

**From:** Steven Long, *NAP*  
**To:** PDo, SDw1 *P O'Reilly + S Warrickby RES*  
**Date:** 1/2/01 2:04PM  
**Subject:** Fwd: Risk Assessment of IP2 SGTR & Loss of Bus 6A

*DD/28*

**From:** James Trapp  
**To:** Brian Holian; Peter Wilson; Richard Barrett; Steven Long  
**Date:** 12/26/00 7:07AM  
**Subject:** Risk Assessment of IP2 SGTR & Loss of Bus 6A

Per Steve's requested I've attached the risk evaluation completed to address this condition. I will add that since we completed this evaluation, the ASP folks have analyzed the Aug. 99 loss of bus 6A event and have significantly reduce the CCDP for this event over previous estimates by Region I and the licensee. The reason for the reduction is better estimates for recovery actions and methods which weren't included in the previous evaluations. Sunil would be your contact for the latest information regarding this analysis. To my understanding, the attached evaluation is the only attempt to assess the risk of a SGTR and the loss of bus 6A. Hope this helps! If not please give me a call 610-337-5186. Thanks

**Risk Assessment for Indian Point Unit 2  
A Hypothetical Case  
Loss of Safeguards Electrical Bus 6A  
Coincident with a Steam Generator Tube Rupture**

**Background:**

**February 15, 2000 - Steam Generator Tube Rupture**

The Indian Point Unit 2 facility experienced a steam generator tube rupture (SGTR) on February 14, 2000 when a flaw in the U-bend of tube R2C5 in steam generator 24 failed. This flaw had not been detected during the last nondestructive examination of steam generator tubes because of programmatic problems. During the recovery process following the SGTR, there were no failures in equipment or operator actions that were needed to mitigate the consequences of the event.

The conditional core damage probability (CCDP) associated with this event was calculated by ConEd using their risk model as  $7.7\text{E-}05$ . This is comparable to the CCDP of  $3.3\text{E-}04$  calculated using the NRC's Rev. 2-QA Standardized Plant Analysis Risk Model (SPAR) for Indian Point Unit 2. Additional analysis was performed by NRR to quantify the increase in core damage frequency (CDF) and large early release frequency (LERF) that resulted from operation with the flawed steam generator tubes<sup>1</sup>. An incremental increase in CDF was calculated as  $1.0\text{E-}04$  per reactor year for the second year of operation. In accordance with the guidance from MC0609, Appendix H, the LERF frequency equals the CDF for a SGTR, therefore the LERF frequency for this condition is also  $1.0\text{E-}04$ <sup>2</sup>. Risk was dominated by the probability of human error in identifying and isolating the faulted steam generator and depressurizing the reactor coolant system to below the steam generator safety valve pressure.

**August 31, 1999 - Reactor Trip and Loss of Safeguards Electrical Power**

The Indian Point Unit 2 facility also experienced a reactor trip prior to the SGTR on August 31, 1999. This trip was complicated by the loss of the 6A 480 volt ac safeguards electrical bus and the subsequent loss of the 24 battery. The loss of the 6A bus resulted in the loss of some emergency core cooling equipment including: one of the two motor driven auxiliary feedwater (AFW) trains, one of three high pressure injection trains, one of two high pressure recirculation trains, one of two residual heat removal trains and loss of power to one of the two normally closed PORV block valves.

The CCDP associated with this event was calculated as  $2.0\text{E-}04$  by the NRR Operations support team (OST). Risk was dominated by the failure probabilities of the one remaining motor driven AFW pump, the turbine driven AFW pump and the probability for non-recovery of main feedwater. Had auxiliary feedwater failed, core damage could normally be prevented through use of primary bleed and feed. The success for reactor coolant system bleed and feed requires

<sup>1</sup>Subsequent examination determined that other tubes had not been detected during the examination performed prior to the SGTR event.

<sup>2</sup>Reference: memorandum Barrett to Blough, dated May 4, 2000

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flow through both power operated relief valves (PORVs). However, flow through one of the PORVs was prevented because its normally closed block valve receives power from electrical bus 6A.

The CDF calculated using the NRC's Rev. 2-QA Standardized Plant Analysis Risk Model (SPAR) for Indian Point Unit 2 was somewhat less than that calculated by the OST. The Rev 2-QA SPAR<sup>3</sup> model calculated a CCDP for this event of 4.9E-05. The difference being that the SPAR model uses industry average basic event equipment failure data where the OST used data from the IP-2 individual plant evaluation (IPE) without including credit for equipment recovery.

**Risk Analysis of Concurrent Events:**

This analysis constructed a hypothetical event, a SGTR, for which the recovery was complicated by failures in the electrical distribution system similar to those experienced during the August 31 event. Risk would increase because of the loss of safety related equipment and also because of the additional challenges to the operators. The August 31 event proved difficult for the ConEd organization to analyze and react to in a timely manner.

The August 31<sup>st</sup> event was initiated following a normal reactor trip that was complicated by actuation of safeguards bus undervoltage protective devices. A switchyard transformer tap changer was in its manual mode for an extended period. The event would have been a routine reactor trip had the tap changer been in automatic mode. Following the loss of self generation, safeguards 480 volt ac bus voltage sagged because of plant distribution system impedance. Protective instrumentation started all three emergency diesel generators (EDGs). When the diesel generators were ready to load, their output breakers were closed onto the three safeguards electrical buses. However, the generator output breaker to bus 6A tripped open on overload. Subsequent investigation found issues with the overcurrent trip device calibration process, including the type of equipment used for this activity. Although the process deficiencies may have resulted in a common cause failure of all three EDG output breakers, only one of the breakers' overcurrent trip point was set low enough to cause an overcurrent trip. The above referenced risk analysis for this event did not include recovery of the EDG, recovery of offsite power or activation of the station blackout cross-connection from Unit 1. Recovery was not considered because it is a complex process and the licensee's organization performed poorly during follow-up to the event as evidenced by their allowing a station battery to discharge to the point of cell reversal.

<sup>3</sup> The IP-2 Rev 2-QA SPAR model was corrected to reflect the normally CLOSED position of the PORV block valves and was revised to credit operator recovery of the RHR suction path MOVs for shutdown cooling. The SPAR model human error recovery process was used to calculate the HRA for this recovery action as 2.0E-03 after consultation with RI operator licensing personnel.

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In reviewing the circumstances of these two events, it is clear that the causes for the August 31<sup>st</sup> event may not have revealed themselves until the SGTR event had there not been the earlier reactor trip. If that were the case, the SGTR recovery would have become complicated by the loss of power to important emergency safeguards equipment. A SGTR is a significant challenge to operators who would then have to cope with additional degraded plant equipment.

A risk assessment was performed of this hypothetical event, this assessment imposed the bus 6A electrical failures on to the SGTR event analysis. The CCDP was calculated using the NRC's Rev. 2-QA SPAR as 3.8E-04. The probability for core damage was dominated by the failure to identify and isolate the faulted steam generator and the failure to depressurize the RCS. This assessment did not calculate new human error probabilities for actions needed to recover from a SGTR. The loss of the 6A 480 volt electrical bus is expected to increase these failure probabilities because it complicates the recovery and causes additional stress to the operators. A copy of this analysis is Attachment 1.

