	5	0.307	60	110	71	110	0	56	TS	15	32	40
3HV0516	0.75	UNB/FUS	WKM	0.785	0.00800	5.0	10.00	114	58	10	5	0.307	60	110	71	110	0	56	TS	15	36	45
3HV0517	0.75	UNB/FUS	WKM	0.785	0.00800	5.0	10.00	424	117	10	5	0.307	1622	2391	1344	2391	0	1056	TS	75	50	50
3HV4705	4	BAL/FOS	WKM	0.571	0.00710	5.0	10.00	1685	0	3	15	0.307	0	2099	2099	2032	1159	1197	TS	41	40	40
3HV4706	4	BAL/FOS	WKM	0.571	0.00920	5.0	10.00	370	0	3	15	0.307	0	2099	2099	2032	1159	1197	TS	41	43	43
3HV4712	4	BAL/FUS	WKM	0.571	0.00725	5.0	10.00	228.0	0	5	15	0.307	1423	1423	1423	1423	0	812	TS	40	40	50
3HV4713	4	BAL/FUS	WKM	0.571	0.00870	5.0	10.00	356	0	5	15	0.307	1423	1423	1423	1423	0	812	TS	40	39	49
3HV4715	6	BAL/FOS	WKM	0.738	0.01500	5.0	10.00	1013	0	11	36	1.227	2099	2099	0	2032	1499	0	TS	94	144	144
3HV4716	4	UNB/FOS	GIMPEL	1.208	0.00940	5.0	10.00	27	0	10	33	0.369	985	1157	985	1157	1397	0	TS	86	54	62
3HV4730	6	BAL/FOS	WKM	0.738	0.01056	5.0	10.00	476	0	11	36	1.227	2099	2099	0	2032	0	0	TS	94	121	121
3HV8150	10	UNB/FUS	BG-WARN	65.039	***0.01892***	5.0	25.00	***1800***	0	19	179	1.767	213	256	208	249	0	13528	TS	465	696	895
3HV8151	10	UNB/FUS	BG-WARN	65.039	0.01220	5.0	25.00	1214	0	19	179	1.767	213	256	208	249	0	13528	TS	465	711	914
3HV8160	10	UNB/FUS	BG-WARN	65.039	0.01815	5.0	25.00	610	0	19	179	1.767	234	234	206	204	0	13398	TS	230	576	741
3HV9201	2	UNB/FUS	WKM	2.074	0.00780	5.0	10.00	230	0	10	5	0.307	2515	0	7	0	0	15	TS	75	63	79
3HV9217	0.75	UNB/FUS	WKM	0.785	0.00890	5.0	10.00	498	176	10	5	0.307	145	145	142	136	0	112	TS	18	34	43
3HV9322	8	UNB/FOS	T-ROCK	16.873	***0.01890***	5.0	25.00	***905***	0	20	30	2.405	676	211	0	211	3560	0	TS	148	369	461
3HV9325	8	UNB/FOS	T-ROCK	16.873	0.01330	5.0	25.00	6950	0	20	30	2.405	676	211	0	211	3560	0	TS	148	396	495
3HV9328	8	UNB/FOS	T-ROCK	16.873	0.01470	5.0	25.00	1581	0	20	30	2.405	676	211	0	211	3560	0	TS	148	319	399
3HV9231	8	UNB/FOS	T-ROCK	16.873	0.01850	5.0	25.00	2168	0	20	30	2.405	676	211	0	211	3560	0	TS	148	349	436
3HV9334	2	UNB/FUS	WKM	4.468	0.00940	5.0	10.00	357	2156	10	5	0.601	1433	1433	1405	1405	0	6277	TS	15	121	190

TABLE 4A: THRUST MARGIN ASSESSMENT FOR UNIT 3 GLOBE VALVES (Page 2 of 3)

	AS-LEFT TEST DATA AND MARGIN ASSESSMENT																
Valve I.D.	As-Left Static Torque at CST	As-Left Static Thrust at CST	Torque Switch Repeat	Spring Pack Relax	Max Strain Gage Error	Torque Curve Error	TMD Read Error	Dam Signal Error	As-Left Static Torque at CST (adj)	As-Left Static Thrust at CST (adj)	Min Required DB Opening Thrust	Min Required DB Closing Thrust	Avail DB Opening Thrust (adj)	Avail DB Closing Thrust (adj)	Opening DB Thrust Margin	Closing DB Thrust Margin	NOTES
	Tcst,al (ft-lbs)	Fcst,al (lbs)	TSR	SPR	Ef	Et	Etrnd	Edam	T'cst,al (ft-lbs)	F'cst,al (lbs)	Fmino(DB) (lbs)	Fminc(DB) (lbs)	F'avo(DB) (lbs)	F'avc(DB) (lbs)	Fmargo(DB) (%)	Fmargc(DB) (%)	
3HV0396	362	31207	0.05	0.032	0.16	8.00	0.025	0.02	339	25881	18762	19752	37961	25881	102	31	
3HV0508	28	4398	0.20	0.032	0.11	1.50	0.025	0.02	22	3384	1804	2376	5875	3384	226	42	
3HV0510	35	5172	0.10	0.032	0.11	1.50	0.025	0.02	31	4386	1943	3561	10361	4386	433	23	
3HV0512	33	5465	0.20	0.032	0.11	1.50	0.025	0.02	26	4205	2016	2388	9200	4205	356	76	
3HV0514	26	2871	0.10	0.032	0.11	1.50	0.025	0.02	23	2434	731	788	2883	2434	294	209	
3HV0516	34	4750	0.20	0.032	0.11	1.50	0.025	0.02	27	3655	226	283	4500	3655	1891	1191	
3HV0517	30	4759	0.20	0.032	0.11	1.50	0.025	0.02	24	3662	1905	2477	6250	3662	228	48	
3HV4705	29	4981	0.20	0.032	0.11	1.50	0.025	0.02	23	3833	2599	3343	5634	3833	117	15	
3HV4706	30	3984	0.10	0.032	0.11	1.50	0.025	0.02	27	3378	1087	1830	4674	3378	330	85	
3HV4712	31.0	5288	0.10	0.032	0.11	1.50	0.025	0.02	27	4484	763	1722	5517	4484	623	160	
3HV4713	32	4557	0.20	0.032	0.11	1.50	0.025	0.02	25	3507	910	1869	4483	3507	392	88	
3HV4715	83	6869	0.10	0.032	0.11	2.00	0.025	0.02	74	5824	90	4181	9600	5824	10583	39	
3HV4716	40	5579	0.20	0.032	0.16	1.50	0.025	0.02	32	4139	1296	1867	5745	4139	343	122	
3HV4730	74	8568	0.05	0.032	0.11	2.00	0.025	0.02	69	7497	0	3563	11458	7497	11458233	110	1
3HV8150	445	35700	0.05	0.032	0.16	8.00	0.025	0.02	417	29608	23062	20158	36786	29608	60	47	
3HV8151	336	31465	0.05	0.032	0.16	8.00	0.025	0.02	315	26095	22905	20001	58279	26095	154	30	
3HV8160	462	33340	0.05	0.032	0.16	8.00	0.025	0.02	433	27650	18060	18790	31736	27650	76	47	
3HV9201	27	4230	0.20	0.032	0.11	1.50	0.025	0.02	21	3255	368	1238	8077	3255	2095	163	
3HV9217	27	3726	0.10	0.032	0.11	1.50	0.025	0.02	24	3159	682	958	3820	3159	460	230	
3HV9322	179	12403	0.05	0.032	0.11	8.00	0.025	0.02	166	10853	5402	3417	19524	10853	261	218	
3HV9325	187	18420	0.05	0.032	0.16	8.00	0.025	0.02	173	15276	13261	11276	29774	15276	125	35	
3HV9328	202	15232	0.05	0.032	0.16	8.00	0.025	0.02	188	12633	6281	4296	21701	12633	245	194	
3HV9331	121	8588	0.10	0.032	0.16	8.00	0.025	0.02	106	6944	7044	5059	18865	6944	168	37	
3HV9334	112	14545	0.10	0.032	0.11	2.00	0.025	0.02	100	12333	6674	11100	12872	12333	93	11	

