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Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Grand Gulf, Unit 1

Analysis of Core Damage Frequency from Internal Events for Plant Operational State 5 During a Refueling Outage

Internal Events Appendices K to M

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Abstract

This report provides supporting documentation for various tasks associated with the performance of the probabilistic risk assessment for Plant Operational State 5 (approximately Cold Shutdown as defined by Grand Gulf Technical Specifications) during a refueling outage at Grand Gulf, Unit 1 as documented in Volume 2, Part 1 of NUREG/CR-6143. The report contains the following appendices:

- K - HEP Locator Files
- L - Supporting Information for the Plant Damage State Analysis
- M - Summary of Results from the Coarse Screening Analysis - Phase 1A

Contents

Acronyms	vii
Foreword	ix
Acknowledgements	xi
Appendix K HEP Locator Files	K-1
Appendix L Supporting Information for the Plant Damage State Analysis	L-1
L.1 Development of End States	L-1
L.2 Development of Plant Damage States	L-1
Appendix M. Summary of Results from the Coarse Screening Analysis - Phase 1A	M-1
M.1 Objectives	M-1
M.2 Approach	M-1
M.3 Results	M-1
M.3.1 Internal Initiating Events Excluding Fire and Flood	M-1
M.3.1.1 Characterization of Core Damage Sequences	M-1
M.3.1.2 Characterization of Plant Damage States	M-2
M.3.2 Fire Induced Internal Initiating Events	M-4
M.3.2.1 Characterization of Core Damage Sequences	M-4
M.3.2.2 Characterization of Plant Damage States	M-4
M.3.3 Flood Induced Internal Initiating Events.	M-4
M.3.3.1 Characterization of Core Damage Sequences	M-4
M.3.3.2 Characterization of Plant Damage States	M-4
M.4 Conclusions	M-4
M.4.1 Plant Specific Conclusions	M-5
M.4.2 Plant Operational State Conclusions	M-5
M.4.3 Accident Sequence Conclusions	M-5
M.4.4 Plant Damage State Conclusions	M-5
M.4.5 Comparisons to NUREG/CR-4550 Vol. 6	M-6

List of Tables

L-1 End State Characteristics and Attributes	L-3
L-2 Cut Sets by End State	L-8
L-3 End State and Plant Damage State Definitions	L-11
L-4 Plant Damage State Characteristics and Attributes	L-12
L-5 Plant Damage State Definitions.	L-14
M.3.1.1 Sequences Categorized as Potentially High	M-7
M.3.1.2 Sequences Categorized as Potential Medium	M-10
M.3.1.3 Sequences Categorized as Low	M-13
M.3.1.4 PDSs for Potentially High Sequences	M-17
M.3.1.5 PDSs for Potentially Medium Sequences	M-23
M.3.1.6 PDSs for Low Sequences	M-35
M.3.1.7 Potentially High Sequences with Containment Open, Vessel Open, and Fast Core Damage	M-44
M.3.1.8 Potentially High Sequences with Containment Open, Vessel Vented, and Fast Core Damage	M-45
M.3.1.9 Potentially High Sequences with Containment Closed, Vessel Closed, and Fast Core Damage	M-49
M.3.1.10 Potentially High Sequences with Containment Open, Vessel Open, and Intermediate Core Damage	M-50
M.3.1.11 Potentially Medium Sequences with Containment Open, Vessel Open, and Fast Core Damage	M-52

List of Tables (Continued)

M.3.1.12	Potentially Medium Sequences with Containment Open, Vessel Vented, and Fast Core Damage . . .	M-53
M.3.1.13	Potentially Medium Sequences with Containment Closed, Vessel Closed, and Fast Core Damage . . .	M-55
M.3.1.14	Potentially Medium Sequences with Containment Open, Vessel Open, and Intermediate Core Damage .	M-59
M.3.1.15	Low Sequences with Containment Open, Vessel Open, and Fast Core Damage	M-60
M.3.1.16	Low Sequences with Containment Open, Vessel Vented, and Fast Core Damage	M-61
M.3.1.17	Low Sequences with Containment Closed, Vessel Closed, and Fast Core Damage	M-62
M.3.1.18	Low Sequences with Containment Open, Vessel Open, and Intermediate Core Damage	M-69
M.3.2.1	Sequences Categorized as Potentially Medium	M-70
M.3.2.2	Sequences Categorized as Low	M-71
M.3.2.3	PDSs for Sequences Surviving Truncation	M-74

Acronyms

ADHR	Auxiliary Decay Heat Removal
ADS	Automatic Depressurization System
ATWS	Anticipated Transient Without Scram
BNL	Brookhaven National Laboratory
BWR	Boiling Water Reactor
CCW	Component Cooling Water
CDS	Condensate
CI	Containment Isolation
CRD	Control Rod Drive
CRWST	Condensate and Refueling Water Storage Transfer System
CS	Containment Spray
CST	Condensate Storage Tank
CV	Check Valves
CVS	Containment Venting System
DBA	Design Basis Accident
DG	Diesel Generator
ECCS	Emergency Core Cooling Systems
EHC	Electro-Hydraulic Controller
EHV	Emergency Ventilation System
ENSDC	Enhanced Shutdown Cooling
EPS	Emergency Power System
FCV	Flow Control Valve
FDW	Feed Water System
FW	Fire Water
HCU	Hydraulic Control Unit
HPCS	High Pressure Core Spray
IAS	Instrument Air System
IRRAS	Integrated Reliability and Risk Analysis System
LCO	Limiting Condition of Operation
LOCA	Loss of Coolant Accident
LPCI	Low Pressure Coolant Injection
LPCS	Low Pressure Core Spray
MSIV	Main Steam Isolation Valve
MSL	Mean Sea Level
MSR	Moisture Separator Reheater
NPSHA	Net Positive Suction Head Available
NPSHR	Net Positive Suction Head Required
NRC	Nuclear Regulatory Commission
OC	Operating Condition
POS	Plant Operating State
PRA	Probabilistic Risk Assessment
PSW	Plant Service Water
PWR	Pressurized Water Reactor
RCIC	Reactor Core Isolation Cooling
RES	Research (Office of NRC)
RFPT	Reactor Feedwater Pump Turbine
RHR	Residual Heat removal
RPV	Reactor Pressure Vessel
RRS	Reactor Recirculation System
RWCU	Reactor Water Cleanup System
SDC	Shutdown Cooling System(s)
SGTS	Standby Gas Treatment System

Acronyms (Continued)

SL	Safety Limit
SLC	Standby Liquid Control
SP	Suppression Pool
SPC	Suppression Pool Cooling
SPMU	Suppression Pool Makeup
SPMU	Suppression Pool Makeup
SR	Surveillance Requirement
SRV	Safety Relief Valve
SSWXT	Standby Service Water Crosstie
TBCW	Turbine Building Cooling Water
TBV	Turbine Bypass Valve(s)
UFSAR	Updated Final Safety Analysis Report

Foreword

(NUREG/CR-6143 and 6144) Low Power and Shutdown Probabilistic Risk Assessment Program

Traditionally, probabilistic risk assessments (PRA) of severe accidents in nuclear power plants have considered initiating events potentially occurring only during full power operation. Some previous screening analyses that were performed for other modes of operation suggested that risks during those modes were small relative to full power operation. However, more recent studies and operational experience have implied that accidents during low power and shutdown could be significant contributors to risk.

During 1989, the Nuclear Regulatory Commission (NRC) initiated an extensive program to carefully examine the potential risks during low power and shutdown operations. The program includes two parallel projects performed by Brookhaven National Laboratory (BNL) and Sandia National Laboratories (SNL), with the seismic analysis performed by Future Resources Associates. Two plants, Surry (pressurized water reactor) and Grand Gulf (boiling water reactor), were selected as the plants to be studied.

The objectives of the program are to assess the risks of severe accidents due to internal events, internal fires, internal floods, and seismic events initiated during plant operational states other than full power operation and to compare the estimated core damage frequencies, important accident sequences and other qualitative and quantitative results with those accidents initiated during full power operation as assessed in NUREG-1150. The scope of the program includes that of a level-3 PRA.

The results of the program are documented in two reports, NUREG/CR-6143 and 6144. The reports are organized as follows:

For Grand Gulf:

NUREG/CR-6143 - Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Grand Gulf, Unit 1

- Volume 1: Summary of Results
- Volume 2: Analysis of Core Damage Frequency from Internal Events for Plant Operational State 5 During a Refueling Outage
 - Part 1: Main Report
 - Part 1A: Sections 1 - 9
 - Part 1B: Section 10
 - Part 1C: Sections 11 - 14
 - Part 2: Internal Events Appendices A to H
 - Part 3: Internal Events Appendices I and J
 - Part 4: Internal Events Appendices K to M
- Volume 3: Analysis of Core Damage Frequency from Internal Fire Events for Plant Operational State 5 During a Refueling Outage
- Volume 4: Analysis of Core Damage Frequency from Internal Flooding Events for Plant Operational State 5 During a Refueling Outage
- Volume 5: Analysis of Core Damage Frequency from Seismic Events for Plant Operational State 5 During a Refueling Outage
- Volume 6: Evaluation of Severe Accident Risks for Plant Operational State 5 During a Refueling Outage
 - Part 1: Main Report
 - Part 2: Supporting MELCOR Calculations

Foreword (Continued)

For Surry:

NUREG/CR-6144 - Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Surry Unit-1

- Volume 1: Summary of Results**
- Volume 2: Analysis of Core Damage Frequency from Internal Events During Mid-loop Operations**
 - Part 1: Main Report**
 - Part 1A: Chapters 1 - 6**
 - Part 1B: Chapters 7 - 12**
 - Part 2: Internal Events Appendices A to D**
 - Part 3: Internal Events Appendix E**
 - Part 3A: Sections E.1 - E.8**
 - Part 3B: Sections E.9 - E.16**
 - Part 4: Internal Events Appendices F to H**
 - Part 5: Internal Events Appendix I**
- Volume 3: Analysis of Core Damage Frequency from Internal Fires During Mid-loop Operations**
 - Part 1: Main Report**
 - Part 2: Appendices**
- Volume 4: Analysis of Core Damage Frequency from Internal Floods During Mid-loop Operations**
- Volume 5: Analysis of Core Damage Frequency from Seismic Events During Mid-loop Operations**
- Volume 6: Evaluation of Severe Accident Risks During Mid-loop Operations**
 - Part 1: Main Report**
 - Part 2: Appendices**

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Appendix K. HEP Locator Files

This appendix contains the "sequence locator files" used in the solution of the core damage accident sequences. These files document the values assigned to each post-accident human action by the human reliability analysis as described in Section 10 of the main report.

The "locator files" are listed in alpha-numeric order and appear one to a page for easy cross-referencing with the human error probability tables from Section 10.

File Name: LCMK.TIO

Initiator: TIOP5

Event Tree: TIOP5

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
LCMK	0.011	5	HEP 4

TIOP initiator. Random isolation of RWCU resulting in over-pressurization. With letdown isolated and makeup continuing to run, level and pressure will begin to increase. Operators will get an alarm at level 8 and may receive additional pressure related alarms. In addition, operators have approximately 2 and one-half hours to detect the problem and control makeup. In this time period level and pressure would be monitored.

Locator Files

File Name: OISSL.S35

Initiator: S3-5

Event Tree: S3-5

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
ISSSL	0.036	5	HEP 74
OPLDM	1.0		HEP 74
OPSDC (if on RHR)	8.5E-4	10	HEP 1
OPSDC (if on ADHRS)	0.046	10	HEP 2
OPSDC (If preceded by XTIEB)	0.6	10	HEP 20

Small-small LOCA initiator. ISSSL is operator action to detect and isolate a recirculation pump seal leak before level 3 is reached and SDC isolates. In addition, operators must also isolate letdown and increase make-up in the same time period, i.e., before level 3 is reached (OPLDM). Recirculation pump seal leakage is well instrumented and procedures direct operators to first consider a pump seal leak if unidentified leakage occurs and/or drywell pressure increases. Operators will receive a level 4 alarm that will indicate that level is dropping and that a leak may be present. The level 4 alarm will also indicate the need to isolate letdown and provide additional make-up. Operators are aware that SDC will isolate at level 3.

Since the OPLDM actions must occur in the same time period as ISSSL, a single HEP was derived which includes the relevant actions for the two events. Thus, if ISSSL fails, then OPLDM also fails.

OPSDC is treated the same as in other cases where a random failure of SDC occurs. Given the success of ISSSL, operators will be monitoring the relevant parameters and therefore there is no reason to expect any increase in the failure probability for OPSDC.

File Name: OISSL.S3H

Initiator: S3H-5

Event Tree: S3H-5

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
ISSSL	0.036	5	HEP 74
OPLDM	1.0		HEP 74
OPSDC (if on RHR)	8.5E-4	10	HEP 1
OPSDC (if on ADHRS)	0.046	10	HEP 2
OPSDC (If preceded by XTIEB)	0.6	10	HEP 20

Small-small LOCA initiator during HYDRO. ISSSL is operator action to detect and isolate a recirculation pump seal leak before level 3 is reached and SDC isolates. In addition, operators must also isolate letdown and increase make-up in the same time period, i.e., before level 3 is reached (OPLDM). Recirculation pump seal leakage is well instrumented and procedures direct operators to first consider a pump seal leak if unidentified leakage occurs and/or drywell pressure increases. Operators will receive a level 4 alarm that will indicate that level is dropping and that a leak may be present. The level 4 alarm will also indicate the need to isolate letdown and provide additional make-up. Operators are aware that SDC will isolate at level 3.

Since the OPLDM actions must occur in the same time period as ISSSL (37 minutes), a single HEP was derived which includes the relevant actions for the two events. Thus, if ISSSL fails, then OPLDM also fails.

OPSDC is treated the same as in other cases where a random failure of SDC occurs. Given the success of ISSSL, operators will be monitoring the relevant parameters and therefore there is no reason to expect any increase in the failure probability for OPSDC.

Locator Files

File Name: OPCADH13.EAX

Initiator: T1, TIA

Event Tree: EAX (from ADH, Seq. 13 for T1)

EAX (from TIA5h, Seq. 29 for TIA)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.15	10	HEP 21
OPMSV	1.0		HEP 9
OP1SV	0.5	10	HEP 22
OPHIS	1.0		HEP 8
*OPISA	1.0 or 0		

* OPISA (isolating ADH) is completely dependent on OPECS

In this scenario a LOSP occurs, with DIV 1/2 failing, and HPCS unavailable. Thus, a crosstie of the HPCS generator to DIV 2 (1) is called for, per ONEP for loss of AC power. SDC needs to be restored. If the control room diagnoses the likelihood that SDC(B) will isolate on 135 PSI when XTIE completed (OPSDC success), then they will prepare for OPECS. If they fail to do this, OPECS will fail. In this case, OPECS involves isolating ADH manually, starting LPCI(C) pump manually, and doing SRV and MSIV work etc. The trick here is successful OPSDC, which is non-trivial.

File Name: OPCADH14.EAX

Initiator: T1-5

Event Tree: EAX (from ADH, Seq. 14, from T1-5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	1.0		HEP 101

In this scenario, a LOSP occurs and the DIV 1/2 diesel generators fail to start. HPCS is unavailable. Thus, a cross-tie of the HPCS generator to DIV 2 (1) is called for, per the ONEP for Loss of AC Power. SDC needs to be restored. If the control room diagnoses the fact that SDC(B) will isolate on 135 psi when the cross-tie (XTIEB) is completed (OPSDC success), then they will prepare for initiating ECCS water solid operation per the IDHR ONEP (OPECS). If they fail to realize that SDC(B) will not be available (CPSDC fails), then OPECS will most likely fail since the diagnosis, the retrieval of procedures, the opening of two SRVs and the checking closed of the MSIVs must be done in parallel with the cross-tie for sufficient time to be available. In the present scenario, OPSDC fails.

Locator Files

File Name: OPCADH14.TIA

Initiator: TIA5H

Event Tree: EAX (from TIA5H, Seq. 30)

Human Error Events:

	<u>Mean HEPS</u>	<u>EF</u>	<u>Code#</u>
OPECS	1.0		HEP 101

In this scenario, a loss of IA, along with a LOSP occurs. The DIV 1/2 diesel generators fail to start and HPCS is unavailable. Thus, a cross-tie of the HPCS generator to DIV 2 (1) is called for, per the ONEP for Loss of AC power. SDC needs to be restored. If the control room diagnoses the fact that SDC(B) will isolate on 135 psi when the cross-tie (XTIEB) is completed (OPSDC success), then they will prepare for initiating ECCS water solid operation per the IDHR ONEP (OPECS). If they fail to realize that SDC(B) will not be available (OPSDC fails), then OPECS will most likely fail since the diagnosis, the retrieval of procedures, the opening of two SRVs and the checking closed of the MSIVs must be done in parallel with the cross-tie for sufficient time to be available. In the present scenario, OPSDC fails.

File Name: OPCADH20.TIA

Initiator: TIA5H

Event Tree: EA (from TIA5H, Seq. 20)

EAP (from TIA5H, Seq. 24)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.10	10	HEP 14
OPMSV	1.0		HEP 9
OP1SV	0.44	10	HEP 15
OPHIS	1.0		HEP 8
* OPISA	0		HEP 81

The initiator is a loss of IA. In some sequences a LOSP also occurs, but the diesels start and load (DV1-2 succeeds). ADHR is lost as a result of the initiator, but the operators diagnose the loss of SDC (OPSDC succeeds) and attempt to establish SDC(B). SDC(B) fails to start. OPECS involves ensuring that ADHR is isolated and aligning LPCI(C) for initiating ECCS water solid operation.

* OPISA is completely dependent on OPECS. If OPECS is successful, OPISA = 0 (success), otherwise OPISA is a failure, 1.0.

Locator Files

File Name: OPCADH21.TIA

Initiator: TIA5H

Event Tree: EA (from TIA5H, Seq. 21)

EAP (from TIA5H, Seq. 25)

Human Error Events:

	<u>Mean HEPS</u>	<u>EF</u>	<u>Code#</u>
OPECS	1.0		HEP 13

In this loss of IA scenario, OPSDC has failed. That is, the control room has failed to detect/realize the loss of SDC (ADHR) in 37 minutes. Because of the failure of OPSDC and the time and actions required to isolate ADHR and align and start ECCS (per "abnormal operations" in the RHR SOI) and perform the related OPECS action from the IDHR ONEP, OPECS fails (as do the remaining associated human actions).

File name: OPCADH26.TIA

Initiator: TIA5H

Event Tree: HPSWA (from TIA5H, Seq. 26)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	1.0		HEP 102

In this scenario, a loss of IA is followed by a LOSP. The DV1-2 diesels fail to start. HPCS is working (available). OPECS in this case involves deciding to initiate ECCS water solid operation with HPCS. The most significant difference between this and HPSWR (from SDC tree) is that the operators must also diagnose need to isolate ADHR during OPECS. This is a non-trivial difference because with the LOSP and loss of Div 1/2 (or TAB5H initiator and a LOSP), operators will now have to isolate the 8 or 9 valve locally. When 15 min. is assumed for accomplishing this action and the other OPECS actions are considered, insufficient time remains for making the relevant diagnoses.

Locator Files

File Name: OPCSDC10.TIA

Initiator: TIA5H

Event Tree: EP (from TIA5H, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this scenario, a LOSP has occurred, but the diesels successfully start and load (DIV 1/2 succeeds). OPSDC in this case has failed. That is, in 37 min. the control room has not diagnosed the loss of SDC or entered the IDHR ONEP. However, at this point additional alarms could sound, e.g., a low level or high pressure alarm, and by requirements (every 30 min.) the reactor temperature and/or pressure chart recorders would very likely be checked (to reveal increases) in the 23 additional minutes available for this event. Operators must diagnose the need to initiate ECCS water solid operation.

File Name: OPCSDC11.TIA

Initiator: TIA5H

Event Tree: HPSWR (from TIA5H, Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
* OPHIS	0		HEP 8
OPMSV	1		HEP 9
OPSOF	0.06	10	HEP 12

In this loss of IA scenario, a LOSP has occurred and the diesels fail to start (DV1-2 fails). HPCS is working (available). OPECS in this case, involves deciding to go water solid with HPCS.

- * OPHIS is essentially included in the OPECS event in this scenario. Thus, failure probability for OPHIS should be set to 0 when OPECS is successful.

Locator Files

File Name: OPCSDC12.EX

Initiator: T1-5

Event Tree: EX (from SDC, Seq. 12, from T1-5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPMSV	1.0		HEP 9
OPHIS	1.0		HEP 8

In these scenarios a LOSP occurs and the diesel generators fail to start (DV1-2 fails). HPCS is unavailable. Thus, a cross-tie of the HPCS generator to DIV 2 (1) is called for (XTIEB), per the ONEP for loss of AC power. Some form of SDC is needed. If the control room diagnoses the likelihood that SDC(B) will isolate on 135 psi. when the diesel generator cross-tie is completed (OPSDC success), then they will prepare for OPECS. If they fail to do this (OPSDC fails), OPECS will fail. In these sequences, OPSDC has succeeded and the control realizes SDC will not be available. Thus, OPECS involves following the IDHR ONEP and proceeding with ECCS water solid operation. See file OPXTIE.HEP and HEP Calculations 19 and 20 for additional information.

File Name: OPCSDC12.TIA

Initiator: TIA5H

Event Tree: EX (from TIA5H, Seq. 14)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPMSV	1.0		HEP 9
OPHIS	1.0		HEP 8

In these scenarios a loss of Instrument Air occurs and is followed later in the scenario with a LO SP. The diesel generators fail to start (DV1-2 fails) and HPCS is unavailable. Thus, a cross-tie of the HPCS generator to DIV 2 (1) is called for (XTIEB), per the ONEP for loss of AC power. Some form of SDC is needed. If the control room diagnoses the likelihood that SDC(B) will isolate on 135 psi. when the diesel generator cross-tie is completed (OPSDC success), then they will prepare for OPECS. If they fail to do this (OPSDC fails), OPECS will fail. In these sequences, OPSDC has succeeded and the control realizes SDC will not be available. Thus, OPECS involves following the IDHR ONEP and proceeding with ECCS water solid operation. See file OPXTIE.HEP and HEP Calculations 19 and 20 for additional information.