**Effect of Concurrent Events on Human Reliability Analysis**

Additional stress may have affected the Indian Point Unit 2 plant operators performance if bus 6A had failed during the SGTR. This increase stress level was accounted for in an additional risk analysis that used recalculated human error probabilities for four of the five operator tasks associated with the SGTR top events:

RCS-SG	Depressurize RCS to below SG RV setpoint
DEP-REC	Operator depressurizes the RCS after SG RV lift
SGISOL	Ruptured SG isolated
THROTTLE	Throttle HPI to reduce pressure
RCS-DEP	Depressurize RCS to RHR entry

The human error values for these five tasks were originally derived for the Rev. 2-QA SPAR models from sources such as the Surry facility NUREG 1150 study<sup>4</sup>, plant IPE's and the NRC Daily Events Manual. These values were recalculated using the Rev. 3i SPAR Model Human Error Worksheets. For each case, the "Stress" shaping factor associated with task diagnosis or action was set to "Extreme". The following summarizes these changes:

Event Name	Task Description	Original Value	Re-Calculated Value
HPI-XHE-XM-THRTL	Operator fails to throttle HPI flow to reduce RCS pressure	1.0E-02 Surry 1150	5.0E-03
MSS-XHE-XM-ERROR	Operator fails to isolate faulted steam generator	1.0E-03 San Onfre IPE	5.0E-03

<sup>4</sup>Analysis of Core Damage frequency: Surry Unit 1, Internal Events, NUREG/CR-4550

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PCS-XHE-XM-RCOOL	Operator fails to initiate RCS cooldown below SDC	1.0E-03 Daily Events Manual	no change
RCS-XHE-DIAG	Operator fails to diagnose SGTR and start procedures	6.8E-03 Surry 1150	2.1E-02
RCS-XHE-RECOVER	Operator fails to depressurize RCS below SG SRV given SG RV opens	3.5E-03 Surry 1150	5.0E-03
RCS-XHE-XM-SG	Operator fails to initiate RCS depressurization	2.1E-02 Surry 1150	5.0E-03

The CCDP for a SGTR with a loss of the 6A 480 volt electrical bus and re-calculated human error failure probabilities is 4.6E-04. A copy of this risk assessment is Attachment 2. Again, the probability for core damage was dominated by the failure to identify and isolate the faulted steam generator and the failure to depressurize the RCS. The table below lists the human error tasks and the contribution to the CDF from cut sets that the tasks are included.

Event Name	Task Description	Contribution to CDF	
RCS-XHE-RECOVER	Operator fails to depressurize RCS below SG SRV given SG RV opens	1.6E-04	33.6%
RCS-XHE-DIAG	Operator fails to diagnose SGTR and start procedures	1.1E-04	23.8%
MSS-XHE-XM-ERROR	Operator fails to isolate faulted steam generator	7.8E-05	16.9%
RCS-XHE-XM-SG	Operator fails to initiate RCS depressurization	2.6E-05	5.7%
HPI-XHE-XM-THRTL	Operator fails to throttle HPI flow to reduce RCS pressure	2.6E-05	5.7%
PCS-XHE-XM-RCOOL	Operator fails to initiate RCS cooldown below SDC	1.5E-05	3.4%

**Completed by:**  
**Tom Shedlosky**

**Reviewed by:**  
**Jim Trapp**

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Risk Assessment - Indian Point 2 Attachment 1

INITIATING EVENT ASSESSMENT

Fam : IPT2\_2QA  
 User :  
 Ev ID: SGTR W/BUS 6A OOS  
 Desc : Initiating Event Assessment

Code Ver : 6:68  
 Model Ver : 1998/04/14  
 Init Event: IE-SGTR  
 Total CCDP: 3.8E-004

BASIC EVENT CHANGES			
Event Name Type	Description	Base Prob	Curr Prob
ACP-BAC-LP-6A	DIVISION 6A AC POWER 480V BU	9.0E-005	1.0E+000 TRUE
IE-LOOP	LOSS OF OFFSITE POWER INITIA	3.1E-005	+0.0E+000
IE-SGTR	STEAM GENERATOR TUBE RUPTURE	1.6E-006	1.0E+000
IE-SLOCA	SMALL LOCA INITIATING EVENT	2.3E-006	+0.0E+000
IE-TRANS	TRANSIENT INITIATING EVENT	2.7E-004	+0.0E+000

SEQUENCE PROBABILITIES

Truncation : Cumulative : 100.0% Individual : 1.0%

Event Tree Name %Cont	Sequence Name	CCDP
SGTR	11	1.3E-004
34.2		
SGTR	03	1.2E-004
31.6		
SGTR	43	5.7E-005
15.0		
SGTR	04	4.4E-005
11.6		
SGTR	05	1.0E-005
2.6		
SGTR	44	5.5E-006
1.5		
SGTR	08	4.6E-006
1.2		

SEQUENCE LOGIC

Event Tree	Sequence Name	Logic
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**Risk Assessment - Indian Point 2      Attachment 1**

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SGTR	11	/RT /HPI DEP-REC	/AFW-SGTR RCS-SG
SGTR	03	/RT /HPI /SG-DEP /RCS-DEP	/AFW-SGTR /RCS-SG SGISOL RHR
SGTR	43	/RT MFW-NT	AFW-SGTR F&B
SGTR	04	/RT /HPI /SG-DEP	/AFW-SGTR /RCS-SG SGISOL

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		RCS-DEP	
SGTR	05	/RT	/AFW-SGTR
		/HPI	/RCS-SG
		SG-DEP	
SGTR	44	RT	
SGTR	08	/RT	/AFW-SGTR
		/HPI	RCS-SG
		/DEP-REC	/SG-DEP
		SGISOL1	/RCS-DEP
		RHR	

Fault Tree Name	Description
AFW-SGTR	NO OR INSUFFICIENT AFW FLOW DURING SGTR
DEP-REC	OPERATOR FAILS TO DEPRESSURIZE RCS GIVEN SG ADV OR
SR	
F&B	FAILURE TO PROVIDE FEED AND BLEED COOLING
HPI	NO OR INSUFFICIENT FLOW FROM THE HPI SYSTEM
MFV-NT	FAILURE OF THE MAIN FEEDWATER SYSTEM DURING NON-
TRANS	
RCS-DEP	FAILURE TO COOLDOWN RCS TO < RHR PRESSURE
RCS-SG	OPERATOR FAILS TO LOWER RCS PRESSURE TO < SG RV
SETP	
RHR	NO OR INSUFFICIENT FLOW FROM THE RHR SYSTEM
RT	REACTOR FAILS TO TRIP DURING TRANSIENT
SG-DEP	HARDWARE FAILS TO LOWER RCS PRESSURE TO < SG RV
SETPO	
SGISOL	FAILURE TO ISOLATE RUPTURED SG BEFORE RWST DEPLETION
SGISOL1	FAILURE TO DEPRESSURIZE RCS TO ISOLATE SG

**SEQUENCE CUT SETS**

Truncation: Cumulative: 100.0% Individual: 1.0%

Event Tree: SGTR CCDF: 1.3E-004  
Sequence: 11

CCDF	% Cut Set	Cut Set Events
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7.4E-005	55.6	RCS-XHE-RECOVER SGTR-11-NREC	RCS-XHE-XM-SG
3.5E-005	26.5	RCS-XHE-RECOVER SGTR-11-NREC	HPI-XHE-XM-THRTL
2.4E-005	18.0	RCS-XHE-RECOVER SGTR-11-NREC	RCS-XHE-DIAG