TABLE 4A: THRUST MARGIN ASSESSMENT FOR UNIT 3 GLOBE VALVES (Page 3 of 3)

Summary of Table Equations

1) T'cst,al = (Tcst,al * (1 - ((TSR)^2 + ((Et/Tcst,al)^2) + (SPR)^2 + (Etmd)^2 + (Edam)^2)^0.5))

2) F'cst,al = (Fcst,al * (1- ((TSR)^2 + (Ef)^2 + (SPR)^2)^0.5))

3) Fmino(DB) = (((Aeff * MEDPco) - (Asml * MELPoc) + Fapl,al + Wstem + Wdisk + Fse) * (1 + (ROL/100) + (SFD/100)))

4) Fminc(DB) = (((Aeff * MEDPoc) + (Asml * MELPoc) + Fsf - (Wstem + Wdisk) + Fapl,al + Fse) * (1+(ROL/100) + (SFD/100)))

5) F'avo(DB) = (Tavo / SF'al)

6) F'avc(DB) = F'cst,al

8) Fmargo(DB) = (((F'avo(DB) / Fmino(DB))-1) * 100)

7) Fmargc(DB) = (((F'avc(DB) / Fminc(DB))-1) * 100

Table Notes

1) Valve HV4715 & 4730 are balanced globe valves, flow tends to open these valves. Net required open forces are less than zero.

Additional Notes

Test data from recently completed Cycle 10 Refuel Outage has not been fully incorporated to date.

TABLE 5A: TORQUE MARGIN ASSESSMENT FOR UNIT 2 & 3 BUTTERFLY VALVES (Page 1 of 3)

VALVE INFO				SETPOINT CALCULATION INPUTS									
VALVE I.D.	Valve Size (in)	Disc Type	Mfg	Closing Seat Control Logic	Max Line Press MELP (psi)	Max Diff Press MEDP (psid)	Max Flow Qobc (gpm)	DB Static Running Torque Trun(DB) (ft-lbs)	DB Required Seating Torque Ts(DB) (ft-lbs)	DB Required Dynamic Torque Td(DB) (ft-lbs)	DB Minimum Required Stem Torque Tmin(DB) (ft-lbs)	Maximum Allowable Opening Stem Torque Tmaxo (ft-lbs)	Maximum Allowable Closing Stem Torque Tmaxc (ft-lbs)
2HV6211	10	Offset	FISHER	LS	125	99	3000	16	174	157	174	386	298
2HV6216	10	Offset	FISHER	LS	125	100	3000	19	175	189	189	386	298
2HV6223	10	Offset	FISHER	LS	125	99	3000	19	174	189	189	374	374
2HV6236	10	Offset	FISHER	LS	125	99	3000	16	174	157	174	374	374
2HV6495	30	Symetric	FISHER	LS	59	59	17000	202	2515	2020	2515	4079	3885
2HV6497	30	Symetric	FISHER	LS	59	59	17000	202	2515	2020	2515	4079	3885
2HV9302	24	Offset	FISHER	LS	67	67	2248	70	1110	696	1110	2200	2200
2HV9303	24	Offset	FISHER	LS	67	67	2248	70	1110	696	1110	2200	2200
2HV9304	24	Offset	FISHER	LS	58	58	2248	62	972	621	972	2024	2200
2HV9305	24	Offset	FISHER	LS	58	58	2248	62	972	621	972	2024	2200
2HV9900	8	Offset	FISHER	TS	165	137	2240	15	146	147	147	416	445
2HV9949	42	Offset	FISHER	LS	1	1	393	198	1053	201	1053	4735	6510
2HV9950	42	Offset	FISHER	LS	1	1	393	198	1053	201	1053	4746	6526
2HV9971	8	Offset	FISHER	TS	165	137	2240	23	146	233	233	417	445
3HV6211	10	Offset	FISHER	LS	125	99	3000	16	174	157	174	379	298
3HV6216	10	Offset	FISHER	LS	125	100	3000	19	175	189	189	379	298
3HV6223	10	Offset	FISHER	LS	125	99	3000	19	174	189	189	374	374
3HV6236	10	Offset	FISHER	LS	125	99	3000	16	174	157	174	374	374
3HV6495	30	Symetric	FISHER	LS	59	59	17000	202	2515	2020	2515	4079	3885
3HV6497	30	Symetric	FISHER	LS	59	59	17000	162	2515	1616	2515	4079	3885
3HV9302	24	Offset	FISHER	LS	67	67	2248	70	1110	696	1110	2200	2200
3HV9303	24	Offset	FISHER	LS	67	67	2248	70	1110	696	1110	2149	2200
3HV9304	24	Offset	FISHER	LS	58	58	2248	62	972	621	972	2024	2200
3HV9305	24	Offset	FISHER	LS	58	58	2248	62	972	621	972	2024	2200
3HV9900	8	Offset	FISHER	TS	165	137	2240	15	146	147	147	410	445
3HV9949	42	Offset	FISHER	LS	1	1	393	198	1053	201	1053	4758	6542
3HV9950	42	Offset	FISHER	LS	1	1	393	198	1053	201	1053	4700	6463
3HV9971	8	Offset	FISHER	TS	165	137	2240	23	146	233	233	412	445

TABLE 5A: TORQUE MARGIN ASSESSMENT FOR UNIT 2 & 3 BUTTERFLY VALVES (Page 2 of 3)

AS-LEFT TEST DATA AND MARGIN ASSESSMENT											
As-Left Static Closing Stem Torque @ CST	As-Left Average Static Running Torque	Torque Switch Repeat	Spring Pack Relax	Max Strain Gage Error	As-Left Min Required Opening Stem Torque	As-Left Min Required Closing Stem Torque	As-Left Available Opening Stem Torque (adjusted)	As-Left Available Closing Stem Torque (adjusted)	As-Left Opening Torque Margin	As-Left Closing Torque Margin	NOTES
Tcst,al (ft-lbs)	Trun,al (ft-lbs)	TSR	SPR	Ef	Tmino(DB) (ft-lbs)	Tminc(DB) (ft-lbs)	T'avo(DB) (ft-lbs)	T'avc(DB) (ft-lbs)	Tmargo(DB) (%)	Tmargc(DB) (%)	
<174	12.00	0	0	0.11	174	174	386	298	122	71	
<174	11.00	0	0	0.11	189	189	386	298	104	58	
99.70	21.20	0	0	0.11	191	191	374	374	96	96	
155.40	6.76	0	0	0.11	174	174	374	374	115	115	
252.00	169.00	0	0	0.11	2515	2515	4079	3885	62	54	
821.80	88.60	0	0	0.11	2515	2515	4079	3885	62	54	
361.00	143.00	0	0	0.11	1183	1183	2200	2200	86	86	
408.00	136.00	0	0	0.11	1176	1176	2200	2200	87	87	
1114.70	38.00	0	0	0.11	972	972	2024	2200	108	126	
974.24	108.00	0	0	0.11	1018	1018	2024	2200	99	116	
288.00	***15.00***	0.10	0.032	0.11	147	147	416	244	183	66	1
1572.00	288.00	0	0	0.11	1143	1143	4735	6510	314	470	
1211.00	550.00	0	0	0.11	1405	1405	4746	6526	238	364	
381.00	13.50	0.10	0.032	0.11	233	233	417	323	79	39	1
196.00	22.00	0	0	0.11	180	180	379	298	111	66	
188.00	27.00	0	0	0.11	197	197	379	298	92	51	
81.00	20.00	0	0	0.11	190	190	374	374	97	97	
103.00	6.00	0	0	0.11	174	174	374	374	115	115	
643.00	65.00	0	0	0.11	2515	2515	4079	3885	62	54	
626.00	330.00	0	0	0.11	2683	2683	4079	3885	52	45	
397.00	36.00	0	0	0.11	1110	1110	2200	2200	98	98	
853	289	0	0	0.11	1329	1329	2149	2200	62	66	
897	119	0	0	0.11	1029	1029	2024	2200	97	114	
570	33	0	0	0.11	972	972	2024	2200	108	126	
219	11	0.10	0.032	0.11	147	147	410	186	179	26	1
1007	353	0	0	0.11	1208	1208	4758	6542	294	442	
1659	310	0	0	0.11	1165	1165	4700	6463	303	455	
298	17	0.10	0.032	0.11	233	233	412	253	77	8	1