Locator Files

File Name: OPCSDC13.EX

Initiator: T1-5

Event Tree: EX (from SDC, Seq. 13, from T1-5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	1.0		HEP 101

In this scenario, a LOSP occurs and the DIV 1/2 diesel generators fail to start. HPCS is unavailable. Thus, a cross-tie of the HPCS generator to DIV 2 (1) is called for, per the ONEP for Loss of AC power. SDC needs to be restored. If the control room diagnoses the fact that SDC(B) will isolate on 135 psi when the cross-tie (XTIEB) is completed (OPSDC success), then they will prepare for initiating ECCS water solid operation per the IDHR ONEP (OPECS). If they fail to realize that SDC(B) will not be available (OPSDC fails), then OPECS will most likely fail since the diagnosis, the retrieval of procedures, the opening of two SRVs and the checking closed of the MSIVs must be done in parallel with the cross-tie for sufficient time to be available. In the present scenario, OPSDC fails.

File Name: OPCSDC13.EX

Initiator: T1-5

Event Tree: EX (from SDC, Seq. 13, from T1-5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	1.0		HEP 101

In this scenario, a LOSP occurs and the DIV 1/2 diesel generators fail to start. HPCS is unavailable. Thus, a cross-tie of the HPCS generator to DIV 2 (1) is called for, per the ONEP for Loss of AC power. SDC needs to be restored. If the control room diagnoses the fact that SDC(B) will isolate on 135 psi when the cross-tie (XTIEB) is completed (OPSDC success), then they will prepare for initiating ECCS water solid operation per the IDHR ONEP (OPECS). If they fail to realize that SDC(B) will not be available (OPSDC fails), then OPECS will most likely fail since the diagnosis, the retrieval of procedures, the opening of two SRVs and the checking closed of the MSIVs must be done in parallel with the cross-tie for sufficient time to be available. In the present scenario, OPSDC fails.

Locator Files

File Name: OPCSDC13.TIA

Initiator: TIA

Event Tree: EX (from TIA5H, Seq. 15)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	1.0		HEP 101

In this scenario, a loss of IA occurs along with a LOSP. DIV 1/2 diesel generators fail to start, and HPCS is unavailable. Thus, a cross-tie of the HPCS generator to DIV 2 (1) is called for, per the ONEP for Loss of AC power. SDC needs to be restored. If the control room diagnoses the fact that SDC(B) will isolate on 135 psi when the cross-tie (XTIEB) is completed (OPSDC success), then they will prepare for initiating ECCS water solid operation per the IDHR ONEP (OPECS). If they fail to realize that SDC(B) will not be available (OPSDC fails), then OPECS will most likely fail since the diagnosis, the retrieval of procedures, the opening of two SRVs and the checking closed of the MSIVs must be done in parallel with the cross-tie for sufficient time to be available. In the present scenario, OPSDC fails.

File Name: OPCSEL32.TIA

Initiator: TIA5H

Event Tree: E (from L, Seq. 32 and 48, from TIA5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this scenario, a loss of IA has occurred. SDC(B) continues to run. CRD and RWCU auto-isolate and forced recirculation is lost. With the loss of makeup (CRD) and forced recirculation, the potential for a disconnect between the core and the downcomer regions of the core arises. With inadequate level or recirculation, a "functional" loss of SDC can occur. OPDHR is the operator action to diagnose the functional loss of SDC and initiate level control. In these sequences, OPDHR has failed. That is, the operators fail to diagnose the disconnect between the core and the downcomer and the resulting functional loss of SDC in the 10 minutes allowed for OPDHR. However, at this point some additional indicators would be coming available and the operators should notice increases in pressure and temperature on chart recorders per periodic checks (required every 30 minutes). Operators must diagnose the need to initiate ECCS water solid operation.

Locator Files

File Name: OPCSEL32.TIA

Initiator: TIA5H

Event Tree: E (from L, Seq. 32 and 48, from TIA5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this scenario, a loss of IA has occurred. SDC(B) continues to run. CRD and RWCU auto-isolate and forced recirculation is lost. With the loss of makeup (CRD) and forced recirculation, the potential for a disconnect between the core and the downcomer regions of the core arises. With inadequate level or recirculation, a "functional" loss of SDC can occur. OPDHR is the operator action to diagnose the functional loss of SDC and initiate level control. In these sequences, OPDHR has failed. That is, the operators fail to diagnose the disconnect between the core and the downcomer and the resulting functional loss of SDC in the 10 minutes allowed for OPDHR. However, at this point some additional indicators would be coming available and the operators should notice increases in pressure and temperature on chart recorders per periodic checks (required every 30 minutes). Operators must diagnose the need to initiate ECCS water solid operation.

File Name: OPDHR.E1B

Initiator: E1B5H

Event Tree: L (from E1B5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.70	10	HEP 35
* LCMK	0 or 0.011	10	HEP 85 or HEP 4

In this loss of SDC scenario there is no LOSP. OPSDC, RESB and SDC(B) were successful. At some point, either or both forced recirculation and CRD fail, which requires the ops to diagnose the potential for core/downcomer disconnect and the need for makeup. The operators must diagnose the need to isolate RWCU and increase makeup with CRD (if available) or ECCS.

- * In regards to LCMK, since increasing flow with CRD could be a possible option, the operators would have 2.5 hrs to control level and could forget to do so. Thus, when LCMK is preceded by a CRD success, then LCMK = 0.011. However, when ECCS is used, it is assumed that ops would not just walk away from a system injecting 4000 GPM. In this case the HEP for LCMK would be 0.

Locator Files

File Name: OPDHR.E1B

Initiator: E1B5H

Event Tree: L (from E1B5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.70	10	HEP 35
* LCMK	0 or 0.011	10	HEP 85 or HEP 4

In this loss of SDC scenario there is no LOSP. OPSDB, RESB and SDC(B) were successful. At some point, either or both forced recirculation and CRD fail, which requires the ops to diagnose the potential for core/downcomer disconnect and the need for makeup. The operators must diagnose the need to isolate RWCU and increase makeup with CRD (if available) or ECCS.

- * In regards to LCMK, since increasing flow with CRD could be a possible option, the operators would have 2.5 hrs to control level and could forget to do so. Thus, when LCMK is preceded by a CRD success, then LCMK = 0.011. However, when ECCS is used, it is assumed that ops would not just walk away from a system injecting 4000 GPM. In this case the HEP for LCMK would be 0.

File Name: OPDHR.E1D

Initiator: E1D5H

Event Tree: LA (from E1D5H, Seq. 3, 4, 8)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.70	10	HEP 35
* LCMK	0 or 0.011	10	HEP 85 or HEP 4

In this loss of SDC scenario there is no LOSP. OPSDC and RESAD or SDC(B) were successful. At some point, either or both forced recirculation and CRD fail, which requires the operators to diagnose the potential for core/downcomer disconnect and the need for makeup. The operators need to isolate RWCU and diagnose the need to increase makeup with CRD (if available) or CDS.

- * In regards to LCMK, since increasing flow with CRD could be a possible option, the operators would have 2.5 hrs to control level and could forget to do so. Thus, when LCMK is preceded by a CRD success, then LCMK = 0.011. However, when CDS is used, it is assumed that the operators would not just walk away from a system injecting 4000 GPM. In this case the HEP for LCMK would be 0.

Locator Files

File Name: OPDHR.E1T

Initiator: E1T5H

Event Tree: L (from E1T5H, Seq. 3)

Human Error Events:

	OPDHR	0.70	10	HEP 35
*	LCMK	0 or 0.011	10	HEP 85 or HEP 4
**	RM-LT	3.6E-3	5	HEP 56

In this isolation of common SDC suction line scenario, there is no LO SP. OP SDC, RESCS and SDCBS were successful. At some point, either or both forced recirculation and CRD fail, which requires the operators to diagnose the potential for core/downcomer disconnect. Operator must diagnose need to isolate RWCU and increase makeup with CRD (if available) or ECCS. With only 10 min. allowed for this event, the level decrease may be subtle (depending on scenario) and at this point in time SDC is operating.

* In regards to LCMK, since increasing flow with CRD would be a possible option in some scenarios, operators would have 2.5 hrs to control level and could forget to do so. Thus, when LCMK is preceded by CRD success, then LCMK = 0.011. However, when CDS or an ECCS system is used, it is assumed that the operators would not just walk away from a system injecting 4000+ GPM. For these cases, the HEP for LCMK would be 0.

** The value for the operator action to control level in the long-term (RM-LT) was usually placed in the data base.

File Name: OPDHR.E1V

Initiator: E1V5H

Event Tree: LA (from E1V5H, Seq. 3, 4)

Human Error Events:

	OPDHR	0.70	10	HEP 35
*	LCMK	0 or 0.011	10	HEP 85 or HEP 4
**	RM-LT	3.6E-3	5	HEP 56

In this isolation of common SDC suction line there is no LO SP. OPSDC, RESCS and either ADHRS or SDCBS were successful. At some point, either or both forced recirculation and CRD fail, which requires the operators to diagnose the potential for core/downcomer disconnect. Operator must diagnose need to isolate RWCU and increase makeup with CRD (if available), CDS, or ECCS. With only 10 min. allowed for this event, the level decrease may be subtle (depending on scenario).

- * In regards to LCMK, since increasing flow with CRD would be a possible option in some scenarios, operators would have 2.5 hrs to control level and could forget to do so. Thus, when LCMK is preceded by CRD success, then LCMK = 0.011. However, when CDS or an ECCS system is used, it is assumed that the operators would not just walk away from a system injecting 4000+ GPM. For these cases, the HEP for LCMK would be 0.
- ** The value for the operator action to control level in the long-term was usually placed in the data base.

Locator Files

File Name: OPDHR.E2D

Initiator: E2D5H

Event Tree: LA (from E2D5H, Seq. 4,)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.70	10	HEP 35
LCMK	0		HEP 85

In this loss of SDC scenario there is no LOSP. OPSDC and SDCB(S) were successful. At some point, either CRD or forced recirculation fail, which requires the operators to diagnose the potential for core/downcomer disconnect and the need for makeup. Failure of these systems should provide alarms and indications to the control room. The operators will need to diagnose the need to isolate RWCU. The Operator must diagnose need to increase makeup with CRD (if available) or an ECCS system.

File Name: OPDHR.T5D

Initiator: T5D5H

Event Tree: L (from T5D5H, Seq. 3, 7)

LA (from T5D5H, Seq. 18, 19)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.70	10	HEP 35
LCMK	0		HEP 85

In this scenario, SDC(B) was successful, but due to the initiator (loss of CCW), forced recirculation is lost, as is CRD. The operators must diagnose the need to increase makeup and isolate letdown (RWCU). RWCU fails with loss of CCW and may need to be isolated. CDS may be a logical choice for makeup and if it is successful, then LCMK is called.

Locator Files

File Name: OPDHR.TDB

Initiator: TDB5H

Event Tree: L (from SDC, Seq. 1, from TDB5H, Seq. 3)

Human Error Events:

OPDHR	0.48	10	HEP 3
RM-LT	3.6E-3	10	HEP 56

In this loss of DC bus scenario, SDC continues to run, but forced recirculation is lost. Operator must diagnose need to increase makeup. RWCU auto isolates with loss of IA. CRD not available for increased flow, nor is CDS. OPDHR in this case includes use of HPCS for makeup. Thus, if OPDHR succeeds, then RM-LT is operator action to provide long-term makeup for any lost level and/or leakage (10 hrs.) Events downstream of a successful OPDHR which involve initiation of HPCS should be set to 0 (success) , e.g., OPLEC in R tree.

File Name: OPDHR.TIF

Initiator: TIOF5

Event Tree: L (from SDC, Seq. 1, from TIOF5, Seq. 2)
 LA (from ADH, Seq. 1, 2, from TIOF5, Seq. 3)
 LP (from SDC, Seq. 5, from TIOF5, Seq. 2)
 LAP (from ADH, Seq. 6, from TIOF5, Seq. 3)

Human Error Events:

	OPDHR	0.48	10	HEP 3
*	LCMK	0 or 0.011	5	HEP 85 or 4
**	RM-LT	3.6E-3	5	HEP 56

In this inadvertent actuation of LPCI scenario, the operators successfully stop injection (OPSLP succeeds). Either SDC(B) or ADHRS continues to run or is started. At some point, either forced recirculation, RWCU, CRD, or any combination of the three fail, which requires the operators to diagnose the potential for a core/downcomer disconnect which could result in a functional loss of SDC. Failure of these systems should provide alarms/indications to the control room. The operators must diagnose the need to increase makeup with CRD (if available), CDS, or ECCS.

- * In regards to LCMK, since increasing flow with CRD would be a possible option in some scenarios, operators would have 2.5 hrs to control level and could forget to do so. Thus, when LCMK is preceded by CRD success, then LCMK = 0.011. However, when CDS or an ECCS system is used, it is assumed that the operators would not just walk away from a system injecting 4000+ GPM. For these cases, the HEP for LCMK would be 0.
- ** The value for the operator action to control level in the long-term (RM-LT) was usually placed in the data base.

Locator Files

File Name: OPDHR.TIH

Initiator: TIHP5

Event Tree: L (from SDC, Seq. 1, from TIHP5, Seq. 2)
LA (from ADH, Seq. 1, 2, from TIHP5, Seq. 3)
LP (from SDC, Seq. 5, from TIHP5, Seq. 2)
LAP (from ADH, Seq. 6, from TIHP5, Seq. 3)

Human Error Events:

	OPDHR	0.48	10	HEP 3
*	LCMK	0 or 0.011	5	HEP 85 or 4
**	RM-LT	3.6E-3	5	HEP 56

In this inadvertent actuation of HPCS scenario, injection is stopped by HPCS auto-isolation on high level. Either SDC(B) or ADHRS continues to run or is started. At some point, either forced recirculation, RWCU, CRD, or any combination of the three fail, which requires the operators to diagnose the potential for a core/downcomer disconnect which could result in a functional loss of SDC. Failure of these systems should provide alarms/indications to the control room. The operators must diagnose the need to increase makeup with CRD (if available) or ECCS.

* In regards to LCMK, since increasing flow with CRD would be a possible option in some scenarios, operators would have 2.5 hrs to control level and could forget to do so. Thus, when LCMK is preceded by CRD success, then LCMK = 0.011. However, when CDS or an ECCS system is used, it is assumed that the operators would not just walk away from a system injecting 4000+ GPM. For these cases, the HEP for LCMK would be 0.

** The value for the operator action to control level in the long-term (RM-LT) was usually placed in the data base.

File Name: OPDHR.TIO

Initiator: TIOP5

Event Tree: L (from SDC, Seq. 1, from TIOP5, Seq. 2)
 LA (from ADH, Seq. 1, 2, from TIOP5, Seq. 3)
 LP (from SDC, Seq. 5, from TIOP5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.12	10	HEP 77

TIOP5 represents the occurrence of a mismatch between letdown and makeup (because of a decrease in letdown), which leads to a potential overpressurization of the vessel. In this scenario, operators have responded to the problem by controlling makeup (LCMK succeeds). Later in the scenario, makeup (CRD) fails or doesn't fail. SDC(B) or ADHRS has continued to run. RWCU may be functioning (even if at a decreased rate), which could lead to a draindown of the vessel if CRD has failed. OPDHR calls for operators to control level either: 1) before the lowering of level leads to a disconnect between the core and the downcomer, which could result in a "functional" loss of SDC, or 2) before increasing level leads to overpressurization of the vessel. A loss of CRD would be alarmed, as would a level decrease to level 4. Similarly, levels 7 and 8 would also be alarmed if level was increasing. While operators may have only 10 min. to diagnose and respond to the problem, they successfully responded to the earlier mismatch between letdown and makeup (LCMK) and should be closely monitoring level. Thus, OPDHR in this context is somewhat different than in other transients. In spite of the fact that the existing conditions might not directly enter the operators into a procedure, they will be striving to keep water level at the appropriate place. In cases where CRD is lost, the operators will have to decide which system to use to provide the makeup (most likely an ECCS system unless SDC is from ADHRS, in which case CDS might be an option). Thus, once the correct diagnosis is made, the decision is "dynamic" in the sense that the operators are not "directly" procedure driven.

Locator Files

File Name: OPDHR.TLM

Initiator: TLM5H

Event Tree: L (from SDC, Seq. 1, from TLM5H, Seq. 3)
LP (from SDC, Seq. 5, from TLM5H, Seq. 3)
LA (from ADH, Seq. 1, 2, from TLM5H, Seq. 5)
LAP (from ADH, Seq. 6, from TLM5H, Seq. 5)

Human Error Events:

OPDHR	0.48	10	HEP 3
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In this loss of makeup (CRD) scenario (TLM5H), some form of SDC is successful (RHR/SDC or ADHRS). If a LOSP occurs, the diesels start and load (DV1-2 succeeds). Operators must diagnose the need to provide/increase makeup to avoid a functional loss of SDC occurring from a disconnect between the core and the downcomer regions of the vessel. Since a loss of CRD (makeup) is the initiator, OPDHR includes initiation of some ECCS system for makeup. Thus, sequences involving a successful OPDHR in which CRD1 has failed would imply a successful initiation of an ECCS system for makeup. Thus, when going to the R tree, OPLEC should be set to 0 (success).

File Name: OPDHR.TRP

Initiator: TRPT5

Event Tree: L (from SDC, Seq. 1, from TRPT5, Seq. 3)
 LP (from SDC, Seq. 5, from TRPT5, Seq. 3)
 LA (from ADH, Seq. 1, 2, from TRPT5, Seq. 5)
 LAP (from ADH, Seq. 6, from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.48	10	HEP 3
* LCMK	0 or 0.011	10	HEP 85 or 4

In this loss of forced recirculation scenario (TRPT5), some form of SDC is successful (RHR/SDC or ADHRS). If a LOSP occurs, the diesel starts and loads (DV1-2 succeeds). The operators must diagnose the need to provide/increase makeup to avoid a functional loss of SDC occurring from a disconnect between the core and the downcomer regions of the vessel. If CRD is unavailable, then OPDHR includes initiation of some ECCS system for makeup. Thus, sequences involving a successful OPDHR in which CRD1 has failed would imply a successful initiation of an ECCS system for makeup. Thus, when going to the R tree, OPLEC should be set to 0 (success).

- * In regards to LCMK, since increasing flow with CRD would be a possible option in some scenarios, operators would have 2.5 hrs to control level and could forget to do so. Thus, when LCMK is preceded by CRD success, then LCMK = 0.011. However, when CDS or an ECCS system is used, it is assumed that the operators would not just walk away from a system injecting 4000+ GPM. For these cases, the HEP for LCMK would be 0.

Locator Files

File Name: OPDHR&.LP&

Initiator: T1-5

Event Tree: LP (from SDC, Seq. 5, from T1-5, Seq. 3)

LAP (from ADH, Seq. 6, from T1-5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.48	10	HEP 3
* LCMK	0 or 0.011	10	HEP 85 or 4

In this scenario, SDC(B) was successful, but forced recirculation is lost. Operator must diagnose the need to increase makeup to avoid a "functional" loss of SDC.

- * In regards to LCMK, since increasing flow with CRD would be a possible option in some scenarios, operators would have 2.5 hrs to control level and could forget to do so. Thus, when LCMK is preceded by CRD success, then LCMK = 0.011. However, when CDS or an ECCS system is used, it is assumed that the operators would not just walk away from a system injecting 4000+ GPM. For these cases, the HEP for LCMK would be 0.

File Name: OPDHR&.TIA

Initiator: TIA5H

Event Tree: L (from TIA5H, Seq. 3)
 LP (from TIA5H, Seq. 7)
 LA (from TIA5H, Seq. 18)
 LAP (from TIA5H, Seq. 22)

Human Error Events:

OPDHR	0.48	10	HEP 3
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In this scenario, SDC(B) was successful, but forced recirculation is lost. The operator must diagnose the need to increase makeup. Since this is a TIA sequence, CRD will not be available for increased flow.

Note. OPDHR in this case includes use of some ECCS system for makeup. Thus, events downstream of a successful OPDHR which involve initiation of ECCS should be set to 0 (success).

Locator Files

File Name: OPDHRHYD.E2C

Initiator: E2C-5

Event Tree: L (from ADEPS, Seq. 4, from OVPRS, Seq. 4,
from E2C-5, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.108	10	HEP 58
LCMK (CDS or ECCS)	0		HEP 85
LCMK (CRD)	0.011	5	HEP 4
RM-LT	3.6E-3	5	HEP 56

In this scenario, the operators are in hydro test when RWCU fails to run in the recirculation mode. An SRV opens on safety set point and fails to close, resulting in depressurization. The operators recognize the need to unisolate and initiate SDC(B) (SDCUI succeeds). SDC(B) successfully runs. Operators have 8.7 hrs. to accomplish SDCUI. Operators must now diagnose the need to provide makeup due to the potential for an eventual disconnect between the core and the downcomer without level control (OPDHR).

At this point, the operators have done everything correctly and the ONEP for IDHR has been pulled (SDC was initiated). Given the previous events, the operators will be likely to have an awareness of the need for makeup. OPDHR in this case could include an attempt to use CDS or ECCS, if CRD is not available. Given the injection rates for CDS or ECCS, it was assumed that the operators would control level once they began injection, i.e., not just walk away. If CRD continued to run, level control was not necessarily assumed to occur. RM-LT represents the operators providing long-term makeup for level control

File Name: OPDHRHYD.LP

Initiator: T1-5

Event Tree: L (from ADEPP, Seq. 2 from OVPRP, Seq. 4,
from HYDRO, Seq. 6, from T1-5, Seq 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.108	10	HEP 58
LCMK (ECCS)	0		HEP 85
LCMK (CRD)	0.011	5	HEP 4

In this scenario, the operators are in a HYDRO test when a LOSP occurs. A diesel starts (DV1-2 succeeds). FCIRC, CDS, and RWCU are lost. An SRV opens on safety set point and fails to close, resulting in depressurization. The operators recognize the need to unisolate SDC(B). SDC(B) successfully runs (SDCUI succeeds). The operators have 8.7 hrs. to accomplish SDCUI. Operator must now diagnose the need to provide makeup due to the potential for an eventual disconnect between the core and the downcomer without level control.

At this point, the operators have done everything correctly and the ONEP for IDHR has been pulled. Given the previous events, the operators will be likely to have an awareness of the need for makeup. OPDHR in this case includes an attempt to use ECCS (if CRD1 fails). Given the injection rates for ECCS, it was assumed that the operators would control level once they began injection, i.e., not just walk away.

Locator Files

File Name: OPDHRHYD.T5D

Initiator: T5D5H

Event Tree: L (from ADEP, Seq. 3, from OVPR, Seq. 4,
from HYDRO, Seq. 5, from T5D5H, Seq 34)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.108	10	HEP 58
LCMK	0		HEP 85

In this scenario, the operators are in hydro test when a loss of CCW occurs. FCIRC, CRD, and RWCU are lost. No LO SP. An SRV opens on its safety set point and fails to close, resulting in depressurization. The operators recognize the need to isolate RWCU and unisolate SDC(B). SDC(B) successfully runs (SDCUI). Operators have 8.7 hrs. to accomplish SDCUI. Operator must now diagnose the need to provide makeup due to the potential for an eventual disconnect between the core and the downcomer without level control.