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Event Tree: SGTR  
 Sequence: 03

CCDP: 1.2E-004

CCDP	% Cut Set	Cut Set Events	
3.8E-005	31.7	RHR-MDP-FC-2B SGTR-03-NREC	MSS-VCF-HW-ISOL
3.0E-005	25.0	RHR-MOV-OO-RWST SGTR-03-NREC	MSS-VCF-HW-ISOL
2.0E-005	16.7	MSS-VCF-HW-ISOL SGTR-03-NREC	RHR-XHE-SUCTION
1.0E-005	8.3	RHR-XHE-XM SGTR-03-NREC	MSS-VCF-HW-ISOL
5.6E-006	4.7	RHR-MDP-CF-ALL SGTR-03-NREC	MSS-VCF-HW-ISOL
3.8E-006	3.2	RHR-MDP-FC-2B SGTR-03-NREC	MSS-XHE-XM-ERROR
3.0E-006	2.5	RHR-MOV-OO-RWST SGTR-03-NREC	MSS-XHE-XM-ERROR
2.6E-006	2.2	RHR-MOV-CF-DIS SGTR-03-NREC	MSS-VCF-HW-ISOL
2.0E-006	1.7	MSS-XHE-XM-ERROR SGTR-03-NREC	RHR-XHE-SUCTION
1.4E-006	1.2	RHR-MOV-OC-VLV SGTR-03-NREC	MSS-VCF-HW-ISOL

Event Tree: SGTR  
 Sequence: 43

CCDP: 5.7E-005

CCDP	% Cut Set	Cut Set Events	
2.8E-005	49.0	AFW-MDP-FC-21 SGTR-43-NREC	AFW-TDP-FC-22
1.2E-005	21.3	AFW-PMP-CF-ALL	SGTR-43-NREC
7.9E-006	13.8	AFW-TDP-FC-22 SGTR-43-NREC	AFW-AOV-CC-MSG21
4.0E-006	7.0	AFW-AOV-CF-SGS	SGTR-43-NREC
1.5E-006	2.6	AFW-MDP-CF-AB SGTR-43-NREC	AFW-TDP-FC-22
7.2E-007	1.3	AFW-TDP-FC-22 SGTR-43-NREC	AFW-CKV-CC-SG21

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6.5E-007	1.1	AFW-TDP-FC-22	ACP-BAC-LP-2-3A
		SGTR-43-NREC	
5.9E-007	1.0	AFW-CKV-CF-SUCT	SGTR-43-NREC
5.9E-007	1.0	AFW-CKV-CF-SGS-S	SGTR-43-NREC
5.9E-007	1.0	AFW-CKV-CF-PMPS	SGTR-43-NREC

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Event Tree: SGTR  
 Sequence: 04

CCDP: 4.4E-005

CCDP	% Cut Set	Cut Set Events	
3.0E-005	68.2	PCS-VCF-HW SGTR-04-NREC	MSS-VCF-HW-ISOL
1.0E-005	22.7	PCS-XHE-XM-RCOOL SGTR-04-NREC	MSS-VCF-HW-ISOL
3.0E-006	6.8	PCS-VCF-HW SGTR-04-NREC	MSS-XHE-XM-ERROR
1.0E-006	2.3	PCS-XHE-XM-RCOOL SGTR-04-NREC	MSS-XHE-XM-ERROR

Event Tree: SGTR  
 Sequence: 05

CCDP: 1.0E-005

CCDP	% Cut Set	Cut Set Events	
1.0E-005	100.0	PCS-PSF-HW	SGTR-05-NREC

Event Tree: SGTR  
 Sequence: 44

CCDP: 5.5E-006

CCDP	% Cut Set	Cut Set Events	
4.3E-006	77.8	RPS-XHE-XM-SCRAM SGTR-44-NREC	RPS-VCF-FO-ELEC
1.1E-006	20.6	RPS-BKR-FC-FTO SGTR-44-NREC	RPS-XHE-ERROR
8.9E-008	1.6	RPS-VCF-FO-MECH	SGTR-44-NREC

Event Tree: SGTR  
 Sequence: 08

CCDP: 4.6E-006

CCDP	% Cut Set	Cut Set Events	
8.0E-007	17.4	RHR-MDP-FC-2B MSS-VCF-HW-ISOL	RCS-XHE-XM-SG SGTR-08-NREC

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6.3E-007	13.7	RHR-MOV-OO-RWST	RCS-XHE-XM-SG
		MSS-VPF-HW-ISOL	SGTR-08-NREC
4.2E-007	9.2	RCS-XHE-XM-SG	MSS-VPF-HW-ISOL
		RHR-XHE-SUCTION	SGTR-08-NREC
3.8E-007	8.3	RHR-MDP-FC-2B	HPI-XHE-XM-THRTL
		MSS-VPF-HW-ISOL	SGTR-08-NREC
3.0E-007	6.5	RHR-MOV-OO-RWST	HPI-XHE-XM-THRTL
		MSS-VPF-HW-ISOL	SGTR-08-NREC
2.6E-007	5.6	RHR-MDP-FC-2B	RCS-XHE-DIAG
		MSS-VPF-HW-ISOL	SGTR-08-NREC
2.1E-007	4.6	RCS-XHE-XM-SG	RHR-XHE-XM
		MSS-VPF-HW-ISOL	SGTR-08-NREC

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2.0E-007	4.5	RHR-MOV-OO-RWST	RCS-XHE-DIAG
		MSS-VCF-HW-ISOL	SGTR-08-NREC
2.0E-007	4.4	HPI-XHE-XM-THRTL	MSS-VCF-HW-ISOL
		RHR-XHE-SUCTION	SGTR-08-NREC
1.4E-007	3.0	RCS-XHE-DIAG	MSS-VCF-HW-ISOL
		RHR-XHE-SUCTION	SGTR-08-NREC
1.2E-007	2.6	RHR-MDP-CF-ALL	RCS-XHE-XM-SG
		MSS-VCF-HW-ISOL	SGTR-08-NREC
1.0E-007	2.2	HPI-XHE-XM-THRTL	RHR-XHE-XM
		MSS-VCF-HW-ISOL	SGTR-08-NREC
8.0E-008	1.7	RHR-MDP-FC-2B	RCS-XHE-XM-SG
		MSS-XHE-XM-ERROR	SGTR-08-NREC
6.8E-008	1.5	RCS-XHE-DIAG	RHR-XHE-XM
		MSS-VCF-HW-ISOL	SGTR-08-NREC
6.3E-008	1.4	RHR-MOV-OO-RWST	RCS-XHE-XM-SG
		MSS-XHE-XM-ERROR	SGTR-08-NREC
5.6E-008	1.2	RHR-MDP-CF-ALL	HPI-XHE-XM-THRTL
		MSS-VCF-HW-ISOL	SGTR-08-NREC
5.5E-008	1.2	RCS-XHE-XM-SG	RHR-MOV-CF-DIS
		MSS-VCF-HW-ISOL	SGTR-08-NREC

BASIC EVENTS (Cut Sets Only)

