ENCLOSURE 3

Seismic Risk Ranking to Support the IST Risk Ranking Process

PALO VERDE
NUCLEAR GENERATING STATION

DOCUMENT TITLE SHEET

DOCUMENT NUMBER		
13-NS-C28		
Q	QAG	NQR X

Title / Description: Seismic Risk Ranking to Support the IST Risk Ranking Process

REV. NO.	REVISION DESCRIPTION	Preparer / Date	RE / Date	Second Party Verification / Date	Mech. / Date	Civil / Date	Elec. / Date	I & C / Date	Independent Verification / Date	Other (Specify Org.) / Date
△										
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△0	Initial Issue	NA	[signature] 12/06/96	NA	NA	NA	NA	NA	[signature] 12/06/96	NA

CROSS DISCIPLINE REVIEW (Mech., Civil, Elec., I & C)

Executive Summary

This evaluation was performed to provide seismic risk importance information to support the IST risk ranking project. The IST risk ranking task is a subtask of a pilot-project which is evaluating the feasibility of extending the test interval of low safety significant components. APS released a report in December 1995 (Reference 1), which described the PVNGS IST risk ranking process. The December 1995 report included a seismic risk ranking for each component which was evaluated therein. The seismic risk ranking In the December 1995 submittal (Section 4.1.3.4) was based on whether the seismic event required an additional functional response, other than the functional responses considered within the (internal-events) PRA, and if so whether this additional functional requirement significantly increased the risk importance of the component.

The NRC has requested additional information (Reference 2) regarding the external events ranking process, including consideration that external events could potentially alter the overall component importance despite the fact that it does not require a component functional response other than that which has already been considered in the PVNGS (internal-events) PRA. Therefore this new study considers both whether a seismic event significantly increases the frequency with which a component is required to operate for accident mitigation purposes, in addition to considering whether a seismic event requires an additional functional response which may not have been considered in the Internal events ranking process. This study reevaluates the seismic risk ranking of each of the components which was ranked in Reference 1 (approximately 240 separate valve groups).

The results of the study are documented in Table 1 and in appendix A of this study. Of approximately 240 valve groups which were considered, 38 valve groups were ranked as medium risk and 2 valves were ranked as high risk. For the remainder of the valves it was shown that the Internal events PRA risk was much more affected by a proposed test interval change than the seismic risk and that it is therefore appropriate to risk rank those components based on their importance to the internal events PRA and/or that the resulting seismic risk increase was small enough in absolute terms to justify a ranking of low using the Reference 1 criteria of a Fussel-Vesely measure less than 1E-3 and a Risk Achievement Worth of less than 2.

The components which were found to have significant impact on the seismic risk relative to the internal events impact were:

(1) Components which affect the ability to establish Shutdown Cooling (SDC) conditions including Auxiliary Pressurizer Spray System (APSS), SDC, and Atmospheric Dump Valve (ADV) components. This is because large seismic events could potentially result in long term unavailability of offsite power, loss of some CST inventory (inventory in excess of Tech Specification required volumes) and unavailability of CST makeup. (In the internal events PRA, SDC is typically not required as a means of long term cooling). The two components which were ranked as high risk components were motor operated valves required to maintain the charging pump suction following a loss of offsite power (CH-501 and CH-532) which have relatively high failure probabilities and are single failure points which could prevent establishing SDC entry conditions (conservatively taking no credit for operator action to either prevent or recover from gas binding of the charging pumps).

(2) Components that isolate non-seismically qualified piping from the containment and are not maintained closed. This is because the seismic event could be

postulated to result in a direct breach of the containment following a seismic event if both containment isolation valves were to fail open. (Failure of these valves to close following an internally initiated core damage event is generally not critical since the piping remains intact preventing a direct release to containment).

Table of Contents

Seismic Risk Ranking-- IST Program

1.0 Introduction

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The NRC has requested additional information (Reference 2) regarding the external events ranking process, including consideration that external events could potentially alter the overall component importance despite the fact that it does not require a component functional response other than that which has already been considered in the PVNGS (internal-events) PRA. Therefore this new study considers both whether a seismic event significantly increases the frequency with which a component is required to operate for accident mitigation purposes, in addition to considering whether a seismic event requires an additional functional response which may not have been considered in the Internal events ranking process.

This study is intended to provide a revised assessment of the importance of IST components to seismic risk, in consideration of NRC comments in Reference 2 (Specifically question # PRA-9 from Page 19 which is included as Appendix B of this study).).

2.0 General Approach

The general approach was to reevaluate the safety significance of each component which was considered in the original IST ranking and to make an assessment about whether the safety significance of the valve as measured by the internal events PRA should be increased due to the frequency with which the component would be required to mitigate a seismic event. If the frequency with which a component is required to operate to mitigate a seismically initiated event was estimated to be much less than the frequency that it is required to mitigate a similar internal initiating event then it is appropriate for the component ranking to be based upon the components importance to the internal events PRA, and the seismic risk significance was rated low. [For a select few components which were recognized as being most important to seismic risk (and relatively more important to seismic events than to internal events) a scoping evaluation was performed to verify that the low ranking was justified on an absolute basis using the decision criteria of the original IST ranking (RAW < 2; FV < 1E-3)].

3.0 Risk Importance Assumptions/Guidelines

In evaluating the risk significance of plant components to mitigating a seismic event a number of simplifying assumptions were made:

(1) Seismic events were judged to be minor contributors to the Internal events initiating event frequencies for Large and Medium LOCAs, Main Steam-line Breaks, and Steam Generator Tube Rupture events. The Palo Verde SSE frequency is 8E-5/yr (Reference 4, Table 6-1) and Reference 5 shows typical fragilities for primary piping and seismically qualified secondary piping at levels in excess of several times the SSE peak ground acceleration. Therefore it is concluded that the seismic initiated initiating event frequencies for these events are substantially less than the corresponding internal events initiating event frequency. EPRI-NP-6041-SL (Page 3-8 and 3-9) also concludes that these events are minor contributors to seismic risk, based on previous industry studies.

(2) Seismic events can be a significant contributor to the frequency of extended loss of offsite power events. Scoping calculations performed within this study for the seismically initiated loss of offsite power events will conservatively assume no credit for recovery of offsite power for a period of 24 hours, and will assume that the (non-seismic) Gas Turbine Generators are unavailable. An extended loss of offsite power event requires operation of the Auxiliary Pressurizer Spray System (the Pressurizer Vents are a possible backup but not credited herein) and the SDC system and this impact is considered in scoping calculations performed herein.

(3) Seismic events were judged to be minor contributors to Transient Events with offsite power available. Since the OBE frequency is 3E-4/yr (References 4 and 6) and since seismic events below this level would not be expected to cause reactor trip or damage to balance of plant equipment and the transient, and the internal events initiating frequency for these transient events is several orders of magnitude higher.

(4) Seismically induced small LOCAs are not expected since RCS pipping and attached instrumentation lines are seismic category 1. Regardless, since the internal events PRA small LOCA initiating event frequency (IEF) 8E-3/yr is much greater than the SSE frequency, it is clear that seismic events do not significantly impact the overall IEF. The frequency of a small LOCA with concurrent loss of offsite power is potentially affected and this will be considered in the ranking of HPSI components and High Pressure Recirculation components. It is assumed for the purpose of scoping calculations performed in this study that ten percent of seismically induced loss of offsite power events also cause a concurrent small LOCA.

(5) In estimating risk for seismically initiated events no credit is taken for operation of non-seismic category equipment. The N train AFW pump is the notable example of equipment which is credited for accident mitigation in the internal events PRA but is conservatively assumed failed for seismically initiated loss of offsite power events. The N train pump is

located in the Turbine Building and may not be available for seismic events of SSE size and larger due to seismic-interaction concerns.

(6) If a concern relating to seismic risk was noted from extending the test interval of a particular component then that component was ranked as Medium risk unless a scoping calculation indicated that it would meet the criteria in Reference 1 for designating a component as high risk (i.e. - Fussel-Vesely Value of 0.01 corresponding to a CDF of > 4.7E-7 involving failure of that component or a risk increase greater than 4.7E-5 corresponding to a risk achievement worth greater than 2). Some of the components designated as medium may not meet the reference 1 criteria of being rated a medium (e.g. - normally open containment isolation valves on non-seismic category 1 piping whose failure would increase the frequency of a core damage event with failure of containment isolation but would not affect core damage frequency).

4.0 Results and Conclusions

The Results of the study are documented in Table 1 and in appendix A of this study. Each of the valve groups which were ranked in Reference 1 (approximately 240 separate valve groups) were re-ranked for seismic risk importance. Thirty-eight valve groups were ranked as medium risk and two valves were ranked as high risk. For the remainder of the valves it was shown that the Internal events PRA risk was much more affected by a proposed test interval change than the seismic risk and that it is therefore appropriate to risk rank those components based on their importance to the internal events PRA and/or that the resulting seismic risk increase was small enough in absolute terms to justify a ranking of low using the Reference 1 criteria of a Fussel-Vesely measure less than 1E-3 and a RAW less than 2.

The components which were found to have significant impact on the seismic risk relative to the internal events impact were:

(1) Components which affect the ability to establish Shutdown Cooling (SDC) conditions including Auxiliary Pressurizer Spray System (APSS), SDC, and Atmospheric Dump Valve (ADV) components. This is because large seismic events could potentially result in long term unavailability of offsite power, loss of some CST inventory (inventory in excess of Tech Specification required volumes) and unavailability of CST makeup. (In the internal events PRA, SDC is typically not required as a means of long term cooling). The two components which were ranked as high risk components were motor operated valves required to maintain the charging pump suction following a loss of offsite power (CH-501 and CH-532) which have relatively high failure probabilities and are single failure points which could prevent establishing SDC entry conditions (conservatively taking no credit for operator action to either prevent or recover from gas binding of the charging pumps).

(2) Components that isolate non-seismically qualified piping from the containment and are not maintained closed. This is because the seismic event could be postulated to result in a direct breach of the containment following a seismic event if both containment isolation valves were to fail open. (Failure of these

valves to close following an internally initiated core damage event is generally not critical since the piping remains intact preventing a direct release to containment).

5.0 References

1. Arizona Public Service Request for Exemption from 10CFR50.55a (f) (4) (i) and (ii) for Inservice Testing (IST) Frequency, Supplement 1, dated December 20, 1995.
2. NRC letter dated 15 March, 1996, 'Request for Additional Information on Risk-Informed Inservice Testing Pilot Plant - PVNGS'.
3. NUREG/CR-3558, 'Handbook of Nuclear Power Plant Fragilities,' June 1985.
4. Risk Engineering, 'Seismic Hazard Evaluation for PVNGS (Wintersburg, Arizona), April 5, 1993.
5. EPRI-NP-6041-SL, 'A Methodology for Assessment of Nuclear Power Plant Seismic Margin (Revision 1),' August 1991.
6. PVNGS Design Basis Manual C5, 'Seismic Topical Design Basis Manual,' Revision 0.

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Table 1A - Summary of Valve Seismic Risk Significance Evaluation (All systems except SI and CH which is addressed in Tables C2 and C3)

Valve ID	Seismic Risk Significance	IST	Description/Function	Comments/ Basis for Seismic Risk Ranking
AF System:				
AFA-V007	L	Y	AFW Pump AFA-P01 Suction Check Valve Prevent reverse flow in the suction side piping of the A- train pump and to open to allow sufficient flow to the operable steam generator(s) to support an orderly, or controlled, shutdown and cooldown of the reactor following design basis events.	Fail to Close (FTC) failure mode: Since all AFA suction and discharge piping is seismic category 1 a seismic event would not fail the piping, therefore the risk significance of the FTC/FTRC failure mode will be driven by non-seismic events (The probability of a demand to close would be proportional to the number of AFA demands, and the AFA pump will be primarily demanded by loss of main feedwater and loss of offsite power events).
AFA-V015 AFA-V137	L	Y	AFW PP AFA-P01 Discharge Chk Valve To close to prevent reverse flow in the discharge side piping of the A- train pump and to open to allow sufficient flow to the operable steam generator(s) to support an orderly, or controlled, shutdown and cooldown of the reactor following design basis events.	Fail to Open (FTO) failure mode: Since the frequency with which the AFA pump is needed to mitigate a non-seismic event (estimated as 2.7E-4/yr in Appendix A) is much greater than the frequency with which the AFA pump is needed to mitigate a seismic event (estimated as 7.7E-6/yr in Appendix A), the risk importance of the AFA pump and associated valves is driven by non-seismic events.
AFB-V022	L	Y	Suction Check Valve Pump AFB-P01 Suction Check Valve To close to prevent reverse flow in the suction side piping of the B-train pump and to open to allow sufficient flow to the operable steam generator(s) to support an orderly, or controlled, shutdown and cooldown of the reactor following design basis events.	Fail to Close (FTC) failure mode: Since all AFB suction and discharge piping is seismic category 1 a seismic event would not fail the piping, therefore the risk significance of the FTC/FTRC failure mode will be driven by non-seismic events (The probability of a demand to close would be proportional to the number of AFB demands, and the AFB pump will be primarily demanded by loss of main feedwater and loss of offsite power events).
AFB-V024 AFB-V138	L	Y	AFB-P01 Discharge side Chk Valve To close to prevent reverse flow in the discharge side piping of the B-train pumps and to open to allow sufficient flow to the operable steam generator(s) to support an orderly, or controlled, shutdown and cooldown of the reactor following design basis events.	Fail to Open (FTO) failure mode: Since the frequency with which the AFB pump is needed to mitigate a non-seismic event (estimated as 8.5E-4/yr in Appendix A) is much greater than the frequency with which the AFA pump is needed to mitigate a seismic event (estimated as 8.2E-6/yr in Appendix A), the risk importance of the AFB pump and associated valves is driven by non-seismic events.
AFA-V079 AFB-V080	L	Y	AF Pump Discharge To FW SG To remain closed to prevent reverse flow of main feedwater into AF System A- and B-train piping, to open to allow sufficient flow to the operable steam generator(s) to support an orderly, or controlled, shutdown and cooldown of the reactor following design basis events. Containment Isolation	The high risk significance ranking of these valves is based on the need for these valves to open following a SGTR or SLB event. Since all this piping is seismic category 1, the probability of either of these events occurring from a seismic event (SSE frequency = 8E-5) is much less than the probability that they occur for other reasons. Therefore the risk rankings for these valves should be based on their importance to non-seismic events.
AFB-HV30 AFB-HV31	L	Y	AFW Pump B Flow Control Valve to SG To regulate the flow of auxiliary feedwater at the discharge side of B- train pump. The AF System is designed to provide sufficient flow to the operable steam generator(s) to support an orderly, or controlled, shutdown and cooldown of the reactor following design basis events.	Fail to Open (FTO) failure mode: Since the frequency with which the AFB pump is needed to mitigate a non-seismic event (estimated as 8.5E-4/yr in Appendix A) is much greater than the frequency with which the AFA pump is needed to mitigate a seismic event (estimated as 8.2E-6/yr in Appendix A), the risk importance of the AFB pump and associated valves is driven by non-seismic events.

Table 1[illegible]mmary of Valve Seismic Risk Significance Evaluation ([illegible]stems except SI and CH which is addressed in Tables C2 and [illegible]

Valve ID	Seismic Risk Significance	IST	Description/Function	Comments/ Basis for Seismic Risk Ranking
AFB-UV34 AFB-UV35	L	Y	AFW Pump B Supply to SG Isolation To isolate the flow of auxiliary feedwater at the discharge side of B-train pump and to provide sufficient flow to the operable steam generator(s) to support an orderly, or controlled, shutdown and cooldown of the reactor following design basis events. Containment Isolation	Fail to Open (FTO) failure mode: Since the frequency with which the AFB pump is needed to mitigate a non-seismic event (estimated as 8.5E-4/yr in Appendix A) is much greater than the frequency with which the AFA pump is needed to mitigate a seismic event (estimated as 8.2E-6/yr in Appendix A), the risk importance of the AFB pump and associated valves is driven by non-seismic events.
AFA-HV32 AFC-HV33	L	Y	AFW Pump A Discharge Isol to SG To regulate the flow of auxiliary feedwater at the discharge side of A-train pump to provide sufficient flow to the operable steam generator(s) to support an orderly, or controlled, shutdown and cooldown of the reactor following design basis events.	Fail to Open (FTO) failure mode: Since the frequency with which the AFA pump is needed to mitigate a non-seismic event (estimated as 2.7E-4/yr in Appendix A) is much greater than the frequency with which the AFA pump is needed to mitigate a seismic event (estimated as 7.7E-6/yr in Appendix A), the risk importance of the AFA pump and associated valves is driven by non-seismic events.
AFC-UV36 AFA-UV37	L	Y	AFW to SG Downstream Valve To isolate the flow of auxiliary feedwater at the discharge side of A- train pump and to provide sufficient flow to the operable steam generator(s) to support an orderly, or controlled, shutdown and cooldown of the reactor following design basis events. Containment Isolation	Fail to Open (FTO) failure mode: Since the frequency with which the AFA pump is needed to mitigate a non-seismic event (estimated as 2.7E-4/yr in Appendix A) is much greater than the frequency with which the AFA pump is needed to mitigate a seismic event (estimated as 7.7E-6/yr in Appendix A), the risk importance of the AFA pump and associated valves is driven by non-seismic events.
AFA-HV54	L	Y	AFW Turbine Trip And Throttle Valve To act as a trip valve during normal operation for the A-train pump turbine drive and to provide sufficient flow to the operable steam generator(s) to support an orderly, or controlled, shutdown and cooldown of the reactor following design basis events.	Fail to Remain Open (FTRO) failure mode: Since the frequency with which the AFA pump is needed to mitigate a non-seismic event (estimated as 2.7E-4/yr in Appendix A) is much greater than the frequency with which the AFA pump is needed to mitigate a seismic event (estimated as 7.7E-6/yr in Appendix A), the risk importance of the AFA pump and associated valves is driven by non-seismic events.
AFA-V002	L	N	Main Steam Supply to AFW PP A (Manual Valve)	Fail to Remain Open (FTRO) failure mode: Since the frequency with which the AFA pump is needed to mitigate a non-seismic event (estimated as 2.7E-4/yr in Appendix A) is much greater than the frequency with which the AFA pump is needed to mitigate a seismic event (estimated as 7.7E-6/yr in Appendix A), the risk importance of the AFA pump and associated valves is driven by non-seismic events.
AFA-V006 CTA-V015	L	N	AFA-P01 CST Suction (Manual Valves)	
AFA-V016	L	N	AFA-P01 Discharge (Manual Valve)	
AFB-V021 CTB-V014	L	N	AFB-P01 CST Suction (Manual Valves)	Fail to Open (FTO) failure mode: Since the frequency with which the AFB pump is needed to mitigate a non-seismic event (estimated as 8.5E-4/yr in Appendix A) is much greater than the frequency with which the AFB pump is needed to mitigate a seismic event (estimated as 8.2E-6/yr in Appendix A), the risk importance of the AFB pump and associated valves is driven by non-seismic events.
AFB-V025	L	N	AFB-P01 Discharge (Manual Valve)	
AFN-V001 AFN-V013	L	N	AFN-P01 Suction (Manual Valve) AFN-P01 Discharge Manual Valve	The AFN pump is located in the turbine building and is not seismically qualified and therefore cannot be relied upon to operate following a seismic event. Even if it were assumed to be capable to withstand a major seismic event (e.g. - the SSE) the frequency with which it is required to mitigate non-seismic events (1.9E-4/yr) would be much greater than the frequency with which it would be required to mitigate a seismic initiated event (<<1E-5/yr). Therefore the risk ranking for this valve should be based on its importance to mitigating non-seismic events.