At this point, the operators have done everything correctly and the ONEP for IDHR has been pulled. Given the previous events, the operators will be likely to have an awareness of the need for makeup. OPDHR in this case includes an attempt to use CDS or ECCS. Given the injection rates for CDS or ECCS, it was assumed that the operators would control level once they began injection, i.e., not just walk away.

File Name: OPDHRHYD.TIA

Initiator: TIA5H

Event Tree: L (from ADEP, Seq. 3, from OVPR, Seq. 4,
from HYDRO, Seq. 5, from TIA5H, Seq 33)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.108	10	HEP 58
LCMK	0		HEP 85

In this scenario, the operators are in a HYDRO test when a loss of IA occurs. FCIRC, CRD, and RWCU are lost. No LOSP. An SRV opens on its safety set point and fails to close, resulting in depressurization. The operators recognize the need to isolate RWCU and unisolate SDC(B). SDC(B) successfully runs (SDCUI). Operators have 8.7 hrs. to accomplish SDCUI. Operator must now diagnose the need to provide makeup due to the potential for an eventual disconnect between the core and the downcomer without level control.

At this point, the operators have done everything correctly and the ONEP for IDHR has been pulled. Given the previous events, the operators will be likely to have an awareness of the need for makeup. OPDHR in this case includes an attempt to use CDS or ECCS. Given the injection rates for CDS or ECCS, it was assumed that the operators would control level once they began injection, i.e., not just walk away.

Locator Files

File Name: OPDHRHYD.TIO

Initiator: TIOP5

Event Tree: L (from ADEP, Seq. 3, from OVPR, Seq. 4,
from TIOP5, Seq 19)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.108	10	HEP 58
LCMK (CDS or ECCS)	0		HEP 85
LCMK (CRD)	0.011	5	HEP 4
RM-LT	3.6E-3	5	HEP 56

In this scenario, the operators are conducting a HYDRO test when a mismatch between letdown and makeup occurs. No LO SP. An SRV opens on its safety set point and fails to close, resulting in depressurization. The operators recognize the need to unisolate and initiate SDC(B) (SDCUI succeeds). SDC(B) successfully runs. Operators have 8.7 hrs. to accomplish SDCUI. Operators must now diagnose the need to provide makeup due to the potential for an eventual disconnect between the core and the downcomer without level control (OPDHR).

At this point, the operators have done everything correctly and the ONEP for IDHR has been pulled (SDC was initiated). Given the previous events, the operators will be likely to have an awareness of the need for makeup. OPDHR in this case could include an attempt to use CDS or ECCS, if CRD is not available. Given the injection rates for CDS or ECCS, it was assumed that the operators would control level once they began injection, i.e., not just walk away. If CRD continued to run, level control was not necessarily assumed to occur. RM-LT represents the operators providing long-term makeup for level control.

File Name: OPDHRHYD.TLM

Initiator: TLM5H

Event Tree: L (from ADEP, Seq. 3, 5, from TLM5H, Seq. 7)

LP (from ADEPP, Seq. 2, from TLM5H, Seq. 8)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.108	10	HEP 58
LCMK	0		HEP 85
RM-LT	3.6E-3	5	HEP 56

In this scenario, the operators are in hydro test when CRD (makeup) is lost. If a LOSP occurs, then the emergency diesel generators start and load (DV1-2 OK). RWCU fails to continue to operate in recirculation mode and the operators recognize the need to unisolate and initiate SDC (SDCUI succeeds). SDC(B) or ADHRS successfully starts. Operators have 8.7 hrs. to accomplish SDCUI. Operators must now diagnose the need to provide makeup due to the potential for an eventual disconnect between the core and the downcomer without level control (OPDHR).

At this point, the operators have done everything correctly and the ONEP for IDHR has been pulled (SDC was initiated). Given the previous events, the operators will be likely to have an awareness of the need for makeup. OPDHR in this case could include an attempt to use CDS or ECCS. Given the injection rates for CDS or ECCS, it was assumed that the operators would control level once they began injection, i.e., not just walk away. RM-LT represents the operators providing long-term makeup for level control.

Locator Files

File Name: OPDHRHYD.TRP

Initiator: TRPT5

Event Tree: L (from ADEP, Seq. 3, 5, from TRPT5, Seq. 7)

LP (from ADEPP, Seq. 2, from TRPT5, Seq. 8)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.108	10	HEP 58
LCMK (CDS or ECCS)	0		HEP 85
LCMK (CRD)	0.011	5	HEP 4
RM-LT	3.6E-3	5	HEP 56

In this scenario, the operators are in a HYDRO test when forced recirculation is lost. If a LOSP occurs, then the emergency diesel generators start and load (DV1-2 OK). The operators successfully depressurize the vessel (OPNCF) and they recognize the need to unisolate and initiate SDC (SDCUI succeeds). SDC(B) or ADHRS successfully starts. Operators have 8.7 hrs. to accomplish SDCUI. Operators must now diagnose the need to provide makeup due to the potential for an eventual disconnect between the core and the downcomer without level control (OPDHR).

At this point, the operators have done everything correctly and the ONEP for IDHR has been pulled (SDC was initiated). Given the previous events, the operators will be likely to have an awareness of the need for makeup. OPDHR in this case could include an attempt to use CDS or ECCS, if CRD is not available. Given the injection rates for CDS or ECCS, it was assumed that the operators would control level once they began injection, i.e., not just walk away. If CRD continued to run, level control was not necessarily assumed to occur. RM-LT represents the operators providing long-term makeup for level control.

File Name: OPDHRHYD.TRP

Initiator: TRPT5

Event Tree: L (from ADEP, Seq. 3, 5, from TRPT5, Seq. 7)

LP (from ADEPP, Seq. 2, from TRPT5, Seq. 8)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.108	10	HEP 58
LCMK (CDS or ECCS)	0		HEP 85
LCMK (CRD)	0.011	5	HEP 4
RM-LT	3.6E-3	5	HEP 56

In this scenario, the operators are in a HYDRO test when forced recirculation is lost. If a LOSP occurs, then the emergency diesel generators start and load (DV1-2 OK). The operators successfully depressurize the vessel (OPNCF) and they recognize the need to unisolate and initiate SDC (SDCUI succeeds). SDC(B) or ADHRS successfully starts. Operators have 8.7 hrs. to accomplish SDCUI. Operators must now diagnose the need to provide makeup due to the potential for an eventual disconnect between the core and the downcomer without level control (OPDHR).

At this point, the operators have done everything correctly and the ONEP for IDHR has been pulled (SDC was initiated). Given the previous events, the operators will be likely to have an awareness of the need for makeup. OPDHR in this case could include an attempt to use CDS or ECCS, if CRD is not available. Given the injection rates for CDS or ECCS, it was assumed that the operators would control level once they began injection, i.e., not just walk away. If CRD continued to run, level control was not necessarily assumed to occur. RM-LT represents the operators providing long-term makeup for level control.

Locator Files

File Name: OPDHRHYD.TRV

Initiator: TORV5

Event Tree: L (from ADEP, Seq. 3, from TORV5, Seq. 3)

LP (from ADEPP, Seq. 2, from TORV5, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.108	10	HEP 58
LCMK	0		HEP 85
RM-LT	3.6E-3	5	HEP 56

In this scenario, the operators are in a HYDRO test when an inadvertent stuck open relief valve occurs. If a LOSP occurs, then the emergency diesel generator starts and loads (DV1-2 OK). RWCU fails to continue to operate in recirculation mode and the operators recognize the need to unisolate and initiate SDC (SDCUI succeeds). SDC(B) successfully starts. Operators have 8.7 hrs. to accomplish SDCUI. Operators must now diagnose the need to provide makeup due to the potential for an eventual disconnect between the core and the downcomer without level control (OPDHR).

At this point, the operators have done everything correctly and the ONEP for IDHR has been pulled (SDC was initiated). Given the previous events, the operators will be likely to have an awareness of the need for makeup. OPDHR in this case would include an attempt to use CDS or ECCS. Given the injection rates for CDS or ECCS, it was assumed that the operators would control level once they began injection, i.e., not just walk away. RM-LT represents the operators providing long-term makeup for level control.

File Name: OPDHRHYR.TIO

Initiator: TIOP5

Event Tree: L (from ADEP, Seq. 2, from OVPR, Seq. 4,
from TIOP5, Seq 19)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.015	5	HEP 87
LCMK (CDS or ECCS)	0		HEP 85
LCMK (CRD)	0.011	5	HEP 4
RM-LT	3.6E-3	5	HEP 56

In this scenario, the operators are in a HYDRO test when a mismatch between letdown and makeup occurs. No LO SP. An SRV opens on safety set point and fails to close, resulting in depressurization. RWCUC continues to run in recirculation mode (RWCUC). The operators need to diagnose the need to provide makeup due to the potential for an eventual disconnect between the core and the downcomer without level control (OPDHR). Since letdown in this scenario will be relatively small and RWCUC is providing core cooling as long as the level stays high, the operators have 115 min. to diagnose the need and provide makeup. Since the IDHR ONEP will not be immediately indicated, the operators will have to diagnose the potential disconnect on their own. Given the initiator, the likelihood that the operators will check level during the time available, and the fact that operators showed an awareness of the disconnect problem during interviews, the control room crew would have a reasonable probability of an appropriate response. OPDHR in this case could include an attempt to use CDS or ECCS, if CRD is not available. Given the injection rates for CDS or ECCS, it was assumed that the operators would control level once they began injection, i.e., not just walk away. If CRD continued to run, level control was not necessarily assumed to occur (LCMK). RM-LT represents the operators providing long-term makeup for level control.

Locator Files

File Name: OPDHRHYR.TRP

Initiator: TRPT5

Event Tree: L (from ADEP, Seq. 2, from TRPT5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.015	5	HEP 87
LCMK (CDS or ECCS)	0		HEP 85
LCMK (CRD)	0.011	5	HEP 4
RM-LT	3.6E-3	5	HEP 56

In this scenario, the operators are in hydro test when forced recirculation is lost. No LOSP. The operators successfully depressurize the vessel (OPNCF succeeds). RWCUC continues to run in recirculation mode (RWCUC). The operators need to diagnose the need to provide makeup due to the potential for an eventual disconnect between the core and the downcomer without level control (OPDHR). Since letdown in this scenario will be relatively small and RWCUC is providing core cooling as long as the level stays high, the operators have 115 min. to diagnose the need and provide makeup. Since the IDHR ONEP will not be immediately indicated, the operators will have to diagnose the potential disconnect on their own. Given the initiator, the likelihood that the operators will check level during the time available, and the fact that operators showed an awareness of the disconnect problem during interviews, the control room crew would have a reasonable probability of an appropriate response. OPDHR in this case could include an attempt to use CDS or ECCS, if CRD is not available. Given the injection rates for CDS or ECCS, it was assumed that the operators would control level once they began injection, i.e., not just walk away. If CRD continued to run, level control was not necessarily assumed to occur (LCMK). RM-LT represents the operators providing long-term makeup for level control.

File Name: OPDHRHYR.TLM

Initiator: TLM5H

Event Tree: L (from ADEP, Seq. 2, from TLM5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.015	5	HEP 87
LCMK (CDS or ECCS)	0		HEP 85
RM-LT	3.6E-3	5	HEP 56

In this scenario, the operators are in hydro test when CRD (makeup) is lost. No LOSP. RWCUC continues to run in recirculation mode (RWCUC). The operators need to diagnose the need to provide makeup due to the potential for an eventual disconnect between the core and the downcomer without level control (OPDHR). Since letdown in this scenario will be relatively small and RWCUC is providing core cooling as long as the level stays high, the operators have 115 min. to diagnose the need and provide makeup. Since the IDHR ONEP will not be immediately indicated, the operators will have to diagnose the potential disconnect on their own. Given the initiator, the likelihood that the operators will check level during the time available, and the fact that operators showed an awareness of the disconnect problem during interviews, the control room crew would have a reasonable probability of an appropriate response. OPDHR in this case could include an attempt to use CDS or ECCS. Given the injection rates for CDS or ECCS, it was assumed that the operators would control level once they began injection, i.e., not just walk away. RM-LT represents the operators providing long-term makeup for level control.

Locator Files

File Name: OPDHRHYR.TIO

Initiator: TIOP5

Event Tree: L (from ADEP, Seq. 2, from OVPR, Seq. 4,
from TIOP5, Seq 19)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.015	5	HEP 87
LCMK (CDS or ECCS)	0		HEP 85
LCMK (CRD)	0.011	5	HEP 4
RM-LT	3.6E-3	5	HEP 56

In this scenario, the operators are in a HYDRO test when a mismatch between letdown and makeup occurs. No LO SP. An SRV opens on safety set point and fails to close, resulting in depressurization. RWCUC continues to run in recirculation mode (RWCUC). The operators need to diagnose the need to provide makeup due to the potential for an eventual disconnect between the core and the downcomer without level control (OPDHR). Since letdown in this scenario will be relatively small and RWCUC is providing core cooling as long as the level stays high, the operators have 115 min. to diagnose the need and provide makeup. Since the IDHR ONEP will not be immediately indicated, the operators will have to diagnose the potential disconnect on their own. Given the initiator, the likelihood that the operators will check level during the time available, and the fact that operators showed an awareness of the disconnect problem during interviews, the control room crew would have a reasonable probability of an appropriate response. OPDHR in this case could include an attempt to use CDS or ECCS, if CRD is not available. Given the injection rates for CDS or ECCS, it was assumed that the operators would control level once they began injection, i.e., not just walk away. If CRD continued to run, level control was not necessarily assumed to occur (LCMK). RM-LT represents the operators providing long-term makeup for level control.

File Name: OPDHRHYR.TRV

Initiator: TORV5

Event Tree: L (from ADEP, Seq. 2, from TORV5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPDHR	0.015	5	HEP 87
LCMK (CDS or ECCS)	0		HEP 85
LCMK (CRD)	0.011	5	HEP 4
RM-LT	3.6E-3	5	HEP 56

In this scenario, the operators are in hydro test when an inadvertent stuck open relief valve occurs, resulting in vessel depressurization. RWCUC continues to run in recirculation mode (RWCUC). The operators need to diagnose the need to provide makeup due to the potential for an eventual disconnect between the core and the downcomer without level control (OPDHR). Since letdown in this scenario will be relatively small and RWCUC is providing core cooling as long as the level stays high, the operators have 115 min. to diagnose the need and provide makeup. Since the IDHR ONEP will not be immediately indicated, the operators will have to diagnose the potential disconnect on their own. Given the initiator, the likelihood that the operators will check level during the time available, and the fact that operators showed an awareness of the disconnect problem during interviews, the control room crew would have a reasonable probability of an appropriate response. OPDHR in this case could include an attempt to use CDS or ECCS, if CRD is not available. Given the injection rates for CDS or ECCS, it was assumed that the operators would control level once they began injection, i.e., not just walk away. If CRD continued to run, level control was not necessarily assumed to occur (LCMK). RM-LT represents the operators providing long-term makeup for level control.

Locator Files

File Name: OPDHRLAP.E1V

Initiator: E1V5H

Event Tree: LAP (from E1V5H, Seq. 11)

Human Error Events:

	OPDHR	0.48	10	HEP 3
*	LCMK	0 or 0.011	10	HEP 85 or 4
**	RM-LT	3.6E-3	5	HEP 56

In this isolation of common SDC suction line initiator, a LOSP occurs at some point. The diesel generator starts (DV1-2 OK). OPSDC, RESCS and either ADHRS or SDCBS were successful. RWCU auto-isolates. CRD fails or doesn't fail. Failure of the makeup and letdown systems should provide alarms/indications to the control room. Operator must diagnose need to increase makeup with CRD (if available), CDS, or ECCS to avoid core/downcomer disconnect problems.

- * In regards to LCMK, since increasing flow with CRD would be a possible option in some scenarios, operators would have 2.5 hrs to control level and could forget to do so. Thus, when LCMK is preceeded by CRD success, then LCMK = 0.011. However, when CDS or an ECCS system is used, it is assumed that the operators would not just walk away from a system injecting 4000+ GPM. For these cases, the HEP for LCMK would be 0.
- ** The value for the operator action to control level in the long-term (RM-LT) was usually placed in the data base.

File Name: OPDHRLAP.E1V

Initiator: E1V5H

Event Tree: LAP (from E1V5H, Seq. 11)

Human Error Events:

	OPDHR	0.48	10	HEP 3
*	LCMK	0 or 0.011	10	HEP 85 or 4
**	RM-LT	3.6E-3	5	HEP 56

In this isolation of common SDC suction line initiator, a LOSP occurs at some point. The diesel generator starts (DV1-2 OK). OPSDC, RESCS and either ADHRS or SDCBS were successful. RWCU auto-isolates. CRD fails or doesn't fail. Failure of the makeup and letdown systems should provide alarms/indications to the control room. Operator must diagnose need to increase makeup with CRD (if available), CDS, or ECCS to avoid core/downcomer disconnect problems.

- * In regards to LCMK, since increasing flow with CRD would be a possible option in some scenarios, operators would have 2.5 hrs to control level and could forget to do so. Thus, when LCMK is preceeded by CRD success, then LCMK = 0.011. However, when CDS or an ECCS system is used, it is assumed that the operators would not just walk away from a system injecting 4000+ GPM. For these cases, the HEP for LCMK would be 0.
- ** The value for the operator action to contol level in the long-term (RM-LT) was usually placed in the data base.

Locator Files

File Name: OPDHRLP.E1T

Initiator: E1T5H

Event Tree: LP (from E1T5H, Seq. 10)

Human Error Events:

	OPDHR	0.48	10	HEP 3
*	LCMK	0 or 0.011	10	HEP 85 or 4
**	RM-LT	3.6E-5	5	HEP 56

In this isolation of common SDC suction line initiator, a LOSP occurs at some point. The diesel generator starts (DV1-2 OK). OPSDC, RESCS and SDCBS were successful. RWCU auto-isolates. CRD fails or doesn't fail. Failure of the makeup and letdown systems should provide alarms/indications to the control room. Operator must diagnose need to increase makeup with CRD (if available) or ECCS to avoid core/downcomer disconnect problems.

- * In regards to LCMK, since increasing flow with CRD would be a possible option in some scenarios, operators would have 2.5 hrs to control level and could forget to do so. Thus, when LCMK is preceeded by CRD success, then LCMK = 0.011. However, when CDS or an ECCS system is used, it is assumed that the operators would not just walk away from a system injecting 4000+ GPM. For these cases, the HEP for LCMK would be 0.
- ** The value for the operator action to control level in the long-term was usually placed in the data base.

File Name: OPDHROP.TIH

Initiator: TIHP5

Event Tree: L (from SDC, Seq. 1, from TIHP5, Seq. 4)
 LA (from ADH, Seq. 1, 2, from TIHP5, Seq. 5)
 LP (from SDC, Seq. 5, from TIHP5, Seq. 4)

Human Error Events:

	OPDHR	0.48	10	HEP 3
*	LCMK	0 or 0.011	5	HEP 85 or 4
**	RM-LT	3.6E-3	5	HEP 56

In this inadvertent actuation of HPCS scenario, injection is stopped by the operators (OPHPC succeeds) when the HPCS auto-isolation on high level fails (HPCAO fails). Either SDC(B) or ADHRS continues to run or is started. At some point, either forced recirculation, RWCU, CRD, or any combination of the three fail, which requires the operators to diagnose the potential for a core/downcomer disconnect which could result in a functional loss of SDC. Failure of these systems should provide alarms/indications to the control room. The operators must diagnose the need to increase makeup with CRD (if available), CDS, or ECCS.

* In regards to LCMK, since increasing flow with CRD would be a possible option in some scenarios, operators would have 2.5 hrs to control level and could forget to do so. Thus, when LCMK is preceeded by CRD success, then LCMK = 0.011. However, when CDS or an ECCS system is used, it is assumed that the operators would not just walk away from a system injecting 4000+ GPM. For these cases, the HEP for LCMK would be 0.

** The value for the operator action to control level in the long-term (RM-LT) was usually placed in the data base.

Locator Files

File Name: OPDHRP.E1B

Initiator: E1B5H

Event Tree: LP (from E1B5H, Seq. 11)

Human Error Events:

OPDHR	0.48	10	HEP 3
LCMK	0		HEP 85

In this loss of SDC scenario, a LOSP occurs at some point. OPSDC, RESB and SDC(B) were successful, but forced recirculation is lost, as is CRD and CDS. RWCU isolates automatically. Operator must diagnose need to increase makeup with ECCS system.

File Name: OPDHRP.E1D

Initiator: E1D5H

Event Tree: LAP (from E1D5H, Seq. 14)

Human Error Events:

OPDHR	0.48	10	HEP 3
LCMK	0		HEP 85

In this loss of SDC scenario, a LOSP occurs at some point. OPSDC and SDC(B) were successful, but forced recirculation is lost, as is CRD and CDS. RWCU isolates automatically. Operator must diagnose need to increase makeup with ECCS system.

Locator Files

File Name: OPDHRP.E2D

Initiator: E2D5H

Event Tree: LAP (from E2D5H, Seq. 8)

Human Error Events:

OPDHR	0.48	10	HEP 3
LCMK	0		HEP 85

In this loss of SDC scenario, a LOSP occurs at some point. OPSDC and SDC(B) were successful, but forced recirculation is lost, as is CRD and CDS. RWCU isolates automatically. Operator must diagnose need to increase makeup with ECCS system.

File Name: OPDHRP.T5D

Initiator: T5D5H

Event Tree: LAP (from tree T5D5H, Seq. 23)

Human Error Events:

OPDHR	0.48	10	HEP 3
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In this loss of CCW scenario, a LOSP occurs at some point. OPSDC and SDC(B) were successful, but forced recirculation is lost, as is CRD and CDS. RWCU isolates automatically. The operators must diagnose the need to increase makeup with an ECCS system. This CCW scenario is very much like the LOSP scenario. RWCU does not have to be isolated and CDS is not available.