Event Name Prob	Description	Curr
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ACP-BAC-LP-2-3A 005	DIVISION 2A/3A AC POWER 480V BUS FAILS	9.0E-
AFW-AOV-CC-MSG21 003	SG-21 FLOW CONTROL VALVE 406A FAILS	1.1E-
AFW-AOV-CF-SGS 005	CCF OF STEAM GENERATOR INLET AOVs (FCVS)	1.9E-
AFW-CKV-CC-SG21 004	STEAM GENERATOR 21 INLET CHECK VALVE FAILS	1.0E-
AFW-CKV-CF-PMPS 006	CCF OF AFW PUMP DISCHARGE CHECK VALVES	2.7E-
AFW-CKV-CF-SGS-S 006	CCF OF SG INLET CHECK VALVES - SGTR	2.7E-
AFW-CKV-CF-SUCT 006	CCF OF AFW PUMP SUCTION CHECK VALVES	2.7E-
AFW-MDP-CF-AB 004	COMMON CAUSE FAILURE OF MOTOR DRIVEN PUMPS	2.1E-
AFW-MDP-FC-21 003	AFW MOTOR DRIVEN PUMP 21 FAILS	3.9E-
AFW-PMP-CF-ALL	COMMON CAUSE FAILURE OF AFW PUMPS	5.6E-

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005		
AFW-TDP-FC-22	AFW TURBINE DRIVEN PUMP 22 FAILS	3.3E-
002		
HPI-XHE-XM-THRTL	OPERATOR FAILS TO THROTTLE HPI TO REDUCE PRES	1.0E-
002		
MSS-VCF-HW-ISOL	RUPTURED STEAM GENERATOR ISOLATION FAILURES	1.0E-
002		
MSS-XHE-XM-ERROR	OPERATOR FAILS TO ISOLATE FAULTED STEAM GENER	1.0E-
003		
PCS-PSF-HW	HARDWARE FAILURES CAUSING FAILURE TO DEPRESSU	1.0E-
005		
PCS-VCF-HW	TBVS/COND/CIR FAILURES	3.0E-
003		
PCS-XHE-XM-RCOOL	OPERATOR FAILS TO INITIATE RCS COOLDOWN BELOW	1.0E-
003		
RCS-XHE-DIAG	OPERATOR FAILS TO DIAGNOSE SGTR TO START PROC	6.8E-
003		
RCS-XHE-RECOVER	OPERATOR FAILS TO DEPRESSURIZE RCS BELOW SG S	3.5E-
003		
RCS-XHE-XM-SG	OPERATOR FAILS TO INITIATE RCS DEPRESSURIZATI	2.1E-
002		
RHR-MDP-CF-ALL	RHR PUMP COMMON CAUSE FAILURES	5.6E-
004		
RHR-MDP-FC-2B	RHR TRAIN B FAILS	3.8E-
003		
RHR-MOV-CF-DIS	COMMON CAUSE FAILURE OF RHR DISCHARGE MOVS	2.6E-
004		
RHR-MOV-OC-VLV	RHR DISCHARGE VALVE FAILS	1.4E-
004		
RHR-MOV-OO-RWST	RHR/RWST ISOLATION MOV FAILS	3.0E-
003		
RHR-XHE-SUCTION	OPERATOR FAILS TO RECOVER RHR SUCTION PATH	2.0E-
003		

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Event Name Prob	Description	Curr
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RHR-XHE-XM 003	OPERATOR FAILS TO INITIATE RHR SYSTEM	1.0E-
RPS-BKR-FC-FTO 006	RPS BREAKERS FAIL TO OPEN	5.7E-
RPS-VCF-FO-ELEC 004	CONTROL ROD DRIVES REMAIN ENERGIZED	4.3E-
RPS-VCF-FO-MECH 008	CONTROL ROD ASSEMBLIES FAIL TO INSERT	8.9E-
RPS-XHE-ERROR 001	OPERATOR FAILS TO DE-ENERGIZE MG SETS	2.0E-
RPS-XHE-XM-SCRAM 002	OPERATOR FAILS TO MANUALLY TRIP THE REACTOR	1.0E-
SGTR-03-NREC 1.0E+000	SGTR SEQUENCE 03 NONRECOVERY PROBABILITY	
SGTR-04-NREC 1.0E+000	SGTR SEQUENCE 04 NONRECOVERY PROBABILITY	
SGTR-05-NREC 1.0E+000	SGTR SEQUENCE 05 NONRECOVERY PROBABILITY	
SGTR-08-NREC 1.0E+000	SGTR SEQUENCE 08 NONRECOVERY PROBABILITY	
SGTR-11-NREC 1.0E+000	SGTR SEQUENCE 11 NONRECOVERY PROBABILITY	
SGTR-43-NREC 001	SGTR SEQUENCE 43 NONRECOVERY PROBABILITY	2.2E-
SGTR-44-NREC 1.0E+000	SGTR SEQUENCE 44 NONRECOVERY PROBABILITY	

**Risk Assessment - Indian Point 2**  
**Loss of Safeguards Electrical Bus 6A**  
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**Risk Assessment - Indian Point 2      Attachment 1**

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**Risk Assessment - Indian Point 2**  
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Risk Assessment - Indian Point 2 Attachment 1

INITIATING EVENT ASSESSMENT

Fam : IPT2\_2QA  
 User :  
 Ev ID: SGTR W/BUS 6A OOS  
 Desc : Initiating Event Assessment

Code Ver : 6:68  
 Model Ver : 1998/04/14  
 Init Event: IE-SGTR  
 Total CCDP: 4.6E-004

BASIC EVENT CHANGES				
Event Name Type	Description	Base Prob	Curr Prob	
---	---	---	---	---
ACP-BAC-LP-6A	DIVISION 6A AC POWER 480V BU	9.0E-005	1.0E+000	TRUE
HPI-XHE-XM-THRTL	OPERATOR FAILS TO THROTTLE H	1.0E-002	5.0E-003	
IE-LOOP	LOSS OF OFFSITE POWER INITIA	3.1E-005	+0.0E+000	
IE-SGTR	STEAM GENERATOR TUBE RUPTURE	1.6E-006	1.0E+000	
IE-SLOCA	SMALL LOCA INITIATING EVENT	2.3E-006	+0.0E+000	
IE-TRANS	TRANSIENT INITIATING EVENT	2.7E-004	+0.0E+000	
MSS-XHE-XM-ERROR	OPERATOR FAILS TO ISOLATE FA	1.0E-003	5.0E-003	
RCS-XHE-DIAG	OPERATOR FAILS TO DIAGNOSE S	6.8E-003	2.1E-002	
RCS-XHE-RECOVER	OPERATOR FAILS TO DEPRESSURI	3.5E-003	5.0E-003	
RCS-XHE-XM-SG	OPERATOR FAILS TO INITIATE R	2.1E-002	5.0E-003	

SEQUENCE PROBABILITIES

Truncation : Cumulative : 100.0% Individual : 0.0%

Event Tree Name %Cont	Sequence Name	CCDP
---	---	---
SGTR	03	1.6E-004
34.8		
SGTR	11	1.6E-004
34.8		
SGTR	04	6.0E-005
13.0		
SGTR	43	5.7E-005
12.4		

**Risk Assessment - Indian Point 2**  
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**Risk Assessment - Indian Point 2      Attachment 1**

SGTR	05	1.0E-005
2.2		
SGTR	44	5.5E-006
1.2		
SGTR	08	5.1E-006
1.1		
SGTR	13	3.4E-006
0.7		
SGTR	09	1.9E-006
0.4		
SGTR	10	3.1E-007
0.1		
SGTR	16	8.8E-008
0.0		
SGTR	18	2.9E-008
0.0		
SGTR	14	2.2E-009
0.0		
SGTR	17	5.8E-011
0.0		