TABLE 5A: TORQUE MARGIN ASSESSMENT FOR UNIT 2 & 3 BUTTERFLY VALVES (Page 3 of 3)

Summary of Table Equations

1) Tmino(DB) = Tmin(DB) + (if, Trun,al > Trun(DB), then, Trun,al - Trun(DB))

2) Tminc(DB) = Tmin(DB) + (if, Trun,al > Trun(DB), then, Trun,al - Trun(DB))

3) T'avo(DB) = Tmaxo

4) T'avc(DB) = Tmaxc for Limit Seated, (Tcst,al * (1- ((TSR)^2 + (SPR)^2 + (Ef)^2)^0.5))

5) Tmargo(DB) = (((T'avo(DB) / Tmino(DB))-1) * 100)

6) Fmargc(DB) = (((T'avc(DB) / Tminc(DB))-1) * 100)

Table Notes

1) Valves are torque seated, all other butterfly valves are limit seated.

Additional Notes

1) Test data from recently completed Cycle 10 Refuel Outage has not been fully incorporated to date.

2) The individual torque elements which make-up the specified value for Tmin(DB) include items such as: bearing torque, packing torque, hydrostatic torque, and upstream disturbance effects. Maximum dynamic torque is calculated at 10 degree increments to determine worst case required torque and seating torque is calculated at max system conditions assuming no friction losses. The greater of the dynamic torque or seating torque is defined as Tmin(DB). Due to the complexity of this calculation it is not practicable to identify each element which contributes to the value of Tmin(DB). SONGS calculation method for butterfly valves is consistent with vendor recommendations and includes consideration of EPRI PPM findings. The SONGS MOCALC program for determining butterfly valve torque requirements has been compared to the EPRI PPM methodology and found to be similar in predicting the magnitude of required valve torque.

TABLE 6A: TORQUE MARGIN ASSESSMENT FOR UNIT 2 & 3 R/R GLOBE VALVES (Page 1 of 3)

VALVE INFO				SETPOINT CALCULATION INPUTS																				
VALVE I.D	Valve Size (in)	Disc Type	Mfg	Effective DP Disk Area Aeff (in2)	DB Baseline Coeff of Friction COFbl	DB Baseline Stem Factor SFbl (ft)	Stem Factor Degrade Allow SFD (%)	Rate of Load ROL (%)	As-Left Average Stem Packing Torque Tapl,al (ft-lbs)	Disc Sealing Force Fsf (lbs)	Valve Stem and Disc Weight Wsd (lbs)	Valve Lower Stem Area Asml (in2)	Max O to C Line Press MELPoc (psi)	Max C to O Line Press MELPco (psi)	Max O to C Diff Press MEDPoc (psid)	Max C to O Diff Press MEDPco (psid)	Req DP Force Open Fdpo (lbs)	Req DP Force Close Fdpc (lbs)	Closing Sea. Control Logic	Seismic Force Fse (lbs)	Horiz Valve Force Fhz (lbs)	Other Closing Forces Fother,oc (lbs)	Avail Open Torque at DV Tavo (ft-lbs)	Avail Close Torque at DV Tavc (ft-lbs)
2HV9323	2	FOS/UNB	T-R	1.981	0.20	0.00977	5.0	10.00	26.0	0	10	0.601	1288	1431	1287	1417	2806	0	TS	18	140	2596	124	155
2HV9324	2	FOS/UNB	T-R	2.511	0.20	0.00977	5.0	10.00	19.5	0	10	0.601	1288	1431	1285	1417	3558	0	TS	18	112	3031	118	148
2HV9326	2	FOS/UNB	T-R	2.511	0.20	0.00977	5.0	10.00	24.5	0	10	0.601	1288	1431	1285	1417	3558	0	TS	18	112	3031	118	148
2HV9327	2	FOS/UNB	T-R	1.770	0.20	0.00977	5.0	10.00	28.5	0	10	0.601	1288	1431	1285	1417	2507	0	TS	18	140	1608	125	156
2HV9329	2	FOS/UNB	T-R	1.770	0.20	0.00977	5.0	10.00	47.0	0	10	0.601	1288	1431	1289	1417	2507	0	TS	18	140	2407	123	154
2HV9330	2	FOS/UNB	T-R	1.770	0.20	0.00977	5.0	10.00	25.5	0	10	0.601	1288	1431	1289	1417	2507	0	TS	18	140	2235	125	156
2HV9332	2	FOS/UNB	T-R	3.101	0.20	0.00977	5.0	10.00	39.0	0	10	0.601	1290	1433	1292	1417	4394	0	TS	18	140	4366	122	152
2HV9333	2	FOS/UNB	T-R	1.770	0.20	0.00977	5.0	10.00	25.0	0	10	0.601	1289	1432	1292	1417	2507	0	TS	18	140	2067	121	151
2HV9420	3	FOS/UNB	T-R	3.850	0.20	0.00977	5.0	10.00	29.0	0	10	0.601	13	1290	0	1274	4905	0	TS	14	140	3638	117	146
2HV9434	3	FOS/UNB	T-R	5.079	0.20	0.00977	5.0	10.00	29.0	0	10	0.601	13	1290	0	1274	6471	0	TS	14	140	5319	115	144
3HV9323	2	FOS/UNB	T-R	2.100	0.20	0.00977	5.0	10.00	35.0	0	10	0.601	1288	1431	1287	1417	2975	0	TS	18	140	2394	121	152
3HV9324	2	FOS/UNB	T-R	1.770	0.20	0.00977	5.0	10.00	39.0	0	10	0.601	1288	1431	1285	1417	2507	0	TS	18	140	1622	124	154
3HV9326	2	FOS/UNB	T-R	2.511	0.20	0.00977	5.0	10.00	22.0	0	10	0.601	1288	1431	1285	1417	3558	0	TS	18	140	2212	123	154
3HV9327	2	FOS/UNB	T-R	1.931	0.20	0.00977	5.0	10.00	55.0	0	10	0.601	1288	1431	1285	1417	2736	0	TS	18	140	2485	125	156
3HV9329	2	FOS/UNB	T-R	2.280	0.20	0.00977	5.0	10.00	42.0	0	10	0.601	1288	1431	1289	1417	3231	0	TS	18	140	2407	122	152
3HV9330	2	FOS/UNB	T-R	1.981	0.20	0.00977	5.0	10.00	25.7	0	10	0.601	1288	1431	1289	1417	2806	0	TS	18	140	2130	125	156
3HV9332	2	FOS/UNB	T-R	2.021	0.20	0.00977	5.0	10.00	36.0	0	10	0.601	1290	1433	1292	1417	2863	0	TS	18	140	2435	118	148
3HV9333	2	FOS/UNB	T-R	1.770	0.20	0.00977	5.0	10.00	36.0	0	10	0.601	1289	1432	1292	1417	2507	0	TS	18	140	2062	120	150
3HV9420	3	FOS/UNB	T-R	4.562	0.20	0.00977	5.0	10.00	30.5	0	10	0.601	13	1290	0	1274	5812	0	TS	14	140	5058	115	144
3HV9434	3	FOS/UNB	T-R	2.405	0.20	0.00977	5.0	10.00	27.0	0	10	0.601	13	1290	0	1274	3064	0	TS	14	140	3286	115	144

TABLE 6A: TORQUE MARGIN ASSESSMENT FOR UNIT 2 & 3 R/R GLOBE VALVES (Page 2 of 3)