Locator Files

File name: OPECAD10.TAB

Initiator: TAB5H

Event Tree: HPSWA (from ADH, Seq. 10, from TAB5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	1.0		HEP 102

In this scenario, the only AC bus has failed and is followed by a LOSP. Thus, no DV1-2. HPCS is working (available). OPECS in this case involves deciding to initiate ECCS water solid operation with HPCS. The most significant difference between this and HPSWR (from SDC tree) is that the operators must also diagnose need to isolate ADHR during OPECS. This is a non-trivial difference because with the LOSP and loss of Div 1/2 (or TAB5H initiator and a LOSP), operators will now have to isolate the 8 or 9 valve locally. When 15 min. is assumed for accomplishing this action and the other OPECS actions are considered, insufficient time remains for making the relevant diagnoses.

File Name: OPECADH5.TAB

Initiator: TAB5H

Event Tree: EA (from ADH, Seq. 5, from TAB5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	1.0		HEP 17

In this loss of AC bus scenario, OPSDC has failed. That is, the control room has failed to detect the loss of SDC (ADHR) in 37 min, given that the only useful AC bus has failed (B train) and rendered any useful B systems unavailable. Because of this failure and the need to diagnose the need to isolate ADHR and start HPCS (for which no step by step procedures are available, i.e., the IDHR ONEP indicates use of any available ECCS system but nothing about isolating ADHR), the HEP derived for OPECS is equal to 1.0. The critical problem here is that a control room failure to diagnose the loss of the operating SDC in this circumstance does not bode well for doing so in OPECS, in which the need to isolate ADHR must be determined without procedures.

Locator Files

File Name: OPECADH5.TDB

Initiator: TDB5H

Event Tree: EA (from ADH, Seq. 5, form TDB5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	1.0		HEP 17

In this loss of DC bus scenario, OPSDC has failed. That is, the control room has failed to detect the loss of SDC (ADHR) in 37 min, given that the only useful DC bus has failed (B train) and rendered any useful B systems unavailable. Because of this failure and the need to diagnose the need to isolate ADHR and start HPCS (for which no step by step procedures are available, i.e., the IDHR ONEP indicates use of any available ECCS system but nothing about isolating ADHR), the HEP derived for OPECS is equal to 1.0. The critical problem here is that a control room failure to diagnose the loss of the operating SDC in this circumstance does not bode well for doing so in OPECS, in which the need to isolate ADHR must be determined without procedures.

File Name: OPECC.S25

Initiator: S2-5

Event Tree: ES (from S15NF, Seq. 1, from S1XFR, Seq. 1,
from S2-5, Seq. 11, 22)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECC	0.01	5	HEP 75
OPSRV	0		HEP 75
OPMSV	0		HEP 75

OPECC is the operator action to initiate ECCS water solid after providing a dump of SPMU (OPSPM succeeds) in the context of a small LOCA inside containment. The small LOCA is not immediately isolated. Reactor level is dropping and ECCS pumps will initiate automatically at level 2. Since operators have initiated SPMU, it is assumed that they are aware of the small LOCA. Several alarms have sounded to indicate that level is dropping, including a level 3 alarm which will indicate a loss of SDC. With level dropping and a loss of SDC, EP-2 and the IDHR ONEP will direct the operators to start ECCS (if it hasn't already) and initiate ECCS water solid operation.

OPSRV, which is the operator action to open at least 1 SRV, is covered as part of OPECC in this case. Thus, if OPECC succeeds, it is assumed that the operators opened at least 1 SRV per the IDHR ONEP and OPSRV is set to succeed. OPMSV, which is the closing of any open MSIVs is assumed to take place during the 3 hours allowed for OPECC and OPSRV. Checking closed MSIVs is part of procedure for going ECCS water solid. Thus, OPMSV is set to succeed if OPECC succeeds.

Locator Files

File Name: OPECC.S2H

Initiator: S2H-5

Event Tree: ES (from S1HNF, Seq. 4, from S1XFR, Seq. 1,
from S2H-5, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECC	0.01	5	HEP 75
OPSRV	0		HEP 75

OPECC is the operator action to initiate ECCS water solid after providing a dump of SPMU (OPSPM succeeds) in the context of a small LOCA inside containment. The small LOCA occurred during HYDRO test and it is not immediately isolated. Reactor level is dropping and ECCS pumps will initiate automatically at level 2. Since operators have initiated SPMU, it is assumed that they are aware of the small LOCA. Several alarms have sounded to indicate that level is dropping, including a level 3 alarm which will indicate a loss of SDC. With level dropping and a loss of SDC. EP-2 and the IDHR ONEP will direct the operators to start ECCS (if it hasn't already) and initiate ECCS water solid operation.

OPSRV is part of OPECC in this case. Thus, if OPECC succeeds, it is assumed that the operators opened 2 SRVs per the IDHR ONEP. Twenty SRVs may be available.

MSIVs are closed during HYDRO.

File Name: OPECC.S35

Initiator: S3-5

Event Tree: ES (from S15NF, Seq. 1, from S1XFR, Seq. 1,
from S3-5, Seq. 32)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECC	0.01	5	HEP 75
OPSRV	0		HEP 75
OPMSV	0		HEP 75

OPECC is the operator action to initiate ECCS water solid after providing a dump of SPMU (OPSPM succeeds) in the context of a small-small LOCA inside containment. The small-small LOCA is not immediately isolated. Reactor level is slowly dropping. Alarms will sound at level 4 and 3 and SDC will isolate at level 3. The ECCS pumps will initiate automatically at level 2. Numerous signals have indicated the LOCA and operators have initiated SPMU, indicating they are aware of the loss of level. With level dropping and a loss of SDC, EP-2 and the IDHR ONEP will direct the operators to start ECCS (if it hasn't started already) and initiate ECCS water solid operation.

OPSRV, which is the operator action to open at least 1 SRV, is covered as part of OPECC in this case. Thus, if OPECC succeeds, it is assumed that the operators opened at least 1 SRV per the IDHR ONEP and OPSRV is set to succeed. OPMSV, which is the closing of any open MSIVs is assumed to take place during the 3 hours allowed for OPECC and OPSRV. Checking closed MSIVs is part of procedure for going ECCS water solid. Thus, OPMSV is set to succeed if OPECC succeeds.

Locator Files

File Name: OPECLAP.T5D

Initiator: T5D5H

Event Tree: EAP (from LAP, Seq. 8, 15, from T5D5H, Seq. 23)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

A loss of CCW is the initiator. At some point it is followed by LOSP with the diesels successfully starting and loading (DV1-2 succeeds). ADHR is lost, but the operators successfully start SDC(B). RWCU isolates automatically with the LOSP. CRD and forced recirculation are lost. With the loss of makeup and forced recirculation, the potential for a disconnect between the core and the downcomer regions of the core arises. With inadequate level or recirculation, a "functional" loss of SDC can occur. OPDHR is the operator action to diagnose the functional loss of SDC and initiate level control. In these sequences, OPDHR has failed. That is, the operators fail to diagnose the disconnect between the core and the downcomer and the resulting functional loss of SDC in the 10 minutes allowed for OPDHR. However, at this point some additional indicators would be coming available and the operators should notice increases in pressure and temperature on chart recorders per periodic checks (required every 30 minutes). Operators must diagnose the need to initiate ECCS water solid operation.

File Name: OPECS.H15

Initiator: H1-5H

Event Tree: E (from RH2, Seq. 1, 10, 23, 29, 38, 51,
from H1-5H, Seq. 5, 10)

EA (from RAH2, Seq. 1, 19,
from H1-5H, Seq. 15)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.003	5	HEP 114
OP1SV	0.015	5	HEP 115
* OPHIS	0 or 1.0		HEP 8
OPMSV	1.0		HEP 9

The H1-5H initiator is a diversion to SP via RHR. The operators initially fail (in 3 min.) to identify diversion and isolate (OPL1S) before level 3 is reached. Level 3 isolation signal fails (logic) for 8 and 9 valve, so valves fail to close. An ECCS system auto-starts on low level and the operators successfully control level (LCHPC or LC-LP succeed). The operators then decide to manually isolate SDC (ISO89 succeeds). Given the manual isolation of SDC, the operators will be aware of the need for SDC and they will have entered the IDHR ONEP. In fact, since they were already in a "backwards" water solid operation mode (through RHR to SP and back into vessel through ECCS system), the decision to isolate SDC is assumed to indicate a decision to initiate the normal means of ECCS water solid operation. With ECCS already injecting, in OPECS the operators need only to open 2 SRVs and check closed the MSIVS. Even if only get 1SRV, operators unlikely to turn off ECCS given EP-2 instructs operation of ECCS for makeup. Moreover, since diagnosis for water solid operation was assumed to be made in ISO89, there is ample time available to diagnose the need to proceed with 1 SRV. Thus, a somewhat lower value was obtained for OP1SV in these sequences than in some others.

- * HEP for OPHIS depends on which system is already operating in the sequence. If HPCS started in RH2, then OPHIS should be set to succeed. If LPCI started, then OPHIS should not be asked. If it is, it should fail.

Locator Files

File Name: OPECS.J2

Initiator: J2-5

Event Tree: E (from A5ISJ, Seq. 1, 6, from J2-5, Seq. 2)
EP (from A5ISJ, Seq. 2, 7, from J2-5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 61
OP1SV	0.302	10	HEP 107
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

A break in the SDC line has occurred outside containment. MV 8 or 9 auto-isolates on low level (level 3), which results in isolation of the break and SDC. If a LOSP also occurs, the diesels start and load (DV1-2 succeeds). Level 3 alarms (RPV level below 11.4) will cause the operators to enter EP-2, which will direct them to restore level. The RHR pump trip alarms and closure of MV 8 or 9 will indicate a loss of SDC and the corresponding IDHR to the operators. The operators will then enter the IDHR ONEP, which will instruct them to initiate ECCS water solid operation.

Note: Relative to the HEPs used for OPECS and OP1SV in other similar sequences, the values used above were somewhat conservative. More appropriate HEPs, in terms of consistency with the current analysis, would have been HEP 64 (0.043) for OPECS and HEP 63 (0.08) for OP1SV. Where important, the differences will be considered and taken into account during recovery.

File Name: OPECS.T5D

Initiator: T5D5H

Event Tree: E (from T5D5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.12	10	HEP 39
OP1SV	0.31	10	HEP 40
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

Loss of CCW initiator with a random failure of SDC(B). The operators successfully detect the loss of SDC (OPSDC succeeds). The operators must diagnose need to isolate RWCU and initiate ECCS water solid operation per the IDHR ONEP. All relevant information is provided in the ONEPs for Loss of CCW and IDHR. Substantial indicators should be available.

Locator Files

File Name: OPECS.TIF

Initiator: TIOF5

Event Tree: E (from TIOF5, Seq. 4)
 EP (from TIOF5, Seq. 5)
 EA (from AIAD, Seq. 2, from TIOF5, Seq. 14)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.04	5	HEP 88
OP1SV	0.302	10	HEP 109
OPHIS	1.0		HEP 8
OPISA	0		HEP 81

Spurious actuation of LPCI or LPCS initiator (TIOF5). Operators would get level 7 and level 8 alarms within 1 min. of actuation. Level would be increasing rapidly and operators would check systems likely to allow such level changes. Pump starts and valve openings would be indicated. OPSLP is operator action to detect and stop the inadvertent injection prior to overpressurization. OPSLP fails (less than 7 min. for diagnosis) in this scenario and the operating SDC system isolates on high pressure (135 psi). If a LOSP occurs, the diesel generators successfully start. Additional alarms would sound. Operators would enter IDHR ONEP and attempt to initiate ECCS water solid operation to provide SDC. MSIVs are closed.

File Name: OPECS.TIH

Initiator: TIHP5

Event Tree: E (from AISD, Seq. 1, from TIHP5, Seq. 6)
EA (from AIAD, Seq. 2, from TIHP5, Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.04	5	HEP 88
OP1SV	0.302	10	HEP 109
* OPISA	0		HEP 81
OPHIS	1.0		HEP 8

Spurious actuation of HPCS initiator (TIHP5). Operators would get level 7 and level 8 alarms within 1 min. of actuation. HPCS should auto-isolate on high level (HPCAO). If the auto-isolation fails, level would be increasing rapidly and operators would check systems likely to allow such level changes. Pump starts and valve openings would be indicated. OPHPC is operator action to detect and stop the inadvertent injection prior to overpressurization. OPHPC fails (less than 7 min. for diagnosis) in this scenario and the operating SDC system isolates on high pressure (135 psi). If a LOSP occurs, the diesel generators successfully start. Additional alarms would sound. Operators would enter IDHR ONEP and attempt to initiate ECCS water solid operation to provide SDC. MSIVs are closed.

* Operator action to isolate ADHRS (OPISA) is set to 0 (SUCCESS) because ADHR auto-isolates on high pressure.

Locator Files

File Name: OPECS&.EP

Initiator: T1-5

Event Tree: EP (from SDC, Seq. 7, from T1-5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

In this scenario, OPSDC has succeeded and the appropriate ONEP has been entered prior to start of OPECS. That is, operators have diagnosed loss of SDC(B), and entered the IDHR ONEP. RWCU (letdown) has isolated due to the initiator. LPCI(C) or HPCS is available for ECCS water solid operation. LPCI(C) is assumed to be system of choice. In this instance of OPECS, credit is not taken for operators initiating HPCS if LPCI(C) fails. All available time (23 min.) is allocated to diagnosing the need and initiating LPCI(C) , thus OPHIS (operator initiation of HPCS), which must occur in the same time frame as OPECS, is set to fail at this point in the sequence (credit for HPCS may be taken during recovery analysis if not asked elsewhere). OP1SV represents the probability the control room will proceed with ECCS water solid operation if only 1 SRV can be opened. OPMSV is operator action to notice any open MSIVs and close them during first 4.4 min. of OPECS.

File name: OPECS&.HPA

Initiator: T1-5

Event Tree: HPSWA (from ADH, Seq. 10, from T1-5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	1.0		HEP 102

In this scenario a LOSP has occurred and the DV1-2 diesels have failed to start. HPCS is working (available). OPECS in this case, involves deciding to initiate ECCS water solid operation with HPCS. The most significant difference between this and HPSWR (from SDC tree) is that the operators must also diagnose need to isolate ADHR during OPECS. This is a non-trivial difference because with the LOSP and loss of Div 1/2 (or TAB5H initiator and a LOSP), operators will now have to isolate the 8 or 9 valve locally. When 15 min. is assumed for accomplishing this action and the other OPECS actions are considered, insufficient time remains for making the relevant diagnoses.

Locator Files

File Name: OPECS&.HPR

Initiator: T1-5

Event Tree: HPSWR (from SDC, Seq. 9)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
* OPHIS	0		HEP 8
OPMSV	1		HEP 9
OPSOF	0.06	10	HEP 12

In this scenario, a LOSP has occurred and the diesel generators have failed to start (DV1-2 fails). HPCS is working (available). OPECS in this case, involves deciding to go water solid with HPCS.

- * OPHIS is completely dependent on OPECS. If OPECS succeeds, then so does OPHIS which is the operator action to initiate HPCS. Thus, failure probability for OPHIS should be set to 0 when OPECS is successful.

File Name: OPECS10.T5D

Initiator: T5D5H

Event Tree: EP (from T5D5H, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this scenario the initiator was a loss of CCW. At some point later a LOSP has occurred, but the diesels successfully start and load (DIV 1/2 succeeds). OPSDC in this case has failed. That is, in 37 min. the control room has not diagnosed the loss of SDC or entered the IDHR ONEP. However, at this point additional alarms could sound, e.g., a low level or high pressure alarm, and by requirements (every 30 min.) the reactor temperature and/or pressure chart recorders would very likely be checked (to reveal increases) in the 23 additional minutes available for this event. In the present case, it was assumed that LPCI (C) would be the operators choice for initiating ECCS water solid operation.

Locator Files

File Name: OPECS21.T5D

Initiator: T5D5H

Event Tree: EA (from T5D5H, Seq. 21)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.12	10	HEP 39
OP1SV	0.31	10	HEP 40
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
* OPISA	0		HEP 81

Loss of CCW initiator with a random failure of ADHR. The operators detect the loss of SDC and attempt to establish SDC(B), but it fails to start. The operators must diagnose need to isolate RWCU and initiate ECCS water solid operation. ADHR should already be isolated with the success of OPSDC. All relevant information is provided in the ONEPs for Loss of CCW and IDHR and the RHR SOI. Substantial indicators should be available.

- * OPISA is completely dependent on OPECS. If OPECS succeeds, then the operators will have isolated ADHR and OPISA succeeds.

File Name: OPECS22.T5D

Initiator: T5D5H

Event Tree: EA (from T5D5H, Seq. 22)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.31	10	HEP 46
OP1SV	0.57	10	HEP 47
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
* OPISA	0		HEP 81

Loss of CCW initiator with a random failure of ADHR. RWCU is lost and does not necessarily auto-isolate. The operators fail on OPSDC, so they have not detected the loss of SDC (ADHR in this case) in 37 minutes. However, at this point an additional alarm would be likely to sound (low level) and reactor pressure and temperature would be likely to be checked (periodic check required every 30 min.) The operators must diagnose the need to isolate RWCU and initiate ECCS water solid operation. They also need to isolate ADHR to prevent overpressurization of low pressure piping. The IDHR ONEP and the RHR SOI must be retrieved and read.

- * Completely dependent on OPECS. If OPECS successful, then ADHR was isolated by the operators and OPISA is successful. OPISA had to be done concurrently with OPECS.

Locator Files

File Name: OPECS3.T5A

Initiator: T5A5H

Event Tree: E (from T5A5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 16
OP1SV	0.112	10	HEP 105
* OPHIS	0		HEP 8
OPMSV	1.0		HEP 9

In this scenario, a loss of SSW has occurred. SDC(B) fails and the operators recognize the loss of SDC (OPSDC succeeds). The control room has entered the relevant ONEPs. They are instructed by the IDHR ONEP to initiate ECCS water solid operation with any available system. Given the initiator, HPCS is the only available system.

- * OPHIS is completely dependent on OPECS. If OPECS succeeds, then OPHIS succeeds.

Note. The HEP used above for OPECS (HEP 16) assumed that the operators might be required to isolate the SDC low pressure piping by closing the 8 or 9 valve from the control room. In actuality, isolating the low pressure piping would probably not be required in this scenario. Thus, HEP 6 for OPECS (0.035) would have been a more appropriate and consistent HEP in the context of the overall analysis. However, the use of HEP 16 is just slightly more conservative.

File Name: OPECS4.T5A

Initiator: T5A5H

Event Tree: E (from T5A5H, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
* OPHIS	0		HEP 8
OPMSV	1.0		HEP 9

In this scenario, a loss of SSW has occurred. SDC(B) is lost. OPSDC in this case has failed. That is, in 37 min. the control room has not diagnosed the loss of SDC or entered the IDHR ONEP. However, at this point additional alarms could sound, e.g., a low level or high pressure alarm, and by requirements (every 30 min.) the reactor temperature and/or pressure chart recorders would very likely be checked (to reveal increases) in the 23 additional minutes available for this event. Operators must diagnose the need to initiate ECCS water solid operation.

* OPHIS is completely dependent on OPECS. If OPECS succeeds, the OPHIS succeeds.

Locator Files

File Name: OPECS9.T5D

Initiator: T5D5H

Event Tree: EP (from T5D5H, Seq. 9)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

In this scenario (a loss of CCW, followed sometime later by a LOSP), OPSDC has succeeded and the appropriate ONEP has been entered prior to start of OPECS. That is, the operators have diagnosed the loss of SDC(B) (which fails to restart even though DV1-2 was successful), and entered the IDHR ONEP. RWCU auto isolates and CRD is lost. Operators must initiate LPCI(C) and perform related actions. No time for HPCS initiation was assumed if LPCI fails, so OPHIS is set to 1.0.

File Name: OPECSA07.E2D

Initiator: E2D5H

Event Tree: EA (from E2D5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	1.0		HEP 13

In this loss of ADHR scenario, OPSDC has failed. That is, the control room has failed to detect/realize the loss of SDC (ADHR) in 37 minutes. Because of the failure of OPSDC and the time and actions required to isolate ADHR and align and start ECCS (per "abnormal operations" in the RHR SOI), and perform the related OPECS action from the IDHR ONEP, OPECS fails (as do the remaining associated human actions).

Locator Files

File Name: OPECSA12.E1D

Initiator: E1D5H

Event Tree: EA (from E1D5H, Seq. 12)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	1.0		HEP 13

In this isolation of ADHR scenario, OPSDC has failed. That is, the control room has failed to detect/realize the loss of SDC (ADHR) in 37 minutes. Because of the failure of OPSDC and the time and actions required to isolate ADHR and align and start ECCS (per "abnormal operations" in the RHR SOI) and perform the related OPECS action from the IDHR ONEP, OPECS fails (as do the remaining associated human actions).

File Name: OPECSAD2.E1V

Initiator: E1V5H

Event Tree: EA (from E1V5H, Seq. 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
OPISA	0		HEP 81

The above scenario reflects an isolation of the SDC common suction line. ADHRS is lost and the operators diagnose the loss of SDC (OPSDC successful). The crew successfully unisolates SDC (RESCS succeeds), but ADHRS fails to run. SDC(B) also fails to start. The operators have entered the IDHR procedure and are directed to initiate ECCS water solid operation.

Locator Files

File Name: OPECSAD5.E2V

Initiator: E2V5H

Event Tree: EA (from E2V5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this loss of SDC common suction line scenario, OPSDC has failed. That is, in 37 min. the control room has not diagnosed the loss of SDC (initially ON ADHRS) or pulled ONEP. However, at this point it is possible that an additional alarm would indicate low level (level 4) and by requirements (every 30 min.) the reactor temperature (and/or pressure) chart recorder would very likely be checked (to reveal increases) in the 23 min. available for this event. With the additional time and new indicators, it was assumed that the HEP computations for OPECS etc. would parallel those for similar events in which the need for an ECCS system must be diagnosed and the related actions carried-out without a successful OPSDC.

File Name: OPECSAD5.TIO

Initiator: TIOP5

Event Tree: EA (from ADH, Seq. 5, from TIOP5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 78
OP1SV	0.302	10	HEP 108
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
OPISA	0		HEP 81

In this TIOP5 scenario, LCMK has succeeded with the operators controlling level to handle the mismatch between letdown and makeup. Later in the scenario, ADHRS fails and OPSDC in this case has failed. That is, in 37 min. the control room has not diagnosed the loss of SDC or entered the IDHR ONEP. However, by requirements (every 30 min.) the reactor temperature (and/or pressure) chart recorder would very likely be checked (to reveal increases) in the 23 min. available for this event. In addition, if a boil-off had begun, a low level alarm (level 4) may occur. With the additional time and new indicators, it was assumed that the HEP computations for OPECS etc. would parallel those for similar events in which the need for an ECCS system must be diagnosed and the related actions carried-out without a successful OPSDC.