**SEQUENCE LOGIC**

Event Tree	Sequence Name	Logic
---	---	---
SGTR	03	/RT /HPI /SG-DEP
		/AFW-SGTR /RCS-SG SGISOL

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		/RCS-DEP	RHR
SGTR	11	/RT /HPI DEP-REC	/AFW-SGTR RCS-SG
SGTR	04	/RT /HPI /SG-DEP RCS-DEP	/AFW-SGTR /RCS-SG SGISOL
SGTR	43	/RT MFW-NT	AFW-SGTR F&B
SGTR	05	/RT /HPI SG-DEP	/AFW-SGTR /RCS-SG
SGTR	44	RT	
SGTR	08	/RT /HPI /DEP-REC SGISOL1 RHR	/AFW-SGTR RCS-SG /SG-DEP /RCS-DEP
SGTR	13	/RT HPI /SG-DEP	/AFW-SGTR /RCS-SG1 SGISOL
SGTR	09	/RT /HPI /DEP-REC SGISOL1	/AFW-SGTR RCS-SG /SG-DEP RCS-DEP
SGTR	10	/RT /HPI /DEP-REC	/AFW-SGTR RCS-SG SG-DEP
SGTR	16	/RT HPI /DEP-REC SGISOL1	/AFW-SGTR RCS-SG1 /SG-DEP
SGTR	18	/RT HPI DEP-REC	/AFW-SGTR RCS-SG1

**Risk Assessment - Indian Point 2**  
**Loss of Safeguards Electrical Bus 6A**  
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**Risk Assessment - Indian Point 2      Attachment 1**

SGTR	14	/RT	/AFW-SGTR
		HPI	/RCS-SG1
		SG-DEP	

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**Risk Assessment - Indian Point 2 Attachment 1**

SGTR 17 /RT /AFW-SGTR  
 HPI RCS-SG1  
 /DEP-REC SG-DEP

Fault Tree Name	Description
AFW-SGTR	NO OR INSUFFICIENT AFW FLOW DURING SGTR
DEP-REC	OPERATOR FAILS TO DEPRESSURIZE RCS GIVEN SG ADV OR
SR	
F&B	FAILURE TO PROVIDE FEED AND BLEED COOLING
HPI	NO OR INSUFFICIENT FLOW FROM THE HPI SYSTEM
MFW-NT	FAILURE OF THE MAIN FEEDWATER SYSTEM DURING NON-
TRANS	
RCS-DEP	FAILURE TO COOLDOWN RCS TO < RHR PRESSURE
RCS-SG	OPERATOR FAILS TO LOWER RCS PRESSURE TO < SG RV
SETP	
RCS-SG1	OPERATOR FAILS TO LOWER RCS PRESSURE TO < SG RV
SETPO	
RHR	NO OR INSUFFICIENT FLOW FROM THE RHR SYSTEM
RT	REACTOR FAILS TO TRIP DURING TRANSIENT
SG-DEP	HARDWARE FAILS TO LOWER RCS PRESSURE TO < SG RV
SETPO	
SGISOL	FAILURE TO ISOLATE RUPTURED SG BEFORE RWST DEPLETION
SGISOL1	FAILURE TO DEPRESSURIZE RCS TO ISOLATE SG

**SEQUENCE CUT SETS**

Truncation: Cumulative: 100.0% Individual: 1.0%

Event Tree: SGTR  
 Sequence: 03

CCDP: 1.6E-004

CCDP	% Cut Set	Cut Set Events
3.8E-005	23.3	RHR-MDP-FC-2B MSS-VCF-HW-ISOL SGTR-03-NREC
3.0E-005	18.4	RHR-MOV-OO-RWST MSS-VCF-HW-ISOL SGTR-03-NREC

**Risk Assessment - Indian Point 2**  
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**Risk Assessment - Indian Point 2      Attachment 1**

2.0E-005	12.2	MSS-VCF-HW-ISOL SGTR-03-NREC	RHR-XHE-SUCTION
1.9E-005	11.6	RHR-MDP-FC-2B SGTR-03-NREC	MSS-XHE-XM-ERROR
1.5E-005	9.2	RHR-MOV-OO-RWST SGTR-03-NREC	MSS-XHE-XM-ERROR
1.0E-005	6.1	MSS-XHE-XM-ERROR SGTR-03-NREC	RHR-XHE-SUCTION
1.0E-005	6.1	RHR-XHE-XM SGTR-03-NREC	MSS-VCF-HW-ISOL
5.6E-006	3.4	RHR-MDP-CF-ALL SGTR-03-NREC	MSS-VCF-HW-ISOL
5.0E-006	3.1	RHR-XHE-XM SGTR-03-NREC	MSS-XHE-XM-ERROR
2.8E-006	1.7	RHR-MDP-CF-ALL SGTR-03-NREC	MSS-XHE-XM-ERROR

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 Loss of Safeguards Electrical Bus 6A  
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**Risk Assessment - Indian Point 2 Attachment 1**

2.6E-006

1.6

RHR-MOV-CF-DIS  
 SGTR-03-NREC

MSS-VCF-HW-ISOL

Event Tree: SGTR  
 Sequence: 11

CCDP: 1.6E-004

CCDP	% Cut Set	Cut Set Events	
1.1E-004	67.7	RCS-XHE-RECOVER SGTR-11-NREC	RCS-XHE-DIAG
2.5E-005	16.1	RCS-XHE-RECOVER SGTR-11-NREC	RCS-XHE-XM-SG
2.5E-005	16.1	RCS-XHE-RECOVER SGTR-11-NREC	HPI-XHE-XM-THRTL

Event Tree: SGTR  
 Sequence: 04

CCDP: 6.0E-005

CCDP	% Cut Set	Cut Set Events	
3.0E-005	50.0	PCS-VCF-HW SGTR-04-NREC	MSS-VCF-HW-ISOL
1.5E-005	25.0	PCS-VCF-HW SGTR-04-NREC	MSS-XHE-XM-ERROR
1.0E-005	16.7	PCS-XHE-XM-RCOOL SGTR-04-NREC	MSS-VCF-HW-ISOL
5.0E-006	8.3	PCS-XHE-XM-RCOOL SGTR-04-NREC	MSS-XHE-XM-ERROR

Event Tree: SGTR  
 Sequence: 43

CCDP: 5.7E-005

CCDP	% Cut Set	Cut Set Events	
2.8E-005	49.0	AFW-MDP-FC-21 SGTR-43-NREC	AFW-TDP-FC-22
1.2E-005	21.3	AFW-PMP-CF-ALL	SGTR-43-NREC
7.9E-006	13.8	AFW-TDP-FC-22 SGTR-43-NREC	AFW-AOV-CC-MSG21
4.0E-006	7.0	AFW-AOV-CF-SGS	SGTR-43-NREC
1.5E-006	2.6	AFW-MDP-CF-AB	AFW-TDP-FC-22

**Risk Assessment - Indian Point 2**  
**Loss of Safeguards Electrical Bus 6A**  
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**Risk Assessment - Indian Point 2      Attachment 1**