Table 1A - Summary of Valve Seismic Risk Significance Evaluation (All systems except SI and CH which is addressed in Tables C2 and C3)

Valve ID	Seismic Risk Significance	IST	Description/Function	Comments/ Basis for Seismic Risk Ranking
AFN-V012	L	N	AFW PP AFN-P01 Discharge Chk To prevent reverse flow in the discharge side piping of the N-train pump and to provide sufficient flow to the steam generator(s) for the control of reactor coolant temperature during normal start-up, hot standby and shutdown conditions, and for initial fill and makeup.	Fail to Open Failure mode - Since the AFN pump is located in the Turbine building it cannot be relied upon to operate following a major seismic event (refer to AFN-V001 basis for additional rationale). Fail to Close/ Prevent Reverse Flow - If the N pump discharge piping were to fail as a result of the seismic event and the check valve were to fail to close unacceptable consequences would result if both FWIVs failed to close and both check valves in the seismic 1 piping were to fail. The probability of such a scenario is < 1E-9/yr so the seismic contribution to the components risk significance is negligible.
CTA-HV004 CTA-HV001	M	Y	AFN-P01 Suction From Condensate Storage Tank	If the AFN pump is running when the seismic event occurs and the N train piping fails and both CT-1 and CT-4 fail to close there would be an uncontrolled loss of CST inventory from the break. The risk increase from failure of either valve is negligible (8E-5/yr SSE frequency * 0.05 probability that N pump is in service at the time of the seismic event * 1.4E-3 probability that CT-4 fails). However since standard design practice of having these valves powered by separate electrical trains has been deviated from in order to allow greater AFN reliability, it is judged that the expert panel should consider this fact in determining the CT-1 and CT-4 ranking.
CP System:				
CPA-UV2A CPB-UV3A	L	N	CTMT Bldg Refueling Purge Sup. Duct Isolation Damper	At least one of the two series valves in each of the 4 containment penetrations would be required to close following a seismic induced core damage event if a containment purge was in progress at the time of the seismic event. Since the frequency of a seismic induced core damage event occurring with containment purge in progress (<5E-8/yr) and since failures of both valves would be required to get a potential Large Early Release, failure a single valve would result in a LERF increase of <5E-10 (Failure of a single AOV was estimated as 1.5E-6/hr from NUREG/CR-2770 page 52 with 18 month test). Therefore LERF would not be significantly changed if one of these valves were to fail (internal events LERF is > 1E-6/yr). Only 4A,4B,5A,5B are opened at power and only for short periods of time to depressurize the containment, therefore (given the low frequency of a seismic event with these valves open estimated at less than 1E-6) it is judged. However since these valves provide a large direct flow path it is recommended that the test interval for these valves not be extended beyond 18 months.
CPA-UV2B CPB-UV3B	L	N	CTMT Bldg Refueling Purge Exh. Duct Isolation Damper	
CPA-UV4A CPB-UV5A	L	N	CTMT Bldg Pwr. Acc. Purge Sup. Duct Isolation Damper	
CPA-UV4B CPB-UV5B	L	N	CTMT Bldg Pwr. Acc. Purge Exh. Duct Isolation Damper	
CT System:				
CTA-V016 CTB-V020	M	N	Cdns Transfer Pump Discharge Chk Vlv	These valves are not modeled in the internal events PRA, and only CTAV016 and CTBV020 impact the reliability of safety systems following a seismic event. However CTA-V016 and CTA-V020 impacts the availability of makeup to the EC, EW and DG Cooling Water surge tanks, and it is conceivable that the seismic event could result in some leakage from these systems (e.g. - see 41AL-1RK7C Alarm Window 7C14A). Therefore it is recommended that the CT-16/ CT-20 stroke test interval not be extended beyond 18 months.
CTA-V018 CTB-V019	L	N	CST Pump to SFP (Manual Valves)	
CTA-V037 CTA-V038	L	N	Fuel Pool Supply Line Chk Vlv from CT Pump	
CTA-V015	See AFA-V006			
CTB-V014	See AFB-V021			
CTA-HV004 CTA-HV001	See AF Table			

Table [illegible]ummary of Valve Seismic Risk Significance Evaluation [illegible]stems except SI and CH which is addressed in Tables C2 and [illegible]

Valve ID	Seismic Risk Significance	IST	Description/Function	Comments/ Basis for Seismic Risk Ranking
DG/DF System:				
DFA-V012 DFB-V019	L	Y	DG F.O. Transfer Pump Discharge Chk Vlv	These valves are required to open (for core damage mitigation) during an extended loss of offsite power with the GTG failed or unavailable. Although a large seismic event could cause an extended loss of off-site power and potentially fail the GTG, the frequency of such an event (approximately 8E-5/yr from Appendix A) is much less than the frequency of an extended loss of offsite power as evaluated in the PVNGS PRA (approximately 1E-3/yr; 0.078/yr * 0.0615 (3-hr non-recovery probability) * 0.2 GTG failure probability. Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance.
DGA-V066 DGA-V067 DGB-V068 DGB-V069	L	Y	Start Air Dryer Discharge Check Valve	Fail to Close - Since these check valves form the boundary between seismic category 1 piping and seismic category 3 piping, there is potentially some incremental risk by extending the IST frequency. However since there are 2 air start receivers per diesel, the DG failure probability is only increased by 1.4E-3 if the test frequency is extended to 6 years (CV-RC 5.4E-7/hr * 3 years * 0.1 assumed Beta), which (when combined with 8E-5, seismic initiating frequency) still indicates a FV and RAW ranking of Low. Therefore these valves are ranked low for seismic risk, however if the test interval is increased to three years it is recommended that the test be staggered such that at least one valve one each DG is tested every 3 years. Fail to Open - As shown in Appendix A, the probability the DGs (and therefore these valves) are required to operate in order to mitigate a non-seismic event is much greater than the probability that they are required to mitigate a seismic event. Therefore the risk importance of these valves (for this mode) should be based upon their importance to the internal events PRA (which is minimal due to redundancy and due to the fact that these valves get tested during DG test starts).
DGA-V317 DGB-V417	L	Y	DG Jkt Wtr Circ Pump Discharge	These components were ranked high risk in Reference 1. As shown in Appendix A, the probability that the DGs are required to operate in order to mitigate a non-seismic event is much greater than the probability that they are required to mitigate a seismic initiated event. Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance.
DGA-V318 DGB-V418	L	Y	Jkt Wtr Htr Discharge	
DGA-V510 DGB-V610	L	Y	Check Valve for Turbo LO Filters	
DGA-V520 DGB-V620	L	Y	DG FO Sply HDR Chk Vlv	
DGA-V355 DGB-V455	L	Y	Spring Loaded Chk Valve at L.O. PP	
DGA-V364 DGB-V464	L	Y	DG L.O. Circ Htr	
DGA-V332 DGB-V432	L	Y	DG F.O. Suction. Strnr Discharge Chk Valve	The probability that the DG is required to mitigate a non-seismic is much greater than the probability that it is required to mitigate a non-seismic event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance.
DGA-V396 DGA-V397 DGB-V496 DGB-V497	L	Y	DG Start Air Chk Vlv	The probability that the DG is required to mitigate a non-seismic is much greater than the probability that it is required to mitigate a non-seismic event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance.

Table 1A - Summary of Valve Seismic Risk Significance Evaluation (All systems except SI and CH which is addressed in Tables C2 and C3)

Valve ID	Seismic Risk Significance	IST	Description/Function	Comments/ Basis for Seismic Risk Ranking
DGA-V523 DGA-V524 DGB-V623 DGB-V624	L	Y	DG Turbo Air Discharge To Start Air Chk Vlv	The probability that the DG is required to mitigate a non-seismic is much greater than the probability that it is required to mitigate a non-seismic event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance.
DGA-UV3 DGB-UV4 DGA-UV5 DGB-UV6 DGA-UV7 DGB-UV8 DGA-UV9 DGB-UV10 DGA-UV11 DGB-UV12 DGA-UV15 DGB-UV16	L	Y	DG Start Air Control Valve	The probability that the DG is required to mitigate a non-seismic is much greater than the probability that it is required to mitigate a non-seismic event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance.
DGA-PSV5 DGB-PSV6 DGA-PSV7 DGB-PSV8	L	Y	DG Start Air Rec Press Safety Valve	The probability that the DG is required to mitigate a non-seismic is much greater than the probability that it is required to mitigate a non-seismic event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance.
DW System:				
DWE-V061 DWE-V062	L	N	Containment Isolation -	System is not required in order to mitigate a seismic initiated event (such as loss of offsite power or small LOCA, therefore it is low risk significant for seismic events. Valves are locked closed during normal operation such that non-seismic piping is not a concern.
EC System:				
ECA-PSV75 ECB-PSV76	L	Y	Expansion Tank Pressure Relief Valves To prevent system over-pressurization in case of volume expansion.	The frequency with which a particular EC train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance. (Also as noted in Reference 1, these relief valves are not required to operate to allow system function to be achieved, they only must not spuriously actuate at system operating pressures and this function is tested during frequent system operational runs).
ECA-PSV95 ECB-PSV96	L	Y	ESF Switchgear Room Essential ACUs (Cooling Coil) Pressure Relief Valves To prevent system over-pressurization in case complete/partial plugging of tubes or inadvertent closure of isolation valve.	The frequency with which a particular EC train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance. (Also as noted in Reference 1, these relief valves are not required to operate to allow system function to be achieved, they only must not spuriously actuate at system operating pressures and this function is tested during frequent system operational runs).

Table 1[illegible]mmary of Valve Seismic Risk Significance Evaluation ([illegible]stems except SI and CH which is addressed in Tables C2 and[illegible]

Valve ID	Seismic Risk Significance	IST	Description/Function	Comments/ Basis for Seismic Risk Ranking
ECA-PSV97 ECB-PSV98	L	Y	Control Room Complex Essential Air Filtration Units (Cooling Coil) Pressure Relief Valves To prevent system over-pressurization in case complete/partial plugging of tubes or inadvertent closure of isolation valve.	The frequency with which a particular EC train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance. (Also as noted in Reference 1, these relief valves are not required to operate to allow system function to be achieved, they only must not spuriously actuate at system operating pressures and this function is tested during frequent system operational runs).
ECA-PSV99 ECB-PSV100	L	Y	Electrical Penetration Room Air Cooling Units (Cooling Coil) Pressure Relief Valves To prevent system over-pressurization in case plugging of tubes or inadvertent closure of isolation valve.	The frequency with which a particular EC train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance. (Also as noted in Reference 1, these relief valves are not required to operate to allow system function to be achieved, they only must not spuriously actuate at system operating pressures and this function is tested during frequent system operational runs).
ECA-PSV101 ECB-PSV102	L	Y	ECW Pump Room Air Cooling Units (Cooling Coil) Pressure Relief Valves To prevent system over-pressurization in case plugging of tubes or inadvertent closure of isolation valve.	The frequency with which a particular EC train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance. (Also as noted in Reference 1, these relief valves are not required to operate to allow system function to be achieved, they only must not spuriously actuate at system operating pressures and this function is tested during frequent system operational runs).
ECA-PSV103 ECB-PSV104	L	Y	CS Pump Room Air Cooling Units (Cooling Coil) Pressure Relief Valves To prevent system over-pressurization in case plugging of tubes or inadvertent closure of isolation valve.	The frequency with which a particular EC train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance. (Also as noted in Reference 1, these relief valves are not required to operate to allow system function to be achieved, they only must not spuriously actuate at system operating pressures and this function is tested during frequent system operational runs).
ECA-PSV105 ECB-PSV106	L	Y	HPSI Pump Room Air Cooling Units (Cooling Coil) Pressure Relief Valves To prevent system over-pressurization in case plugging of tubes or inadvertent closure of isolation valve.	The frequency with which a particular EC train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance. (Also as noted in Reference 1, these relief valves are not required to operate to allow system function to be achieved, they only must not spuriously actuate at system operating pressures and this function is tested during frequent system operational runs).
ECA-PSV107 ECB-PSV108	L	Y	LPSI Pump Room Air Cooling Units (Cooling Coil) Pressure Relief Valves. To prevent system over-pressurization in case plugging of tubes or inadvertent closure of isolation valve.	The frequency with which a particular EC train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance. (Also as noted in Reference 1, these relief valves are not required to operate to allow system function to be achieved, they only must not spuriously actuate at system operating pressures and this function is tested during frequent system operational runs).
ECB-PSV109 ECA-PSV117	L	Y	Auxiliary Feed Water Pump Room Air Cooling Units (Cooling Coil) Pressure Relief Valves To prevent system over-pressurization in case plugging of tubes or inadvertent closure of isolation valve.	The frequency with which a particular EC train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance. (Also as noted in Reference 1, these relief valves are not required to operate to allow system function to be achieved, they only must not spuriously actuate at system operating pressures and this function is tested during frequent system operational runs).

Table 1A - Summary of Valve Seismic Risk Significance Evaluation (All systems except SI and CH which is addressed in Tables C2 and C3)

Valve ID	Seismic Risk Significance	IST	Description/Function	Comments/ Basis for Seismic Risk Ranking
ECB-PSV120 ECA-PSV121	L	Y	DC Equipment Room Air Cooling Units (Cooling Coils) Pressure Relief Valves To prevent system over-pressurization in case plugging of tubes or inadvertent closure of isolation valve	The frequency with which a particular EC train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance. (Also as noted in Reference 1, these relief valves are not required to operate to allow system function to be achieved, they only must not spuriously actuate at system operating pressures and this function is tested during frequent system operational runs).
EW System:				
EWA-UV065 EWA-UV145	L	Y	NC Cross-tie Valve. To allow EW water train A to supply cooling to portions of the NC system.	These valves would be needed to supply ECW to portions of the NCW system following a loss of plant cooling water or a loss of nuclear cooling water pumps. However the NC system is not seismic category 1, therefore ECW cannot be relied upon for this purpose following a major seismic event. Regardless the frequency of a loss of plant cooling water or a loss of nuclear cooling water due to other causes is much greater than the frequency of a seismically caused loss of plant cooling water or nuclear cooling water. The major seismic safety significance of these valves would be to close if they were initially open when a major seismic event occurred requiring isolation to conserve EW inventory. Due to the low probability of this scenario, and the fact that it would affect only one train of ECW and only if the valves were to fail to close, and the fact that the HPSI A and AFW A pumps only have moderate dependence on cooling, the seismic risk significance is ranked low. In the event EW-65 and EW-145 were open at the time of the seismic event, EW-65 and EW-145 would be required to closed. Although the risk significance of these valves was shown to be low since the valves are normally maintained closed in mode 1, this presupposes that the valves will be maintained closed with infrequent exceptions lasting less than 72 hours.
EWA-PSV47 EWB-PSV48 EWA-PSV61 EWB-PSV62 EWA-PSV79 EWB-PSV80 EWA-PSV103 EWB-PSV104 EWA-PSV105 EWB-PSV106	L	Y	SDC HX Safeties, EW Service Water Safeties, EW HX Safeties, EW Surge Tank Safeties	The frequency with which a particular EW train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance. (Also as noted in Reference 1, these relief valves are not required to operate to allow system function to be achieved, they only must not spuriously actuate at system operating pressures and this function is tested during periodic system operational runs).
EWA-HCV41 EWB-HCV42 EWA-HCV53 EWB-HCV54 EWA-HCV005 EWB-HCV006 EWA-HCV135 EWB-HCV136 EWA-HCV071 EWB-HCV072 EWA-V021 EWB-V043 EWA-V022 EWB-V044	L	N	EW to SDCHX Manual Service Valves, EW Pump Suction and Header Isolation Valves, EW HX Inlet Isolation, EW to Essential Chiller Inlet Isolation, EW to Essential Chiller Outlet	These valves are normally open manual valves which are not required to change position for accident mitigation. Therefore they are low risk significant. (Periodic cycling of these valves would not significantly decrease seismic risk, since they are already highly reliable components which are tested by system operational and test demands which verify flow through the valves not by cycling the valve.