Locator Files

File Name: OPECSAD5.TLM

Initiator: TLM5H

Event Tree: EA (from ADH, Seq. 5, from TLM5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 78
OP1SV	0.302	10	HEP 108
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
OPISA	0		HEP 81

In this TLM5H scenario, a loss of CRD (makeup) has occurred. Later in the scenario, ADHRS fails and OPSDC in this case has failed. That is, in 37 min. the control room has not diagnosed the loss of ADHRS or entered the IDHR ONEP. However, by this time a low level alarm would probably sound (level 4) and by requirements (every 30 min.) the reactor temperature (and/or pressure) chart recorder would very likely be checked (to reveal increases) in the 23 min. available for this event. With the additional time and new indicators, it was assumed that the HEP computations for OPECS etc. would parallel those for similar events in which the need for an ECCS system must be diagnosed and the related actions carried-out without a successful OPSDC.

File Name: OPECSAD5.TRP

Initiator: TRPT5

Event Tree: EA (from ADH, Seq. 5, from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 78
OP1SV	0.302	10	HEP 108
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
OPISA	0		HEP 81

In this TRPT5 scenario, a loss of forced recirculation has occurred. Later in the scenario, ADHRS fails and OPSDC in this case has failed. That is, in 37 min. the control room has not diagnosed the loss of ADHRS or entered the IDHR ONEP. However, by requirements (every 30 min.) the reactor temperature (and/or pressure) chart recorder would very likely be checked (to reveal increases) in the 23 min. available for this event. In addition, if any boil-off had begun, a low level alarm could occur (level 4). With the additional time and new indicators, it was assumed that the HEP computations for OPECS etc. would parallel those for similar events in which the need for an ECCS system must be diagnosed and the related actions carried-out without a successful OPSDC.

Locator Files

File Name: OPECSADF.E1V

Initiator: E1V5H

Event Tree: EA (from E1V5H, Seq. 10)
EAP (from E1V5H, Seq. 17)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this isolation of SDC common suction line scenario, OPSDC has failed. That is, in 37 min. the control room has not diagnosed the loss of SDC (ADHRS in this case) or entered the IDHR ONEP. However, at this point in time it is possible that an additional alarm would indicate low level and by requirements (every 30 min.) the reactor temperature (and/or pressure) chart recorder would very likely be checked (to reveal increases) in the 23 min. available for this event. With the additional time and new indicators, it was assumed that the HEP computations for OPECS etc. would parallel those for similar events in which the need for an ECCS system must be diagnosed and the related actions carried-out without a successful OPSDC. Credit was not taken for HPCS at this point in time because of the limited time available.

File Name: OPECSADH.E1D

Initiator: E1D5H

Event Tree: EA (from E1D5H, Seq. 6, 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 16
OP1SV	0.112	10	HEP 105
* OPHIS	0		HEP 8
OPMSV	1.0		HEP 9
* OPISA	0		HEP 81

The above scenario reflects an isolation of ADH. The operators recognize the loss of SDC (OPSDC succeeds) and either succeed or fail at unisolating ADH (RESAD succeeds or fails). If RESAD does succeed, ADHR fails. In either case they attempt to start SDC(B), but it fails to start. OPECS involves isolating ADHR from the control room (if necessary) by closing 8 or 9 valve and initiating HPCS from CR for ECCS water solid operation per the IDHR ONEP. With the loss of ADH and SDC(B), it is conservatively assumed that neither LPCI(C) nor (B) are available.

* OPHIS and OPISA are completely dependent on OPECS. If OPECS succeeds, then OPHIS and OPISA succeed.

Locator Files

File Name: OPECSADH.E1V

Initiator: E1V5H

Event Tree: EA (from E1V5H, Seq. 8)
EAP (from E1V5H, Seq. 15)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
OPISA	0		HEP 81

The above scenario reflects an isolation of the SDC common suction line. ADHRS is lost and the operators diagnose the loss of SDC (OPSDC successful). The crew fails to unisolate SDC (RESCS fails). The operators have entered the IDHR procedure are directed to initiate ECCS water solid operation.

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File Name: OPECSADH.E2D

Initiator: E2D5H

Event Tree: EA (from E2D5H, Seq. 6)
EAP (from E2D5H, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 16
OP1SV	0.112	10	HEP 105
* OPHIS	0		HEP 8
OPMSV	1.0		HEP 9
* OPISA	0		HEP 81

The above scenario reflects a loss of ADH. In some cases the initiator is followed by a LO SP and the diesels successfully start and load (DV1-2 succeeds). The operators recognize the loss of SDC (OPSDC succeeds) and attempt to start SDC(B), but it fails to start. OPECS involves isolating ADHR from control room (if necessary) by closing 8 or 9 valve and initiating HPCS from CR for ECCS water solid operation per the IDHR ONEP. With the loss of ADH and failure of SDC(B), it is conservatively assumed that neither LPCI(C) nor (B) are available.

* OPHIS and OPISA are completely dependent on OPECS. If OPECS succeeds, then OPHIS and OPISA succeed.

Locator Files

File Name: OPECSADH.E2V

Initiator: E2V5H

Event Tree: EA (from E2V5H, Seq. 4)

EAP (from E2V5H, Seq. 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

E2V5H initiator, which is a loss of SDC common suction line. If a LOSP has occurred, the diesel generators successfully start (DV1-2 OK). All SDC has been rendered unavailable and the operators have diagnosed the loss of the ADHRS and entered the IDHR ONEP prior to start of OPECS (OPSDC has succeeded). By procedure they are directed to initiate ECCS water solid operation.

File Name: OPECSADH.TAB

Initiator: TAB5H

Event Tree: EA (from ADH, Seq. 4, from TAB5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 16
OP1SV	0.112	10	HEP 105
* OPHIS	0		HEP 8
OPMSV	1.0		HEP 9
* OPISA	0		HEP 81

In this scenario, OPSDC has succeeded and the appropriate ONEP has been entered prior to start of OPECS. That is, operators have diagnosed the loss of ADH in the context of the loss of the 1E AC bus and entered the IDHR ONEP. OPECS involves isolating ADH from the control room (if necessary) by closing the 8 or 9 valve and initiating HPCS from the CR.

* OPHIS and OPISA are completely dependent on OPECS. If OPECS succeeds, then OPHIS and OPISA succeed.

Locator Files

File Name: OPECSADH.TDB

Initiator: TDB5H

Event Tree: EA (from ADH, Seq. 4, from TDB5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 16
OP1SV	0.112	10	HEP 105
* OPHIS	0		HEP 8
OPMSV	1.0		HEP 9
* OPISA	0		HEP 81

In this scenario, OPSDC has succeeded and the appropriate ONEP has been entered prior to start of OPECS. That is, operators have diagnosed the loss of ADH in the context of the loss of the 1E DC bus and entered the IDHR ONEP. OPECS involves isolating ADH from the control room (if necessary) by closing the 8 or 9 valve and initiating HPCS from the CR.

- * OPHIS and OPISA are completely dependent on OPECS. If OPECS succeeds, then OPHIS and OPISA succeed.

File Name: OPECSADH.TIF

Initiator: TIOF5

Event Tree: EAP (from ADH, Seq. 8, from TIOF5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPISA	0		HEP 81
OPHIS	1		HEP 8
OPMSV	1		HEP 9

TIOF5 initiator, which is an inadvertent actuation of LPCI. Operators successfully stop injection. If a LOSP also occurs, the diesel generators successfully start (DV1-2 OK). Later in the scenario, a random isolation of ADHRS occurs. The operators have diagnosed the loss of the ADHRS, attempted to establish SDC(B) with no luck, and entered the IDHR ONEP prior to start of OPECS (OPSDC has succeeded). By procedure they are directed to initiate ECCS water solid operation.

Locator Files

File Name: OPECSADH.TIH

Initiator: TIHP5

Event Tree: EAP (from ADH, Seq. 8, from TIHP5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPISA	0		HEP 81
OPHIS	1		HEP 8
OPMSV	1		HEP 9

TIHP5 initiator, which is an inadvertent actuation of HPCS. HPCS auto-isolates on high level. If a LOSP also occurs, the diesel generators successfully start (DV1-2 OK). Later in the scenario, a random isolation of ADHRS occurs. The operators have diagnosed the loss of the ADHRS, attempted to establish SDC(B) with no luck, and entered the IDHR ONEP prior to start of OPECS (OPSDC has succeeded). By procedure they are directed to initiate ECCS water solid operation.

File Name: OPECSADH.TIO

Initiator: TIOP5

Event Tree: EA (from ADH, Seq. 4, from TIOP5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9
OPISA	0		HEP 81

TIOP5 initiator, which is a mismatch between letdown and makeup potentially leading to over-pressurization. Operators successfully control letdown and makeup (LCMK OK). Later in the scenario, a random isolation of ADHRS occurs. OPSDC has succeeded and the operators have attempted to start SDC(B), but it fails. The appropriate ONEP has been entered prior to start of OPECS. That is, operators have diagnosed the loss of ADHR, attempted a restart with no luck, and entered the IDHR ONEP. By procedure they are directed to initiate ECCS water solid operation. LPCI(C) is assumed the system of choice. LPCI(C) was placed in standby during OPSDC and ADHR is isolated. No credit was taken for HPCS at this point if LPCI(C) failed.

Locator Files

File Name: OPECSADH.TLM

Initiator: TLM5H

Event Tree: EA (from ADH, Seq. 4, from TLM5H, Seq. 5)

EAP (from ADH, Seq. 8, from TLM5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

TLM5H initiator, which is a loss of CRD (makeup). If a LOSP has occurred, the diesel generators successfully start (DV1-2 OK). Later in the scenario, a random isolation of ADHRS occurs. The operators have diagnosed the loss of the ADHRS, attempted to establish SDC(B) with no luck, and entered the IDHR ONEP prior to start of OPECS (OPSDC has succeeded). By procedure they are directed to initiate ECCS water solid operation.

File Name: OPECSADH.TRP

Initiator: TRPT5

Event Tree: EA (from ADH, Seq. 4, from TRPT5, Seq. 5)

EAP (from ADH, Seq. 8, from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9
OPISA	0		HEP 81

TRPT5 initiator, which is a loss of forced recirculation. If a LOSP has occurred, the diesel generators successfully start (DV1-2 OK). Later in the scenario, a random isolation of ADHRS occurs. The operators have diagnosed the loss of the ADHRS, attempted to establish SDC(B) with no luck, and entered the IDHR ONEP prior to start of OPECS (OPSDC has succeeded). By procedure they are directed to initiate ECCS water solid operation.

Locator Files

File Name: OPECSADP.E1D

Initiator: E1D5H

Event Tree: EAP (from E1D5H, Seq. 16)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 16
OP1SV	0.112	10	HEP 105
* OPHIS	0		HEP 8
OPMSV	1.0		HEP 9
* OPISA	0		HEP 81

The above scenario reflects an isolation of ADHR followed at some point by a LOSP. The diesels successfully start and load (DV1-2 succeeds). The operators recognize the loss of SDC (OPSDC succeeds). Given the LOSP, the operators do not attempt a restart of ADHR, but they do attempt to start SDC(B). SDC(B) fails to start. OPECS involves isolating ADHR from control room (if necessary) by closing 8 or 9 valve and initiating HPCS from CR for ECCS water solid operation per the IDHR ONEP. With the isolation of ADH and failure of SDC(B), it is conservatively assumed that neither LPCI(C) nor (B) would be available. Thus, HPCS is the only available ECCS system.

- * OPHIS and OPISA are completely dependent on OPECS. If OPECS succeeds, then OPHIS and OPISA succeed.

File Name: OPECSALA.E1D

Initiator: E1D5H

Event Tree: EA (from LA, Seq. 5, 38, from E1D5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.45	10	HEP 59
OP1SV	0.45	10	HEP 60
* OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
* OPISA	0		HEP 81

An isolation of SDC (ADHR) occurs. The operators detect the loss of SDC (OPSDC succeeds) and successfully restore ADHR (successful RESCS and ADHR2). At some later point, a loss of forced recirculation and/or a loss of makeup occurs. RWCU (letdown) continues to run. The operators initially fail to control level to avoid a disconnect between the core and the downcomer which results in a functional loss of SDC (OPDHR fails). OPECS involves diagnosing the need and isolating ADH and RWCU from control room, initiating LPCI (must realign ADHRS to LPCI), and carrying-out related OPECS actions.

- * In this scenario OPHIS is set equal to 1.0 and OPISA is set equal to 0 (success). LPCI is the ECCS system of choice, so no credit taken for HPCS at this point, and OPIS is contained in OPECS. Thus if OPECS succeeds, OPIS succeeds.

Locator Files

File Name: OPECSALA.E1V

Initiator: E1V5H

Event Tree: EA (from LA, Seq. 5, 21, 16, 38, from E1V5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.45	10	HEP 59
OP1SV	0.45	10	HEP 60
* OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
* OPISA	0		HEP 81

An isolation of the SDC common suction line occurs. The operators detect the loss of SDC (OPSDC succeeds) and successfully restore ADHR (successful RESCS and ADHR2). At some later point, a loss of forced recirculation and/or a loss of makeup occurs. RWCU (letdown) continues to run. The operators initially fail to control level to avoid a disconnect between the core and the downcomer which results in a functional loss of SDC (OPDHR fails). OPECS involves diagnosing the need and isolating ADH and RWCU from control room, initiating LPCI (must realign ADHRS to LPCI), and carrying-out related OPECS actions.

- * In this scenario OPHIS is set equal to 1.0 and OPISA is set equal to 0 (success). LPCI is the ECCS system of choice, so no time for HPCS, and OPIS is contained in OPECS. Thus if OPECS succeeds, OPIS succeeds.

File Name: OPECSALB.E1D

Initiator: E1D5H

Event Tree: EA (from LA, Seq. 32, 48, from E1D5H, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.12	10	HEP 39
OP1SV	0.31	10	HEP 40
* OPHIS	0		HEP 8
OPMSV	1.0		HEP 9
* OPISA	0		HEP 81

The above scenario reflects an isolation of the ADHR system. The operators detect the loss of SDC (OPSDC succeeds). They attempt to unisolate ADHR, but it fails to run. The operators then successfully align and start SDC(B). The operators initially fail to detect the need for level control during the 10 minutes allowed for OPDHR (OPDHR fails). The operators must diagnose the need to isolate RWCU from the control room and initiate ECCS water solid operations (OPECS). With the loss of ADHR, LPCI(C) is assumed unavailable. Since RHR(B) aligned for SDC, HPCS may be the system of choice for ECCS injection.

- * In this scenario OPHIS and OPISA are set equal to 0 (success) because they are both completely dependent on OPECS, which succeeds.

Locator Files

File Name: OPECSALB.E2D

Initiator: E2D5H

Event Tree: EA (from LA, Seq. 5, 38, 32, 48, from E2D5H, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.12	10	HEP 39
OP1SV	0.31	10	HEP 40
* OPHIS	0		HEP 8
OPMSV	1.0		HEP 9
* OPISA	0		HEP 81

The above scenario reflects a loss of the ADHR system. The operators detect the loss and align SDC(B). The operators initially fail to detect the need for level control during the 10 minutes allowed for OPDHR (OPDHR fails). The operators must diagnose the need to isolate RWCU from the control room and initiate ECCS water solid operations (OPECS). With the loss of ADHR, LPCI(C) is assumed unavailable. Since RHR(B) aligned for SDC, HPCS may be the system of choice for ECCS injection.

- * In this scenario OPHIS and OPISA are set equal to 0 (success) because they are both completely dependent on OPECS, which succeeds.

File Name: OPECSDC0.E1B

Initiator: E1B5H

Event Tree: E (from E1B5H, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

An isolation of SDC is the initiator. OPSDC in this case has failed. That is, in 37 min. the control room has not diagnosed the loss of SDC or entered the IDHR ONEP. However, at this point additional alarms could sound, e.g., a low level or high pressure alarm, and by requirements (every 30 min.) the reactor temperature and/or pressure chart recorders would very likely be checked (to reveal increases) in the 23 additional minutes available for this event. Operators must diagnose the need to initiate ECCS water solid operation.

Locator Files

File Name: OPECSDC4.TAB

Initiator: TAB5H

Event Tree: E (from SDC, Seq. 4, from TAB5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
OPHIS	0		HEP 8
OPMSV	1.0		HEP 9
OPSOF	0.06	10	HEP 12

In this scenario, the only AC bus is gone, thus no power to Divisions 1 or 2. A LOSP has not occurred. OPSDC in this case has failed. That is, in 37 min. the operators have not diagnosed the loss of SDC in the context of the loss of the bus, and therefore, have not pulled the IDHR ONEP. However, at this point an additional alarm would be likely to sound (low level) and by requirements (every 30 min.) the reactor temperature and pressure chart recorders should be checked in the 23 min. available for this event. Temperature and pressure increases would be revealed. With the additional time and some new indicators, it was assumed that the HEP computations for OPECS etc. would parallel those from other cases where the need for HPCS must be diagnosed and the related OPECS actions carried-out without a successful OPSDC event.

File Name: OPECSDC5.E2T

Initiator: E2T5H

Event Tree: E (from E2T5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this loss of SDC common suction line scenario, OPSDC has failed. That is, in 37 min. the control room has not diagnosed the loss of SDC or pulled ONEP. However, at this point it is possible that an additional alarm would indicate low level (level 4) and by requirements (every 30 min.) the reactor temperature (and/or pressure) chart recorder would very likely be checked (to reveal increases) in the 23 min. available for this event. With the additional time and new indicators, it was assumed that the HEP computations for OPECS etc. would parallel those for similar events in which the need for an ECCS system must be diagnosed and the related actions carried-out without a successful OPSDC.

Locator Files

File Name: OPECSDC5.TIA

Initiator: TIA5H

Event Tree: E (from TIA5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

In this scenario, OPSDC has succeeded and the appropriate ONEP has been entered prior to start of OPECS. That is, the control room has diagnosed loss of SDC(B) (a random failure occurring sometime after the loss of Instrument Air), and they have entered the IDHR ONEP. The ONEP directs the control room to initiate ECCS water solid operation.

File Name: OPECSDC6.E2B

Initiator: E2B5H

Event Tree: E (from E2B5H, Seq. 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

An isolation of SDC is the initiator. OPSDC in this case has failed. That is, in 37 min. the control room has not diagnosed the loss of SDC or entered the IDHR ONEP. However, at this point additional alarms could sound, e.g., a low level or high pressure alarm, and by requirements (every 30 min.) the reactor temperature and/or pressure chart recorders would very likely be checked (to reveal increases) in the 23 additional minutes available for this event. Operators must diagnose the need to initiate ECCS water solid operation.

Locator Files

File Name: OPECSDC6.TIA

Initiator: TIA5H

Event Tree: E (from TIA5H, Seq. 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

A loss of IA is the initiator. It is followed at some point by a random failure of SDC(B). OPSDC in this case has failed. That is, in 37 min. the control room has not diagnosed the loss of SDC or entered the IDHR ONEP. However, at this point additional alarms could sound, e.g., a low level or high pressure alarm, and by requirements (every 30 min.) the reactor temperature and/or pressure chart recorders would very likely be checked (to reveal increases) in the 23 additional minutes available for this event. Operators must diagnose the need to initiate ECCS water solid operation.

File Name: OPECSDC9.TAB

Initiator: TAB5H

Event Tree: HPSWR (from SDC, Seq. 9, from TAB5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
OPHIS	0		HEP 8
OPMSV	1		HEP 9
OPSOF	0.06	10	HEP 12

In this loss of the only AC bus initiator, a LOSP has also occurred. HPCS is working (available). OPECS in this case, involves deciding to go water solid with HPCS.

- * OPHIS in this case is included in the OPECS event. Thus, failure probability for OPHIS should be set to 0 when OPECS is successful.

Locator Files

File Name: OPECSDC9.TDB

Initiator: TDB5H

Event Tree: HPSWR (from SDC, Seq. 9,
from TDB5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
* OPH1S	0		HEP 8
OPMSV	1		HEP 9
OPSOF	0.06	10	HEP 12

In this scenario, a loss of DC bus initiator has occurred, along with a LOSP and the division 1 and 2 diesel generators failing to start. HPCS is working (available). OPECS in this case, involves deciding to go water solid with HPCS.

- * OPHIS in this case is covered in the OPECS event. Thus, failure probability for OPHIS should be set to 0 when OPECS is successful.

File Name: OPECSDC9.TIA

Initiator: TIA5H

Event Tree: EP (from TIA5H, Seq. 9)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

In this loss of Instrument Air scenario, a LOSP has occurred and DV1-2 has succeeded. OPSDC has succeeded and the appropriate ONEP has been entered prior to the start of OPECS. That is, the control room has diagnosed the loss of SDC(B) (a random failure occurring sometime after the loss of Instrument Air), and entered the IDHR ONEP. The ONEP directs the control room to initiate ECCS water solid operation.

Locator Files

File Name: OPECSDCF.E1T

Initiator: E1T5H

Event Tree: E (from E1T5H, Seq. 9)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this isolation of SDC common suction line scenario, OPSDC has failed. That is, in 37 min. the control room has not diagnosed the loss of SDC or entered the IDHR ONEP. However, at this point in time it is possible that an additional alarm would indicate low level and by requirements (every 30 min.) the reactor temperature (and/or pressure) chart recorder would very likely be checked (to reveal increases) in the 23 min. available for this event. With the additional time and new indicators, it was assumed that the HEP computations for OPECS etc. would parallel those for similar events in which the need for an ECCS system must be diagnosed and the related actions carried-out without a successful OPSDC. Credit was not taken for HPCS at this point in time because of the limited time available.

File Name: OPECSEAR.E1D

Initiator: E1D5H

Event Tree: EA (from RA, Seq. 28, from LA, Seq. 37,
from E1D5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.042	10	HEP 103
OP1SV	0.30	10	HEP 104
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
OPISA	0		HEP 81

In this isolation of ADHR scenario, OPSDC has succeeded, the ADHR has been unisolated (RESAD succeeds), ADHR has been restored. CRD fails. The operators attempt to control level with CDS (OPDHR succeeds), so they are aware of the need for level control. RWCU has been isolated. CDS fails. Level control with ECCS (OPLEC in R tree) fails because time available was spent in OPDHR initiating CDS and because procedures do not clearly call for ECCS injection in conjunction with SDC. With the loss in their ability to control level, inadequate decay heat removal will be a concern. The IDHR ONEP instructs the operators to initiate ECCS water solid operation. At this point in the scenario, the operators have done everything correctly. Isolation of ADHR, alignment and injection with LPCI, and the related OPECS actions are accomplished from the control room. No time for HPCS initiation was assumed, so OPHIS was set to 1.0. OPISA, isolation of ADHR, is completely dependent on OPECS.