7.2E-007	1.3	SGTR-43-NREC AFW-TDP-FC-22	AFW-CKV-CC-SG21
6.5E-007	1.1	SGTR-43-NREC AFW-TDP-FC-22	ACP-BAC-LP-2-3A
5.9E-007	1.0	SGTR-43-NREC AFW-CKV-CF-SUCT	SGTR-43-NREC
5.9E-007	1.0	AFW-CKV-CF-SGS-S	SGTR-43-NREC
5.9E-007	1.0	AFW-CKV-CF-PMPS	SGTR-43-NREC

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Risk Assessment - Indian Point 2 Attachment 1

Event Tree: SGTR  
Sequence: 05

CCDP: 1.0E-005

CCDP	% Cut Set	Cut Set Events	
-----	-----	-----	-----
1.0E-005	100.0	PCS-PSF-HW	SGTR-05-NREC

Event Tree: SGTR  
Sequence: 44

CCDP: 5.5E-006

CCDP	% Cut Set	Cut Set Events	
-----	-----	-----	-----
4.3E-006	77.8	RPS-XHE-XM-SCRAM	RPS-VCF-FO-ELEC
		SGTR-44-NREC	
1.1E-006	20.6	RPS-BKR-FC-FTO	RPS-XHE-ERROR
		SGTR-44-NREC	
8.9E-008	1.6	RPS-VCF-FO-MECH	SGTR-44-NREC

Event Tree: SGTR  
Sequence: 08

CCDP: 5.1E-006

CCDP	% Cut Set	Cut Set Events	
-----	-----	-----	-----
8.0E-007	15.6	RHR-MDP-FC-2B	RCS-XHE-DIAG
		MSS-VCF-HW-ISOL	SGTR-08-NREC
6.3E-007	12.3	RHR-MOV-OO-RWST	RCS-XHE-DIAG
		MSS-VCF-HW-ISOL	SGTR-08-NREC
4.2E-007	8.2	RCS-XHE-DIAG	MSS-VCF-HW-ISOL
		RHR-XHE-SUCTION	SGTR-08-NREC
4.0E-007	7.8	RHR-MDP-FC-2B	RCS-XHE-DIAG
		MSS-XHE-XM-ERROR	SGTR-08-NREC
3.2E-007	6.2	RHR-MOV-OO-RWST	RCS-XHE-DIAG
		MSS-XHE-XM-ERROR	SGTR-08-NREC
2.1E-007	4.1	RCS-XHE-DIAG	RHR-XHE-XM
		MSS-VCF-HW-ISOL	SGTR-08-NREC
2.1E-007	4.1	RCS-XHE-DIAG	MSS-XHE-XM-ERROR
		RHR-XHE-SUCTION	SGTR-08-NREC
1.9E-007	3.7	RHR-MDP-FC-2B	HPI-XHE-XM-THRTL
		MSS-VCF-HW-ISOL	SGTR-08-NREC
1.9E-007	3.7	RHR-MDP-FC-2B	RCS-XHE-XM-SG

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**Risk Assessment - Indian Point 2 Attachment 1**

1.5E-007	2.9	MSS-VCF-HW-ISOL	SGTR-08-NREC
		RHR-MOV-OO-RWST	HPI-XHE-XM-THRTL
1.5E-007	2.9	MSS-VCF-HW-ISOL	SGTR-08-NREC
		RHR-MOV-OO-RWST	RCS-XHE-XM-SG
1.2E-007	2.3	MSS-VCF-HW-ISOL	SGTR-08-NREC
		RHR-MDP-CF-ALL	RCS-XHE-DIAG
1.1E-007	2.1	MSS-VCF-HW-ISOL	SGTR-08-NREC
		RCS-XHE-DIAG	RHR-XHE-XM
1.0E-007	2.0	MSS-XHE-XM-ERROR	SGTR-08-NREC
		HPI-XHE-XM-THRTL	MSS-VCF-HW-ISOL
		RHR-XHE-SUCTION	SGTR-08-NREC

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**Risk Assessment - Indian Point 2 Attachment 1**

1.0E-007	2.0	RCS-XHE-XM-SG	MSS-VCF-HW-ISOL
		RHR-XHE-SUCTION	SGTR-08-NREC
9.5E-008	1.9	RHR-MDP-FC-2B	HPI-XHE-XM-THRTL
		MSS-XHE-XM-ERROR	SGTR-08-NREC
9.5E-008	1.9	RHR-MDP-FC-2B	RCS-XHE-XM-SG
		MSS-XHE-XM-ERROR	SGTR-08-NREC
7.5E-008	1.5	RHR-MOV-OO-RWST	HPI-XHE-XM-THRTL
		MSS-XHE-XM-ERROR	SGTR-08-NREC
7.5E-008	1.5	RHR-MOV-OO-RWST	RCS-XHE-XM-SG
		MSS-XHE-XM-ERROR	SGTR-08-NREC
5.9E-008	1.2	RHR-MDP-CF-ALL	RCS-XHE-DIAG
		MSS-XHE-XM-ERROR	SGTR-08-NREC
5.5E-008	1.1	RCS-XHE-DIAG	RHR-MOV-CF-DIS
		MSS-VCF-HW-ISOL	SGTR-08-NREC

Event Tree: SGTR  
 Sequence: 13

CCDP: 3.4E-006

CCDP	% Cut Set	Cut Set Events	
1.2E-006	35.1	HPI-MOV-OC-SUCT	MSS-VCF-HW-ISOL
		SGTR-13-NREC	
7.6E-007	22.8	HPI-MDP-CF-ALL	MSS-VCF-HW-ISOL
		SGTR-13-NREC	
5.9E-007	17.5	HPI-MOV-OC-SUCT	MSS-XHE-XM-ERROR
		SGTR-13-NREC	
3.8E-007	11.4	HPI-MDP-CF-ALL	MSS-XHE-XM-ERROR
		SGTR-13-NREC	
1.2E-007	3.7	HPI-MDP-FC-2A	HPI-MDP-FC-2B
		MSS-VCF-HW-ISOL	SGTR-13-NREC
9.2E-008	2.8	MSS-VCF-HW-ISOL	HPI-CKV-CF-CLINJ
		SGTR-13-NREC	
6.2E-008	1.9	HPI-MDP-FC-2A	HPI-MDP-FC-2B
		MSS-XHE-XM-ERROR	SGTR-13-NREC
4.6E-008	1.4	MSS-XHE-XM-ERROR	HPI-CKV-CF-CLINJ
		SGTR-13-NREC	

Event Tree: SGTR  
 Sequence: 09

CCDP: 1.9E-006

CCDP	% Cut Set	Cut Set Events	

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6.3E-007	33.6	PCS-VCF-HW	RCS-XHE-DIAG
		MSS-VCF-HW-ISOL	SGTR-09-NREC
3.2E-007	16.8	PCS-VCF-HW	RCS-XHE-DIAG
		MSS-XHE-XM-ERROR	SGTR-09-NREC
2.1E-007	11.2	PCS-XHE-XM-RCOOL	RCS-XHE-DIAG
		MSS-VCF-HW-ISOL	SGTR-09-NREC
1.5E-007	8.0	PCS-VCF-HW	RCS-XHE-XM-SG
		MSS-VCF-HW-ISOL	SGTR-09-NREC
1.5E-007	8.0	PCS-VCF-HW	HPI-XHE-XM-THRTL
		MSS-VCF-HW-ISOL	SGTR-09-NREC