Table [illegible]ummary of Valve Seismic Risk Significance Evaluation [illegible]ystems except SI and CH which is addressed in Tables C2 an[illegible]

Valve ID	Seismic Risk Significance	IST	Description/Function	Comments/ Basis for Seismic Risk Ranking
FP System:				
FPE-V089 FPE-V090	L	Y	Containment Isolation	A seismic event would not reasonably be expected to result in a fire inside containment that would threaten any equipment relied upon for event mitigation.
GA System:				
GAE-V011 GAA-UV1	L	Y	High Pressure N2 Containment Isolation Valves	Neither of these valves would be required to operate in order to achieve event mitigation for any event which would potentially be caused by a seismic event (such as a loss of offsite power or a small LOCA). If the valves are maintained closed except to add Nitrogen pressure to the SITs, then the stroke test for both valves could be extended to 6 years. Extending the Appendix J leak test could result in some increased leakage but PRAs (NUREG-1493) have shown minimal risk impact and could be allowed if a NUREG-1493 type analysis is done to support the extension.
GAE-V015 GAA-UV2	M	Y	Low Pressure N2 Sply to RDT (Containment Isolation) Valves	Neither of these valves would be required to operate in order to achieve event mitigation for any event which would potentially be caused by a seismic event (such as a loss of offsite power or a small LOCA). However since the piping is nonseismic and GA-UV002 is normally open it is recommended (per the discussion in Appendix A.3) that the stroke test of these valves not be extended beyond 18 months. Extending the Appendix J leak test could result in some increased leakage but PRAs (NUREG-1493) have shown minimal risk impact and could be allowed if a NUREG-1493 type analysis is done to support the extension.
GR System:				
GRA-UV1 GRB-UV2	L	N	RDT/Gas Surge Header- CTMT Isolation	Neither of these valves would be required to operate in order to achieve event mitigation for any event which would potentially be caused by a seismic event (such as a loss of offsite power or a small LOCA). GR-1 and GR-2 would be required to close/remain closed following a seismically induced core damage event to minimize the radionuclide release from containment. However, considering the low frequency of a seismically induced core damage event, and both the check valve and the solenoid valve UV-2 not closing it is clear that the baseline PVNGS IPE frequency of 4.0E-8/yr (PVNGS IPE, Page 11-170) is not significantly increased if the test interval is increased to 6 years. However it is recommended that the overall impact on the probability of core damage with containment isolation failure be performed (considering both internal and seismic events) before extending the stroke closed test frequency on GR-2 and GR-15 beyond 18 months. Extending the Appendix J leak test could result in some increased leakage but PRAs (NUREG-1493) have shown minimal risk impact.
HC System:				
HCB-UV44 HCA-UV45 HCA-UV46 HCB-UV47	L	N N	RU-1 CTMT Isol Solenoid Valves	None of these valves would be required to operate in order to achieve event mitigation for any event which would potentially be caused by a seismic event (such as a loss of offsite power or a small LOCA). Nor is there any significant impact on the probability of an uncontrolled release since system piping is seismic category 1.
HP System:				

Table 1A - Summary of Valve Seismic Risk Significance Evaluation (All systems except SI and CH which is addressed in Tables C2 and C3)

Valve ID	Seismic Risk Significance	IST	Description/Function	Comments/ Basis for Seismic Risk Ranking
HPA-V002 HPB-V004	L	N	CTMT H2 Cntrl Rtn Line Chk Valve	None of these valves would be required to operate in order to achieve event mitigation for any event which would potentially be caused by a seismic event (such as a loss of offsite power or a small LOCA). Also since the Hydrogen Analyzer, Hydrogen Recombiners and Attached piping is category 1 and the piping is normally isolated the frequency of a uncontrolled release would not be increased, if the test frequency were extended. There would be some impact on the reliability to the Hydrogen analyzers and Hydrogen Recombiners which should be considered prior to extending the test interval.
HPA-HV7A HPB-HV8A	L	N	CTMT Post-LOCA H2 Monitor Inlet Sol Valve	
HPA-HV7B HPB-HV8B	L	N	CTMT Post-LOCA H2 Monitor Outlet Sol Valve	
HPA-UV1 HPB-UV2	L	N	CTMT H2 Control Upstream Supply Isolation	None of these valves would be required to operate in order to achieve event mitigation for any event which would potentially be caused by a seismic event (such as a loss of offsite power or a small LOCA). Also since the Hydrogen Analyzer, Hydrogen Recombiners and Attached piping is category 1 and the piping is normally isolated the frequency of a uncontrolled release would not be increased, if the test frequency were extended. There would be some impact on the reliability to the Hydrogen analyzers and Hydrogen Recombiners which should be considered prior to extending the test interval.
HPA-UV3 HPB-UV4	L	N	CTMT H2 Control Downstream Supply Isolation	
HPA-UV5 HPB-UV6	L	N	CTMT H2 Control Return Isolation	
HPA-UV23	L	N	CTMT H2 Return Isolation from PASS	
HPA-UV24	L	N	CTMT H2 Supply Isolation to PASS	
IA System:				
IAE-V021 IAA-UV2	L M	Y	CTMT Isolation Air Supply Check Valve CTNTMT Isolation Inst Air Isolation (SOV)	Neither of these valves would be required to operate in order to achieve event mitigation for any event which would potentially be caused by a seismic event (such as a loss of offsite power or a small LOCA). However, as shown in Appendix A, extending the test interval of these valves could affect the frequency of a core damage event with failure of containment isolation (if all non seismic category 1 piping is assumed to rupture due to the seismic event). Therefore it is recommended that the stroke test on IAA-UV2 remain at every 18 months).
IAE-V072 IAE-V073	L	Y	Service Air CTMT Isol West PPR	Neither of these valves would be required to operate in order to achieve event mitigation for any event which would potentially be caused by a seismic event (such as a loss of offsite power or a small LOCA). Also since V072 is locked closed (per 73DP-9XI01) there is no significant potential for a breach of containment via this line.
NC System:				
NCE-V118 NCB-UV401 NCA-UV402 NCB-UV403	L M M M	Y Y	Chk Valve in NCW supply to Containment (NCE-V118) NCW Containment Isolation MOV NCW Containment Isolation MOV NCW Containment Isolation MOV	None of these valves would be required to operate in order to achieve event mitigation for any event which would potentially be caused by a seismic event (such as a loss of offsite power or a small LOCA). However, as shown in appendix A, extending the test interval of these valves could affect the frequency of a core damage event with failure of containment isolation (if all non seismic category 1 piping is assumed to rupture due to the seismic event). Therefore it is recommended that the stroke test on the NC containment isolation valves remain at every 18 months).
NCA-PSV250 NCB-PSV251	L	Y	Fuel Pool HT Ex A NCWS Relief	Neither of these valves would be required to operate in order to achieve event mitigation for any event which would potentially be caused by a seismic event (such as a loss of offsite power or a small LOCA).
PC System:				
PCE-V070 PCE-V071	L		Fuel Pool Cleanup Suction CTMT Isol	These valves are manual valves which are locked closed during normal power operations and are not required to operate to achieve event mitigation for any event which would potentially be caused by a seismic event (such as a loss of offsite power or a small LOCA). Extending the Appendix J leak test could result in some increased leakage but PRAs (NUREG-1493) have shown minimal risk impact.
PCE-V075 PCE-V076	L		Fuel Pool Cleanup Rtn CTMT Isol	

Table [illegible] ummary of Valve Seismic Risk Significance Evaluation ([illegible] stems except SI and CH which is addressed in Tables C2 and [illegible]

Valve ID	Seismic Risk Significance	IST	Description/Function	Comments/ Basis for Seismic Risk Ranking
PCN-V215	L		SFP to BAMP Isolation Valve	This valve would not be required to operate in order to achieve event mitigation for any event which would potentially be caused by a seismic event (such as a loss of offsite power or a small LOCA).
PCA-PSV35 PCB-PSV36	L		Pressure Relief PC Hx	Neither of these valves would be required to operate in order to achieve event mitigation for any event which would potentially be caused by a seismic event (such as a loss of offsite power or a small LOCA).
RD System:				
RDA-UV23 RDB-UV24	L	M	CTMT Isol Valve from Rad Sump Pumps	The only required function of these valves following a seismic initiated event would be to close to achieve containment isolation. The effect on success of containment isolation is similar to NC-402 and NC-403 and therefore it is recommended that the test interval not be extended beyond 18 months on these valves. Extending the Appendix J leak test could result in some increased leakage but PRAs (NUREG-1493) have shown minimal risk impact.
RDB-UV407	Not Mod.	Y	CTMT Radwaste Sump Pumps Discharge for PASS	The valve would not be required to operate to achieve event mitigation nor for to achieve containment isolation for any event which would be caused by a seismic event (such as loss of offsite power or a LOCA)
SP system				
SPB-V012 SPA-V041	L	Y	Check Valve Discharge Side ESP Pump Pump Discharge Check Valve. Flow/Pressure Control such that SP System operates at its designed pressure and flow.	The frequency with which a particular SP train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance.
SPA-HV49A SPB-HV50A	L	Y	SP Inlet Isol Valve Spray Header Valve Normally open valves. Allow SP flow to spray nozzles for heat rejection to atmosphere.	The frequency with which a particular SP train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance.
SPA-HV49B SPB-HV50B	L	Y	SP Inlet Spray By-pass Spray Header Bypass Valve HV-49B/50B are normally closed; HV-50B/49B may be opened (and HV-50A/49A closed) to bypass the spray nozzles.	The frequency with which a particular SP train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance.
SPE-HCV-207 SPE-HCV-208	L	Y	Spray Pond Cross-Connect Spray Pond Cross Tie Valves. To provide isolation between spray ponds A and B when both SP trains are operating. During single train operation, allows both volumes of pond water to be available for long term cooling.	Neither of these valves would be required to operate to mitigate a seismically initiated event such as a loss of offsite power.

Table 1A - Summary of Valve Seismic Risk Significance Evaluation (All systems except SI and CH which is addressed in Tables C2 and C3)

Valve ID	Seismic Risk Significance	IST	Description/Function	Comments/ Basis for Seismic Risk Ranking
SPA-PSV29 SPB-PSV30	L	Y	Essential Cooling Water Heat Exchanger Tube Side Thermal Relief	None of these valves would be required to operate in order to mitigate a seismically initiated event such as a loss of offsite power.
SPA-PSV137 SPB-PSV144	L	Y	Fuel Oil Cooler Thermal Relief	
SPA-PSV139 SPB-PSV142	L	Y	Diesel Generator Jacket Water Cooler Thermal Relief	
SPB-PSV138 SPA-PSV143	L	Y	Lube Oil Cooler Thermal Relief	
SPB-PSV140 SPA-PSV141	L	Y	Air Intercooler Thermal Relief	
SPA-HCV125 SPB-HCV126 SPA-HCV-127 SPB-HCV128 SPA-HCV133 SPB-HCV134 SPA-HCV135 SPB-HCV136	L	N	Diesel Generator Jacket Water and Lube Oil Cooler Manual Isolation Valves. Diesel Generator Jacket Water and Lube Oil Cooler Heat Exchanger Isolation	These valves are locked open valves and are required to remain open (and unplugged) to allow sufficient cooling to the DGs. Sufficient flo3w through these valves is effectively tested during DG testing and no additional testing is warranted as a result of any seismic risk concerns.
SPA-HCV045 SPB-HCV046 SPA-HCV047 SPB-HCV048	L	N	Essential Cooling Water Heat Exchanger Manual Isolation Valves	Low risk significant as valves are normally locked open and only closed for maintenance. The frequency with which a particular SP/EW train is required in order to mitigate a seismically initiated event is much less than the frequency with which it would be required to mitigate a non-seismically initiated event (Appendix A). Therefore it is appropriate to base the risk ranking for these valves on the PRA (Internal events) importance.
SS System:				
SSB-UV200 SSA-UV203	L	Y	Hot Leg Sample CTMT Isol	These valves are not required to operate in order to mitigate a seismically initiated event such as a loss of offsite power.
SSB-UV201 SSA-UV204	L	Y	Press Surge Sample CTMT Isol	These valves are not required to operate in order to mitigate a seismically initiated event such as a loss of offsite power.
SSB-UV202 SSA-UV205	L	Y	Press S/S Sample CTMT Isol	These valves are not required to operate in order to mitigate a seismically initiated event such as a loss of offsite power.
WC System:				
WCE-V039	L	Y	Check Valve Inlet to CTMT Isol at U060	If it is conservatively assumed that all non-seismic piping fails during the seismic event then these valves are important to maintain containment isolation following a seismically induced core damage event (see appendix A). Therefore it is recommended that the stroke tests for the MOVs not be extended beyond 18 months.
WCB-UV61 WCA-UV62	M M	Y	CHW Return CTMT Isol	
WCB-UV63	M	Y	Norm CHW Sup CTMT Isol	

Table 1B - Summary of SI Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
SIA-V105 SIB-V104	L	N	Y	CS Pump suction manual valves	These locked open MOVs are adequately tested by the quarterly pump test. Additional stroking of these valves would not significantly reduce seismic risk (since failure of these valves to fail to remain open is a small contributor to overall core damage.
SIE-V113 SIE-V123 SIE-V133 SIE-V143	L	Y	Y	Discharge HPSI To Reactor Coolant Loops Containment isolation. Prevents reverse flow and provides isolation during SDC operation. Open to allow HPSI flow.	The frequency with which these valves are required to either open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIE-V114 SIE-V124 SIE-V134 SIE-V144	L	Y	Y	Discharge LPSI To Reactor Coolant Loops Containment isolation. Prevents pressurization of low pressure header during HPSI operation. Open to allow LPSI or SDC Flow.	The frequency with which these valves are required to either open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-V157 SIB-V158	L	Y	Y	Check Valve on Suction Side of CS Pump Prevent reverse flow during normal shutdown cooling or pump maintenance. Open to allow suction path for CS flow.	The frequency with which these valves are required to either open in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-V164 SIB-V165	L	Y	Y	CTMT Isol Check Valve at Pen U021 Containment isolation. Prevent reverse drainage of containment spray header. Open to allow containment spray flow.	The frequency with which these valves are required to open in order to mitigate a non-seismically initiated event is much greater than the frequency with which it is required to open to mitigate a seismically initiated event (See Appendix A). Extending the Appendix J leak test could result in some increased leakage but PRAs (NUREG-1493) have shown minimal risk impact.
SIA-V201 SIB-V200	L	Y	Y	LPSI Pump 1 Suction Check Valve Prevent reverse flow during shutdown cooling and pump maintenance. Open to allow LPSI flow.	The frequency with which these valves are required to either open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA. In order to support SDC operation closure of this valve is not required since the associated MOV is closed and CH-305/306 also prevent back-flow to the RWT).
SIA-V205 SIB-V206	L	Y	Y	Containment Recirculation Sump Screen Prevent reverse flow of RWT to sump. Open to allow SI flow from the containment sump.	The frequency with which these valves are required to either open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIE-V215 SIE-V225 SIE-V235 SIE-V245	L	Y	Y	SI Tank Discharge Check Valve Isolate the SITs from the RCS when RCS pressure is above SIT pressure during heat-up, shutdown and normal operating conditions. Open to allow SIT flow.	The frequency with which these valves are required to either open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIE-V217 SIE-V227 SIE-V237 SIE-V247	L	Y	Y	Combined ECCS/SIT To Reactor Coolant Isolate the SIS from the RCS when RCS pressure is above SIS pressure during heat-up, shutdown and normal operating conditions. Open to allow SIT, LPSI, HPSI, and/or SDC flow.	The frequency with which these valves are required to either open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.

Table 1B - Summary of SI Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
SIA-V470 SIB-V402	L	N	Y	HPSI Pump manual suction	These locked open manual valves are adequately tested by the quarterly pump test. Additional stroking of these valves would not significantly reduce seismic risk (since failure of these valves to fail to remain open is a small contributor to overall core damage.
SIA-V404 SIB-V405	L	Y	Y	HPSI Pump Discharge Check Valve Prevent reverse flow during pump maintenance and check valve testing (via charging pumps). Open to allow HPSI flow.	The frequency with which these valves are required to either open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-V424 SIB-V426	L	Y	N	Check Valve on HPSI Recirc Prevent reverse flow during LPSI and CS pump testing and shutdown cooling operation. (This assures double valve isolation of potential flow paths to the RWT.) Open to provide mini-flow protection for the HPSI pumps.	The frequency with which these valves are required to either open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-V434 SIB-V446	L	Y	Y	LPSI Pump 1 Discharge Check Valve Prevent reverse flow during pump maintenance and potential over-pressurization due to transient thermal effects. Open to provide LPSI or shutdown cooling flow.	The frequency with which these valves are required to either open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-V435 SIB-V447	L	N	Y	LPSI Pump Discharge	The frequency with which these valves are required to either open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA. (These valves have some impact on SDC reliability; However since the CS pump can backup the LPSI pump for SDC and since normal shutdown operation checks the valve at an acceptable periodicity no additional testing of this valve is required to ensure acceptable SDC reliability).
SIA-V451 SIB-V448	L	Y	Y	Check Valve on LPSI Recirc Prevent reverse flow during HPSI and CS pump testing. Open to provide mini-flow protection for the LPSI pumps.	The frequency with which these valves are required to either open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIE-V463	L	Y	N	SIT to RWT outboard isolation.	Low Risk Significant as valve is normally closed, and is not required to open to mitigate a seismically initiated event such as a small LOCA or a loss of offsite power.
SIA-V476 SIB-V478	L	N	Y	HPSI Pump Discharge manual valves	The frequency with which these locked open valves are required to remain open in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-V485 SIB-V484	L	Y	N	CS Pump Discharge Check Valve Prevent reverse flow during pump maintenance and potential over-pressurization due to transient thermal effects. Open to allow CS pump flow.	The frequency with which these valves are required to open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.