Locator Files

File Name: OPECSEAR.E1V

Initiator: E1V5H

Event Tree: EA (from RA, Seq. 28, from LA, Seq. 31, 37, 47,
from E1V5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.042	10	HEP 103
OP1SV	0.30	10	HEP 104
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
OPISA	0		HEP 81

In this isolation of SDC common suction line scenario, OPSDC has succeeded, the SDC line has been unisolated (RESCS succeeds), and SDC(B) has been started or ADHR has been restored. CRD fails. The operators attempt to control level with CDS (OPDHR succeeds), so they are aware of the need for level control. RWCU has been isolated. CDS fails. Level control with ECCS (OPLEC in R tree) fails because time available was spent in OPDHR initiating CDS and because procedures do not clearly call for ECCS injection in conjunction with SDC. With the loss in their ability to control level, inadequate decay heat removal will be a concern. The IDHR ONEP instructs the operators to initiate ECCS water solid operation. At this point in the scenario, the operators have done everything correctly. Isolation of ADHR, alignment and injection with LPCI, and the related OPECS actions are accomplished from the control room. No time for HPCS initiation was assumed, so OPHIS was set to 1.0. OPISA, isolation of ADHR, is completely dependent on OPECS.

File Name: OPECSEAR.TRP

Initiator: TRPT5

Event Tree: EA (from RA, Seq. 28, from LA, Seq. 20, 37,
from ADH, Seq. 1, from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.042	10	HEP 103
OP1SV	0.30	10	HEP 104
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
OPISA	0		HEP 81

In this loss of forced recirculation scenario, ADHR continues to run. CRD fails. The operators attempt to control level with CDS (OPDHR succeeds), so they are aware of the need for level control. RWCU has been isolated. CDS fails. Level control with ECCS (OPLEC in R tree) fails because time available was spent in OPDHR initiating CDS. With the loss in their ability to control level, inadequate decay heat removal will be a concern. The IDHR ONEP instructs the operators to initiate ECCS water solid operation. At this point in the scenario, the operators have done everything correctly. Isolation of ADHR, alignment and injection with LPCI, and the related OPECS actions are accomplished from the control room. No time for HPCS initiation was assumed, so OPHIS was set to 1.0. OPISA, isolation of ADHR, is completely dependent on OPECS.

Locator Files

File Name: OPECSEQ8.EAP

Initiator: T1-5

Event Tree: EAP (from ADH, Seq. 8, from T1-5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.10	10	HEP 14
OPMSV	1.0		HEP 9
OP1SV	0.44	10	HEP 15
OPHIS	1.0		HEP 8
* OPISA	0		HEP 81

The initiator is a LOSP, but the diesels start and load (DV1-2 succeeds). ADHR is lost as a result of the initiator, but the operators diagnose the loss of SDC (OPSDC succeeds) and attempt to establish SDC(B). SDC(B) fails to start. OPECS involves ensuring that ADHR is isolated and aligning LPCI(C) for initiating ECCS water solid operation.

- * OPISA is completely dependent on OPECS. If OPECS is successful, OPISA = 0 (success), otherwise OPISA is a failure, 1.0.

File Name: OPECSEQ9.EAP

Initiator: T1-5

Event Tree: EAP (from ADH, Seq. 9, from T1-5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	1.0		HEP 13

In this LOSP scenario, OPSDC has failed. That is, the control room has failed to detect/realize the loss of SDC (ADHR) in 37 minutes. Because of the failure of OPSDC and the time and actions required to isolate ADHR and align and start ECCS (per "abnormal operations" in the RHR SOI) and perform the related OPECS action from the IDHR ONEP, OPECS fails (as do the remaining associated human actions).

Locator Files

File Name: OPECSHPR.E1B

Initiator: E1B5H

Event Tree: HPSWR (from E1B5H, Seq. 19)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
* OPHIS	0		HEP 8
OPMSV	1		HEP 9
OPSOF	0.06	10	HEP 12

In this scenario, all of RHR loop B has isolated. A LOSP occurs and the division 1 and 2 diesels fail to start (DV1-2 fails). HPCS is working (available). OPECS in this case, involves deciding to go water solid with HPCS.

- * OPHIS in this case is covered in the OPECS event. Thus, failure probability for OPHIS should be set to 0 when OPECS is successful.

File Name: OPECSHPR.E1T

Initiator: E1T5H

Event Tree: HPSWR (from E1T5H, Seq. 17)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
OPHIS	0		HEP 8
OPMSV	1		HEP 9

In this isolation of SDC common suction scenario, a LOSP has occurred and the DGs have failed to start (DV1-2 fails). All SDC is lost. HPCS is working (available). OPECS in this case, involves deciding to go water solid with HPCS. OPHIS in this case is covered in the OPECS event. Thus, failure probability for OPHIS should be set to 0 when OPECS is successful.

Locator Files

File Name: OPECSHPR.E1V

Initiator: E1V5H

Event Tree: HPSWA (from E1V5H, Seq. 18)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
OPHIS	0		HEP 8
OPMSV	1		HEP 9

In this isolation of SDC common suction scenario (initially on ADHRS), a LOSP has also occurred and the DGs have failed to start (DV1-2 fails). All SDC is lost. HPCS is working (available). OPECS in this case, involves deciding to go water solid with HPCS. OPHIS in this case is covered in the OPECS event. Thus, failure probability for OPHIS should be set to 0 when OPECS is successful.

File Name: OPECSHPR.E2B

Initiator: E2B5H

Event Tree: HPSWR (from E2B5H, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
* OPHIS	0		HEP 8
OPMSV	1		HEP 9
OPSOF	0.06	10	HEP 12

In this scenario, all of RHR loop B has failed. A LOSP has occurred and the diesels have failed to start (DV1_2 fails). HPCS is working (available). OPECS in this case, involves deciding to go water solid with HPCS.

* OPHIS in this case is covered in the OPECS event. Thus, failure probability for OPHIS should be set to 0 when OPECS is successful.

Locator Files

File Name: OPECSHPR.E2T

Initiator: E2T5H

Event Tree: HPSWR (from E2T5H, Seq. 8)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
OPHIS	0		HEP 8
OPMSV	1		HEP 9

In this loss of SDC common suction scenario, all of SDC is unavailable. A LOSP has occurred and DIV 1&2 failed, but HPCS is working (available). OPECS in this case, involves deciding to go water solid with HPCS. OPHIS in this case is covered in the OPECS event. Thus, failure probability for OPHIS should be set to 0 when OPECS is successful.

File Name: OPECSHPR.T5A

Initiator: T5A5H

Event Tree: HPSWR (from T5A5H, Seq. 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
* OPHIS	1 or 0		HEP 8
OPMSV	1		HEP 9
OPSOF	0.06	10	HEP 12

In this scenario, a loss of SSW has occurred and is followed at some later point with a LO SP. SDC(B) is lost, but HPCS is working (available). OPECS in this case, involves deciding to go water solid with HPCS. This situation is similar to that in T1-5 and TAB5H.

- * OPHIS in this case is covered in the OPECS event. Thus, failure probability for OPHIS should be set to 0 when OPECS is successful.

Locator Files

File Name: OPECSHPR.E1T

Initiator: E1T5H

Event Tree: HPSWR (from E1T5H, Seq. 17)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
OPHIS	0		HEP 8
OPMSV	1		HEP 9

In this isolation of SDC common suction scenario, a LOSP has occurred and the DGs have failed to start (DV1-2 fails). All SDC is lost. HPCS is working (available). OPECS in this case, involves deciding to go water solid with HPCS. OPHIS in this case is covered in the OPECS event. Thus, failure probability for OPHIS should be set to 0 when OPECS is successful.

File Name: OPECSHPR.T5D

Initiator: T5D5H

Event Tree: HPSWR (from T5D5H, Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
* OPHIS	0		HEP 8
OPMSV	1		HEP 9
OPSOF	0.06	10	HEP 12

In this scenario, a loss of CCW has occurred and is followed at some point by a LOSP. The diesels fail to start (DV1-2 fails). HPCS is working (available). OPECS in this case, involves deciding to go water solid with HPCS. This situation is similar to that in T1-5, T5A5H, and TAB5H.

- * OPHIS in this case is covered in the OPECS event. Thus, failure probability for OPHIS should be set to 0 when OPECS is successful.

Locator Files

File Name: OPECSHPR.TRP

Initiator: TRPT5

Event Tree: HPSWR (from SDC, Seq. 9, from TRPT5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
OPHIS	0		HEP 8
OPMSV	1		HEP 9

In this loss of forced recirculation scenario (TRPT5), a LOSP has occurred and DV1-2 has failed. HPCS is working (available). OPECS in this case, involves the operators decision to go water solid with HPCS. OPHIS in this case is synonymous with the OPECS event. Thus, failure probability for OPHIS should be set to 0 when OPECS is successful.

File Name: OPECSHY2.EP

Initiator: T1-5

Event Tree: EP (from LP, Seq. 8, from ADEPP, Seq. 2,
from O/PRP, Seq. 4, from HYDRO, Seq. 6,
from T1-5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 50
OP1SV	0.112	10	HEP 51
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this scenario, a LOSP occurs when in HYDRO. RWCU and CDS is lost. A diesel starts (DV1-2 succeeds). An SRV opens on its safety setpoint and fails to close. The vessel depressurizes. In the ADEPP trees, the operators accomplish the necessary steps to align some form of SDC (SDCUI succeeds), and SDC starts on demand. However, the operators fail to control level to avoid a disconnect between the core and the downcomer and a functional loss of SDC. The IDHR ONEP directs the operators to go ECCS water solid (OPECS) once the potential disconnect is diagnosed and SDC is functionally lost. There would be many indications of plant status and up to 8.7 hours could have elapsed before needing OPECS, i.e., the HYDRO test is done late in the shutdown and little decay heat would be left. The operators have previously diagnosed the need for SDC and it was assumed that the operators would have retrieved the relevant ONEPS. RWCU is isolated from the initiator.

Locator Files

File Name: OPECSHY2.TIA

Initiator: TIA5H

Event Tree: E (from ADEP, Seq. 6, 8, from OVPR, Seq. 4,
from HYDRO, Seq. 5, from TIA5H, Seq. 33)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1.0		HEP 8
OPMSV	1		HEP 9

In this scenario, a loss of IA occurs while in HYDRO. No LO SP. FCIRC, CRD, CDS, and RWCU are lost. The SRVs open on safety setpoint and fail to close (SAFEC). Depressurization occurs. In ADEP tree either SDCUI fails (8.7 hours for this event) because the operators fail to accomplish the necessary steps to initiate SDC(B) or ADHR (in 8.7 HRS.) or SDCUI succeeds, but SDC(B) and ADHR1 fail due to hardware. Thus, enter E tree and operator action to initiate ECCS water solid operation (OPECS). Many indications for plant status will be available and up to 8.7 hours could have elapsed before needing OPECS related actions (because HYDRO test is done late in the outage and little decay heat would be left). Upon entering OPECS, it is at least assumed that the operators have diagnosed the loss of SDC and RWCU in the context of a loss of IA and entered the IDHR ONEP and other relevant procedures. Thus, OPECS is entered in a way that is similar to scenarios where OPSCD was successful and the operators have diagnosed the loss of SDC.

File Name: OPECSHY2.TRP

Initiator: TRPT5

Event Tree: E (from L, Seq. 48, from ADEP, Seq. 3,
from TRPT5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 50
OP1SV	0.112	10	HEP 51
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this scenario, in HYDRO when a loss of forced recirculation occurs, the operators successfully depressurize. In the ADEP tree, the operators accomplish the necessary steps to align some form of SDC (SDCUI succeeds), and SDC(B) starts on demand. However, the operators fail to control level to avoid a disconnect between the core and the downcomer and a functional loss of SDC. The IDHR ONEP directs the operators to go ECCS water solid (OPECS) once the potential disconnect is diagnosed and SDC is functionally lost. There would be many indications of plant status and up to 8.7 hours could have elapsed before needing OPECS, i.e., the HYDRO test is done late in the shutdown and little decay heat would be left. The operators have previously diagnosed the need for SDC and it was assumed that the operators would have retrieved the relevant ONEPS. RWCU was in recirculation mode.

Locator Files

File Name: OPECSHY2.TRV

Initiator: TORV5

Event Tree: E (from L, Seq. 48, from ADEP, Seq. 3,
from TORV5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 50
OP1SV	0.112	10	HEP 51
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

The initiator is an inadvertent stuck open relief valve during a HYDRO test. The vessel depressurizes and the operators accomplish the necessary steps to align some form of SDC (SDCUI succeeds), and SDC(B) starts on demand. However, the operators fail to control level to avoid a disconnect between the core and the downcomer and a functional loss of SDC. The IDHR ONEP directs the operators to go ECCS water solid (OPECS) once the IDHR is diagnosed. There would be many indications of plant status and up to 8.7 hours could have elapsed before needing OPECS, i.e., the HYDRO test is done late in the shutdown and little decay heat would be left. The operators have previously diagnosed the need for SDC and it was assumed that the operators would have retrieved the relevant ONEPS. RWCU was in recirculation mode.

File Name: OPECSHYD.EP

Initiator: T1-5

Event Tree: E (from ADEPP, Seq. 4, 6, from OVPRP, Seq. 4)
from HYDRO, Seq. 6, from T1-5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this scenario, a LOSP occurs while in HYDRO. RWCU and CDS is lost. In the ADEPP trees, either the operators fail to accomplish the necessary steps to align some form of SDC (SDCUI fails) or SDCUI succeeds, but SDC(B) fails on demand. The IDHR ONEP directs the operators to go ECCS water solid (OPECS). There would be many indications of plant status and up to 8.7 hours could have elapsed before needing OPECS, i.e., the HYDRO test is done late in the shutdown and little decay heat would be left. It was assumed that upon entering OPECS, the operators would have diagnosed the loss of SDC and entered the IDHR ONEP. Thus, OPECS is entered in a way that is similar to scenarios where OPSDC was successful.

Locator Files

File Name: OPECSHYD.HPR

Initiator: T1-5

Event Tree: HPSWR (from HYHPA, Seq. 4, from HYDRO, Seq. 7,
from T1-5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 10
OP1SV	0.302	10	HEP 11
* OPHIS	0		HEP 8
OPMSV	1		HEP 9
OPSOF	0.06	10	HEP 12

In this scenario, a LOSP during a HYDRO test occurs and the diesels fail (DV1-2 fail). HPCS is working (available). An SRV opens on its safety setpoint and stays open, resulting in depressurization. These events leads to the HPSWR tree and situation is comparable to the same events during POS 5 when not in a HYDRO test. OPECS in this case, involves deciding to go water solid with HPCS.

- * OPHIS in this case is covered in the OPECS event. Thus, failure probability for OPHIS should be set to 0 when OPECS is successful.

File Name: OPECSHYD.T5D

Initiator: T5D5H

Event Tree: E (from L, Seq. 32, 48, from ADEP, Seq. 3,
from OVPR, Seq. 4, from HYDRO, Seq. 5,
from T5D5H, Seq. 34)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 50
OP1SV	0.112	10	HEP 51
* OPHIS	1.0		HEP 8
OPMSV	1		HEP 9

In this scenario, a HYDRO test is being conducted when a loss of CCW occurs. RWCU is lost. The SRVs open on safety setpoint and fail to close (SAFEC). Vessel depressurization occurs. In the ADEP tree SDCUI succeeds (8.7 hours for this event). That is, the operators take necessary steps to initiate SDC(B) and isolate RWCU. In the L tree, the operators fail to recognize the potential disconnect between the core and the downcomer and fail to initiate makeup to facilitate good circulation (OPDHR fails in 10 min. allowed). Thus, enter E tree and need to initiate ECCS water solid operation (OPECS). There would be many indications for plant status and up to 8.7 hours could have elapsed before needing OPECS (because HYDRO test done late and little decay heat left). Upon entering OPECS, the operators have isolated RWCU and started SDC(B), having recognized the need for SDC. The IDHR ONEP has been pulled and instructions for going water solid are called-out in the procedure. Thus, OPECS (23 min. allowed) is entered in a way that is similar to scenarios where OPSDC was successful and SDC was initiated.

- * Since first choice for OPECS in this case is to use LPCI(C), OPHIS will be set to 1.0.

Locator Files

File Name: OPECSHYD.TAB

Initiator: TAB5H

Event Tree: E (from ADEP, Seq. 6, 8, from OVPR, Seq. 4,
from HYDRO, Seq. 5, from TAB5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	0		HEP 8
OPMSV	1		HEP 9

In this scenario, in HYDRO when TAB5H initiator occurs. RWCU is lost. No LOSP. The SRVs open on safety setpoint and fail to close (SAFEC). Depressurization occurs. In ADEP tree either SDCUI fails (8.7 hours for this event) because the operators fail to accomplish the necessary steps to initiate ADHRS (in 8.7 HRS.) or SDCUI succeeds, but ADHR1 fails due to hardware. Thus, enter E tree and operator action to initiate ECCS water solid operation (OPECS). Many indications for plant status will be available and up to 8.7 hours could have elapsed before needing OPECS related actions (because HYDRO test is done late in the outage and little decay heat would be left). Upon entering OPECS, it is at least assumed that the operators have diagnosed the loss of SDC and RWCU in the context of a loss of the available AC bus and entered the IDHR ONEP and other relevant procedures (loss of AC Power). Thus, OPECS is entered in a way that is similar to scenarios where OPSDC was successful and the operators have diagnosed the loss of SDC. These values are conservative given the preceding 8.7 hours, but with such low decay heat levels, the operators may not be very concerned.

Since the OPECS actions in this case demand the use of HPCS, OPHIS (operator action to initiate HPCS) will be 0 (success) if OPECS is successful.

File Name: OPECSHYD.TDB

Initiator: TDB5H

Event Tree: E (from ADEP, Seq. 6, 8, from OVPR, Seq. 4,
from HYDRO, Seq. 5, from TAB5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	0		HEP 8
OPMSV	1		HEP 9

In this scenario, in operating in HYDRO when the available DC bus is lost. RWCU is lost. No LOSEP. The SRVs open on safety setpoint and fail to close (SAFE). Depressurization occurs. In ADEP tree either SDCUI fails (8.7 hours for this event) because ops fail to accomplish necessary steps to initiate ADHRS (in 8.7 HRS.) or SDCUI succeeds, but ADHR1 fails due to hardware. Thus, enter E tree and OPECS. Many indications for plant status and up to 8.7 hours could have elapsed before needing OPECS (because HYDRO test done late in outage and little decay heat is left). Upon entering OPECS, it is at least assumed that the operators have diagnosed loss of SDC and RWCU in the context of a loss of the available DC bus and entered the IDHR ONEP and other relevant procs (loss of power). Thus, OPECS is entered in a way that is similar to scenarios where OPSDC was successful and the same calculations were assumed (HEP 6). These values are very conservative given the preceding 8.7 hours, but with such low decay heat levels, there would seem to be at least some possibility that the control room would be less vigilant in regards to SDC than usual.

Since the OPECS actions in this case require the use of HPCS, OPHIS (operator action to initiate HPCS) must be set to 0 (success) if OPECS is successful.

Locator Files

File Name: OPECSHYD.TIA

Initiator: TIA5H

Event Tree: E (from L, Seq. 32, 48, from ADEP, Seq. 3,
from OVPR, Seq. 4, from HYDRO, Seq. 5,
from TIA5H, Seq. 33)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 50
OP1SV	0.112	10	HEP 51
OPHIS	1		HEP 8
OPMSV	1		HEP 9

In this scenario, the operators are conducting a HYDRO test when a loss of IA occurs. RWCU isolates and CRD is lost. The SRVs open on safety setpoint and fail to close (SAFEC). Depressurization occurs. The operators take the necessary steps to initiate SDC(B) (SDCUI succeeds, 8.7 hours for this event). In the L tree, the operators fail to recognize a potential disconnect between core and downcomer which results in inadequate circulation and fail to provide level control (OPDHR fails in the 10 minutes allowed). The operators have an additional 23 min. in OPECS to detect and respond to the loss of SDC and additional indicators would become available. Periodic checks of the chart recorders for increases in temperature and pressure would be due during the time for OPECS. The operators must diagnose the need to initiate ECCS water solid operation. OPECS in this scenario is entered in a way that is similar to scenarios where OPSDC was successful and SDC(B) was initiated. LPCI(C) is assumed the system of choice, so OPHIS (initiation of HPCS) is set to fail (1.0).

File Name: OPECSHYD.TLM

Initiator: TLM5H

Event Tree: E (from ADEP, Seq. 6, 8, from TLM5H, Seq. 7)
EP (from ADEPP, Seq. 4, from TLM5H, Seq. 8)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this scenario, in HYDRO when a loss of CRD (makeup) occurs and RWCU fails to continue to run in recirculation mode. In the ADEP or ADEPP trees, either the operators fail to accomplish the necessary steps to align some form of SDC (SDCUI fails) or SDCUI succeeds, but both SDC(B) and ADHRS fail on demand. The IDHR ONEP directs the operators to go ECCS water solid (OPECS). There would be many indications of plant status and up to 8.7 hours could have elapsed before needing OPECS, i.e., the HYDRO test is done late in the shutdown and little decay heat would be left. It was assumed that upon entering OPECS, the operators would have diagnosed the loss of SDC and entered the IDHR ONEP. Thus, OPECS is entered in a way that is similar to scenarios where OPSDC was successful, e.g., see file OPECS.EP.

Locator Files

File Name: OPECSHYD.TRP

Initiator: TRPT5

Event Tree: E (from ADEP, Seq. 6, 8, from TRPT5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this scenario, a loss of forced recirculation occurs in HYDRO and RWCU fails to continue to run in recirculation mode. The operators successfully depressurize the vessel (OPCNF succeeds). In ADEP tree, either the operators fail to accomplish the necessary steps to align some form of SDC (SDCUI fails) or SDCUI succeeds but both SDC(B) and ADHRS fail on demand. The IDHR ONEP directs the operators to go ECCS water solid (OPECS). There would be many indications of plant status and up to 8.7 hours could have elapsed before needing OPECS, i.e., the HYDRO test is done late in the shutdown and little decay heat would be left. It was assumed that upon entering OPECS, the operators would have diagnosed the loss of SDC and entered the IDHR ONEP. Thus, OPECS is entered in a way that is similar to scenarios where OPSDC was successful, e.g., see file OPECS.EP.