AS-LEFT TEST DATA AND MARGIN ASSESSMENT																
As-Left Static Torque at CST **Tcst,al** (ft-lbs)	As-Left Close Torque S. **TSS,al**	Torque Switch Repeat **TSR**	Spring Pack Relax **SPR**	TMD Read Error **Etmd**	Dam Sig.al Error **Edam**	Torque Curve Error **Et**	As-Left Static Torque at CST (adj) **T'cst,al** (ft-lbs)	Min Required DB Opening Thrust **Fmino,req** (lbs)	Min Required DB Closing Thrust **Fminc,req** (lbs)	Min Required DB Opening Torque **Tmino,req** (ft-lbs)	Min Required DB Closing Torque **Tminc,req** (ft-lbs)	Avail DB Opening Torque (adj) **T'avo** (ft-lbs)	Avail DB Closing Torque (adj) **T'avc** (ft-lbs)	Opening DB Torque Margin **Tmargo(DB)** (%)	Closing DB Torque Margin **Tmargc(DB)** (%)	**NOTES**
101	2.50	0.05	0.032	0.025	0.02	2.0	94	6482	7207	63	70	124	94	96	33	
114	2.5	0.05	0.032	0.025	0.02	2.0	106	6548	6910	64	68	118	106	84	57	
118	2.75	0.05	0.032	0.025	0.02	2.0	110	7137	7498	70	73	118	110	69	50	
81	2.00	0.05	0.032	0.025	0.02	2.0	75	6432	6365	63	62	125	75	99	21	
117	2.50	0.05	0.032	0.025	0.02	2.0	109	8610	9461	84	92	123	109	46	18	
92	1.750	0.05	0.032	0.025	0.02	2.0	85	6079	6733	59	66	125	85	110	30	
129	2.75	0.05	0.032	0.025	0.02	2.0	120	9837	10773	96	105	122	120	27	14	
118	2.00	0.05	0.032	0.025	0.02	2.0	110	6020	6481	59	63	121	110	106	73	
122	2.625	0.05	0.032	0.025	0.02	2.0	114	9243	7902	90	77	117	114	30	47	1
112	2.00	0.05	0.032	0.025	0.02	2.0	104	11043	9667	108	94	115	104	7	10	1
107	2.50	0.05	0.032	0.025	0.02	2.0	100	7735	8034	76	78	121	100	60	27	
111	2.00	0.05	0.032	0.025	0.02	2.0	103	7668	7617	75	74	124	103	66	39	
97	2.00	0.05	0.032	0.025	0.02	2.0	90	6875	6294	67	61	123	90	83	47	
114	2.00	0.05	0.032	0.025	0.02	2.0	106	9814	10493	96	103	125	106	30	3	
107	2.50	0.05	0.032	0.025	0.02	2.0	100	8852	8873	86	87	122	100	41	15	
121	2.25	0.05	0.032	0.025	0.02	2.0	112	6446	6636	63	65	125	112	98	73	
100	2.000	0.05	0.032	0.025	0.02	2.0	93	7724	8199	75	80	118	93	36	16	
119	2.50	0.05	0.032	0.025	0.02	2.0	110	7315	7770	71	76	120	110	68	45	
122	2.25	0.05	0.032	0.025	0.02	2.0	114	10462	9554	102	93	115	114	13	22	1
95	1.88	0.05	0.032	0.025	0.02	2.0	88	6890	7318	67	71	115	88	71	23	1

TABLE 6A: THRUST MARGIN ASSESSMENT FOR UNIT 2 & 3 R/R GLOBE VALVES (Page 3 of 3)

Summary of Table Equations

1) T'cst,al = (Tcst,al * (1 - ((TSR)^2 + ((Et/Tcst,al)^2) + (SPR)^2 + (Etmd)^2 + (Edam)^2)^0.5))

2) Fmino,req = (((Aeff * MEDPco) + (Tapl,al / SFbl) + Wsd + Fse + Fhz) * (1 + (ROL/100) + (SFD/100)))

3) Fminc,req = ((Fdpc + (Asml * MELPoc) + Fsf + (Tapl,al / SFbl) + Fse + Fhz + Fother,oc) * (1+(ROL/100) + (SFD/100)))

4) Tmino,req = Fmino,req * SFbl

5) Tminc,req = Fminc,req * SFbl

6) T'avo = Tavo

7) T'avc = T'cst,al

8) Tmargo(DB) = (((T'avo / Tmino,req))-1) * 100)

9) Tmargc(DB) = (((T'avc / Tminc,req))-1) * 100)

Table Notes

1) Valves 9420 & 9434 have closing MEDP equal to zero therefore the 10% ROL factor has not been included in determining Fminc,req.

Additional Notes

1) Test data from recently completed Cycle 10 Refuel Outage has not been fully incorporated to date.

2) All rising/rotating stem globe valves have been dynamically tested at, or near full design basis system conditions.

ENCLOSURE 4

APPENDIX 1

Definition of Terms

GATE VALVE MARGIN ASSESSMENT SPREADSHEET DEFINITIONS

Valve ID: This field in the margin assessment identifies tag numbers of each gate valve included in the GL 89-10 and 96-05 population.

GPA No: This field in the margin assessment identifies the group performance assessment (GPA) number for each valve. Group performance assessments were performed to summarize available test data for a population group in accordance with GL 89-10 Supplement 6. Test data was evaluated to provide confirmation of assumed design basis inputs such as valve factor, stem factor and rate of load.

Valve Size: This field in the margin assessment identifies the valve body size.

Disc Type: This field in the margin assessment identifies the disc type of the valve. There are four different types of discs in the gate valve population. The disc types are split, solid, flex, and double disc.

Mfg: This field in the margin assessment identifies the manufacturer of the subject valve.

Design Basis Open Valve Factor (VFo): This field in the margin assessment identifies the bounding open valve factor as determined by the applicable GPA and utilized in the setpoint calculation for determination of the design basis thrust requirements. Actual in-situ valve factor may be significantly lower but no higher.

Design Basis Close Valve Factor (VFc): This field in the margin assessment identifies the bounding closing valve factor as determined by the applicable GPA and utilized in the setpoint calculation for determination of the design basis thrust requirements. Actual in-situ valve factor may be significantly lower but no higher.

As-Left Stem Factor at CST (SF'al): This field in the margin assessment identifies the adjusted valve stem factor at control switch trip as determined from as-left static testing. The stem factor is calculated from the as-left baseline static test and includes adjustments for instrument inaccuracy. If valve specific test data in unavailable, the bounding stem factor from the applicable GPA is specified.

Stem Factor Degradation Allowance (SFD): For the purpose of margin assessment, all valves have a stem factor degradation allowance of 5% specified. This margin is include to accommodate potential changes in stem factor between maintenance intervals. Periodic testing performed to date has shown this value to be conservative given the current 1 cycle PM interval for stem lubrication.

Rate of Loading Factor (ROL): This field in the margin assessment identifies the rate of loading factor assumed in the margin assessments. This factor was calculated in the GPA's and has been included as a multiplier to the required opening and closing thrust requirements of the margin assessments. As part of the GL 89-10 closeout inspection, when determining available margin, SONGS agreed to apply a ROL value no less than 10% for all gate valve regardless of in-situ test data which suggested a lower value was appropriate.

GATE VALVE MARGIN ASSESSMENT SPREADSHEET DEFINITIONS (cont'd)

As-Left Packing Load (Fpl,al): This field in the margin assessment identifies the average valve packing load as determined by static in-situ testing. If valve specific test data in unavailable, the bounding packing load assumed in the MOV setpoint calculation is specified.

Valve Seat Area (Ast): This field in the margin assessment identifies the valve seat area as specified in the MOV setpoint calculation and used when evaluating dynamic test data in order to determine valve factors.

Valve Lower Stem Area (Asml): This field in the margin assessment identifies the valve lower stem area as specified in the MOV setpoint calculation and is used to calculate stem rejection forces.