Table 1B - Summary of SI Valve S[illegible]c Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
SIA-V486 SIB-V487	L	Y	Y	Check Valve on CS Recirc Prevent reverse flow during LPSI and HPSI pump and shutdown cooling operations. Open to provide mini-flow protection for the CS Pumps.	The frequency with which these valves are required to open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-V522 SIB-V532	L	Y	Y	HLI Check Valve Prevent reverse flow during normal RC and shutdown cooling operations. Open to allow hot leg injection flow.	The frequency with which these valves are required to open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-V523 SIB-V533	L	Y	Y	HLI Check Valve Prevent reverse flow during normal RC and shutdown cooling operations. Open to allow hot leg injection flow. Containment Isolation.	The frequency with which these valves are required to open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIE-V540 SIE-V541 SIE-V542 SIE-V543	L	Y	Y	Discharge HPSI/LPSI Discharge to Reactor Coolant Loop (Class boundary) Prevent reverse flow for SIS-RCS isolation. Open to provide HPSI, LPSI and/or SDC flow.	The frequency with which these valves are required to open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-V957 SIB-V958	L	N	Y	HLI valve	The frequency with which these valves are required to open or remain open in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-HV306 SIB-HV307	M	Y	Y	LPSI Hdr Discharge Isol Throttled as necessary during SDC operation to maintain RCS cooldown rates.	The frequency with which these valves are required to remain open in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA. Since closure of these valves is necessary to facilitate SDC operation it is recommended that the test frequency of these valves not be extended beyond 18 months without additional justification (Appendix A.7).
SIA-HV604 SIB-HV609	L	Y	Y	HPSI Long Term Recirc Isol Open for Long Term Cooling.	The frequency with which these valves are required to open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIC-HV321 SID-HV331	L	Y	Y	HPSI Long Term Recirc Cntmt Isol Opened for hot leg injection during long term recirculation. Containment Isolation.	The frequency with which these valves are required to open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.

Table 1B - Summary of SI Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
SIA-HV605 SIA-HV606 SIA-HV607 SIA-HV608 SIB-HV613 SIB-HV623 SIB-HV633 SIB-HV643	L	Y	N	SI TanK Vent Open to allow SITs to be depressurized during cool-downs.	At least one of two SIT valves on each SIT is required to open to establish SDC per 40OP-9ZZ10 if the seismic event were to result in an extended loss of offsite power. (However if necessary failure of both valves on a single SIT could be compensated by closing the SIT outlet valve). At least one valve is tested per SIT per refueling outage which is sufficient to maintain adequate reliability. The frequency of requiring SDC (greater than 0.027 per year just for SGTR in the internal events PRA is much greater than requiring SDC in response to a seismic event, (approximately 8E-5/yr for seismic event causing an extended loss of offsite power). Therefore it is appropriate to base the importance of these valves on their importance to the internal events PRA.
SIA-HV657 SIB-HV658	M	Y	Y	SDC Temp Control Throttled open for SDC initiation.	These valves affect the reliability of SDC. Therefore they are ranked M for seismic risk and it is recommended that the test frequency not be extended beyond 18 months without additional justification (Appendix A.7).
SIA-HV683 SIB-HV692	L	N	Y	LPSI Pump Isol Close to initiate SDC.	The frequency with which these valves are required to remain open in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA. (Although these valves are closed to facilitate SDC, failure of the valve to close would not prevent SDC operation since there are check valves to prevent diversion of SDC flow; Therefore normal shutdown operation is sufficient to maintain adequate reliability of this valve relative to its seismic risk importance).
SIA-HV678 SIB-HV679 SIA-HV684 SIB-HV689	L	N	Y	SDC HE Isol Throttle augment LPSI Train with CS pump flow.	These valves are normally open and only required to remain open for CS function. As such it is appropriate to rank these components based on their importance to the internal events PRA (see Appendix A). (Failure of one or both of these valves to close on a train of SDC would not prevent SDC operation).
SIA-HV685 SIB-HV694	M	Y	Y	LPSI Cross Connect To SDCHE Open to initiate SDC.	These valves are required to open to align the LPSI pumps to the SDC HX. Since this valve is used to provide the primary SDC path and SDC reliability affects seismic risk (Appendix A.7), it is recommended that the IST test for these valves not be extended beyond 1 year without additional justification.
SIA-HV686 SIB-HV696	M	Y	Y	SDC HX to RCS Supply Open to initiate SDC.	These valves are required to open to align SDC. They are rated as Medium Risk based on the discussion in Appendix A.7.
SIA-HV687 SIB-HV695	L	N	Y	CS Isol from spray header Closed for initiation of SDC.	The valve is normally open and although it is closed to establish SDC, failure of the valve to close would not prevent the affected SDC train from operating. Operation of the valve from normal shutdown operation is sufficient to maintain SDC seismic risk at acceptable levels.
SIA-HV688 SIB-HV693	L	Y	N	SDC HE A Bypass Open to assure CS flow capability down to 200F during Shutdown Cooling.	The valve is normally closed and is not required to open to mitigate any event which would be caused by a seismic event such as a loss of offsite power or small LOCA.
SIA-HV691 SIB-HV690	M	Y	Y	Shutdown Cooling Warm-up Bypass Ctmt Isol Opened for SDC initiation. Containment Isolation.	These valves are operated for successful SDC. They are rated as Medium Risk based on the discussion in Appendix A.7.
SIA-HV698 SIB-HV699	L	Y	Y	HPSI Pump Cold Leg Injection Isolation Required to equalize hot leg and cold leg flow following (some) LOCAs.	The frequency with which these valves are required to close or remain open in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.

Table 1B - Summary of SI Valve Se[illegible]Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
SIB-UV322 SIB-UV332	L	Y	N	Hot Leg Inj Chk Valve Leakoff Isol Open to allow drain off of RCS leakage to RDT accumulating past first SI header check valve.	Low Risk Significant as valve is not required to operate to mitigate an event which would be expected to result from a seismic event such as a loss of offsite power or a small LOCA.
SIB-UV611 SIB-UV621 SIB-UV631 SIB-UV641	L	Y	N	SIT Fill and Drain Isol Open to allow filling and draining of SIT liquid water inventory. Closed to assure SIT integrity assuming of LOCA during SIT fill & drain.	Valves are normally closed and are not required to operate in order to mitigate an event which would be caused by a seismic event such as a loss of offsite power or small LOCA.
SIA-UV634 SIA-UV644 SIB-UV614 SIB-UV624	M	Y	Y	SIT Tank Isol Discharge	Medium risk as valves are required to be closed in order to establish SDC (Appendix A.7).
SIA-UV635 SIA-UV645 SIB-UV615 SIB-UV625	L	Y	Y	LPSI Discharge Hdr Ctmt Isol Vlv Throttled open for SDCS warm-up during SDC initiation. Open for LPSI LOCA flow. Containment Isolation.	The frequency with which these valves are required to open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-UV617 SIB-UV616 SIA-UV627 SIB-UV626 SIA-UV637 SIB-UV636 SIA-UV647 SIB-UV646	L	Y	Y	HPSI Discharge Hdr Ctmt Isol Vlv Required to open on SIAS to provide SI path to the RCS. Provide throttling capability during injection mode of operation and during long-term recirculation. Containment Isolation.	The frequency with which these valves are required to open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIB-UV618 SIB-UV628 SIB-UV638 SIB-UV648	L	Y	N	SI Loop Drain Allows drain off of RCS leakage to RDT accumulating past first SI header check valve. Close to assure SIT integrity for LOCA postulated during bleed-off options.	Valves are normally closed and are not required to operate in order to mitigate an event which would be caused by a seismic event such as a loss of offsite power or small LOCA. The frequency with which these valves are required to close or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-UV651 SIB-UV652	M	Y	Y	Shutdown Cooling Suction Isol Vlv Open to initiate SDC and/or LTOP. Close to isolate RCS from SIS.	These valves are operated for successful SDC. They are rated as Medium Risk based on the discussion in Appendix A.7.
SIA-UV655 SIB-UV656 SIC-UV653 SID-UV654	M	Y	Y	Shutdown Cooling Suction Ctmt Isol Vlv Open to initiate SDC. Close to isolate RCS from SIS. Containment Isolation.	These valves are operated for successful SDC. They are rated as Medium Risk based on the discussion in Appendix A.7.

Table 1B - Summary of SI Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
SIA-UV660 SIB-UV659	L	Y	Y	Combined ECCS Recirc to RWT Close on RAS to preclude flow of water to the RWT. Close on initiation of shutdown cooling to preclude flow of water to the RWT.	The frequency with which these valves are required to close or remain open in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to close or remain open in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-UV664 SIB-UV665	L	Y	Y	CS Pump Recirc to RWT Close on RAS to preclude flow of water to the RWT. Close on initiation of shutdown cooling to preclude flow to the RWT.	The frequency with which these valves are required to close or remain open in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to close or remain open in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-UV666 SIB-UV667	L	Y	N	HPSI Pump Recirc to RWT Isol Close on RAS to preclude flow of water to the RWT.	The frequency with which these valves are required to close or remain open in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to close or remain open in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-UV669 SIB-UV668	L	Y	Y	LPSI Pump Recirc to RWT Isol Close on initiation of shutdown cooling. Note that valve also closes on RAS even though LPSIs are off during recirculation mode. This conservative design feature precludes flow to the RWT if the LPSI fails "on".	The frequency with which these valves are required to close or remain open in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to close or remain open in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-UV672 SIB-UV671	L	Y	Y	Ctmt Spray Control Vlv Open on CSAS to provide containment spray. Containment Isolation.	The frequency with which these valves are required to open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-UV673 SIA-UV674 SIB-UV675 SIB-UV676	L	Y	Y	Butterfly Containment Sump Isolation Opens on RAS to provide sump recirculation. Containment Isolation.	The frequency with which these valves are required to open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
SIA-UV682	L	Y	N	SIT Fill and Drain Hdr CTMT Isol Open to allow filling and draining of SIT liquid water inventory. Close to assure SIT integrity for LOCA postulated during SIT fill and drain. Containment Isolation.	Low Risk Significant as valves are normally closed and are not required to operate to mitigate a seismic event such a s a loss of offsite power or a small LOCA.
SIA-UV708	M	Y	N	Recirc Sump A for PASS Open to allow PASS operations. Close for Containment Isolation.	PASS Piping is seismic category 3, and this valve is a containment Isolation Valve. Therefore it is recommended that the test interval for this valve be maintained at less than or equal to 18 months.

Table 1B - Summary of SI Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
SIA-UV709 SIB-UV710	L	Y	N	HPSI Pump for PASS Open to allow PASS operations. Close on SIAS to preclude diversion of SI minimum flow.	Low Risk Significant as valves are normally closed and are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA
SIA-PSV151 SIB-PSV140	L	Y	N	CTMT Recirc Sump Relief Open to provide system overpressure protection. Containment Isolation.	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA
SIA-PSV150 SIB-PSV141	L	Y	N	PSV Fuel Pool Clg to EDT Open to provide system overpressure protection.	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA
SIA-PSV161 SIA-PSV162 SIB-PSV192 SIB-PSV193	L	Y	N	PSV LPSI to Fuel Pool Clg Open to provide system overpressure protection.	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA. (Normal shutdown operation is sufficient to verify that valves do not open at SDC operating pressures).
SIA-PSV468 SIB-PSV166	L	Y	Y	PSV HPSI Pump LTC Open to provide system overpressure protection.	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA
SIA-PSV469 SIB-PSV169	L	Y	N	PSV SDC Open to provide system overpressure protection. Containment Isolation.	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA
SIA-PSV179 SIB-PSV189	L	Y	N	Relief Pressure Shutdown Cooling Open to provide system overpressure protection. Open to provide RCS LTOP. Containment Isolation	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA.
SIA-PSV194 SIB-PSV191	L	Y	N	PSV SDC HE Out to EDT Open to provide system overpressure protection.	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA. (Normal shutdown operation is sufficient to verify that valves do not open at SDC operating pressures).
SIE-PSV211 SIE-PSV221 SIE-PSV231 SIE-PSV241	L	Y	N	PSV SI Tank Open to provide system overpressure protection.	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA.
SIA-PSV285 SIB-PSV286	L	Y	N	PSV Recirc Thermal Relief Open to provide system overpressure protection.	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA.
SIA-PSV289 SIB-PSV287	L	Y	N	PSV SDC Recirc Thermal Relief Open to provide system overpressure protection	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA.

Table 1B - Summary of SI Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
SIE-PSV288	L	Y	N	PSV SI Drain Hdr to EDT Open to provide system overpressure protection.	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA.
SIE-PSV407	L	Y	N	SIT Fill and Drain Hdr Relief to EDT - Outside CTMT Open to provide system overpressure protection.	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA.
SIA-PSV417 SIB-PSV409	L	Y	Y	PSV Therm Relief to EDT Open to provide system overpressure protection.	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA.
SIA-PSV439 SIB-PSV449	L	Y	N	PSV LPSI Therm Relief to EDT Open to provide system overpressure protection.	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA. (Normal shutdown operation is sufficient to verify that valves do not open at SDC operating pressures).
SIE-PSV473	L	Y	N	SIT Fill and Drain Hdr Relief to RDT - Inside CTMT Open to provide system overpressure protection.	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA.
SIE-PSV474	L	Y	N	PSV SI Drain to RDT Open to provide system overpressure protection. Containment Isolation.	Low Risk Significant as valves are not required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA.

Table 1C - Summary of CH Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
CHB-V305 CHA-V306	L	Y	Y	Refueling Water Tank And Safety Injection Pumps	The frequency with which these valves are required to open or remain closed in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to open or remain closed in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
CHE-V429 CHE-VM70	M	Y	N	Charging Pumps To Regenerative Heat exchanger Line	Valves required to reopen following the seismic event to ensure Auxiliary Pressurizer Spray availability (See Appendix A.7).

Table 1C - Summary of CH Valve S[illegible]c Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
CHE-V431	M	Y	N	APSS Injection Check Valve	Valve ranked as medium risk per Appendix A.7 as it is required to open to establish Auxiliary Pressurizer Spray. (The valve is required to open to initiate APS flow and has a failure probability of less than 1E-3 based on current 18 month test and generic failure rates).
CHE-V435	M	Y	N	Spring Cooled Regenerative Heat Exchanger Charging Line To RC Loop 2A HV-239	Valve ranked as medium risk as failure of the valve could result in inadequate back-pressure for Auxiliary Pressurizer spray (Appendix A.7).
CHB-HV203 CHA-HV205	M	Y	Y	Auxiliary Pressurizer Spray Valves	Valves ranked as medium risk valves. The accident sequence seismically induced loss of offsite power with both APSS valves failed with a 4.2E-6 failure rate (NUREG/CR-2770) and a Beta of 0.07 from PLG-0500 results in a sequence frequency 0f 7.7E-8/yr which would increase by a factor of four if test frequency was extended to 6 years. Intangible factors for conservative ranking is industry experience with solenoid valves and previous issues with Auxiliary Pressurizer Spray reliability.
CHE-HV239 CHE-PDV240	M	Y	Y	Close to Assure Flow to APS	Situation is similar to APSS valves above. Failure of both valves to close could result in inadequate APSS flow. Situation is marginal bit conservative ranking was selected based on intangible reasons above.
CHB-HV530 CHA-HV531	L	Y	Y	RWT Supply Valves to ECCS Trains	The frequency with which these valves are required to close or remain open in order to mitigate non-seismically initiated events is much greater than the frequency that they would be required to close or remain open in order to mitigate a seismically initiated event (See Appendix A). Therefore it is appropriate to base the risk significance of these valves based on their importance to the internal events PRA.
CHE-HV536	H	Y	N	Isolation For Refueling Water Tank Gravity Feed Line To Charging Pumps	Valve is High risk significant for seismic importance per discussion in Appendix A.7. If manual operation of the valve were considered, it could be argued that valves are medium risk. however due to the desirability of maintaining remote control of these valves, and previous charging pump problems with gas binding the high ranking is judged appropriate.
CHN-UV501	H	Y	N	For Volume Control Tank Outlet Line	Valve is High risk significant for seismic importance per discussion in Appendix A.7. If manual operation of the valve were considered, it could be argued that valves are medium risk. however due to the desirability of maintaining remote control of these valves, and previous charging pump problems with gas binding the high ranking is judged appropriate.
CHB-V327	M	Y	N	Charging pump common isolation valves from SI train B suction line (normally closed valve)	Conservatively assuming that the normal suction path via 536 is inadequate due to depletion of RWT inventory this valve would be required to open to maintain a suction source for the charging pumps and APSS. since APSS availability is potentially affected, this valve was ranked as medium risk per Appendix A.7.
CHAV177	L	Y	N	Boric Acid Makeup Check Valve to VCT Outlet	Since Boric Acid Makeup Pumps do not have power following a seismically induced loss of offsite power, the reliability of this valve negligibly impacts seismic risk.
CHAV190	M	Y	N	RWT to VCT Line Check Valve	Valve is medium risk to seismic risk importance per discussion in Appendix A.7. The valve is required to open to maintain the normal CH-536 RWT suction source to Auxiliary Pressurizer Spray. (Although the alternate supply CHB-V327 could be manually aligned it is highly desirable to maintain remote control of the charging pump suction in the first hours of the loss of offsite power event to avoid gas binding the charging pumps). Since failure of the valve could result in unavailability of APSS, the valve was ranked as Medium risk.