File Name: OPECSHYD.TRV

Initiator: TORV5

Event Tree: E (from ADEP, Seq. 6, from TORV5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this scenario, in HYDRO when an inadvertent open relief valve occurs. RWCU fails to continue to run in recirculation mode. The vessel depressurizes. In the ADEP tree, either the operators fail to accomplish the necessary steps to align some form of SDC (SDCUI fails) or SDCUI succeeds but both SDC(B) and ADHRS fail on demand. The IDHR ONEP directs the operators to go ECCS water solid (OPECS). There would be many indications of plant status and up to 8.7 hours could have elapsed before needing OPECS, i.e., the HYDRO test is done late in the shutdown and little decay heat would be left. It was assumed that upon entering OPECS, the operators would have diagnosed the loss of SDC and entered the IDHR ONEP. Thus, OPECS is entered in a way that is similar to scenarios where OPSDC (diagnosis of loss of SDC) was successful.

Locator Files

File Name: OPECSISO.A5

Initiator: A5

Event Tree: E (from A5ISO Seq. 1, from A5, Seqs. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.043	10	HEP 64
OP1SV	0.08	10	HEP 63
OPHIS	1.0		HEP 8
* OPMSV			

IE is A5 with the break outside containment (break in feedwater line assumed). Check valves isolate break but not before level 3 is reached (feedwater lines are below level 3). Level 3 signal isolates 8 and 9 valves, SDC pump trips, and therefore SDC is lost. With the level 3 alarms, operators will know the level dropped and will expect auto-isolation of 8 & 9 valves and loss of SDC. A Level 3 takes the operators to EP-2 where they are clearly instructed to start ECCS. Loss of SDC will also cause operators to enter ONEP for IDHR, which also instructs initiation of ECCS to go water solid. Operators must isolate RWCU (letdown, which should be obvious given significant level drop), start LPCI (C), and perform other OPECS actions, e.g., open SRV etc. Even if only get 1SRV, operators unlikely to turn off ECCS given need for makeup and fact that EP-2 has instructed initiation of ECCS for makeup i.e., not just dependent on ONEP for instructions. Thus, a somewhat lower value for OP1SV was used here than has been used in some other sequences, e.g., transients. LPCI(C) assumed system of choice. No available time was assumed for HPCS, given the diagnosis and actions demanded. Thus, OPHIS set to 1.0 for now.

- * OPMSV not relevant here because the sequence will not survive the $1.0E-2$ probability that the MSIVs are open.

File Name: OPECSISO.H15

Initiator: H1-5H

Event Tree: E (from A5ISO Seq. 1, from H1-5H, Seqs. 3,)

EP (from A5ISO Seq. 2, from H1-5H, Seqs. 7)

EA (from A5ISO, Seq. 6, from H1-5H, Seq. 13)

EAP (from A5ISO, Seq. 7, from H1-5H, Seq. 17)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.043	10	HEP 64
OP1SV	0.08	10	HEP 63
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

H1-diversion to SP via RHR. (If LO SP, then DV1-2 succeeds). Operators fail to ID diversion and isolate (OPL1S) before level 3 is reached. Level 3 isolation signal for 8 and 9 valve succeeds and valves close. Thus, the diversion is functionally isolated, but SDC is lost. With level 4 and 3 alarms, the operators will know level dropped and will expect auto-isolation of 8 & 9 valves and loss of SDC. Level 3 takes the operators to EP-2 where clearly instructed to start ECCS. Loss of SDC will also cause operators to enter ONEP for inadequate DHR, which also instructs initiation of ECCS to go water solid. In non-LO SP sequences, operators will need to isolate RWCU at some point, but since CRD is still running, letdown and makeup are matched. They will also need to start LPCI (C), and perform other OPECS actions, e.g., open SRV etc. Even if only get 1SRV, operators are unlikely to turn off ECCS given need for makeup and fact that EP-2 has instructed initiation of ECCS for makeup i.e., not just dependent on ONEP for instructions. Thus a somewhat lower value for OP1SV was used here than has been used in some other sequences. LPCI (C) assumed system of choice. No available time was assumed for HPCS, given the diagnosis and actions demanded.

Locator Files

File Name: OPECSISO.S15

Initiator: S1-5

Event Tree: E (from A5ISO Seq. 1, from S1-5, Seqs. 4)
EA (from A5ISO Seq. 6, from S1-5, Seqs. 8)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.043	10	HEP 64
OP1SV	0.08	10	HEP 63
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

S1-5 initiator with the break outside containment (break in feedwater line assumed). Check valves isolate break but not before level 3 is reached (feedwater lines are below level 3). Level 3 signal isolates 8 and 9 valves, SDC pump trips, and therefore ADHRS is lost, as is SDC(B). With the level 3 alarms, operators will know level dropped and will expect auto-isolation of 8 & 9 valves and loss of SDC. Level 3 takes the operators to EP-2 where they are clearly instructed to start ECCS. Loss of SDC will also cause operators to enter ONEP for IDHR, which also instructs initiation of ECCS to go water solid. Operators must isolate RWCU (letdown, which should be obvious given significant level drop), start LPCI (C), and perform other OPECS actions, e.g., open SRV etc. Even if only get 1SRV, operators unlikely to turn off ECCS given need for makeup and fact that EP-2 has instructed initiation of ECCS for makeup i.e., not just dependent on ONEP for instructions. Thus, a somewhat lower value for OP1SV was used here than has been used in some other sequences, e.g., transients. LPCI(C) assumed system of choice. No available time was assumed for HPCS, given the diagnosis and actions demanded. Thus, OPHIS set to 1.0 at this point in scenario.

File Name: OPECSISO.S25

Initiator: S2-5

Event Tree: E (from A5ISO, Seq. 1, from S1XFR, Seq. 3,
from S2-5, Seqs. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.043	10	HEP 64
OP1SV	0.08	10	HEP 63
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

S2-5 initiator with the break outside containment (break in feedwater line assumed). Check valves isolate break but not before level 3 is reached (feedwater lines are below level 3). Level 3 signal isolates 8 and 9 valves and the SDC pump trips. SDC is lost. With the level 3 alarms, operators will know level dropped and will expect auto-isolation of 8 & 9 valves and loss of SDC. Level 3 takes the operators to EP-2 where they are clearly instructed to start ECCS. Loss of SDC will also cause operators to enter ONEP for IDHR, which also instructs initiation of ECCS to go water solid. Operators must isolate RWCU (letdown, which should be obvious given significant level drop), start LPCI (C), and perform other OPECS actions, e.g., open SRV etc. Even if only get 1SRV, operators unlikely to turn off ECCS given need for makeup and fact that EP-2 has instructed initiation of ECCS for makeup i.e., not just dependent on ONEP for instructions. Thus, a somewhat lower value for OP1SV was used here than has been used in some other sequences, e.g., transients. LPCI(C) assumed system of choice. No available time was assumed for HPCS, given the diagnosis and actions demanded. Thus, OPHIS set to 1.0 at this point in scenario.

Locator Files

File Name: OPECSISO.S2H

Initiator: S2H-5

Event Tree: E (from A5ISH, Seq. 3, from S1XFR, Seq. 3,
from S2H-5, Seqs. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.043	10	HEP 64
OP1SV	0.08	10	HEP 63
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

S2H-5 initiator with the break outside containment (break in feedwater line assumed) during HYDRO. Check valves isolate break but not before level 3 is reached (feedwater lines are below level 3). Level 3 signal isolates 8 and 9 valves and the SDC pump trips. SDC is lost. With the level 3 alarms, operators will know level dropped and will expect auto-isolation of 8 & 9 valves and loss of SDC. Level 3 takes the operators to EP-2 where they are clearly instructed to start ECCS. Loss of SDC will also cause operators to enter ONEP for IDHR, which also instructs initiation of ECCS to go water solid. Operators must isolate RWCU (letdown, which should be obvious given significant level drop and no SDC), start LPCI (C), and perform other OPECS actions, e.g., open SRV etc. Even if only get 1SRV, operators unlikely to turn off ECCS given need for makeup and fact that EP-2 has instructed initiation of ECCS for makeup i.e., not just dependent on ONEP for instructions. Thus, a somewhat lower value for OP1SV was used here than has been used in some other sequences, e.g., transients. LPCI(C) assumed system of choice. No available time was assumed for HPCS, given the diagnosis and actions demanded. Thus, OPHIS set to 1.0 at this point in scenario.

File Name: OPECSL.TDB

Initiator: TDB5H

Event Tree: E (from L, Seq. 32, 48, from SDC, Seq. 1,
from TDB5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this scenario, a loss of the 1E DC bus has occurred. SDC(B) continues to run, so OPSDC is not asked. CRD and RWCU auto-isolate. With the loss of makeup and forced recirculation, the potential for a disconnect between the core and the downcomer regions of the core arises. With inadequate level or recirculation, a "functional" loss of SDC can occur. OPDHR is the operator action to diagnose the functional loss of SDC and initiate level control. In these sequences, OPDHR has failed. That is, the operators fail to diagnose the disconnect between the core and the downcomer and the resulting functional loss of SDC in the 10 minutes allowed for OPDHR. However, at this point some additional indicators would be coming available and the operators should notice increases in pressure and temperature on chart recorders per periodic checks (required every 30 minutes). Operators must diagnose the need to initiate ECCS water solid operation.

Locator Files

File Name: OPECSL.TIF

Initiator: TIOF5

Event Tree: E (from L, Seq. 5, 14, 32, 38, 48,
from SDC, Seq. 1, from TIOF5, Seq. 2)

EA (from LA, Seq. 5, 38, 48, from ADH, Seq. 1, 2,
from TIOF5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.40	10	HEP 37
OP1SV	0.64	10	HEP 38
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
OPISA	0		HEP 81

In this inadvertent actuation of LPCI initiator, SDC(B) or ADHRS continues to run. The operators successfully stop the LPCI injection (OPSLP succeeds). At some point later, CRD fails and in some cases forced recirculation or RWCU fail. Operators must diagnose need to restore makeup and isolate letdown (RWCU) to avoid a functional loss of SDC because of a disconnect between the core and the downcomer. However, in this scenario, OPDHR fails and we go to the E tree. In this scenario, OPECS is somewhat like OPDHR because the operators must recognize the potential disconnect between the core and the downcomer (SDC(B) or ADHRS is still running). Operators now have an additional 23 min. to recognize the problem, isolate RWCU (whether running or failed), and go ECCS water solid to restore level and provide SDC. LPCI(C) is assumed to be the ECCS system of choice. No credit is given for HPCS in this scenario because of insufficient time. OPISA is completely dependent on OPECS.

Note that in these scenarios the operators have done nothing to demonstrate they are aware of a problem. OPSDC is not asked since SDC continues to run and OPDHR fails.

File Name: OPECSL.TIH

Initiator: TIHP5

Event Tree: E (from L, Seq. 5, 14, 32, 38, 48,
from SDC, Seq. 1, from TIHP5, Seq. 2, 4)

EA (from LA, Seq. 5, 38, 48, from ADH, Seq. 1, 2,
from TIHP5, Seq. 3, 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.40	10	HEP 37
OP1SV	0.64	10	HEP 38
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
OPISA	0		HEP 81

In this inadvertent actuation of HPCS initiator, SDC(B) or ADHRS continues to run. HPCS auto-isolates at level 8 or the auto-isolation fails and the operators successfully stop the HPCS injection (OPHPC succeeds). At some point later, CRD fails and in some cases forced recirculation or RWCU fail. Operators must diagnose need to restore makeup and isolate letdown (RWCU) to avoid a functional loss of SDC because of a disconnect between the core and the downcomer. However, in this scenario, OPDHR fails and we go to the E tree. In this scenario, OPECS is somewhat like OPDHR because the operators must recognize the potential disconnect between the core and the downcomer (SDC(B) or ADHRS is still running). Operators now have an additional 23 min. to recognize the problem, isolate RWCU (whether running or failed), and go ECCS water solid to restore level and provide SDC. LPCI(C) is assumed to be the ECCS system of choice. No credit is given for HPCS in this scenario

Locator Files

File Name: OPECSL5.TRP

Initiator: TRPT5

Event Tree: EA (from LA, Seq. 16, 32¹, 48¹, from ADH, Seq 2,
from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 50
OPMSV	1.0		HEP 9
OP1SV	0.112	10	HEP 51
OPHIS	1.0		HEP 8
* OPISA	0		HEP 81

The above scenario reflects a loss of forced recirculation, followed at some point by a loss of ADHR. The operators diagnose the loss of SDC and successfully align and start SDC(B) for cooling (OPSDC succeeds). At some point CRD and/or RWCU fail. The operators initially fail to recognize the disconnect between the core and the downcomer resulting from inadequate recirculation and fail to control letdown and makeup (OPDHR fails). The operators have an additional 23 min. in OPECS to detect and respond to the loss of SDC and additional indicators would become available. Periodic checks of the chart recorders for increases in temperature and pressure would be due during this time for OPECS. The operators must diagnose the need to initiate ECCS water solid operation.

* OPISA is completely dependent on OPECS. If OPECS succeeds, so does OPISA.

¹ Note: In sequences 32 and 48 in the LA tree, RWCU fails and may need to be isolated by the operators in OPECS and OP1SV. Isolation of RWCU was not included in determining HEP 50 and 51, respectively. More appropriate and slightly more conservative HEPs, in terms of consistency with the current analysis, would have been HEP 39 (0.12) for OPECS and HEP 40 (0.31) for OP1SV.

File Name: OPECSL5.E1V

Initiator: E1V5H

Event Tree: EA (from LA, Seq. 5, 16, 21, 32¹, 38, 48¹,
from E1V5H, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 50
OPMSV	1.0		HEP 9
OP1SV	0.112	10	HEP 51
OPHIS	1.0		HEP 8

The above scenario reflects an isolation of SDC common suction line, followed by a successful OPSDC and a successful restoration SDC(B) (RESCS), after initially being on ADHR. ADHR fails, but SDC(B) is established. At some point forced recirculation and/or CRD and/or RWCU fail. The operators initially fail to recognize the disconnect between the core and the downcomer resulting from inadequate recirculation and fail to control letdown and makeup (OPDHR fails). The operators have an additional 23 min. in OPECS to detect and respond to the loss of SDC and additional indicators would become available. Periodic checks of the chart recorders for increases in temperature and pressure would be due during this time for OPECS. The operators must diagnose the need to initiate ECCS water solid operation.

¹ Note: In sequences 32 and 48 in the LA tree, RWCU fails and may need to be isolated by the operators in OPECS and OP1SV. Isolation of RWCU was not included in determining HEP 50 and 51, respectively. More appropriate and slightly more conservative HEPs, in terms of consistency with the current analysis, would have been HEP 39 (0.12) for OPECS and HEP 40 (0.31) for OP1SV.

Locator Files

File Name: OPECSL5.E1T

Initiator: E1T5H

Event Tree: E (from L, Seq. 5, 16, 21, 32¹, 38, 48¹,
from E1T5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 50
OPMSV	1.0		HEP 9
OP1SV	0.112	10	HEP 51
OPHIS	1.0		HEP 8

The above scenario reflects an isolation of SDC common suction line, followed by a successful OPSDC and a successful restoration of SDC(B) (RESCS). At some point forced recirculation and/or CRD and/or RWCU fail. The operators initially fail to recognize the disconnect between the core and the downcomer resulting from inadequate recirculation and fail to control letdown and makeup (OPDHR fails). The operators have an additional 23 min. in OPECS to detect and respond to the loss of SDC and additional indicators would become available. Periodic checks of the chart recorders for increases in temperature and pressure would be due during this time for OPECS. The operators must diagnose the need to initiate ECCS water solid operation.

¹ Note: In sequences 32 and 48 in the LA tree, RWCU fails and may need to be isolated by the operators in OPECS and OP1SV. Isolation of RWCU was not included in determining HEP 50 and 51, respectively. More appropriate and slightly more conservative HEPs, in terms of consistency with the current analysis, would have been HEP 39 (0.12) for OPECS and HEP 40 (0.31) for OP1SV.

File Name: OPECSL5.E1B

Initiator: E1B5H

Event Tree: E (from L, Seq. 5, 16, 32¹, 38, 48¹,
from E1B5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 50
OPMSV	1.0		HEP 9
OP1SV	0.112	10	HEP 51
OPHIS	1.0		HEP 8

The above scenario reflects an inadvertent isolation of SDC, followed by a successful OPSDC and a successful restoration SDC(B) (RESCS). That is, the operators recognize the loss of SDC(B) and successfully restore it. At some point forced recirculation and/or CRD and/or RWCU fail. The operators initially fail to recognize the disconnect between the core and the downcomer resulting from inadequate recirculation and fail to control letdown and makeup (OPDHR fails). The operators have an additional 23 min. in OPECS to detect and respond to the loss of SDC and additional indicators would become available. Periodic checks of the chart recorders for increases in temperature and pressure would be due during this time for OPECS. The operators must diagnose the need to initiate ECCS water solid operation.

¹ Note: In sequences 32 and 48 in the LA tree, RWCU fails and may need to be isolated by the operators in OPECS and OP1SV. Isolation of RWCU was not included in determining HEP 50 and 51, respectively. More appropriate and slightly more conservative HEPs, in terms of consistency with the current analysis, would have been HEP 39 (0.12) for OPECS and HEP 40 (0.31) for OP1SV.

Locator Files

File Name: OPECSL32.T5D

Initiator: T5D5H

Event Tree: E (from L, Seq. 32, 48, from T5D5H, Seq.3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.40	10	HEP 37
OP1SV	0.64	10	HEP 38
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this loss of CCW scenario, SDC(B) continues to run, but due to the initiator, forced recirculation, CRD, and RWCU are lost. The operators must diagnose need to increase makeup and isolate RWCU (letdown). However, in this scenario, OPDHR fails. That is, the operators initially fail to diagnose the need for level control to avoid a functional loss of SDC. OPECS involves recognizing the "functional loss of SDC," entering the IDHR ONEP, diagnosing the need to initiate ECCS water solid operation, and isolating RWCU.

File Name: OPECSL.TRP

Initiator: TRPT5

Event Tree: E (from L, Seq. 16, 21, 25, 32, 38, 48,
from SDC, Seq. 1, from TRPT5, Seq. 3)

EA (from LA, Seq. 16, 21, 25, 32, 38, 48,
from ADH, Seq. 1, from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.40	10	HEP 37
OP1SV	0.64	10	HEP 38
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
OPISA	0		HEP 81

In this loss of forced recirculation scenario, SDC(B) or ADHR continues to run. At some later point, either or both RWCU and CRD fail. Operators must diagnose need to restore makeup and/or isolate letdown (RWCU) to avoid a functional loss of SDC because of a disconnect between the core and the downcomer. However, in this scenario, OPDHR fails and we go to the E tree. In this scenario, OPECS is somewhat like OPDHR because the operators must recognize the potential disconnect between the core and the downcomer (SDC(B) or ADHR is still running). Operators now have an additional 23 min. to recognize the problem, isolate RWCU (whether running or failed), and go ECCS water solid to restore level and provide SDC. If ADHR is running, it must be isolated. LPCI(C) is assumed to be the ECCS system of choice. No credit is given for HPCS in this scenario because of insufficient time.

Note that in these scenarios the operators have done nothing to demonstrate they are aware of a problem. OPSDC is not asked since SDC continues to run and OPDHR fails.

Locator Files

File Name: OPECSL.TLM

Initiator: TLM5H

Event Tree: E (from tree L, Seq. 5, 14, 32, 38, 48,
from SDC, Seq. 1, from TLM5H, Seq.3)

EA (from LA, Seq. 5, 38, from ADH, Seq. 1,
from TLM5H, Seq.5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.40	10	HEP 37
OP1SV	0.64	10	HEP 38
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this loss of makeup (CRD) scenario, SDC(B) continues to run. Operators must diagnose need to restore makeup and isolate letdown (RWCU) to avoid a functional loss of SDC because of a disconnect between the core and the downcomer. However, in this scenario, OPDHR fails and we go to the E tree. In this scenario, OPECS is somewhat like OPDHR because the operators must recognize the potential disconnect between the core and the downcomer (SDC(B) is still running). Operators now have an additional 23 min. to recognize the problem, isolate RWCU (whether running or failed), and go ECCS water solid to restore level and provide SDC. LPCI(C) is assumed to be the ECCS system of choice. No credit is given for HPCS in this scenario because of insufficient time.

Note that in these scenarios the operators have done nothing to demonstrate they are aware of a problem. OPSDC is not asked since SDC continues to run and OPDHR fails.

File Name: OPECSL.TIH

Initiator: TIHP5

Event Tree: E (from L, Seq. 5, 14, 32, 38, 48,
from SDC, Seq. 1, from TIHP5, Seq. 2, 4)

EA (from LA, Seq. 5, 38, 48, from ADH, Seq. 1, 2,
from TIHP5, Seq. 3, 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.40	10	HEP 37
OP1SV	0.64	10	HEP 38
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
OPISA	0		HEP 81

In this inadvertent actuation of HPCS initiator, SDC(B) or ADHRS continue to run. HPCS auto-isolates at level 8 or the auto-isolation fails and the operators successfully stop the HPCS injection (OPHPC succeeds). At some point later, CRD fails and in some cases forced recirculation or RWCU fail. Operators must diagnose need to restore makeup and isolate letdown (RWCU) to avoid a functional loss of SDC because of a disconnect between the core and the downcomer. However, in this scenario, OPDHR fails and we go to the E tree. In this scenario, OPECS is somewhat like OPDHR because the operators must recognize the potential disconnect between the core and the downcomer (SDC(B) or ADHRS is still running). Operators now have an additional 23 min. to recognize the problem, isolate RWCU (whether running or failed), and go ECCS water solid to restore level and provide SDC. LPCI(C) is assumed to be the ECCS system of choice. No credit is given for HPCS in this scenario because of insufficient time and because they may have to unisolate HPCS if the auto-isolation was successful. OPISA is completely dependent on OPECS.

Note that in these scenarios the operators have done nothing to demonstrate they are aware of a problem. OPSDC is not asked since SDC continues to run and OPDHR fails. Because of insufficient time and because they may have to unisolate HPCS if the auto-isolation was successful, OPISA is completely dependent on OPECS.

Note that in these scenarios the operators have done nothing to demonstrate they are aware of a problem. OPSDC is not asked since SDC continues to run and OPDHR fails.