Valve Stem and Disc Weight (Wsd): This field in the margin assessment identifies the combined weight of the valve stem and disc.

Maximum Expected Closing Line Pressure (MELPoc): This field in the margin assessment identifies the maximum expected closing line pressure as calculated by the GL 89-10 Operating Basis Calculations (CBC).

Maximum Expected Opening Line Pressure (MELPco): This field in the margin assessment identifies the maximum expected opening line pressure as calculated by the GL 89-10 Operating Basis Calculations (OBC).

Maximum Expected Closing Differential Pressure (MEDPoc): This field in the margin assessment identifies the maximum expected closing differential pressure as calculated by the GL 8910 Operating Basis Calculations (OBC).

Maximum Expected Opening Differential Pressure (MEDPco): This field in the margin assessment identifies the maximum expected opening differential pressure as calculated by the GL 89-10 Operating Basis Calculations (OBC).

Closing Seat Control Logic: This field in the margin assessment identifies the closing seat control logic. A MOV will be either torque seated (TS), bypass seated (BS), or limit seated (LS).

Seismic Force (Fse): This field in the margin assessment identifies the seismic force value used in the MOV setpoint calc. Seismic force is calculated by multiplying the stem and disc weight by the maximum seismic acceleration anticipated for a given valve under a seismic event. This load is conservatively included in determination of the minimum required opening and closing thrust.

Available Operator Opening Torque (Tavo): This field in the margin assessment identifies the design basis available opening output torque of the actuator at degraded voltage. This value is identified in the MOV setpoint calculation.

Available Operator Closing Torque (Tavc): This field in the margin assessment identifies the design basis available closing output torque of the actuator at degraded voltage. This value is identified in the MOV setpoint calculation.

As-Left Static Torque at CST (Tcst,al): This field in the margin assessment identifies the actuator output torque at control switch trip from the as-left static baseline test and does not include any adjustments for diagnostic accuracy.

As-Left Static Thrust at CST (Fcst,al): This field in the margin assessment identifies the actuator output thrust at control switch trip from the as-left static baseline test and does not include any adjustments for diagnostic accuracy.

Torque Switch Repeatability (TSR): This field in the margin assessment identifies the actuator torque switch repeatability based on the actuator output torque and the close torque switch setting from the as-left static baseline test. The values of TSR are specified by Limitorque and range from 0.05 to 0.20. TSR is only applicable to torque seated valves.

Spring Pack Relaxation (SPR): This field in the margin assessment identifies the maximum expected spring pack relaxation which could affect actuator output. The maximum value of SPR is 3.2% or 0.032 based on review of Limitorque bulletins. SPR is only applicable to torque seated valves.

Max Strain Gage Error (Ef): This field in the margin assessment identifies the strain gage error associated with the installed strain gage used to obtain actuator output thrust values. Stem mounted strain gages have a specified error of 11% and yoke mounted gages have a specified error of 16%.

Torque Curve Error (Et): This field in the margin assessment identifies the calibrated springpack curve torque error specified by the springpack calibration equipment manufacturer (B&W). The error associated with determining actuator output torque from springpack displacement is a function of Et and the torque at control switch trip.

TMD Read Error (Etmd): This field in the margin assessment identifies the error associated with the measurement of the springpack displacement. A displacement monitoring transducer supplied by MOVATS is installed to measure springpack displacement. The error value is specified by MOVATS.

Data Acquisition Module Error (Edam): This field in the margin assessment identifies the error associated with the MOVATS data acquisition module. The error value is specified by MOVATS.

Adjusted As-Left Static Torque at CST (T'cst,al): This field in the margin assessment identifies the as-left actuator output torque at CST for the baseline static test with adjustments for inaccuracies. The applied inaccuracies include the square root sum of squares for torque switch repeatability, torque curve error, springpack relaxation, MOVATS DMT and DAM read inaccuracies. The T'cst,al value is calculated within the spreadsheet and the equation is shown on page 3 of the table.

Adjusted As-Left Static Thrust at CST (F'cst,al): This field in the margin assessment identifies the as-left actuator output thrust at CST for the baseline static test with adjustments for inaccuracies. The applied inaccuracies include the square root sum of squares for torque switch repeatability, strain gage error, and springpack relaxation. Acquisition errors are included as part of the overall strain gage error and not included seperately. The F'cst,al value is calculated within the spreadsheet and the equation is shown on page 3 of the table.

Minimum Required Design Basis Opening Thrust (Fmino(DB)): This field in the margin assessment identifies the calculated minimum required opening thrust at design basis condition based on as-left test and design basis data. The Fmino(DB) value is calculated within the spreadsheet and the equation is shown on page 3 of the table. Refer to the spreadsheet for equation details.

Minimum Required Design Basis Closing Thrust (Fminc(DB)): This field in the margin assessment identifies the calculated minimum required closing thrust at design basis condition based on as-left test and design basis data. The Fminc(DB) value is calculated within the spreadsheet and the equation is shown on page 3 of the table. Refer to the spreadsheet for equation details.

Adjusted As-Left Available Design Basis Opening Thrust (F'avo(DB)): This field in the margin assessment identifies the calculated as-left available opening thrust based on the available opening torque (Tavo) divided by the adjusted as-left stem factor (SF'al) as shown on page 3 of the table. This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

Adjusted As-Left Available Closing Thrust (F'avc,al): For torque seated valves, this field identifies the maximum available closing thrust at CST from the as-left static baseline test and is equal to F'cst,al. For limit seated valves (LS and BS), F'avc,al is calculated from the as-left available closing torque (Tavc) divided by the adjusted as-left stem factor (SF'al). These equations are shown on page 3 of the table. This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

Limiting Allowable Open Valve Factor (VFlimo): This field in the margin assessment identifies the limiting open valve factor. Based on available open thrust margin, a maximum allowable valve factor is calculated. This field identifies the highest permissible valve factor which could be permitted without increasing the minimum required opening thrust beyond the available actuator opening thrust. This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

Limiting Allowable In-Situ Opening Valve Factor (VFlimo): This field in the margin assessment identifies the limiting open valve factor. Based on available close thrust margin, a maximum allowable valve factor is calculated. This field identifies the highest permissible valve factor which could be permitted without increasing the minimum required closing thrust beyond the available actuator closing thrust. This value is calculated by the spreadsheet. Refer to the page 3 of the spreadsheet for equation details.

Limiting Allowable In-Situ Close Valve Factor (VFlimc): This field in the margin assessment identifies the limiting close valve factor. Based on available close thrust margin, a maximum allowable valve factor is calculated. This field identifies the highest permissible valve factor which could be permitted without increasing the minimum required closing thrust beyond the available actuator closing thrust. This value is calculated by the spreadsheet. Refer to page 3 of the spreadsheet for equation details.

Opening Design Basis Thrust Margin (Fmargo(DB)): This field in the margin assessment identifies the available as-left design basis opening thrust margin based on the calculated minimum required opening thrust (Fmino,(DB)) and the available opening thrust (F'avo(DB)). This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

Closing Design Basis Thrust Margin (Fmargc(DB)): This field in the margin assessment identifies the available as-left design basis closing thrust margin based on the calculated minimum required closing thrust (Fminc,(DB)) and the available closing thrust (F'avc(DB)). This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

GLOBE VALVE MARGIN ASSESSMENT SPREADSHEET DEFINITIONS

Valve ID: This field in the margin assessment identifies tag numbers of each globe valve included in the GL 89-10 and 96-05 population.

Valve Size: This field in the margin assessment identifies the valve body size.

Disc Type: This field in the margin assessment identifies the disc type of the valve. Disc types include unbalanced (UNB), balanced (BAL), flow under seat (FUS), and flow over seat (FOS).

Mfg: This field in the margin assessment identifies the manufacturer of the subject valve.