Table 1C - Summary of CH Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
CHAV316 CHBV319 CHEV322	L	Y	N	Charging Pump suction isolation valve	These valves would not be expected to be required to operate to mitigate a seismically initiated event such a s a loss of offsite power or a small LOCA.
CHAV328 CHBV331 CHEV334	L	Y	N	Charging Pump Discharge Check Valve	These valves would not be expected to be required to operate to mitigate a seismically initiated event such a s a loss of offsite power or a small LOCA.
CHAV755 CHBV756 CHEV757	L	Y	N	Charging Pump Alternate suction isolation valve	Low Risk Significance due to separate supplies to each charging pump. Failure of 1 valve to close to align suction source from SI does not disable other pumps.
CHEV433	L	Y	N	Charging Line to RCS	Low Risk Significance as function of valve does not impact APSS, and funct6ion of the valve to open/ remain open is continuously tested during normal power operation.
CHAHV524	L	Y	N	Charging line Isolation Containment Isolation Valve	Low Risk Significance due to power disabled with valve in the open position.and normal charging flow provides adequate verification that the valve is open.
CHAPSV315 CHBPSV318 CHEPSV321	L	Y	N	Charging Pump Suction Pressure Relief Valve	Low seismic risk significance as valves would not be required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA.
CHAPCV326 CHBPSV325 CHEPSV324	L	Y	N	Charging Pump Discharge Pressure Relief Valve	Low seismic risk significance as valves would not be required to operate to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA.
CHAUV506 CHBUV505	L	Y	N	Reactor Coolant Seal Bleed-off Containment Isolation Valve	Low risk significance as function of valve does not impact APSS.
CHAUV516 CHBUV515 CHBUV523	M	Y	N	Letdown Isolation Valve	Although piping is seismic category 1 and unlikely to fail due to a seismic event the consequences of a break of this piping with failure of the letdown isolation valves is large (potential core damage with containment bypass). Therefore it probably is not desirable to extend the test frequency of these valves beyond a refueling outage.
CHAUV560 CHBUV561	L	Y	N	Reactor Drain Tank Outlet Isolation Valve	Associated piping is seismic category 1 therefore any reliability based testing requirements are driven by internal events not seismic events.
CHAUV580	M	Y	N	Reactor Makeup Water to RDT Containment Isolation Valve	This is a containment isolation valve that isolates non-seismic category 1 piping therefore it is recommended that the test interval not be extended beyond 18 months.
CHAUV715	M	Y	N	PASS Containment Isolation Valve	PASS is seismic category 3 and this valve serves a containment isolation function. Therefore it is recommended that the test interval not be extended beyond 18 months.
CHBHV255	L	Y	N	RCP Seal Injection Containment Isolation Valve	Charging/ Seal Injection piping is seismic category 1 therefore any risk based testing requirements are driven by internal events not seismic events.
CHNV835	L	Y	N	RCP Seal Injection Supply Line Check Valve	Charging/ Seal Injection piping is seismic category 1 therefore any reliability based testing requirements are driven by internal events not seismic events.
CHBUV924	M	Y	N	Letdown to PASS Isolation Valve	This is a containment isolation valve which isolates non-seismic category 1 piping. Therefore it is recommended that the test interval not be extended to more than every 18 months.
CHNPSV115	L	Y	N	VCT Outlet Pressure Relief Valve	Valve is not required to operate to mitigate a seismically initiated event such a s a loss of offsite power or a small LOCA.

Table 1C - Summary of CH Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
CHNPSV199	M	Y	N	Valve Relief for Reactor Coolant Pump Containment	Valve could be required to operate during an extended loss of offsite power. Therefore extending the test interval of this valve may not be desirable without evaluating the effects of PSV failure on accident mitigation.
CHNPSV345 CHNPSV354	L	Y	N	Intermediate Letdown Pressure Relief Valve	These valves are much more likely to be required to operate to mitigate a non-seismically initiated event rather than a seismically initiated event. Therefore it is appropriate to rank their importance based on their effects to the internal events PRA.
CHNPSV865	L	Y	N	Seal Injection Heat Exch Pressure Relief Valve	This valves is much more likely to be required to operate to mitigate a non-seismically initiated event rather than a seismically initiated event. Therefore it is appropriate to rank their importance based on their effects to the internal events PRA.
CHNUV514	L	Y	N	Boric Acid Makeup Line Isolation Valve	The reliability of this valve does not significantly effect seismic risk as this flow path relies on pumps which are powered by non-class power.
CHEV440	L	Y	N	Charging Pump Discharge to HPSI Cross-Connect Check Valve	Operation of this valve is not required in order to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA.
CHEV854	L	Y	N	Charging Line Chemical Addition Isolation Valve	Operation of this valve is not required in order to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA.
CHNV118	L	Y	N	VCT Outlet Check Valve	This valves is much more likely to be required to operate to mitigate a non-seismically initiated event rather than a seismically initiated event. Therefore it is appropriate to rank their importance based on their effects to the internal events PRA.
CHNV144	L	Y	N	Manual Isolation Valve from RWT to Spent Fuel Pool Cleanup Pumps	Operation of this valve is not required in order to mitigate a seismically initiated event such as a loss of offsite power or a small LOCA.
CHNV154 CHNV155 CHNV164	L	Y	N	Boric Acid Makeup Pump Discharge Check Valve Boric Acid Makeup Pump Discharge Check Valve Boric Acid Makeup Filter Bypass Valve	The reliability of these valves has minimal impact to seismic risk as the associated pumps are non-class powered and cannot be relied upon to mitigate a seismic event.
CHNV494	L	Y	N	Reactor Makeup Water Supply Check Valve to RDT	This is a normally closed containment check valve in the makeup line to the RDT (used infrequently to maintain RDT level). As long as the outside containment isolation valves CH-560 and CH-715 maintain a test interval of less than or equal to 18 months, extension of the test interval of this valve would have minimal impact on seismic risk. This valve is also a good candidate for extension of the AJLT as studies such as NUREG-1493 have shown minimal risk impact.

Table 1D - Summary of SG Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
SGN-V097 SGN-V098	L	N	Y	Downcomer Manual Isolation Valves	PRA only models the fail to remain open failure mode which is continuously tested in mode 1; Therefore additional testing would have a negligible impact on plant risk

Table 1D - Summary of SG Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
SGN-V431 SGN-V432	L	N	Y	Downcomer Check Valves	PRA only models the fail to remain open failure mode which is continuously tested in mode 1; Therefore additional testing would have a negligible impact on plant risk
SGN-FV1113 SGN-FV1123	L	N	Y	Downcomer Control Valves	These valves may be required to open to allow the N train AFW pump to provide flow. However the N train pump is seismic category 2 and cannot be relied upon to mitigate a major seismic event.
SGN-HV1143 SGN-HV1145	L	N	Y	Feedwater Isolation Bypass Valves	Valve is normally closed and can be opened to bypass the downcomer feedwater control valve. However the N train pump is seismic category 2 and cannot be relied upon to mitigate a major seismic event.
SGN-PV1128	L	N	Y	N2 Supply Valve	These components are required to operate to maintain a source of gas pressure to maintain the downcomer FWIVs (DFWIVs) open following a loss of offsite power event. However the DFWIV are only required to remain open to allow the N train AFW and/or the condensate pumps/MFW pumps to feed the SGs. However these pumps cannot be relied upon following a major seismic event and therefore there is no impact to seismic risk.
SGN-V967	L	N	Y	N2 Accumulator Isolation Valve	
SGN-V968	L	N	Y	N2 Supply to SGN-PSL-1128 Isolation	
SGN-V002 SGN-V008	L	N	Y	Chk Valve for AFW Line	These valves are opened to allow the AFN Pump to feed SG1 (V002) or SG2 (V008). However the N train pump cannot be relied upon to mitigate a seismic event since it6 is seismic category 2.
SGN-V435 SGN-V437	L	N	Y	Air/N2 Manual Valves to DFWIV Air Supply	The function of these valves is to open/remain open to allow the DFWIV to remain open during a loss of offsite power such that the N train AFW pump and/or the condensate pumps can be utilized to feed the SGs. However the N train pump and the condensate pumps cannot be relied upon to mitigate a seismic event since they are not seismic category 1.
SGN-V440 SGN-V441	L	N	Y	DFWIV Supply Check Valves	
SGN-V959	L	N	Y	N2 Check Valve	
SG-PCV1130	L	N	Y	N2 Supply Regulator	
SG-PCV1147	L	N	Y	N2 to Downcomer	
SG-PSV1131	L	N	Y	N2 Supply Relief	Low seismic risk as neither of these valves would be required to operate to mitigate a seismically initiated event such as a loss of offsite power.
SG-PSV1147	L	N	Y	N2 to Downcomer Relief	
SG-V289 SG-V290	L	N	Y	SG Blowdown Manual Isolation	These valves are normally open and would not be required to operate to mitigate a seismically initiated event such as a loss of offsite power. There are two containment isolation valves that could be remotely operated to isolate any failures in the non-seismic category 1 piping downstream of the containment isolation valves.
SGE-V003 SGE-V007 SGE-V005 SGE-V006	M	Y	N	Economizer Line Check Valves	These valves are relied upon to close following a seismically initiated event such as a loss of offsite power to prevent diversion of AFW flow to non-seismically qualified portions of the SG/FW systems. If a conservative but not unreasonable Beta of 0.1, and the non-seismic portion of the SG piping is assumed to fail for all earthquake greater than the SSE (conservative) then the frequency of such an event with failure of both check valves in a single line can be estimated as 1.1E-7/yr [8E-5*(2E-6/hr*8760*0.75)*0.1 Beta] which results in a FV of 2.2E-3 (1.1E-7/4.74E-5 baseline CDF). Since extending the stroke closed tests on these valves could potentially have a non-negligible impact on CDF it is recommended that these IST tests not be extended.

Table 1D - Summary of SG Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
SGE-V346 SGE-V348 SGE-V357 SGE-V358	L	N	Y	IA Check Valve	Low Risk Significant due to redundant Steam paths, redundant air supplies and ADVs can be manually opened following a loss of air supply.
SGE-V642 SGE-V652 SGE-V653 SGE-V693	L	Y	Y	Downcomer Containment Isolation	These valves are relied upon to close following a seismically initiated event such as a loss of offsite power to prevent diversion of AFW flow to non-seismically qualified portions of the SG/FW systems. If a conservative but not unreasonable Beta of 0.1, and the non-seismic portion of the SG piping is assumed to fail for all earthquake greater than the SSE (conservative) than the frequency of such an event with failure of both check valves in a single line can be estimated as 1.1E-7/yr [8E-5*(2E-6/hr*8760*0.75)*0.1 Beta] which results in a FV of 2.2E-3 (1.1E-7/4.74E-5 baseline CDF). Since extending the stroke closed tests on these valves could potentially have a non-negligible impact on CDF it is recommended that these IST tests not be extended.
SGE-V885 SGE-V886	L	N	Y	Steam Bypass to AF Turbine	The fail to remain open failure mode is adequately tested by the AFA pump tests and the valve is not required to operate to mitigate a seismic event.
SGE-V887 SGE-V888	L	Y	Y	Steam Bypass Check Valves	Since the frequency with which the AFA pump is needed to mitigate a non-seismic event is much greater than the frequency with which the AFA pump is needed to mitigate a seismic event (see Appendix A), the risk importance of the AFA pump and associated valves is driven by non-seismic events. (Piping is seismic category 1 and therefore the valve would not be required to close/ remain closed to mitigate a seismic event).
SGE-V889	L	N	Y	Combined Steam Bypass to AF Turb	The fail to remain open failure mode is adequately tested by the AFA pump tests and the valve is not required to operate to mitigate a seismic event.
SGE-V963 SGE-V964 SGE-V965 SGE-V966	L	N	Y	Instrument Air Filter Inlet Valves	Instrument Air power and piping is not seismic category 1 and therefore cannot be relied upon to mitigate a seismic event.
SGB-HV-178 SGA-HV-179 SGA-HV-184 SGB-HV-185	M	Y	Y	ADVs	ADVs are required following a seismically induced loss of offsite power condition to allow SDC entry conditions to be established (refer to Appendix A SDC write-up). If no credit is taken for local manual action of the ADVs, then extending the remote stroke tests on the ADV beyond 18 months could have a non-negligible impact on CDF. [8E-5/yr (Appendix A.2) * 0.07 (Train B power fails; Appendix A.9) * 1.5E-6/hr * 8760 * 0.75* 2 (Probability that one of two train A ADVs fails; AOV failure rate from NUREG/CR-2770 Page 52). =1.1E-7/yr which corresponds to an ADV FV > 1E-3]. By crediting manual operation of the ADVs, the risk ranking could be argued lower but unless there is periodic manual cycling of the valve that verifies reliable manual operation, 73ST-9XI20 (operation of the ADV from its dedicated Nitrogen accumulator) is recommended to remain at a n 18 month periodicity.
SGB-HV200 SGB-HV201	L	Y	N	Chemical Injection	Low Risk as valve is normally closed.and is not required to operate in order to mitigate a seismically initiated event such as a loss of offsite power.

Table 1D - Summary of SG Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
SGB-UV130 SGB-UV135 SGA-UV172 SGA-UV175	L	Y	Y	Downcomer Isolation Valves	Valves are required to close to prevent SG overfill on a feedwater mismatch event which overfills the SGs. Also required to close to prevent SG overcooling/ potential containment overpressure on a mainsteamline break event. The frequency of both of these events is judged to be dominated by non-seismic causes and therefore it is appropriate to base the risk rank of these components on the internal events PRA (see Appendix A). The valves could also be needed to reopen to allow the N train AFW to feed following a reactor trip with MSIS failure. Given some reliability problems which these valves have experienced, extending the IST is not recommended.
SGB-UV132 SGB-UV137 SGA-UV174 SGA-UV177	L	Y	N	Econ FW Isol	Valves are required to close to prevent SG overfill on a feedwater mismatch event which overfills the SGs. Also required to close to prevent SG overcooling/ potential containment overpressure on a mainsteamline break event. The frequency of both of these events is judged to be dominated by non-seismic causes and therefore it is appropriate to base the risk rank of these components on the internal events PRA (see Appendix A).
SGA-UV134 SGA-UV138	L	Y	Y	Steam supply to AF Pump	The frequency with which these valves are required to open to mitigate internally initiated events is much greater than the frequency that it is required to open to mitigate a seismically initiated event (Appendix A.9). The valve would not be required to close to mitigate a seismically initiated event since the valve is normally closed and the piping is seismic category 1. Therefore it is appropriate for the component ranking to be based on the internal events PRA.
SGA-UV134A SGA-UV138A	L	Y	Y	Steam supply to AF pump	The frequency with which these valves are required to open to mitigate internally initiated events is much greater than the frequency that it is required to open to mitigate a seismically initiated event (Appendix A.9). The valve would not be required to close to mitigate a seismically initiated event since the valve is normally closed and the piping is seismic category 1. Therefore it is appropriate for the component ranking to be based on the internal events PRA.
SGA-V043 SGA-V044	L	Y	Y	Steam Supply Check Valves to A AF Pump	The frequency with which these valves are required to open to mitigate internally initiated events is much greater than the frequency that it is required to open to mitigate a seismically initiated event (Appendix A.9). The valve would not be required to close to mitigate a seismically initiated event since the piping is seismic category 1. Therefore it is appropriate for the component ranking to be based on the internal events PRA.
SGE-UV169 SGE-UV183	M	Y	Y	MSIV Bypass Isolation Valves	Main Steam Piping in the Turbine building is not seismically qualified and failure of the MSIV bypass to close following a seismic would significantly complicate event recovery. Although the valve is normally closed it is open occasionally (e.g. - CRDR 1-5-0232), therefore cannot always neglect the importance of this valve. In units and fuel cycles where the valve is being maintained closed, the stroke test can be deferred with no impact on risk, but in operating cycles where it is being maintained open it is recommended that the stroke test be kept at its current periodicity.
SGE-UV170 SGE-UV171 SGE-UV180 SGE-UV181	M	Y	N	MSIVs (IST test 73ST-9SG01)	Main Steam Piping in the Turbine building is not seismically qualified, and failure of the MSIVs to close following a seismic event would significantly complicate event recovery. Extension of MSIV test intervals is therefore not recommended.