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1.1E-007	5.6	PCS-XHE-XM-RCOOL	RCS-XHE-DIAG
		MSS-XHE-XM-ERROR	SGTR-09-NREC
7.5E-008	4.0	PCS-VCF-HW	HPI-XHE-XM-THRTL
		MSS-XHE-XM-ERROR	SGTR-09-NREC
7.5E-008	4.0	PCS-VCF-HW	RCS-XHE-XM-SG
		MSS-XHE-XM-ERROR	SGTR-09-NREC
5.0E-008	2.7	PCS-XHE-XM-RCOOL	RCS-XHE-XM-SG
		MSS-VCF-HW-ISOL	SGTR-09-NREC
5.0E-008	2.7	PCS-XHE-XM-RCOOL	HPI-XHE-XM-THRTL
		MSS-VCF-HW-ISOL	SGTR-09-NREC
2.5E-008	1.3	PCS-XHE-XM-RCOOL	HPI-XHE-XM-THRTL
		MSS-XHE-XM-ERROR	SGTR-09-NREC
2.5E-008	1.3	PCS-XHE-XM-RCOOL	RCS-XHE-XM-SG
		MSS-XHE-XM-ERROR	SGTR-09-NREC

Event Tree: SGTR  
Sequence: 10

CCDP: 3.1E-007

CCDP	% Cut Set	Cut Set Events	
2.1E-007	67.7	RCS-XHE-DIAG	PCS-PSF-HW
		SGTR-10-NREC	
5.0E-008	16.1	RCS-XHE-XM-SG	PCS-PSF-HW
		SGTR-10-NREC	
5.0E-008	16.1	HPI-XHE-XM-THRTL	PCS-PSF-HW
		SGTR-10-NREC	

Event Tree: SGTR  
Sequence: 16

CCDP: 8.8E-008

CCDP	% Cut Set	Cut Set Events	
2.5E-008	28.1	HPI-MOV-OC-SUCT	RCS-XHE-DIAG
		MSS-VCF-HW-ISOL	SGTR-16-NREC
1.6E-008	18.3	HPI-MDP-CF-ALL	RCS-XHE-DIAG
		MSS-VCF-HW-ISOL	SGTR-16-NREC
1.2E-008	14.1	HPI-MOV-OC-SUCT	RCS-XHE-DIAG
		MSS-XHE-XM-ERROR	SGTR-16-NREC
8.0E-009	9.1	HPI-MDP-CF-ALL	RCS-XHE-DIAG
		MSS-XHE-XM-ERROR	SGTR-16-NREC
5.9E-009	6.7	HPI-MOV-OC-SUCT	RCS-XHE-XM-SG
		MSS-VCF-HW-ISOL	SGTR-16-NREC

**Risk Assessment - Indian Point 2**  
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**Risk Assessment - Indian Point 2**      **Attachment 1**

3.8E-009	4.4	HPI-MDP-CF-ALL	RCS-XHE-XM-SG
		MSS-VCF-HW-ISOL	SGTR-16-NREC
2.9E-009	3.3	HPI-MOV-OC-SUCT	RCS-XHE-XM-SG
		MSS-XHE-XM-ERROR	SGTR-16-NREC
2.6E-009	3.0	HPI-MDP-FC-2A	HPI-MDP-FC-2B
		RCS-XHE-DIAG	MSS-VCF-HW-ISOL
		SGTR-16-NREC	
1.9E-009	2.2	RCS-XHE-DIAG	MSS-VCF-HW-ISOL
		HPI-CKV-CF-CLINJ	SGTR-16-NREC
1.9E-009	2.2	HPI-MDP-CF-ALL	RCS-XHE-XM-SG

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**Risk Assessment - Indian Point 2 Attachment 1**

1.3E-009	1.5	MSS-XHE-XM-ERROR HPI-MDP-FC-2A RCS-XHE-DIAG SGTR-16-NREC	SGTR-16-NREC HPI-MDP-FC-2B MSS-XHE-XM-ERROR
9.7E-010	1.1	RCS-XHE-DIAG HPI-CKV-CF-CLINJ	MSS-XHE-XM-ERROR SGTR-16-NREC
Event Tree: SGTR Sequence: 18		CCDP: 2.9E-008	

CCDP	% Cut Set	Cut Set Events	
1.2E-008	42.5	RCS-XHE-RECOVER RCS-XHE-DIAG	HPI-MOV-OC-SUCT SGTR-18-NREC
8.0E-009	27.6	RCS-XHE-RECOVER RCS-XHE-DIAG	HPI-MDP-CF-ALL SGTR-18-NREC
2.9E-009	10.1	RCS-XHE-RECOVER RCS-XHE-XM-SG	HPI-MOV-OC-SUCT SGTR-18-NREC
1.9E-009	6.6	RCS-XHE-RECOVER RCS-XHE-XM-SG	HPI-MDP-CF-ALL SGTR-18-NREC
1.3E-009	4.5	RCS-XHE-RECOVER HPI-MDP-FC-2B SGTR-18-NREC	HPI-MDP-FC-2A RCS-XHE-DIAG
9.7E-010	3.3	RCS-XHE-RECOVER HPI-CKV-CF-CLINJ	RCS-XHE-DIAG SGTR-18-NREC
3.1E-010	1.1	RCS-XHE-RECOVER HPI-MDP-FC-2B SGTR-18-NREC	HPI-MDP-FC-2A RCS-XHE-XM-SG
Event Tree: SGTR Sequence: 14		CCDP: 2.2E-009	

CCDP	% Cut Set	Cut Set Events	
1.2E-009	52.6	HPI-MOV-OC-SUCT SGTR-14-NREC	PCS-PSF-HW
7.6E-010	34.2	HPI-MDP-CF-ALL SGTR-14-NREC	PCS-PSF-HW
1.2E-010	5.6	HPI-MDP-FC-2A PCS-PSF-HW	HPI-MDP-FC-2B SGTR-14-NREC
9.2E-011	4.1	PCS-PSF-HW SGTR-14-NREC	HPI-CKV-CF-CLINJ

**Risk Assessment - Indian Point 2**  
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**Coincident with a Steam Generator Tube Rupture**

**Risk Assessment - Indian Point 2      Attachment 1**

2.3E-011	1.0	HPI-TNK-VF-RWST	PCS-PSF-HW
		SGTR-14-NREC	
2.3E-011	1.0	PCS-PSF-HW	HPI-CKV-CF-PMPS
		SGTR-14-NREC	

Event Tree: SGTR  
Sequence: 17  
CCDP: 5.8E-011

CCDP	% Cut Set	Cut Set Events
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-		

**Risk Assessment - Indian Point 2**  
 Loss of Safeguards Electrical Bus 6A  
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**Risk Assessment - Indian Point 2 Attachment 1**

2.5E-011	42.5	HPI-MOV-OC-SUCT	RCS-XHE-DIAG
		PCS-PSF-HW	SGTR-17-NREC
1.6E-011	27.6	HPI-MDP-CF-ALL	RCS-XHE-DIAG
		PCS-PSF-HW	SGTR-17-NREC
5.9E-012	10.1	HPI-MOV-OC-SUCT	RCS-XHE-XM-SG
		PCS-PSF-HW	SGTR-17-NREC
3.8E-012	6.6	HPI-MDP-CF-ALL	RCS-XHE-XM-SG
		PCS-PSF-HW	SGTR-17-NREC
2.6E-012	4.5	HPI-MDP-FC-2A	HPI-MDP-FC-2B
		RCS-XHE-DIAG	PCS-PSF-HW
		SGTR-17-NREC	
1.9E-012	3.3	RCS-XHE-DIAG	PCS-PSF-HW
		HPI-CKV-CF-CLINJ	SGTR-17-NREC
6.2E-013	1.1	HPI-MDP-FC-2A	HPI-MDP-FC-2B
		RCS-XHE-XM-SG	PCS-PSF-HW
		SGTR-17-NREC	