Effective DP Disc Area (Aeff): This field in the margin assessment identifies the effective disc area subject to DP forces. This value is the bounding area as determined by in-situ dynamic testing. Multiplying the maximum differential pressure and the effective area will conservatively predict the maximum forces required to overcome differential pressure loads. Use of Aeff eliminates the need to include a typical valve factor type multiplier.

As-Left Stem Factor at CST (SF'al): This field in the margin assessment identifies the adjusted valve stem factor at control switch trip from as-left static testing. The stem factor is calculated from the as-left baseline static test and includes adjustments for instrument inaccuracy. If valve specific test data in unavailable, the bounding stem factor from the applicable GPA is specified.

Stem Factor Degradation Allowance (SFD): For the purpose of margin assessment, all valves have a stem factor degradation allowance of 5% specified. This margin is include to accommodate potential changes in stem factor between maintenance intervals. Periodic testing performed to date has shown this value to be conservative given the current 1 cycle PM interval for stem lubrication.

Rate of Loading Factor (ROL): This field in the margin assessment identifies the rate of loading factor assumed in the margin assessments. This factor was calculated in the GPA's and has been included as a multiplier to the required opening and closing thrust requirements of the margin assessments.

As-Left Average Packing Load (Fapl,al): This field in the margin assessment identifies the average valve packing load as determined by static in-situ testing. If valve specific test data in unavailable, the bounding packing load assumed in the MOV setpoint calculation is specified.

Sealing Force (Fsf): This field in the margin assessment identifies the seat sealing force specified by the MOV setpoint calculation. This force is added to the minimum required closing thrust in order to assure that adequate sealing force is provided for valves with Category A seat leakage requirements.

Valve Stem Weight (Wstem): This field in the margin assessment identifies the valve stem weight as specified in the MOV setpoint calculation.

Valve Disc Weight (Wdisc): This field in the margin assessment identifies the valve disc weight as specified in the MOV setpoint calculation.

Valve Lower Stem Area (Asmi): This field in the margin assessment identifies the valve lower stem area as specified in the MOV setpoint calculation and is used to calculate stem rejection forces.

Maximum Expected Opening Line Pressure (MELPco): This field in the margin assessment identifies the maximum expected opening line pressure as calculated by the GL 89-10 Operating Basis Calculations (OBC).

Maximum Expected Closing Line Pressure (MELPoc): This field in the margin assessment identifies the maximum expected closing line pressure as calculated by the GL 89-10 Operating Basis Calculations (OBC).

Maximum Expected Opening Differential Pressure (MEDPco): This field in the margin assessment identifies the maximum expected opening differential pressure as calculated by the GL 89-10 Operating Basis Calculations (OBC).

Maximum Expected Closing Differential Pressure (MEDPoc): This field in the margin assessment identifies the maximum expected closing differential pressure as calculated by the GL 8910 Operating Basis Calculations (OBC).

Required Opening Differential Pressure Force (Fdpo): This field in the margin assessment identifies the required opening stem thrust due to design basis differential pressure only. This value is obtained from the MOV setpoint calculation and, if applicable, is equal to the effective disk area (Aeff) times the opening differential pressure (MEDPco). NOTE: Fdpo is not applicable to all globe valve configurations. For example, if a globe valve tends to open with pressure (i.e. FUS), the value for Fdpo will be zero.

Required Closing Differential Pressure Force (Fdpc): This field in the margin assessment identifies the required closing stem thrust due to design basis differential pressure only. This value is obtained from the MOV setpoint calculation and, if applicable, is equal to the effective disk area (Aeff) times the closing differential pressure (MEDPoc). NOTE: Fdpc is not applicable to all globe valve configurations. For example, if a globe valve tends to close with pressure (i.e. FOS), the value for Fdpc will be zero.

Seismic Force (Fse): This field in the margin assessment identifies the seismic force value used in the MOV setpoint calc. Seismic force is calculated by multiplying the stem and disc weight by the maximum seismic acceleration anticipated for a given valve under a seismic event. This load is conservatively included in determination of the minimum required opening and closing thrust.

GLOBE VALVE MARGIN ASSESSMENT SPREADSHEET DEFINITIONS (cont'd)

Available Operator Opening Torque (Tavo): This field in the margin assessment identifies the design basis available opening output torque of the actuator at degraded voltage. This value is identified in the MOV setpoint calculation.

Available Operator Closing Torque (Tavc): This field in the margin assessment identifies the design basis available closing output torque of the actuator at degraded voltage. This value is identified in the MOV setpoint calculation.

As-Left Static Torque at CST (Tcst,al): This field in the margin assessment identifies the actuator output torque at control switch trip from the as-left static baseline test and does not include any adjustments for diagnostic accuracy.

As-Left Static Thrust at CST (Fcst,al): This field in the margin assessment identifies the actuator output thrust at control switch trip from the as-left static baseline test and does not include any adjustments for diagnostic accuracy.

Torque Switch Repeatability (TSR): This field in the margin assessment identifies the actuator torque switch repeatability based on the actuator output torque and the close torque switch setting from the as-left static baseline test. The values of TSR are specified by Limitorque and range from 0.05 to 0.20. TSR is only applicable to torque seated valves.

Spring Pack Relaxation (SPR): This field in the margin assessment identifies the maximum expected spring pack relaxation which could affect actuator output. The maximum value of SPR is 3.2% or 0.032 based on review of Limitorque bulletins. SPR is only applicable to torque seated valves.

Max Strain Gage Error (Ef): This field in the margin assessment identifies the strain gage error associated with the installed strain gage used to obtain actuator output thrust values. Stem mounted strain gages have a specified error of 11% and yoke mounted gages have a specified error of 16%.

Torque Curve Error (Et): This field in the margin assessment identifies the calibrated springpack curve torque error specified by the springpack calibration equipment manufacturer (B&W). The error associated with determining actuator output torque from springpack displacement is a function of Et and the torque at control switch trip.

TMD Read Error (Etmd): This field in the margin assessment identifies the error associated with the measurement of the springpack displacement. A displacement monitoring transducer supplied by MOVATS is installed to measure springpack displacement. The error value is specified by MOVATS.

Data Acquisition Module Error (Edam): This field in the margin assessment identifies the error associated with the MOVATS data acquisition module. The error value is specified by MOVATS.

Adjusted As-Left Static Torque at CST (T'cst,al): This field in the margin assessment identifies the as-left actuator output torque at CST for the baseline static test with adjustments for inaccuracies. The applied inaccuracies include the square root sum of squares for torque switch repeatability, torque curve error, springpack relaxation, MOVATS DMT and DAM read inaccuracies. The T'cst,al value is calculated within the spreadsheet and the equation is shown on page 3 of the table.

Adjusted As-Left Static Thrust at CST (F'cst,al): This field in the margin assessment identifies the as-left actuator output thrust at CST for the baseline static test with adjustments for inaccuracies. The applied inaccuracies include the square root sum of squares for torque switch repeatability, strain gage error, and springpack relaxation. Acquisition errors are included as part of the overall strain gage error and not included seperately The F'cst,al value is calculated within the spreadsheet and the equation is shown on page 3 of the table.

Minimum Required Design Basis Opening Thrust (Fmino(DB)): This field in the margin assessment identifies the calculated minimum required opening thrust at design basis condition based on as-left test and design basis data. The Fmino(DB) value is calculated within the spreadsheet and the equation is shown on page 3 of the table. Refer to the spreadsheet for equation details.

Minimum Required Design Basis Closing Thrust (Fminc(DB)): This field in the margin assessment identifies the calculated minimum required closing thrust at design basis condition based on as-left test and design basis data. The Fminc(DB) value is calculated within the spreadsheet and the equation is shown on page 3 of the table. Refer to the spreadsheet for equation details.