Table 1D - Summary of SG Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
SGE-VA019 SGE-VA020 SGE-VA021 SGE-VA022 SGE-VA023 SGE-VA024 SGE-VA025 SGE-VA026	M	Y	N	MSIV IA check valve	These valves are tested in conjunction with MSIV cycling and since the MSIV was ranked as Medium risk above, these components were also ranked as medium risk. Extension of the MSIV leak test is not recommended.
SGA-VA027 SGB-VA030 SGA-VA028 SGB-VA029	L	Y	N	Economizer FWIV Inst. Air Check Valves	Ranked the same as the Economizer FWIV since these components affect the reliability of the Economizer FWIVs.
SGA-UV204 SGA-UV211 SGB-UV219 SGA-UV220 SGB-UV221 SGB-UV222 SGA-UV223 SGB-UV224 SGA-UV225 SGB-UV226 SGA-UV227 SGB-UV228	M	Y	N	SG-1 Hot Leg Blowdown Sample Line Isol Valve	Since the blowdown piping downstream of the outside containment isolation valve is not seismic category 1, and since the inability to isolate a pipe break downstream could significantly complicate event recovery of a seismically initiated event it is recommended that the stroke test of these valves not be extended beyond 18 months. With 18 month test (and no credit for operational demands, and conservatively assuming that the valves are initially open) the probability that both SOVs in a single line fail to close is estimated as approximately 1E-3 (Standard Solenoid Operated Valve Fail to close rate of 2E-6/hr with an assumed Beta of 0.1). (For fail to open mode it is appropriate to rank these valves based on their importance to the internal events PRA.).
SGA-UV500P SGB-UV500Q SGB-UV500R SGA-UV500S	M	Y	Y	Blowdown Isolation	Since the blowdown piping downstream of SG-UV500S is not seismic category 1, and since the inability to isolate a pipe break downstream could significantly complicate event recovery of a seismically initiated event it is recommended that the stroke test of these valves not be extended beyond 18 months. With 18 month test (and no credit for operational demands, and conservatively assuming that the valves are initially open) the probability that both AOVs in a single line fail to close is estimated as approximately 1E-3 (NUREG/CR-2770 Page 52 common mode failure rate of 1.5E-7/hr 8760/2). (For fail to open mode it is appropriate to rank these valves based on their importance to the internal events PRA.).
SGA-UV1133 SGA-UV1134	L	Y	N	Steam Trap Isolation	Low Risk as these valves are not required to operate to mitigate a seismically initiated event.
SGB-UV1135A SGB-UV1135B SGB-UV1136A SGB-UV1136B	L	Y	N	Steam Trap Isolation	Low Risk as these valves are not required to operate to mitigate a seismically initiated event.

Table 1D - Summary of SG Valve Seismic Risk Significance Determination

Valve ID	Seismic Risk Significance	IST	IPE	Description/Function	Comments/ Basis for Seismic Risk Ranking
SGE-PSV554 SGE-PSV555 SGE-PSV556 SGE-PSV557 SGE-PSV558 SGE-PSV559 SGE-PSV560 SGE-PSV561 SGE-PSV572 SGE-PSV573 SGE-PSV574 SGE-PSV575 SGE-PSV576 SGE-PSV577 SGE-PSV578 SGE-PSV579 SGE-PSV691 SGE-PSV692 SGE-PSV694 SGE-PSV695	L	Y	N	Main Steam Relief	These valves are much more likely to be required to mitigate a non-seismically initiated event rather than a seismically initiated event (8E-5/yr from A.2). Therefore it is appropriate to base their risk significance based on the internal events PRA.
SGB-PSV302 SGA-PSV309 SGA-PSV316 SGB-PSV322 SGB-PSV305 SGA-PSV312 SGA-PSV319 SGB-PSV325	M	Y	N	ADV Accumulator System Nitrogen Relief Valves	These valves are tested during the ADV drop test (73ST-9SG05) and by 73ST-9XI20 for the failure mode of preventing successful operation of the ADV due to leakage or spurious operation. Since the ADVs have been ranked as Medium risk in this table, and since these components could potentially fail the ADV function. Since PVNGS experience with the ADV drop test has not been very good, the desirability of extending the test interval should be evaluated considering the PVNGS experience.
SGE-V334 SGE-V339 SGE-V350 SGE-V360	M	Y	Y	Chk Vlv for ADV N2 Supply (IST test is in conjunction with ADV test 73ST-9XI20) and 73ST-9SG05 (ADV Drop Test	These valves are presently tested every refueling outage per 73ST-9XI20. Since Instrument Air cannot be relied upon following a seismic event, these valves are important to remote operation of the valves following a seismic event. However, remote operation of the valve can be backed by local manual action and check valves are reliable devices. Although the RAW and FV values for a single valve clearly would allow some relaxation of this IST test, some restraint is recommended in extending this test interval given that the ADVs have been given the high risk designation by the Reference 1 evaluation team despite the fact that the FV and RAW would have supported a lower value.
SGE-V337 SGE-V342 SGE-V354 SGE-V363	M	N	Y	Accumulator Isolation Valve Tested per 73ST-9XI20 every 18 months and 73ST-9SG05 quarterly (ADV Drop Test)	These valves are presently tested every refueling outage per 73ST-9XI20 and quarterly per 73ST-9SG05. Since Instrument Air cannot be relied upon following a seismic event, these valves are important to remote operation of the valves following a seismic event. However, remote operation of the valve can be backed by local manual action and check valves are reliable devices. See ADV listing for additional discussion of the Medium ranking. The ADV Drop Test could be evaluated for extension; however since the test history has been poor, the desirability of extending the test interval should be evaluated considering the PVNGS experience.

APPENDIX A- Scoping Evaluation of Seismic Risk

A.1 Seismic Core Damage Frequency Estimate

The probability of a seismically induced core damage event has been estimated in Reference A-1 as less than 7E-6 per reactor year based upon the site hazard and a high confidence that the plant can mitigate a seismic event with a peak ground acceleration of 0.3g. The PVNGS IPEEE report (Reference A-2) demonstrates a high confidence that the IPEEE Review Level earthquake (0.3g peak ground acceleration) can be successfully mitigated. This scoping study will use the 7E-6 per reactor year core damage frequency.

A.2 Seismic Loss of Offsite Power Frequency Estimate

From information in Reference A-5 the median seismic capacity of offsite power (limited by ceramic insulators) was estimated as 0.2g. Applying a simple model which assumes that offsite power is unavailable for all seismic events with a peak ground acceleration in excess of 0.2g, Table 6-1 of Reference A-6 indicates a seismically induced loss of offsite power frequency of 8E-5 per year.

A.3 Seismically induced CDF with Failure of Containment Isolation -

Extending the test frequency of certain containment isolation valves has no impact on either the Seismic Core Damage Frequency (CDF) or the Seismic Large Early Release Frequency (LERF). It does however affect the Seismic CDF with concurrent failure of containment isolation. This section evaluates the impact on CDF frequency with containment isolation failure conservatively assuming that non seismic category 1 piping fails during the seismic event (both inside and outside of containment). Not every containment penetration was evaluated only one penetration of each general type was considered.

Containment Penetration Type One: Two series MOVs (both normally open):
For normally open containment Isolation valves on piping which is not seismic category 1 there is a potential increase in the probability of a core damage event with containment isolation failure if the test interval of the containment isolation valves is increased. This increase occurs if it is conservatively assumed that all non-seismic piping fails due to the seismic event. A typical configuration is NC-UV-402 and NC-UV-403. Both valves are currently tested every 18 months. Based on an MOV failure rate of 4.2E-6 per hour and a R2 value of 8E-8 (Reference A-3; Page 72) the seismic CDF with failure of both these valves to close can be estimated as 9.0E-9/yr [7E-6/yr * ((8E-8/hr*6570hr)+ $(4.2E\text{-}6/hr*6570hr)^2$)]. Increasing the test frequency of both of these valves to 6 years will increase the frequency by a factor of 11 to 1.0E-7 per year. Since the IPE (Reference A-4) frequency for CDF with failure of containment isolation is 5.0E-8/yr, and since this frequency would be significantly increased if test intervals are extended beyond 18 months, it is recommended that these valves not be extended beyond an 18 month test interval.

Containment Penetration Type Two - One remotely operated valve and a check Valve in series:
For normally open containment penetrations with a check valve and a remotely operated valve in series the increase in the CDF with containment isolation if the test interval for both valves is extended to six years was calculated. For a typical configuration such as NC-UV-401 and NCV116 the seismic CDF with failure of

containment isolation of this penetration was estimated to increase from 2.5E-9/yr [7E-6/yr * (4.2E-6/hr*6570 hr) * (2E-6 * 6570)] to 4.0E-8/yr if stroke testing of both valves was extended from 18 months to 6 years. Since the frequency of a core damage event with failure of containment isolation would be significantly increased if both series valves were extended to a 6 year periodicity it is recommended that the test interval for these valves (on non-seismic piping) be maintained at 18 months or less.

A.4.DG or SP/EC/EW component required to Mitigate a Seismic Event

The probability that a DG or essential cooling water component is required to mitigate a seismic initiated loss of offsite power event can be shown to be much less than the probability that it is required to mitigate a non-seismically initiated event. Even conservatively assuming that all seismically initiated loss of offsite power events result in sustained loss of offsite power and results in failure of the GTGs the risk increase from failing DGA is estimated as approximately 8E-6 [8E-5/yr * (0.1 failure probability of the B train AFW considering a 24 hour mission time and dependencies on DGB, SPB, AFB, ECB)]. By comparison the risk increase for DGA from the internal events PRA is 1.5E-4 or about twenty times greater. [The risk increase for the B train Essential Chill water System is 8.4E-5 in the internal events PRA, but since the AFB pump is not totally dependent on essential cooling the seismic risk increase for this pump is actually less than the 8E-6 value calculated above (by a factor of two) and the factor of approximately 20 difference is maintained. Therefore it is appropriate to base the importance of these components (and associated subcomponents) upon their importance to the internal events PRA.

The 0.1 is an approximate value for failure of B train secondary cooling, which is judged adequate for the purposes of this risk scoping study, and was estimated as the sum of the DGB, SPB, AFB and ECB:

(a) DGB failure probability was estimated as 0.07 [1.8E-3/hr (Appendix C)* 24 hours; 4.9E-3 for DG fail to start from 94 PRA update; 0.0105 for DG output breaker fails to close from 94 PRA update (CB-FT and CXXFT); and 0.0105 for DG maintenance unavailability].

(b) SPB failure probability was estimated as 4E-3 [the sum of CB-FT, CX5FS, MP-FR, MP-FS, MP6CM events for the SPB pump from the 94 update plus SPB4MANVLS-NV-RM].

(c) ECB failure probability was estimated as 0.02 [2.6E-5/hr fail to start failure rate from Appendix C with monthly start = 0.01; 6.7E-3 for AR7CM, ARHFR, CB-FT, IWFNO, ITFNO (all from the 94 update); and 2.8E-3 for ECBP01 failures from the 94 update.]

(d) AFB failure probability was estimated as 6E-3 [2.75E-6/hr for mpafs+xcbfs+cb4ft from Appendix C with quarterly test, 6.9E-5/hr for mpafr from Appendix C * 24 hour mission time, plus 7.5E-4 mp-cm from the 94 update].

A.5 Containment Spray Recirculation/ High Pressure Recirculation

Containment Spray Pumps have one primary safety function that would be needed following a seismically initiated event such as a loss of offsite power or a small LOCA (The seismic capacity of major RCS components, and RCS/Main Steam-line piping is high enough that seismic events are not significant contributors to Large LOCA or Steam-line Break Initiating events). This function is to provide containment pressure control/ heat removal for seismically initiated LOCAs, and to provide containment heat removal for

seismically initiated core damage events. The probability of a seismically initiated small LOCA can be conservatively estimated as 8E-6/yr (8E-5/yr frequency of exceeding 0.2g peak ground acceleration event, and high confidence that this event doesn't cause significant damage to the RCS pressure boundary based on typical nuclear power plant fragilities). Assuming that all of these events occur concurrent with loss of offsite power (reasonable since the pressure boundary seismic capacity is much greater than the offsite power capacity), the frequency with which a particular valve is required to open to mitigate a seismic event can be estimated as 8E-7/yr [8E-6/yr * 0.1 failure of High pressure recirc and/or containment spray recirculation from the other train (derived below)]. This is negligible compared with the internal events risk achievement worth of 4.1 (13-NS-C20, SIAUV0673 risk ranking) which corresponds to an internal events risk increase of 1.4E-4/yr. Likewise it is appropriate to base the importance ranking of containment spray recirculation to severe accident containment on internal events, since the internal events core damage frequency of 4.7E-5/yr is much greater than the 7E-6/yr seismic core damage frequency from Section A.1. Therefore it is appropriate to base the risk significance of these components on their importance to the internal events PRA.

The 0.1 is an approximate value for failure of recirculation cooling from the other train. cooling and was estimated as the sum of the DGB, SPB, HPSIB, CSB, SRBUV0675/ SRBUV676 failure probabilities.

(a) DGB failure probability was estimated as 0.07 [1.8E-3/hr (Appendix C)* 24 hours; 4.9E-3 for DG fail to start from 94 PRA update; 0.0105 for DG output breaker fails to close from 94 PRA update (CB-FT and CXXFT); and 0.0105 for DG maintenance unavailability.]

(b) SPB failure probability was estimated as 4E-3 [the sum of CB-FT, CX5FS, MP-FR, MP-FS, MP6CM events for the SPB pump from the 94 update plus SPB4MANVLS-NV-RM].

(c) HPSIB failure probability was estimated as 6.3E-3 [summing cb-ft, cb0cm, cx6fs, mp-fr, mp-fs, mp6cm failure modes for SIBP01 from the 94 update].

(d) CSSB failure probability was estimated as 0.01 [summing cb-ft,cx6fs,mp-fr, mp-fs, mp6cm for sibp03 faults from the 94 update].

(e) SIBUV675/SIBUV676 failure probability estimated as 0.015 [estimated as the sum UV675 and 676 faults from 13-NS-C20].

A.6 HPSI/Sump Recirculation Components required to Mitigate a Seismic Event

See Section A.5 above.

A.7 SDC needed to Mitigate a seismic Event

Unlike the other systems considered herein the likelihood that SDC is needed to mitigate a seismic event could be large relative to the likelihood that SDC is needed to mitigate an internally initiated event. From the 1994 PRA update importance listings failing SDC with a probability of unity (1SDCPROC-2OP--2HR) would result in a CDF risk increase of 1.8E-6/yr. By comparison, conservatively assuming that offsite power is never restored within 48 hours on a seismic event the seismic risk increase could be on the order of 8.0E-5/yr (see Section A.2) [since makeup to the CST is non-seismic and therefore potentially unavailable, depletion of the CST inventory could potentially result in core damage within 48 hours if SDC operation cannot be achieved]. Since long term availability of CST inventory is not available following a seismic event, reliability of SDC is important to seismic risk. In absolute terms the Fussel Vesely of a single train of SDC is scoped as approximately 0.006 [8E-5/yr * (0.11 SDC Train A or supporting DG fails) *

0.031 SDC Train B fails / 4.74E-5].

Based upon the SDC train FV value of 0.006 with the SDC train failure probability of 0.031, any single SDC component would have a FV of less than 0.001 (which corresponded to a low Ranking) provided that the component unavailability was less than 5E-3. Typical SDC components such as system MOVs have manual operator capability in addition to remote manual actuation and therefore a refueling test would normally be sufficient to maintain a unreliability of less than 5E-3 (based upon the current upper bound failure rate for a manual valve of 3.8E-7/hr an 18 month test is sufficient). One mitigating factor which would allow extending IST tests on these components is that, most of these valves get exercised every 18 months in the course of normal shutdown operations such that an 18 month IST test may be superfluous. However since SDC reliability is important to seismic risk, and since this impact cannot be showed to be clearly negligible relative to the ranking standards of the IST ranking process, these components were ranked as Medium risk and it is recommended that the test frequency of these components not be extended beyond 18 months without additional justification.

The 0.031 SDC train reliability is an approximate value for failure of the probability of failure of a SDC train.

(a) The probability of failure of one or more of the SDC suction valves failing to open excluding control circuit faults was estimated as 0.023 [Based upon three valves with a failure probability of MV-FO of 1.91E-2 (94 update; 1SIBUV0652-MV-FO) with a 8 hour non-recovery probability of 0.4 (NUREG-4550, Vol. 2, Page C-155)].

(b) The probability of failure of one or more of the SDC suction valves failing to open due to unrecovered control circuit faults was estimated as 7.5E-3 [Based upon three valves with a failure probability of CX4FO of 0.0125 (94 update; 1SIAUV0651-CX4FO) with a 8 hour non-recovery probability of 0.2 (NUREG-4550, Vol. 2, Page C-155)].

(c) The probability of failure of either the DG or SP in the other train was estimated as 0.074 (from Section A.5).

A.8 APSS needed to mitigate a Seismic Event

APSS may be needed to establish SDC following a seismically induced loss of offsite power. The seismic event may result in an extended loss of offsite power which results in the unavailability of normal spray. Although it is probable that pressurizer vents could be used to establish SDC entry conditions, this has never been documented in an FSAR type analysis, therefore it is conservatively assumed that APSS is needed to mitigate a seismically initiated loss of offsite power (if the CST inventory cannot be replenished). Study 13-NS-A35 (Reference A-7) previously evaluated the frequency of an extended loss of offsite power requiring APSS operation as 1.2E-5 for non-seismic events. Using the seismic loss of offsite power frequency from Section A.5 of 8E-5/yr, and conservatively assuming no power recovery and the Reference A-7 analysis, the frequency with which APSS is required to mitigate a seismic event is 4E-5/yr. The original IST ranking ranked a component as high risk if the Fussel-Vesely measure was greater than 0.01 (CDF involving the component is greater than 4.7E-7), and as medium risk if the FV was greater than 0.001 (CDF involving failure of the component is greater than 4.7E-8). Therefore if any component required for APSS operation had a failure probability of greater than 0.012 it would be a high risk component due to seismic considerations (since 4E-5/yr * 0.012 > 4.7E-7), and if it had a failure probability of greater than 0.0012 the component would be a medium risk component. Looking at risk increase, any APSS component whose failure resulted in failure of APSS would result in a Risk Achievement

Worth (RAW) of almost two. Since a RAW of two was sufficient to designate a component as medium risk in the original IST ranking, any component whose failure results in APSS failure would be borderline to medium risk based on seismic considerations alone. Therefore these components were designated as medium risk in the seismic ranking (high risk if the component failure probability was estimated as greater than 0.012).