**BASIC EVENTS (Cut Sets Only)**

Event Name Prob	Description	Curr
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ACP-BAC-LP-2-3A 005	DIVISION 2A/3A AC POWER 480V BUS FAILS	9.0E-
AFW-AOV-CC-MSG21 003	SG-21 FLOW CONTROL VALVE 406A FAILS	1.1E-
AFW-AOV-CF-SGS 005	CCF OF STEAM GENERATOR INLET AOVs (FCVS)	1.9E-
AFW-CKV-CC-SG21 004	STEAM GENERATOR 21 INLET CHECK VALVE FAILS	1.0E-
AFW-CKV-CF-PMPS 006	CCF OF AFW PUMP DISCHARGE CHECK VALVES	2.7E-
AFW-CKV-CF-SGS-S 006	CCF OF SG INLET CHECK VALVES - SGTR	2.7E-
AFW-CKV-CF-SUCT 006	CCF OF AFW PUMP SUCTION CHECK VALVES	2.7E-
AFW-MDP-CF-AB 004	COMMON CAUSE FAILURE OF MOTOR DRIVEN PUMPS	2.1E-
AFW-MDP-FC-21 003	AFW MOTOR DRIVEN PUMP 21 FAILS	3.9E-
AFW-PMP-CF-ALL	COMMON CAUSE FAILURE OF AFW PUMPS	5.6E-

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Risk Assessment - Indian Point 2 Attachment 1

005		
AFW-TDP-FC-22	AFW TURBINE DRIVEN PUMP 22 FAILS	3.3E-
002		
HPI-CKV-CF-CLINJ	CCF OF COLD LEG INLET CHECK VALVES	1.1E-
005		
HPI-CKV-CF-PMPS	CCF OF HPI PUMP DISCHARGE CHECK VALVES	2.7E-
006		
HPI-MDP-CF-ALL	HPI PUMP COMMON CAUSE FAILURES	9.1E-
005		
HPI-MDP-FC-2A	HPI TRAIN A FAILS	3.9E-
003		
HPI-MDP-FC-2B	HPI TRAIN B FAILS	3.8E-
003		
HPI-MOV-OC-SUCT	HPI SUCTION VALVES FAIL	1.4E-
004		
HPI-TNK-VF-RWST	RWST NOT AVAILABLE	2.7E-
006		
HPI-XHE-XM-THRTL	OPERATOR FAILS TO THROTTLE HPI TO REDUCE PRES	5.0E-
003		
MSS-VCF-HW-ISOL	RUPTURED STEAM GENERATOR ISOLATION FAILURES	1.0E-
002		
MSS-XHE-XM-ERROR	OPERATOR FAILS TO ISOLATE FAULTED STEAM GENER	5.0E-
003		
PCS-PSF-HW	HARDWARE FAILURES CAUSING FAILURE TO DEPRESSU	1.0E-
005		
PCS-VCF-HW	TBVS/COND/CIR FAILURES	3.0E-
003		
PCS-XHE-XM-RCOOL	OPERATOR FAILS TO INITIATE RCS COOLDOWN BELOW	1.0E-
003		
RCS-XHE-DIAG	OPERATOR FAILS TO DIAGNOSE SGTR TO START PROC	2.1E-
002		
RCS-XHE-RECOVER	OPERATOR FAILS TO DEPRESSURIZE RCS BELOW SG S	5.0E-
003		
RCS-XHE-XM-SG	OPERATOR FAILS TO INITIATE RCS DEPRESSURIZATI	5.0E-
003		
RHR-MDP-CF-ALL	RHR PUMP COMMON CAUSE FAILURES	5.6E-
004		
RHR-MDP-FC-2B	RHR TRAIN B FAILS	3.8E-
003		
RHR-MOV-CF-DIS	COMMON CAUSE FAILURE OF RHR DISCHARGE MOVES	2.6E-
004		

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**Risk Assessment - Indian Point 2**  
 Loss of Safeguards Electrical Bus 6A  
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Risk Assessment - Indian Point 2 Attachment 1

Event Name Prob	Description	Curr
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RHR-MOV-OO-RWST 003	RHR/RWST ISOLATION MOV FAILS	3.0E-
RHR-XHE-SUCTION 003	OPERATOR FAILS TO RECOVER RHR SUCTION PATH	2.0E-
RHR-XHE-XM 003	OPERATOR FAILS TO INITIATE RHR SYSTEM	1.0E-
RPS-BKR-FC-FTO 006	RPS BREAKERS FAIL TO OPEN	5.7E-
RPS-VCF-FO-ELEC 004	CONTROL ROD DRIVES REMAIN ENERGIZED	4.3E-
RPS-VCF-FO-MECH 008	CONTROL ROD ASSEMBLIES FAIL TO INSERT	8.9E-
RPS-XHE-ERROR 001	OPERATOR FAILS TO DE-ENERGIZE MG SETS	2.0E-
RPS-XHE-XM-SCRAM 002	OPERATOR FAILS TO MANUALLY TRIP THE REACTOR	1.0E-
SGTR-03-NREC 1.0E+000	SGTR SEQUENCE 03 NONRECOVERY PROBABILITY	
SGTR-04-NREC 1.0E+000	SGTR SEQUENCE 04 NONRECOVERY PROBABILITY	
SGTR-05-NREC 1.0E+000	SGTR SEQUENCE 05 NONRECOVERY PROBABILITY	
SGTR-08-NREC 1.0E+000	SGTR SEQUENCE 08 NONRECOVERY PROBABILITY	
SGTR-09-NREC 1.0E+000	SGTR SEQUENCE 09 NONRECOVERY PROBABILITY	
SGTR-10-NREC 1.0E+000	SGTR SEQUENCE 10 NONRECOVERY PROBABILITY	
SGTR-11-NREC 1.0E+000	SGTR SEQUENCE 11 NONRECOVERY PROBABILITY	
SGTR-13-NREC 001	SGTR SEQUENCE 13 NONRECOVERY PROBABILITY	8.4E-
SGTR-14-NREC 001	SGTR SEQUENCE 14 NONRECOVERY PROBABILITY	8.4E-
SGTR-16-NREC 001	SGTR SEQUENCE 16 NONRECOVERY PROBABILITY	8.4E-
SGTR-17-NREC 001	SGTR SEQUENCE 17 NONRECOVERY PROBABILITY	8.4E-
SGTR-18-NREC 001	SGTR SEQUENCE 18 NONRECOVERY PROBABILITY	8.4E-

**Risk Assessment - Indian Point 2**  
**Loss of Safeguards Electrical Bus 6A**  
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**Risk Assessment - Indian Point 2      Attachment 1**

SGTR-43-NREC	SGTR SEQUENCE 43 NONRECOVERY PROBABILITY	2.2E-
001		
SGTR-44-NREC	SGTR SEQUENCE 44 NONRECOVERY PROBABILITY	
1.0E+000		

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