Adjusted As-Left Available Design Basis Opening Thrust (F'avo(DB)): This field in the margin assessment identifies the calculated as-left available opening thrust based on the available opening torque (Tavo) divided by the adjusted as-left stem factor (SF'al) as shown on page 3 of the table. This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

Adjusted As-Left Available Closing Thrust (F'avc,al): For torque seated valves, this field identifies the maximum available closing thrust at CST from the as-left static baseline test and is equal to F'cst,al. The equation is shown on page 3 of the table. This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

Opening Design Basis Thrust Margin (Fmargo(DB)): This field in the margin assessment identifies the available as-left design basis opening thrust margin based on the calculated minimum required opening thrust (Fmino,(DB)) and the available opening thrust (F'avo(DB)). This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

Closing Design Basis Thrust Margin (Fmargc(DB)): This field in the margin assessment identifies the available as-left design basis closing thrust margin based on the calculated minimum required closing thrust (Fminc,(DB)) and the available closing thrust (F'avc(DB)). This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

BUTTERFLY VALVE MARGIN ASSESSMENT SPREADSHEET DEFINITIONS

Valve ID: This field in the margin assessment identifies tag numbers of each butterfly valve included in the GL 89-10 and GL 96-05 population.

Valve Size: This field in the margin assessment identifies the valve body size.

Disc Type: This field in the margin assessment identifies the disc type of the valve. There are two different types of discs in the butterfly valve population. The disc types include model 9220 which is a double offset disc and a model 7600 which is a symmetrical disc.

Manufacturer: This field in the margin assessment identifies the manufacturer of the subject valve. For butterfly valves, Fisher is the only manufacturer.

Seat Control Logic: This field in the margin assessment identifies the closing seat control logic. A MOV will be either torque seated (TS), bypass seated (BS), or limit seated (LS).

Maximum Expected Line Pressure (MELP): This field in the margin assessment identifies the maximum expected line pressure as calculated by the GL 89-10 Operating Basis Calculations (OBC). For butterfly valves no differentiation between opening or closing pressure is made, the bounding value is always specified.

Maximum Expected Differential Pressure (MEDP): This field in the margin assessment identifies the maximum expected differential pressure as calculated by the GL 89-10 Operating Basis Calculations (OBC). For butterfly valves no differentiation between opening or closing is made, the bounding value is always specified.

Maximum Flow (Qobc): This field in the margin assessment identifies the maximum expected flowrate as calculated by the GL 89-10 Operating Basis Calculations (OBC).

Design Basis Static Running Torque (Trun(DB)): This field in the margin assessment identifies the static torque running load (in terms of stem output torque) assumed in the MOV setpoint calculation. The static torque load includes packing and bushing loads based on vendor guidelines.

Design Basis Required Seating/Unseating Torque (Ts(DB)): This field in the margin assessment identifies the required stem torque to seat and unseat the butterfly valve under design basis conditions. This value is calculated in the MOV setpoint calculation.

Design Basis Required Dynamic Torque (Td(DB)): This field in the margin assessment identifies the required stem torque to stroke the butterfly valve fully open or close under design basis conditions. The dynamic torque does not include the seating torque. This value is calculated in the MOV setpoint calculation.

Design Basis Minimum Required Stem Torque (Tmin(DB)): This field in the margin assessment identifies the greater of the seating/unseating torque and the dynamic torque at design basis conditions. This value is obtained from the MOV setpoint calculation..

Maximum Allowable Opening Torque (Tmaxo): This field in the margin assessment identifies the design basis available opening output torque of the actuator at degraded voltage. This value is identified in the MOV setpoint calculation.

Maximum Allowable Closing Torque (Tmaxc): This field in the margin assessment identifies the design basis available closing output torque of the actuator at degraded voltage. This value is identified in the MOV setpoint calculation.

As-Left Static Stem Torque at CST (Tcst,al): This field in the margin assessment identifies the actuator output torque at control switch trip from the as-left static baseline test. This output torque is limited by the torque switch setting for TS valves only and does not include adjustment for instrument inaccuracy. As-left values specified for LS valves is for information only.

As-Left Average Static Running Torque (Trun,al): This field in the margin assessment identifies the average static running torque measured during baseline static testing. The static torque load includes packing and bushing loads and is obtained from the static test data reconciliation. If in-situ test data is unavailable, the setpoint calc value is specified as the default.

Torque Switch Repeatability (TSR): This field in the margin assessment identifies the actuator torque switch repeatability based on the actuator output torque and the close torque switch setting from the as-left static baseline test. The values of TSR are specified by Limitorque and range from 0.05 to 0.20. TSR is only applicable to torque seated valves.

Spring Pack Relaxation (SPR): This field in the margin assessment identifies the maximum expected spring pack relaxation which could affect actuator output. The maximum value of SPR is 3.2% or 0.032 based on review of Limitorque bulletins. SPR is only applicable to torque seated valves.

Max Strain Gage Error (Ef): This field in the margin assessment identifies the strain gage error associated with the installed strain gage used to obtain actuator output thrust values. Stem mounted strain gages have a specified error of 11%. All butterfly valves use stem mounted strain gages.

As-Left Minimum Required Opening Stem Torque (Tmino(DB)): This field in the margin assessment identifies the calculated minimum required opening torque at design basis condition based on as-left static and dynamic test data. This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

As-Left Minimum Required Closing Stem Torque (Tminc,(DB)): This field in the margin assessment identifies the calculated minimum required closing torque at design basis conditions based on as-left static and dynamic test data. This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

BUTTERFLY VALVE MARGIN ASSESSMENT SPREADSHEET DEFINITIONS (cont'd)

Adjusted As-Left Available Opening Stem Torque (T'avo(DB)): This field in the margin assessment identifies the adjusted as-left available opening stem torque. For butterfly valves the value of T'avo(DB) is equal to the value of Tmaxo.

Adjusted As-Left Available Closing Stem Torque (T'avc(DB)): This field in the margin assessment identifies the adjusted as-left available closing stem torque. For LS valves this value is equal to the value of Tmaxc. For TS valves this value is equal to the torque at CST (Tcst,al) from the static baseline test with adjustments for inaccuracies. The applied inaccuracies include the square root sum of squares for torque switch repeatability, spring pack relaxation, and strain gage inaccuracies. The T'avc(DB) value is calculated within the spreadsheet. Refer to sheet 3 of the table for equation details.

As-Left Opening Torque Margin (Tmargo): This field in the margin assessment identifies the available as-left opening torque margin based on the calculated minimum required opening torque (Tmino(DB)) and the as-left adjusted available opening torque (T'avo(DB)) This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

As-Left Closing Torque Margin (Tmargc): This field in the margin assessment identifies the available as-left closing torque margin based on the calculated minimum required closing torque (Tminc(DB)) and the as-left adjusted available closing torque (T'avc(DB)). This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

R/R GLOBE VALVE MARGIN ASSESSMENT SPREADSHEET DEFINITIONS

Valve ID: This field in the margin assessment identifies tag numbers of each globe valve included in the GL 89-10 and 96-05 population.

Valve Size: This field in the margin assessment identifies the valve body size.

Disc Type: This field in the margin assessment identifies the disc type of the valve. Disc types include unbalanced (UNB), balanced (BAL), flow under seat (FUS), and flow over seat (FOS).

Mfg: This field in the margin assessment identifies the manufacturer of the subject valve.

Effective DP Disc Area (Aeff): This field in the margin assessment identifies the effective disc area subject to DP forces. This value is the bounding area as determined by in-situ dynamic testing. Multiplying the maximum differential pressure and the effective area will conservatively predict the maximum forces required to overcome differential pressure loads. Use of Aeff eliminates the need to include a typical valve factor type multiplier.

Baseline Coefficient of Friction (COFbl): This field in the margin assessment identifies the baseline coefficient of friction utilized in the setpoint calculation. When adequately lubricated, a valve stem/stemnut COF is expected to approximate this value. For rising/rotating stem valves the setpoint calc assumed a COFbl equal to 0.20 for all valves. Because of the limitations of the diagnostic test system, no as-left COF or stem factor has been determined for these valves. The specified value of 0.20 for COF is considered conservative based on comparison to other valves in the GL 89-10 population.

Baseline Stem Factor (SFbl): This field in the margin assessment identifies the baseline stem factor utilized in the setpoint calculation at the baseline COF.