A.9 - AFW Pump A needed to mitigate a seismically initiated event.

The frequency with which the AFA pump is needed to mitigate a seismic event was estimated as 8E-6/yr [8E-5/yr (Section A.2) * (0.074 Train B DG/SP fails + 0.026 AFB/ECB fails)]. The Train B DG/SP, and AFB/ECB failure probabilities are from section A.4. Therefore the seismic CDF increase if the AFA pump is assumed failed is 8E-6 which is much less than the internal events risk increase of 2.7E-4/yr (Study 13-NS-C20, RAW = 6.7). Therefore the AFA pump and associated components are much more risk important in mitigating internal events than seismic events.

Checking the risk importance of A Train IST components (from Table 1 of 13-NS-C20) the highest basic event probability for an IST component which is considered for test interval extension in Reference 1 and fails AFA pump to both SGs is 2E-4 (13-NS-C20). Therefore the highest CDF for a a single AFA component being considered for extension is 1.6E-9 (8E-6/yr*2E-4) which results in a Fussel-Vesely (FV) value of 3E-5 which is much less than the 1E-3 FV which warranted a medium risk designation in Reference 1. Similarly the seismic Risk Achievement Worth (RAW) of an A train AFW component is less than or equal to 1.17 since a 8E-6/yr increase in CDF represents only a 15% increase in CDF.

Therefore both in absolute and relative terms the A Train AFW components reviewed in Table 1 of this study may be appropriately designated as low risk.

A.10 - AFW Pump B needed to mitigate a seismically initiated event.

The frequency with which the AFB pump is needed to mitigate a seismic event was estimated as 1.1E-5/yr [8E-5/yr (Section A.2) * (0.074 Train A DG/SP fails + 0.06 AFA pump Fails)]. The A Train DG/SP failure probability is from Section A.4. The AFA fail to start/run/maintenance_unavailability probability was estimated as 0.063 (4.1E-5/hr fail to start failure rate with quarterly test and 5.7E-4 fail to run rate with a 24 hour mission time from Appendix C; 4E-3 AFA maintenance unavailability from 1994 update). Therefore the seismic CDF increase if the AFB pump is assumed failed is 1.1E-5 which is much less than the internal events risk increase of 8.5E-4/yr (Study 13-NS-C20, RAW = 18.9). Therefore the AFA pump and associated components are much more risk important in mitigating internal events than seismic events.

Checking the risk importance of AFB Train IST components (from Table 1 of 13-NS-C20) the highest basic event probability for an IST component which is considered for test interval extension in Reference 1 and fails AFB pump to both SGs is 2E-4 (13-NS-C20). Therefore the highest CDF for a single AFA component being considered for extension is 2E-9 (1.1E-5/yr*2E-4) which results in a Fussel-Vesely (FV) value of 4E-5 which is much less than the 1E-3 FV which warranted a medium risk designation in Reference 1. Similarly the seismic Risk Achievement Worth (RAW) of an A train AFW component is less than or equal to 1.2 since a 1.1E-5/yr increase in CDF represents a 20% increase in CDF over the internal events baseline CDF of 4.7E-5/yr.

Therefore both in absolute and relative terms the B Train AFW components reviewed in Table 1 of this study may be appropriately designated as low risk.

References:

(A-1) Risk Engineering, 'Review Level Earthquake Evaluation: Recommendations for IPEEE Implementation at PVNGS (Wintersburg, Arizona),' Revision 3, April 7, 1993.

(A-2) PVNGS IPEEE Report, 'PVNGS Individual Plant Examination of External Events,' June 1, 1995 (Submitted to the NRC as an Attachment to APS letter # 102-03407-WLS/AKK/GAM dated June 30, 1995).

(A-3) NUREG/ CR-2770, 'Common Cause Fault Rates for Valves,' Sept 1982.

(A-4) PVNGS IPE Report, 'PVNGS Individual Plant Examination, April 7, 1992.

(A-5) NUREG/CR-3558, 'Handbook of Nuclear Power Plant Fragilities,' June 1985.

(A-6) Risk Engineering, 'Seismic Hazard Evaluation for PVNGS (Wintersburg, Arizona),' April 5, 1993.

(A-7) 13-NS-B35, 'Auxiliary Pressurizer Spray (APSS) Reliability Evaluation, Oct. 4, 1994.

Appendix B

Excerpt of IST question PRA-9 from Reference 2

D. SSC Ranking

PRA-9

External Events risk ranking: According to the submittal (Section 4.1.3.4), "each component was reviewed to determine if it had a function during an external event that was different from the function of the component for internal events. If there was a difference in function, the relative importance was determined by assessing the impact of failure of the component and the relative likelihood of the external events." The following are staff comments on this process:

a. The above analysis, by itself, might not be sufficient because:

(i) External events could result in plant initiators (e.g., LOCAs from spurious open PORVs, seal LOCAs, LOSP or SBO, etc.) that could result in relative importances of SSCs being changed. That is, since external events (especially for fires) may contribute significantly to the internal events CDF, the initiating events they result in could cause a relative shift in the overall initiator mix. Consequently, the relative importances of systems/components depended upon for accident mitigation will also change.

(ii) Spatially dependent CCFs which are unique to the external event initiators cannot be taken into account in the simplified analysis.

(iii) The loss of one train of one or more systems (for example, from the loss of one electrical division) from these initiators could cause the relative importances of components in the other train to be changed.

(iv) Components lost as a result of the external event are likely not to be recoverable.

Based on the above, please justify your approach, or provide a revised assessment of the external event risk.

b. A preliminary review of the results in Appendix C of Enclosure 5 shows that there were no components that were re-ranked high because of external event initiators. Is this correct?

c. Does the expert panel contain members that are familiar with the seismic qualification of plant SSCs (for seismic risk) or members that are familiar with plant fire protection (safe shutdown analysis, Appendix R evaluation, etc), or are all insights from the external events evaluation provided by the PRA/IPEEE engineer?

PVNGS Bayesian Update Draft

C.1 BAYESIAN UPDATE INTRODUCTION

The purpose of this Section is to provide the documentation of the Bayesian Update that was performed on selected components for the Palo Verde Nuclear Generating Station (PVNGS) Probabilistic Risk Assessment. The Bayesian Updating process is a statistical technique that is used to combine plant specific failure rates with a failure rate obtained from a generic source.

C.2 SUMMARY OF RESULTS

Table 1 provides the results of the Bayesian Update Analyses, as well as the generic and plant specific data that was used during the process.

Table 1: Bayesian Update Results

Component/ Failure Mode	Generic MEAN	Generic E. F.	Plant Update Data		Updated MEAN	Generic E. F.
			# FAIL.	# HR./ DMD		
1AFBP01----MPAFS 1AFNP01----MPAFS	1.0E-6/hr	5	0	315,000 hrs	6.6E-7/hr	5
1AFBP01---XCPBFS	6.98E-7/hr	5	0	158,000 hrs	5.9E-7/hr	5
1AFNP01---XCPAFS	1.80E-6/h (SIAS)	5	0	26,300 hrs	1.7E-6/hr	5
1AFBP01----MPAFR 1AFNP01----MPAFR	3.0E-5/hr	10	0.5	4200 hrs	6.9E-5/hr	4.84
1AFAP01----TPAFS	5.6E-5/hr	8	1	37,200hrs	4.1E-5/hr	3.5
1AFAP01----TPAFR	5.5E-4/hr	10	0.2	342 hrs	5.7E-4/hr	6.62
1SGAUV0134-MVAFO 1SGAUV0138-MVAFO	2.9E-6/hr	14	1.5	315,000 hrs	4.6E-6/hr	3.16
1SGAUV0134XCMDFO 1SGAUV0138XCMDFO	3.06E-6/hr	5	1	315,000 hrs	3.1E-6/hr	3.13
1SGAUV0134AXCSBFO (17 letters - need to rename 1SGAUV134AXCSBFO)	1.24E-6/hr	5	1	315,000 hrs	2.0E-6/hr	3.13
1PEAG01-DG---2FS 1PEBG02-DG---2FS	0.022/ demand	5	2	598 demands	4.14E-3/d	2.6

Table 1: Bayesian Update Results

Component/ Failure Mode	Generic MEAN	Generic E. F.	Plant Update Data # FAIL.	Plant Update Data # HR./ DMD	Updated MEAN	Generic E. F.
1PEAG01-DG---2FR 1PEBG02-DG---2FR	2.3E-3/hr	10	4.5	2559 hrs	1.77E-3/hr	2.1
1AFBP01----CB4FT 1AFNP01----CB4FT 1ECAE01----CB4FT 1ECBE01----CB4FT 1EWAP01----CB4FT 1SIAP01----CB4FT 1SIAP02----CB4FT 4SIAP03----CB4FT 1SPAP01----CB4FT 1EWBP01----CB4FT 1SIBP01----CB4FT 1SIBP02----CB4FT 4SIBP03----CB4FT 1SPBP01----CB4FT 1PBAS03B---CB4FT 1PBBS04B---CB4FT	6.0E-7	10	4	2.52E+6 hrs	1.5E-6/hr	2.2
Code Change MPLFS 1SIAP01----MPLFS 4SIAP03----MPLFS 1SIBP01----MPLFS 4SIBP03----MPLFS	1.0E-6/hr	5	0	210000 hrs	7.5E-7/hr	5
Code change MPHFS 1SIAP02----MPHFS 1SIBP02----MPHFS	1.0E-6/hr	5	0	105000 hrs	6.2E-7/hr	5
1SIAP01---XCPFFS 1SIBP01---XCPFFS	6.9E-7/hr	5	0	105000 hrs	6.2E-7/hr	5
1SIAP02---XCPEFS 1SIAP02---XCPEFS	4.1E-7/hr	5	0	105000 hrs	3.8E-7/hr	5
4SIAP03---XCPHFS 4SIBP03---XCPHFS	4.1E-7/hr	5	0	105000 hrs	3.8E-7/hr	5
1ECAE01----ARHFS 1ECBE01----ARHFS	4.7E-6/hr	10	3	105000 hrs	2.3E-5/hr	2.4
1ECAE01---XCCAFS 1ECBE01---XCCAFS	7.0E-6/hr	5	0	105000 hrs	3.2E-6/hr	5

C.3 Methodology

The methodology that was used to Bayesian Update the PVNGS data is discussed in Reference 1. For ease of computation, a lotus spreadsheet was developed to perform the calculations for the Bayesian Update. The spread sheet is provided as Table 12.

The following are the equations that were used for the analysis:

Time Failure Data

$$\sigma_{pr} = \frac{ln(EF_{pr})}{1.645}$$

$$mean_{pr} = m_{pr} \times exp\left(\frac{\sigma^2{}_{pr}}{2}\right)$$

$$var_{pr} = m_{pr}^2 \times \exp(\sigma^2{}_{pr}) \times (\exp(\sigma^2{}_{pr}) - 1)$$

where: σ_{pr} = the standard deviation of the prior distribution
EF_{pr} = the Error Factor of the prior distribution
$mean_{pr}$ = the mean of the prior distribution
m_{pr} = the median of the prior distribution
var_{pr} = the variance of the prior distribution

The updated failure rate is then calculated as:

$$mean_{po} = \frac{\alpha + n}{\beta + t}$$

$$var_{po} = \frac{\alpha + n}{(\beta + t)^2}$$

$$\sigma_{po} = \sqrt{ln\left(\left(\frac{var_{po}}{mean_{po}{}^2}\right) + 1\right)}$$

$$EF_{po} = exp(1.645 \times \sigma_{po})$$

$$m_{po} = \frac{mean_{po}}{exp\left(\frac{\sigma_{po}^2}{2}\right)}$$

where:

$$\alpha = \frac{{mean_{pr}}^2}{var_{pr}}$$

$$\beta = \frac{mean_{pr}}{var_{pr}}$$

and: n = the number of plant specific failures
t = the hours during which the failure accrued

Demand Failure Data

$$\sigma_{pr} = \frac{ln\,(EF_{pr})}{1.645}$$

$$mean_{pr} = m_{pr} exp\left(\frac{\sigma_{pr}^2}{2}\right)$$

$$var_{pr} = m_{pr}^2 \times exp\,(\sigma_{pr}^2) \times (exp\,(\sigma_{pr}^2) - 1)$$

where: σ_{pr} = the standard deviation of the prior distribution
EF_{pr} = the Error Factor of the prior distribution
$mean_{pr}$ = the mean of the prior distribution
m_{pr} = the median of the prior distribution
var_{pr} = the variance of the prior distribution

The updated failure rate is then calculated as:

$$mean_{po} = \frac{\alpha + n}{\beta + d}$$

$$var_{po} = \frac{(\alpha + n)\ (\beta + d + 1)}{(\beta + d)^2 ((\beta + d) - (\alpha + n))}$$

$$\sigma_{po} = \sqrt{ln\left(\frac{var_{po}}{mean_{po}^{2}} + 1\right)}$$

$$EF_{po} = exp\,(1.645 \times \sigma_{po})$$

$$m_{po} = \frac{mean_{po}}{exp\left(\frac{\sigma_{po}^{2}}{2}\right)}$$

Where

$$\alpha = \frac{mean_{pr}^{2}\,(1 - mean_{pr})}{var_{pr}} - mean_{pr}$$

$$\beta = \frac{mean_{pr}\,(1 - mean_{pr})}{var_{pr}} - 1$$

and: n = the number of plant specific failures
d = the number of demands

C.4 Review of Plant Specific Data

The following provides the plant specific data that was used for the Bayesian Update. The failure data was obtained from a number of sources which are listed below:

(a) The failure data Trending Data Base was accessed for applicable failure records.

(b) Excel Spreadsheets which are maintained by Maintenance Support to perform Maintenance Rule monitoring activities provides an additional record of failures for the time period since January 1994. Copies of the DG, motor driven AFW, SI and EC excel files that were used for this analysis are maintained at h:\z75479\excel\dg,xls, afbn.xls, sihpsi.xls, silpsi.xls, ec.xls. The spreadsheet afbn.xls was also used to estimate the run hours on the motor driven pumps. and afa.xls was used to estimate run hours on the turbine driven pumps.

(c) Diesel Generator start demands and run hours were estimated from lotus spreadsheets maintained by the system engineer. Copies of these files which show the calculation of technical specification DG run hours for the DGs from 1/90 through 12/95 can be found at /home/glpod/lotus/DG1A.data.wk3, DG1Bdata.wk3, DG2Arundata.wk3, DG2Brundata.wk3, DG3Arundata.wk3, DG3Brundat.wk3.

(d) Data from 1987 through 1991 was also available in Plant FDT books which were assembled in the 1992 period. A copy is available in the PRA library, but in most instances this data was not utilized due to design changes which make the data of questionable relevance to the present design configuration and because more recent experience was judged more relevant in assessing the current reliability of equipment.

The maintenance rule data is particularly helpful for the years it covers as failures are reviewed to determine whether or not they are functional failures of the equipment. The FDT records where utilized are reviewed to screen out failures which do not result in failure of the equipment to perform its PRA function. As an example, if a valve failed to open in its Tech. Spec. allowed time interval but the valve still opened in a time-frame that allowed its PRA function to be met then the failure was excluded even though it may be encoded as MV-FO in FDT.

C.4.1 Turbine Driven AFW Pump Plant Data

From a review of the Maintenance Rule Data base, and the FDT data base the AFA pump failure history shown in Table 2 was assembled. The Turbine driven pumps have experienced recurring overspeed trips between 1987 and 1994 due to overspeed which has been attributed to excessive condensation in the Main-steam lines. However a design modification has been implemented in all 3 units which has decreased the potential for overspeed trips of the turbine-driven AFW pumps. As noted in the 1996 Maintenance Rule summary Report, there were no failures to start or run of the turbine driven AFW pumps in 1995, indicating an improving trend in AFA reliability. Also included in Table 2 is a summary of the failures recorded on the Turbine Driven AFW pumps during the period 1987 - 1991 from the 1992 FDT Summary Book. This was included because the pumps have experienced several trips unrelated to the condensate overspeed problem, which has apparently been solved, and was considered for inclusion in the PRA update if the Bayesian Update had resulted in a failure rate lower than the rate incurred from 1987 - 1991 excluding the

condensate overspeed trips. [Subsequent results showed that the Bayesian updated value (based on 1995 experience alone) was higher than the failure rate from 87 to 91 (excluding overspeed trips due to condensation in the steam lines); therefore the 87 - 91 experience was neglected].f

Table 2: Turbine Driven AFWP Failure Summary (1987 - 1991; 1994-1995)[a] TP-FS

Failure Mode/ PRA Code	Date	EQPT. ID	Description/ WO #	Source/Comments/ Disposition
Fail to Start	5/96		Pump overspeed trip	A fail to start event occured in late May, 1996 (The pump started but tripped off after running for approxiumately 8 minutes per discussion with G. Sowers). The cause of the trip was still not determined as of early June, but did not reoccur on subsequent starts.
Fail to Start TPAFS	6/8/94 12/18/94	3MAFAP01	Pump Overspeed Trips	1995 Maint Rule Report / Maintenance Rule database (AFA.XLS). Both trip were due to condensation, and the likelihood of a recurring failure has been significantly reduced by a design modification which has since been implemented.
Fail to Start TPAFS	7/5/90 2/18/89	2MAFAPP01	Pump overspeed Trips	Both Failures were attributable to condensate in the steam lines. (From 1987 - 1991 FDT Summary Pages 6 and 11)
Fail to Start TPAFS	12/3/89	3JAFAE01	Pump Overspeed Trip	Tripped on Overspeed - defective Resistor (R 17). (From 1987 - 1991 FDT Summary Before Page 1)
Fail to Start TPAFS (?)	8/21/90 9/27/90	1JAFAE01 2JAFAE01	Pump Failed to Achieve Rated Speed	Defective Ramp Circuit. FDT 1987 - 1991 Summary Pages 9,10. Questionable whether these were functional failure given the description
TPAFS (?)	11/30/88	1AFAP01	Pump Fail to Achieve Rated Speed	Defective Relay Circuit CR-5. From FDT Summary 1987 - 1991 before Page 11).

a. 1993 and earlier experience was discarded as not representative to the current system configuration. A design modification has been installed which significantly reduces the probability of an overspeed trip due to condensation in the steam lines.