Stem Factor Degradation Allowance (SFD): For the purpose of margin assessment, all valves have a stem factor degradation allowance of 5% specified. This margin is include to accommodate potential changes in stem factor between maintenance intervals. Periodic testing performed to date has shown this value to be conservative given the current 1 cycle PM interval for stem lubrication.

Rate of Loading Factor (ROL): This field in the margin assessment identifies the rate of loading factor assumed in the margin assessments. This factor was calculated in the GPA's and has been included as a multiplier to the required opening and closing thrust requirements of the margin assessments.

As-Left Average Stem Packing Torque (Tapl,al): This field in the margin assessment identifies the average valve packing load as determined by static in-situ testing. If valve specific test data in unavailable, the bounding packing torque value assumed in the MOV setpoint calculation is specified.

Sealing Force (Fsf): This field in the margin assessment identifies the seat sealing force specified by the MOV setpoint calculation. This force is added to the minimum required closing thrust in order to assure that adequate sealing force is provided for valves with Category A seat leakage requirements.

Valve Stem and Disc Weight (Wsd): This field in the margin assessment identifies the valve stem and disc weight as specified in the MOV setpoint calculation.

Valve Lower Stem Area (Asml): This field in the margin assessment identifies the valve lower stem area as specified in the MOV setpoint calculation and is used to calculate stem rejection forces.

Maximum Expected Closing Line Pressure (MELPoc): This field in the margin assessment identifies the maximum expected closing line pressure as calculated by the GL 89-10 Operating Basis Calculations (OBC).

Maximum Expected Opening Line Pressure (MELPco): This field in the margin assessment identifies the maximum expected opening line pressure as calculated by the GL 89-10 Operating Basis Calculations (OBC).

Maximum Expected Closing Differential Pressure (MEDPoc): This field in the margin assessment identifies the maximum expected closing differential pressure as calculated by the GL 8910 Operating Basis Calculations (OBC).

Maximum Expected Opening Differential Pressure (MEDPco): This field in the margin assessment identifies the maximum expected opening differential pressure as calculated by the GL 89-10 Operating Basis Calculations (OBC).

Required Opening Differential Pressure Force (Fdpo): This field in the margin assessment identifies the required opening stem thrust due to design basis differential pressure only. This value is obtained from the MOV setpoint calculation and, if applicable, is equal to the effective disk area (Aeff) times the opening differential pressure (MEDPco). NOTE: Fdpo is not applicable to all globe valve configurations. For example, if a globe valve tends to open with pressure (i.e. FUS), the value for Fdpo will be zero.

Required Closing Differential Pressure Force (Fdpc): This field in the margin assessment identifies the required closing stem thrust due to design basis differential pressure only. This value is obtained from the MOV setpoint calculation and, if applicable, is equal to the effective disk area (Aeff) times the closing differential pressure (MEDPoc). NOTE: Fdpc is not applicable to R/R globe valve configurations because all of the valves are FOS and flow tends to close the valves.

Seat Control Logic: This field in the margin assessment identifies the closing seat control logic. A MOV will be either torque seated (TS), bypass seated (BS), or limit seated (LS).

Seismic Force (Fse): This field in the margin assessment identifies the seismic force value used in the MOV setpoint calc. Seismic force is calculated by multiplying the stem and disc weight by the maximum seismic acceleration anticipated for a given valve under a seismic event. This load is conservatively included in determination of the minimum required opening and closing thrust.

Horizontal Forces (Fhz): This field in the margin assessment identifies the horizontal load for the MOV. This value is calculated in the MOV setpoint calculation and is applied to R/R globe valves due to the valve stem not being vertical. This value is obtained from the MOV setpoint calculation.

Other Closing Forces (Fother,oc): This field in the margin assessment identifies the other miscellaneous forces included in the determination of the minimum required closing thrusts. For R/R globe valves a Fother force is included to account for disc alignment loads measured during design basis testing. This force was identified during the preparation of the applicable GPA and is included in the MOV setpoint calculation.

Available Operator Opening Torque (Tavo): This field in the margin assessment identifies the design basis available opening output torque of the actuator at degraded voltage. This value is identified in the MOV setpoint calculation.

Available Operator Closing Torque (Tavc): This field in the margin assessment identifies the design basis available closing output torque of the actuator at degraded voltage. This value is identified in the MOV setpoint calculation.

As-Left Static Torque at CST (Tcst,al): This field in the margin assessment identifies the actuator output torque at control switch trip from the as-left static baseline test.

As-Left Closing Torque Switch Setting (TSS,al): This field in the margin assessment identifies the actuator close torque switch setting from the as-left static baseline test.

Torque Switch Repeatability (TSR): This field in the margin assessment identifies the actuator torque switch repeatability based on the actuator output torque and the close torque switch setting from the as-left static baseline test. The values of TSR are specified by Limitorque and range from 0.05 to 0.20. TSR is only applicable to torque seated valves.

Spring Pack Relaxation (SPR): This field in the margin assessment identifies the maximum expected spring pack relaxation which could affect actuator output. The maximum value of SPR is 3.2% or 0.032 based on review of Limitorque bulletins. SPR is only applicable to torque seated valves.

TMD Read Error (Etmd): This field in the margin assessment identifies the error associated with the measurement of the springpack displacement. A displacement monitoring transducer supplied by MOVATS is installed to measure springpack displacement. The error value is specified by MOVATS.

Data Acquisition Module Error (Edam): This field in the margin assessment identifies the error associated with the MOVATS data acquisition module. The error value is specified by MOVATS.

Torque Curve Error (Et): This field in the margin assessment identifies the calibrated springpack curve torque error specified by the springpack calibration equipment manufacturer (B&W). The error associated with determining actuator output torque from springpack displacement is a function of Et and the torque at control switch trip.

Adjusted As-Left Static Torque at CST (T'cst,al): This field in the margin assessment identifies the as-left actuator output torque at CST for the baseline static test with adjustments for inaccuracies. The applied inaccuracies include the square root sum of squares for torque switch repeatability, torque curve error, MOVATS DMT and DAM read inaccuracies. The T'cst,al value is calculated within the spreadsheet.

Minimum Required Design Basis Opening Thrust (Fmino,req): This field in the margin assessment identifies the calculated minimum required opening thrust at design basis condition based on as-left static and dynamic test data. This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

Minimum Required Design Basis Closing Thrust (Fminc,req): This field in the margin assessment identifies the calculated minimum required closing thrust at design basis conditions based on as-left static and dynamic test data. This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

Minimum Required Design Basis Opening Torque (Tmino,req): This field in the margin assessment identifies the calculated minimum required opening torque at design basis condition based on as-left static and dynamic test data. This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

Minimum Required Design Basis Closing Torque (Tminc,req): This field in the margin assessment identifies the calculated minimum required closing torque at design basis conditions based on as-left static and dynamic test data. This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

Adjusted Available Design Basis Opening Torque (T'avo): This field in the margin assessment identifies the adjusted as-left available opening actuator output torque. For R/R globe valves the value of T'avo is equal to the lesser of Tortq or Tavo. This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

Adjusted Available Design Basis Closing Torque (T'avc): This field in the margin assessment identifies the adjusted as-left available closing actuator output torque. For TS valves this value is equal to the adjusted torque at CST (T'cst,al) from the static baseline test and calculated in the test data reconciliation section of the spreadsheet.

As-Left Opening Design Basis Torque Margin (Tmargo(DB)): This field in the margin assessment identifies the available as-left opening torque margin based on the calculated minimum required opening torque (Tmino,req) and the as-left adjusted available opening torque (T'avo). This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.

As-Left Closing Design Basis Torque Margin (Tmargc(DB)): This field in the margin assessment identifies the available as-left closing torque margin based on the calculated minimum required closing torque (Tminc,req) and the as-left adjusted available closing torque (T'avc). This value is calculated by the spreadsheet. Refer to the spreadsheet for equation details.