Table 3: Turbine Driven AFWP Failure Summary (1990-1995) TP-FR[a]

Failure Mode/ PRA Code	Date	EQPT. ID	Description/ WO #	Source/Comments/ Disposition
Fails to Run TPAFR	10/25/95	2MAFAP01 3MAFAP01	WO # 00730429 WO # 00415251	FDT Search on AF pump failures (Appendix A) identifies two events which document incipient failures to run of turbine driven AFW pumps over the subject period. Both of these failures were judged to be incipient failures (One was seal leakage event, the other out of specification vibration) which (with 90% confidence) would not have failed component function with at least 90% confidence. These two events were conservatively included in the Bayesian update as two-tenths of a failure (one-tenth of a failure each).

a. Data prior to 1990 excluded as non-representative. Due to a design problem, there were several cracks found in center shaft sleeves, and a couple of failures of the fourth stage impeller. None of these resulted in an actual fail to run or fail to start event, but the differential pressure was reduced.

Based on the information in Table 3, the failure rate TP-FS was updated with zero failures in three pump years (2.6E+4 hours). Although there is a record of four non condensate related overspeed trips in the eighteen pump years covered by the Table it was decided not to include this data unless the updated rate was less than the 1.9E-5/hr rate implied by the plant specific data due to concerns that the overspeed trip problem is totally solved (by accumulating additional experience on the new design. In order to update the TP-FR failure rate an estimate was needed on the number of run hours per pump per year. Based on data in the Maintenance Rule database spreadsheet afa.xls (looking at Units 2 and 3 from 1/94 to 12/96) it was estimated that each Turbine Driven Pump is run for 19 hours per year. The TP-FR failure rate was then updated with 0.2 failures in 342 run hours.

C.4.2 Motor Driven Auxiliary Feed-water Pump Plant Specific Data

From a review of the FDT data base, Maintenance Rule Reports and Maintenance Rule data bases summaries of AFW motor driven pump failure experience were generated. These summaries are included as Table 4 (Control Circuit fail to start failures) and Table 5 (Motor Driven Pump Failures to Start and Run) below.

Table 4: Motor Driven AFWP Failure Summary (1994-1995) CX Faults[a]

FAILURE MODE/ PRA Code	Date	EQPT. ID	Description/ WO #	Source/Comments/ Disposition
Fail to Start AFN Control Circuit (CX0FS in 94 update)	8/30/94	3MAFNP01	Low Suction Pressure Trip	1995 Maint Rule Report; Suction Pressure Trip has been bypassed, but failure was conservatively included

Table 4: Motor Driven AFWP Failure Summary (1994-1995) CX Faults[a]

FAILURE MODE/ PRA Code	Date	EQPT. ID	Description/ WO #	Source/Comments/ Dispositi
Fail to Start AFN Control Circuit (CX0FS in 94 Update)	11/27/95	1MAFNP01	Low Suction Pressure Trip	1995 Maint Rule Report

a. Additional low pressure suction pressure trips occurred in the early 1990s. However since a recer design change has bypassed the low suction pressure trips, no attempt was made to obtain a comple record of all these trips. Review of the FDT data base and FDT summary revealed no control circui failures on these pumps which prevented pump start since 1990, other than the low pressure suctior pressure trips which are not applicable to the current design configuration, since the low suction prc sure trip has since been disabled.

Table 5: Motor Driven AFWP Failure Summary (1990-1995)[a] MP-FR, MP-F

FAILURE MODE/ PRA Code	Date	EQPT. ID	WO #	Source/Comments/ Disposition
MP-FR, MP-FS				The Maint Rule 1995 Summary Shows th: have been no motor driven pump failures oth the AFN Control Circuit faults above betwe and 12/95.
MP-FR	1-5-90 6-9-90	3MAFNP01 1MAFBP01	# 00401885 # 00428772	The FDT data base (MDP search) listed tw leakage events which occurred between 1-: 12-95, however both of these were incipient f and the pump was capable of perform: intended function (of providing makeup flow SGs for 24 hours or until SDC could be estab:. Therefore, these failures were not considere ures for the purpose of the PRA update.
MP-FR	3-21-95	2MAFBP01	# 00614446	A 3/21/95 sample of the oil sample showed : cant wear on the thrust bearing. In the judger the responsible maintenance engineer, failu: not imminent, but the failure was considere half of a failure as there is some reasonable regarding whether or not the pump would ha vived an extended run period.

a. Data before 1990 was excluded. There were two fourth stage impeller failures in the 1987/1988 ti frame and the design was modified to reduce the likelihood of recurrence. (Even for these events th pump continued to run, and would have been able to provide adequate flow to the SGs for decay he: removal purposes, so inclusion of pre-1990 experience would not necessarily change the result sign cantly

From Table 4, there have been no control circuit failures of the AFB pump in the last 6 years (1990 - 1995). Therefore 1AFBP01---XCPBFS was updated with no failures in 18 pump years.

AFNP01 has experienced two low pressure suction pressure trips in the last 6 pump years of experience. However the low pressure suction pressure trips have since been disabled,

therefore 1AFNP01---XCPAFS will be updated based only upon the 1995 experience of no failures in the last three pump years of experience (26,300 pump hours). Once the AFN circuit is modified to reintroduce a new form of low suction pressure protection, any new pump failure mechanisms which are introduced, should be identified and included in the PRA model as an additional failure mechanism.

There have been no MP-FS events in the last 5 years. Therefore MP-FS will be updated with no failures in 36 pump years. Although there haven't been any MP-FR events in the last 6 years, there have been three events, that could be characterized as incipient failures. The Maintenance Rule database (afbn.xls) indicates 1400 hours of run between 1/94 and 12/95. This was extrapolated to 4200 hours of run for the period 1990 through 1996. The MP-FR failure rate was then updated with 0.5 failures in 4200 hours of pump run.

C.4.3 AFW Pump Steam admission Valves Plant Specific Data

Appendix A provides the printout of all FDT records for work that was performed on the steam admission valves. Table 6 summarizes all failures to open of steam admission valves between 1/90 and 12/95.

Table 6: Turbine Driven AFWP Failure Steam Admission MOV FTO (1990-1995)

FAILURE MODE/ PRA Code	Date	EQPT. ID	Description/ WO #	Source/Comments/ Disposition
1SGAUV0134-MV-FO 1SGAUV0138-MV-FO	8/30/91	2JSGAUV01 34	WO # 00511824	MOV FTO due to motor / torque switch failure (Valve partially opened, but failure was conservatively included)
1SGAUV0134-MV-FO 1SGAUV0138-MV-FO	6/28/93	2JSGAUV01 34	WO # 00602340	Valve Operator thrust insufficient to open valve under design basis conditions (Considered as one-half a failure for purposes of Bayesian update, since probably would not have prevented valve from opening post-accident).
1SGAUV0134-CX-FO 1SGAUV0138-CX-FO	6/16/93	3JSGAUV01 34	WO # 00613617	Limit Switch contact failed open

Table 7: Turbine Driven Bypass Steam admission SOVs (1990-1995) SV-FO,

FAILURE MODE/ PRA Code	Date	EQPT. ID	Description/ WO #	Source/Comments/ Disposition
1SGAUV134ASV-FO 1SGAUV138ASV-FO	4/20/92	3JSGAUV0138A	WO #00551554	Failed Solenoid (SOV may have opened long enough to start TDP but event is conservatively included)
1SGAUV134ACXXFO 1SGAUV138CXXFO	10/31/90	1JSGAUV0138A	WO # 00453491	FTO due to poor electrical connection

From Table 7, PRA events 1SGAUV0134-MV-FO and 1SGAUV0138-MV-FO will be updated with 1.5 failures in 36 valve years (315,000 valve hours). The corresponding CX-FO events will be updated with 1 failure in 36 valve control circuit years (315,000 hours). The SGAUV134A events (SV-FO and CXX-FO) will both be updated with 1 failure in 36 valve years (315,000 hours).

C.4.4 Diesel Generator Plant Specific Data

The DG Spreadsheet (DG.XLS) and the FDT database were reviewed to identify DG functional failures that occurred from 1/1/90 to 12/31/95. The FDT Database is Included in Appendix A.During this period representing 315,000 DG hours, 598 Technical Specification Starts and 2559 Technical specification run hours, the failures listed in Table 9 have occurred which would have affected emergency mode operation. The number of Technical Specification starts and Run Hours are from EXCEL spreadsheets located in /home/glpod/lotus which are copies of corresponding files maintained by the system engineer in /home/nthiboda/z-dg-data/run-log/. The starts and run hours can be broken down as follows:

Table 8: DG Starts and Run Hours (1990 through 1995)

	DG Tech Spec Starts	DG Tech Spec Run Hours
DG 1A	90	411
DG 1B	93	346
DG 2A	104	554.
DG 2B	106	416
DG 3A	103	403
DG 3B	102	428
Total	598	2559

Table 9: DG failures(1990-1995)

FAILURE MODE/ EQPT ID	Date (WO Close Date)	WO	Source/Comments/ Disposition
DG-FR (DG 2B)	1/21/92	00537706	Inspection of Generator Brushes, indicated that a fail to run failure may have been imminent, during an inspection performed following erratic operation due to a failed pre-positioning board (which doesn't affect the emergency mode of operation). Per DG.XLS this was considered a load failure.

Table 9: DG failures(1990-1995)

FAILURE MODE/ EQPT ID	Date (WO Close Date)	WO	Source/Comments/ Disposition
DG-FS (DG 2A)	12/12/90 (12/19/90)	00460115	During a run the exhaust silencer lifted, blowing insulation and the shroud off the silencer. Since this was a tech spec start (i.e. - the DG had already been called operable) this failure is included although it could be excluded as post maintenance test. If this was done however then the run log would need to be reviewed and all run hours for post maintenance tests removed, and time was not available to perform this task).
DG-FR (DG 3B)	7/28/93 (7/30/93)	00621749	A Maint Rule load failure occurred on 7-28-93 when abnormal DG operation was detected during a four hour load run. Subsequent investigation showed malfunction of all four intake and exhaust valves on DG 3B.
DG-FR (DG 2B)	2/16/94		A Maint Rule Failure occurred on 2/16/94 at 15:48 per spreadsheet DG.XLS due to a fractured injection line. The DG had previously been run on this date at from 1000 to approx 1430 for monthly ST. Although the failure in DG.XLS is not applied to the 1000 run, there is an entry in the table that indicates that the failure occurred during Tech Spec Start #166.
DG-FS (DG 2B)	4/6/94 (4/10/94)	00656765	During operability testing, operations detected an abnormal noise and damage to the 4L cylinder was subsequently detected. Since the DG was never loaded due to the failure, this event was considered a fail to start failure although the DG came up to voltage and frequency unloaded.
DG-FR (DG 3B)	4/16/94	006577899	The DG failed at eighteen hours into a 24 hour post maintenance test run due to significant fuel leakage from the 2L Fuel Injection Pump. Since this was a tech spec start (i.e. - the DG had already been called operable) this failure is included although it could be excluded as post maintenance test. If this was done however then the run log would need to be reviewed and all run hours for post maintenance tests removed, and time was not available to perform this task).
DG Fuel Leakage or Lube Oil Leaks	1DGB -12/90 1DGB - 2/91 2DGA - 5/91 3DGA - 4/92 3DGB -10/91	00460824 00468457 00480875 00550603 00519587	These failures were determined not to be functional failures (FDT encoded as DG degraded not failed and they were not severe enough to be considered functional failures in DG.XLS spreadsheet. However there is a small probability that DG fuel leakage/ lube oil leakage could result in DG failure during an extended run. Therefore they are included as one-tenth of a fail to run event for each of the events.

C.4.5 PB Circuit Breakers Plant Specific Data

The FDT database was reviewed to identify fail to close failures on 4160 Volt Circui Breakers. Failure Data for circuit breakers PBAS03B, PBAS03C, PBAS03D, PBAS03E PBAS03F, PBAS03G, PBAS03M, PBAS03S.and the same breakers on PBB was accumu lated for update (16 Breakers per Unit).The PB Circuit Breaker failure experience is sum marized in Table 10.

Table 10: PB Circuit Breaker Failures (1990-1995)

FAILURE MODE/ EQPT ID	Date (WO Close Date)	WO	Source/Comments/ Dispositi
2EPBBS04F (LPSI Pump CB FTC) 2EPBAS03C (ESP CB FTC) 3EPBBS04F (LPSI CB FTC) 1EPBAS03F (LPSI CB FTC)	6/18/90 2/17/92 9/10/92 9/1/94	00430771 00540661 00570742 00635612	Circuit Breaker Failure to Close
1EPBBS04D (CS Pump CB FTC) 2EPBAS03M (ECW CB FTC) 2EPBAS03C (ESP CB FTC) 3EPBBS04F (LPSI CB FTC)	2/8/91 7/30/92 10/09/92 4/8/93	00469955 00566650 00576533 00603885	Circuit Breaker Failed to close due to uncharged closing springs. Due to rec problems of this type a design modific implemented which alarms if the char springs do nor recharge after breaker Since this failure mode is now alarme it will signify the need for corrective a when the breaker is subsequently ope can therefore be eliminated as a CB F
PB Circuit Breaker Control Circuit Faults resulting in Failure of PB Circuit Breakers to Close			FDT Search Indicates no control circu from 1990 - 1995 which resulted in fa the circuit breaker to close.

The PB CB-FT failure rate was therefore updated with4 failures in 2.52E+6 component hours (288 component hours) which corresponds. Control Circuit failures of load breakers are included with the component control circuit (e.g. - for the AF B pump, circuit breaker command faults are included with 1AFBP01----XCPBS).

C.4.6 SI Pump Plant Specific Data

A review of the FDT data base and the Maintenance Rule spreadsheets was performed. As documented in the 1996 Maintenance Rule Report, there were no failures of SI pumps to fail to start or run in the 1995 to 1996 time-frame. Therefore all these pumps and the associated control circuits were updated with no failures for the period 1995 to 1996. Data from the LPSI and CS pumps was combined since these pumps are very similar in design

C.4.7 Essential Chiller Plant Specific Experience

A review of the 1996 Maintenance Rule report and the associated excel spreadsheets were reviewed to identify EC fail to start failures that occurred during this period. EC chiller failures which occurred during the time period of January 1995 to December 1996 are summarized in Table 11:

Table 11: Essential Chiller Failures (1994- 1995)

FAILURE MODE/ EQPT ID	Date	Source/Comments/ Disposition
1ECAE01 (ARHFS)	11-27-95	Chiller tripped on low refrigerant temperature due to a freon leak. (The chiller ran about 30 minutes, but trips in the first hour of operation are included with fail to start, since the chiller requires a period of operation to stabilize and the trip rate is highest in the first minutes of operation.
2ECBE01 (ARHFS)	3-5-95	Chiller tripped on compressor low oil pressure.
3ECAE01 (ARHFS)	11-27-95	Chiller was manually tripped due to low temperature and oil pump cavitation. Maintenance Rule considers this a functional failure since there is some uncertainty regarding the ability to perform if it hadn't been tripped. I also conservatively included it as a full PRA functional failure (partially because of a 96 chiller failure that was excluded since it didn't occur in the 94 to 95 time frame).

All of these failures were attributed to deficiencies in the Chiller and not due to spurious control circuit faults. Therefore the ARHFS failure rate was updated with 3 failures in 12 Chiller years (105,000 Chiller hours). The Control Circuit Failure Rate (XCCAFS) was updated with zero failures in 12 Chiller years. The Fail to run failure rate was not updated but the data in the EC spreadsheet was reviewed, and the data therein is consistent with the generic rate used in the PRA (There have been two documented instances where the Chiller tripped off line but both were attributed to maintenance activities, which would normally be suspended post-accident, and the EC spreadsheets indicate approximately 8000 hours of Chiller run during this period.

C.5 Summary of Calculations

An EXCEL spreadsheet was written to perform the Bayesian update calculations described in section 4.1.2. The results of the spreadsheet calculations as well as intermediate results such as α and β are included in Table 12.