Locator Files

File Name: OPECSLAP.EAP

Initiator: T1-5

Event Tree: EAP (from LAP, Seq. 4, 8, 15, from ADH, Seq. 6,
from T1-5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 50
OPMSV	1.0		HEP 9
OP1SV	0.112	10	HEP 51
OPHIS	1.0		HEP 8
* OPISA	0		HEP 81

The above scenario reflects a loss of ADH as a result of a LOSP. The operators diagnose the loss of SDC (OPSDC succeeds) and successfully align and start SDC(B). Forced recirculation and RWCU are lost. RWCU auto-isolates. In some sequences, CRD is also lost. The operators initially fail to recognize the disconnect between the core and the downcomer resulting in inadequate recirculation and fail to control letdown and makeup (OPDHR fails). The operators have an additional 23 min. in OPECS to detect and respond to the loss of SDC and additional indicators would become available. Periodic checks of the chart recorders for increases in temperature and pressure would be due during the time for OPECS. The operators must diagnose the need to initiate ECCS water solid operation. ADHR has been isolated.

- * OPISA is completely dependent on OPECS. If OPECS is successful, OPISA = 0 (success).

File Name: OPECSLEA.T5D

Initiator: T5D5H

Event Tree: EA (from LA, Seq. 32, 48, from T5D5H, Seq.18, 19)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.40	10	HEP 37
OP1SV	0.64	10	HEP 38
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
* OPISA	0		HEP 81

In this loss of CCW scenario, ADHR continued to run or SDC(B) was started successfully after the loss of ADHR. Due to the initiator (loss of CCW), forced recirculation, CRD, and RWCU are lost. Operator must diagnose need to increase makeup and isolate letdown (RWCU). RWCU fails with the loss of CCW, but must be isolated. The operators initially fail to diagnose the need for makeup and the isolation of letdown (OPDHR fails). That is, the operators initially fail to diagnose the need for level control to avoid a functional loss of SDC. OPECS involves recognizing the "functional loss of SDC," entering the IDHR ONEP, diagnosing the need to initiate ECCS water solid operation, isolating ADHR in some sequences, and isolating RWCU.

- * Isolation of ADHR (OPISA) is completely dependent on OPECS in this context. If OPECS succeeds and they were initially on ADHR, then OPISA succeeds.

Locator Files

File Name: OPECSLEA.TIA

Initiator: TIA5H

Event Tree: EA (from LA, Seq. 32, 48, from TIA5H, Seq. 18)

EAP (from LAP, Seq. 8, 15, from TIA5H, Seq. 22)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 50
OPMSV	1.0		HEP 9
OP1SV	0.112	10	HEP 51
OPHIS	1.0		HEP 8
* OPISA	0		HEP 81

The initiator is a loss of IA. In some sequences, a LOSP also occurs at some point. The operators diagnose the loss of ADHR (OPSDC succeeds) and successfully align and start SDC(B). Forced recirculation and RWCU are lost. RWCU auto-isolates. In some sequences, CRD is also lost. The operators initially fail to recognize the disconnect between the core and the downcomer resulting in inadequate recirculation and fail to control letdown and makeup (OPDHR fails). The operators have an additional 23 min. in OPECS to detect and respond to the loss of SDC and additional indicators would become available. Periodic checks of the chart recorders for increases in temperature and pressure would be due during the time for OPECS. The operators must diagnose the need to initiate ECCS water solid operation. ADHR has been isolated.

- * OPISA is completely dependent on OPECS. If OPECS is successful, OPISA = 0 (success).

File Name: OPECSLEP.T5D

Initiator: T5D5H

Event Tree: EP (from LP, Seq. 8, 15,
from T5D5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

A loss of CCW is the initiator. At some point it is followed by LOSP with the diesels successfully starting and loading (DV1-2 succeeds). SDC(B) continues to run. RWCU isolates automatically with the LOSP. CRD and forced recirculation are lost. With the loss of makeup and forced recirculation, the potential for a disconnect between the core and the downcomer regions of the core arises. With inadequate level or recirculation, a "functional" loss of SDC can occur. OPDHR is the operator action to diagnose the functional loss of SDC and initiate level control. In these sequences, OPDHR has failed. That is, the operators fail to diagnose the disconnect between the core and the downcomer and the resulting functional loss of SDC in the 10 minutes allowed for OPDHR. However, at this point some additional indicators would be coming available and the operators should notice increases in pressure and temperature on chart recorders per periodic checks (required every 30 minutes). Operators must diagnose the need to initiate ECCS water solid operation.

Locator Files

File Name: OPECSLHY.TLM

Initiator: TLM5H

Event Tree: E (from L, Seq. 5, 38, from ADEP, Seq. 2,
from TLM5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OPMSV	1.0		HEP 9
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8

The above scenarios reflect a loss of CRD during a HYDRO Test. RWCU continues to operate in recirculation mode. Operators fail to diagnose the need to provide makeup to avoid a functional loss of SDC through disconnect between the core and the downcomer (OPDHR fails). Eventually, level will drop to the point that the disconnect will occur. A level 4 alarm may occur and operators will perform periodic checks that should reveal temperature and pressure changes. At this point operators will have another 23 min. to enter IDHR ONEP and proceed with ECCS water solid operation.

File Name: OPECSLP.TIF

Initiator: TIOF5

Event Tree: EP (from LP, Seq. 8, 15, from SDC, Seq. 5,
from TIOF5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this inadvertent actuation of LPCI scenario, the operators successfully stop the LPCI injection. A LOSP also occurs at some point, but a diesel generator successfully starts (DIV1-2 succeeds). SDC(B) restarts. RWCU has auto-isolated. At some point a loss of makeup (CRD) occurs. The operators fail to diagnose the potential for core/downcomer disconnect (resulting in a functional loss of SDC) in 10 min. and fail to control level (OPDHR fails). However, at this point some additional indicators could be coming available and operators could notice increases in pressure and temperature on chart recorders per periodic checks. Also, another 15 minutes would be available for the diagnosis and still have time for the needed actions (23 min. total). With the additional time, new indicators, and because the LOSP would be likely to result in the operators attending to relevant parameters, it was assumed that the HEP computations for OPECS would parallel those for similar events in which the need for an ECCS system must be diagnosed and the related actions carried-out.

Locator Files

File Name: OPECSLP.TIH

Initiator: TIHP5

Event Tree: EP (from LP, Seq. 8, 15, from SDC, Seq. 5,
from TIHP5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this inadvertent actuation of HPCS scenario, HPCS auto-isolates at level 8 and injection stops. A LOSP also occurs at some point, but a diesel generator successfully starts (DIV1-2 succeeds). SDC(B) restarts. RWCU has auto-isolated. At some point a loss of makeup (CRD) occurs. The operators fail to diagnose the potential for core/downcomer disconnect (resulting in a functional loss of SDC) in 10 min. and fail to control level (OPDHR fails). However, at this point some additional indicators could be coming available and operators could notice increases in pressure and temperature on chart recorders per periodic checks. Also, another 15 minutes would be available for the diagnosis and still have time for the needed actions (23 min. total).

File Name: OPECSLP.TLM

Initiator: TLM5H

Event Tree: EP (from LP, Seq. 8, 15, from SDC, Seq. 5
from TLM5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this scenario, a loss of makeup (CRD) occurs. A LOSP also occurs at some point, but DIV 1/2 have succeeded. SDC(B) restarts. RWCU has auto-isolated. The operators fail to diagnose the potential for core/downcomer disconnect (resulting in a functional loss of SDC) in 10 min. and they have not diagnosed the need to increase any lost level. However, at this point some additional indicators could be coming available and operators could notice increases in pressure and temperature on chart recorders per periodic checks. Also, another 15 minutes would be available for the diagnosis and still have time for the needed actions (23 min. total).

Locator Files

File Name: OPECSLP.TRP

Initiator: TRPT5

Event Tree: EP (from LP, Seq. 8, 15, from SDC, Seq. 5
from TRPT5, Seq. 3)
EAP (from LAP, Seq. 8, 15, from ADH, Seq. 6
from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9
OPISA	0		HEP 81

In this scenario, a loss of forced recirculation occurs. A LOSP also occurs at some point, but DIV 1/2 have succeeded. SDC(B) is started or restarted. RWCU has auto-isolated and CRD has failed. If ADHR was operating, it is isolated in aligning SDC(B). The operators fail to diagnose the potential for core/downcomer disconnect (resulting in a functional loss of SDC) in 10 min. and they have not diagnosed the need to increase any lost level. However, at this point some additional indicators could be coming available and operators could notice increases in pressure and temperature on chart recorders per periodic checks. Also, another 15 minutes would be available for the diagnosis and still have time for the needed actions (23 min. total). OPISA is completely dependent on OPECS.

File Name: OPECSLP4.EP

Initiator: T1-5

Event Tree: EP (from LP, Seq. 4, from SDC, Seq. 5,
from T1-5, Seq. 3)

EP (from LP, Seq. 8, 15, from SDC, Seq. 5)
from T1-5, Seq. 3)

Human Error Events.

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

In this scenario, a LOSP has occurred, but the diesels successfully start and load (DIV 1/2 succeeds). SDC(B) continues to run. CRD is either OK (Seq.4) or it fails (Seq. 8, 15), but OPDHR fails regardless. That is, the operators fail to diagnose the potential for a disconnect between the core and the downcomer regions of the core. With inadequate level or recirculation (forced recirculation is lost), a "functional" loss of SDC can occur. OPDHR is the operator action to diagnose the functional loss of SDC and initiate level control to allow the connection between the core and the downcomer. In these sequences, OPDHR has failed. That is, the operators fail to diagnose the disconnect between the core and the downcomer and the resulting functional loss of SDC in the 10 minutes allowed for OPDHR. However, at this point some additional indicators would be coming available and the operators should notice increases in pressure and temperature on chart recorders per periodic checks (required every 30 minutes). Operators must diagnose the need to initiate ECCS water solid operation.

Locator Files

File Name: OPECSLP8.TIA

Initiator: TIA5H

Event Tree: EP (from LP, Seq. 8, 15, from TIA5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.138	10	HEP 18
OP1SV	0.302	10	HEP 106
OPHIS	1.0		HEP 8
OPMSV	1.0		HEP 9

A loss of IA is the initiator. At some point a LOSP also occurs, but the diesels start and load (DIV 1/2 succeeds). SDC(B) continues to run. CRD, RWCU, and forced recirculation is lost. With loss of makeup (CRD) and forced recirculation, the potential for a disconnect between the core and the downcomer regions of the core arises. With inadequate level or recirculation, a "functional" loss of SDC to the core can occur. OPDHR is the operator action to diagnose the functional loss of SDC and initiate level control. In these sequences, OPDHR has failed. That is, the operators fail to diagnose the disconnect between the core and the downcomer and the resulting functional loss of SDC in the 10 minutes allowed for OPDHR. However, at this point some additional indicators would be coming available and the operators should notice increases in pressure and temperature on chart recorders per periodic checks (required every 30 minutes). Operators must diagnose the need to initiate ECCS water solid operation.

File Name: OPECSLPE.E1B

Initiator: E1B5H

Event Tree: EP (from LP, Seq. 8, 15, from E1B5H, Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 50
OPMSV	1.0		HEP 9
OP1SV	0.112	10	HEP 51
OPHIS	1.0		HEP 8
* OPISA	0		HEP 81

The above scenario reflects an isolation of SDC, followed at some point by a LOSP. The operators diagnose the loss of SDC (OPSDC succeeds) and successfully align and start SDC(B). Forced recirculation and RWCU are lost. RWCU auto-isolates. In some sequences, CRD is also lost. The operators initially fail to recognize the disconnect between the core and the downcomer resulting in inadequate recirculation and fail to control letdown and makeup (OPDHR fails). The operators have an additional 23 min. in OPECS to detect and respond to the loss of SDC and additional indicators would become available. Periodic checks of the chart recorders for increases in temperature and pressure would be due during the time for OPECS. The operators must diagnose the need to initiate ECCS water solid operation. ADHR has been isolated.

- * OPISA is completely dependent on OPECS. If OPECS is successful, OPISA = 0 (success).

Locator Files

File Name: OPECSLPE.E1T

Initiator: E1T5H

Event Tree: EP (from LP, Seq. 8, 15, from E1T5H, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 50
OPMSV	1.0		HEP 9
OP1SV	0.112	10	HEP 51
OPHIS	1.0		HEP 8

The above scenario reflects an isolation of SDC common suction line, followed by a successful OPSDC and a successful restart of SDC(B). Operators initially fail to control level (OPDHR fails) and go to OPECS with an additional 23 min. Additional indicators would now be coming available and ONEP for IDHR sort of reminds operators to be concerned about disconnect between core and downcomer. Thus, with new 23 min. and reasonable success to this point, it is assumed that the operators have some chance of diagnosing need for ECCS (LPCI(C)) and initiating system. No isolations required.

File Name: OPECSLPE.E1V

Initiator: E1V5H

Event Tree: EAP (from LAP, Seq. 8, 15, from E1V5H, Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.059	10	HEP 50
OPMSV	1.0		HEP 9
OP1SV	0.112	10	HEP 51
OPHIS	1.0		HEP 8

The above scenario reflects an isolation of SDC common suction line, followed by a successful unisolation of SDC, a failure of ADHRS to restart, and a successful start of SDC(B). Operators initially fail to control level (OPDHR fails) and go to OPECS with an additional 23 min. Additional indicators would now be coming available and ONEP for IDHR sort of reminds operators to be concerned about disconnect between core and downcomer. Thus, with new 23 min. and reasonable success to this point, it is assumed that the operators have some chance of diagnosing need for ECCS (LPCI(C)) and initiating system. No isolations required. LPCI(C) on standby after alignment of SDC(B).

Locator Files

File Name: OPECSP.E1T

Initiator: E1T5H

Event Tree: E (from AISD, Seq. 1, from L, Seq. 7, 40,
from E1T5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.023	5	HEP 79
OP1SV	0.11	10	HEP 80
OPHIS	1		HEP 8
* OPMSV	0		

Isolation of SDC common suction line initiator. Operators successfully reestablish SDC. At some later point RWCU fails and CRD continues to run. Operators fail to successfully control letdown and makeup (LCMK fails). Later in the scenario SDC isolates on high pressure. Pump trip alarm would occur and level 7 and 8 alarms would sound if haven't already. Pressure would be up. Operators will have entered IDHR ONEP. Will need to stop makeup (CRD), start LPCI, and perform related OPECS actions for initiating ECCS water solid operation.

- * Since the vessel is pressurizing in these scenarios, ISMSV must be closed. Thus, OPMSV should not be asked in these sequences.

File Name: OPECSP.TIO

Initiator: TIOP5

Event Tree: E (from AISD, Seq. 1, from TIOP5, Seq. 4)

EA (from AIAD, Seq. 2, from TIOP5, Seq. 9)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.023	5	HEP 79
OP1SV	0.11	10	HEP 80
OPHIS	1		HEP 8

* OPMSV

TIOP5 initiator, which is a mismatch between letdown and makeup potentially leading to over-pressurization. Operators fail to successfully control letdown and makeup (LCMK fails). Later in the scenario SDC isolates on high pressure. Pump trip alarm would occur and level 7 and 8 alarms would sound if haven't already. Pressure would be up. Operators will have entered IDHR ONEP. Will need to stop makeup (CRD), start LPCI, and perform related OPECS actions for initiating ECCS water solid operation. In the EA tree, OPISA must succeed because ADHR auto-isolates.

* Since the vessel would not pressurize with the MSIVs open, ISMSV must be closed and OPMSV will not be asked.

Locator Files

File Name: OPECSRTE.E1B

Initiator: E1B5H

Event Tree: E (from R, Seq. 28, from L Seq. 31, 37, 47,
from E1B5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

In these scenarios, either OPSDC has succeeded and SDC(B) was started or SDC(B) continued to run. CRD fails. OPDHR succeeded and CDS initiated, so operators are aware of the need for level control to prevent a disconnect between the downcomer and the core and a resulting loss of adequate core cooling. The appropriate ONEP has been entered (IDHR ONEP). RWCU has been isolated. CDS fails. Level control with ECCS (OPLEC in R tree) fails because time available was spent in OPDHR initiating CDS and because procedures do not clearly call for ECCS injection in conjunction with SDC. In OPECS, all the operators need to do is initiate LPCI(C) from the control room (its on standby by procedures) and perform related OPECS actions. No time for HPCS initiation was assumed if LPCI fails, so OPHIS is set to 1.0.

File Name: OPECSRTE.E1D

Initiator: E1D5H

Event Tree: EA (from RA, Seq. 28, from LA Seq. 31, 37, 47,
from E1D5H, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	0		HEP 8
OPMSV	1		HEP 9

In this loss of ADHR scenario, OPSDC has succeeded and SDC(B) was started. CRD fails. OPDHR succeeds and CDS initiation is attempted, so operators are aware of the need for level control. Appropriate ONEP has been entered (IDHR ONEP). RWCU has been isolated. CDS fails. Level control with ECCS (OPLEC in R tree) fails because time available was spent in OPDHR initiating CDS and because procedures do not clearly call for ECCS injection in conjunction with SDC. In OPECS, HPCS is assumed the system of choice for ECCS water solid because LPCI(C) is assumed unavailable from the loss of and inability of operators to restore ADHRS and because RHR(B) is aligned for SDC. Operators need only initiate HPCS from the control room and perform the related OPECS actions. OPHIS must be set equal to 0 (success) if OPECS succeeds.

Locator Files

File Name: OPECSRTE.E2D

Initiator: E2D5H

Event Tree: EA (from RA, Seq. 28, from LA Seq. 31, 37, 47,
from E2D5H, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	0		HEP 8
OPMSV	1		HEP 9

In this loss of ADHR scenario, OPSDC has succeeded and SDC(B) was started. CRD fails. OPDHR succeeds and CDS initiation is attempted, so operators are aware of the need for level control. Appropriate ONEP has been entered (IDHR ONEP). RWCU has been isolated. CDS fails. Level control with ECCS (OPLEC in R tree) fails because time available was spent in OPDHR initiating CDS and because procedures do not clearly call for ECCS injection in conjunction with SDC. In OPECS, HPCS is assumed the system of choice for ECCS water solid because LPCI(C) is assumed unavailable from the loss of and "non-restorability" of ADHRS and because RHR(B) is aligned for SDC. Operators need only initiate HPCS from the control room and perform the related OPECS actions. OPHIS must be set equal to 0 (success) if OPECS succeeds.

File Name: OPECSRTE.T5D

Initiator: T5D5H

Event Tree: E (from R, Seq. 28, from L Seq. 31, 47,
from T5D5H, Seq. 3)

EA (from RA, Seq. 28, from LA, Seq. 31,
from T5D5H, Seq. 18, 19)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

In these scenarios, either OPSDC has succeeded and SDC(B) was started or SDC(B) or ADHR continued to run. OPDHR succeeded (an attempt was made to initiate CDS), so operators are aware of need for level control to prevent a disconnect between the downcomer and the core and a resulting loss of core cooling. The appropriate ONEP has been entered (IDHR ONEP). RWCU has been isolated. CDS fails and CRD is not available. Level control with ECCS (OPLEC in R tree) fails because time available was spent in OPDHR initiating CDS and because procedures do not clearly call for ECCS injection in conjunction with SDC. In OPECS, the operators are directed by procedure to initiate ECCS water solid operation. Injection with LPCI and the related OPECS actions are accomplished from the control room. No time for HPCS initiation was assumed, so OPHIS was set to 1.0.

Note: For sequence 18-31-28 to the EA tree listed above, ADHR would have to be isolated prior to initiating water solid operation. Isolation of ADHR was not included in determining HEP 6 and 7, OPECS and OP1SV, respectively. Thus, the above values are incorrect in the context of the analysis. More appropriate values (in the context of the analysis) would have been HEP 103 for OPECS (0.042) and HEP 104 for OP1SV (0.30). Thus, the values used were slightly less conservative.

Locator Files

File Name: OPECSRTE.TRP

Initiator: TRPT5

Event Tree: E (from R, Seq. 28, from L Seq. 20, 37,
from ADEP, Seq. 2, from TRPT5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

A loss of forced recirculation during a HYDRO test is the initiator. RWCU continues to run in recirculation mode. CRD fails, but the operators attempt to control level with CDS (OPDHR succeeds). Thus, they are aware of the need for adequate cooling, but CDS fails to start on demand. It is assumed that the operators have entered the IDHR ONEP. Level control with ECCS (OPLEC in R tree) fails because time available was spent in OPDHR initiating CDS. In OPECS, which is initiation of ECCS water solid operation, all the operators need to do is initiate LPCI(C) from the control room (its on standby by procedure) and perform related OPECS actions. No time for HPCS initiation was assumed if LPCI fails, so OPHIS is set to 1.0.

File Name: OPECSRTE.TRV

Initiator: TORV5

Event Tree: E (from R, Seq. 28, from L Seq. 37,
from ADEP, Seq. 2, from TORV5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

An inadvertent stuck open relief valve during a HYDRO test is the initiator. RWCU continues to run in recirculation mode. CRD fails, but the operators attempt to control level with CDS (OPDHR succeeds). Thus, they are aware of the need for adequate cooling, but CDS fails to start on demand. It is assumed that the operators have entered the IDHR ONEP. Level control with ECCS (OPLEC in R tree) fails because time available was spent in OPDHR initiating CDS. In OPECS, which is the initiation of ECCS water solid operation, all the operators need to do is initiate LPCI(C) from the control room (its on standby by procedure) and perform related OPECS actions. No time for HPCS initiation was assumed if LPCI fails, so OPHIS is set to 1.0.

Locator Files

File Name: OPECSSDC.E1B

Initiator: E1B5H

Event Tree: E (from E1B5H, Seq. 5, 8)

EP (from E1B5H, Seq. 13, 16)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

In this scenario, SDC(B) isolates. The operators have detected the loss of SDC and entered the IDHR ONEP (OPSDC succeeds). In addition, the operators have either attempted to restore SDC(B) (RESB in Seqs. 5 & 13), but the system failed or they failed to attempt restoration (RESB in Seqs. 8 & 16). Regardless, the operators are aware of inadequate decay heat removal and have entered the ONEP for IDHR. By procedure they are directed to initiate ECCS water solid operation.

File Name: OPECSSDC.E1T

Initiator: E1T5H

Event Tree: E (from E1T5H, Seq. 5, 7)

EP (from E1T5H, Seq. 12, 14)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

In this scenario, the SDC common suction line isolates. OPSDC has succeeded and IDHR ONEP has been entered prior to start of OPECS. That is, operators have diagnosed the loss of SDC(B), and entered IDHR ONEP. In this scenario the operators have either attempted to restore SDC(B) (RESCS in Seq. 5 & 12), but the system failed or they failed to complete restoration (RESCS in Seqs. 7 & 14). If a LOSP has occurred, the DGs started (DV1-2 OK). Regardless, operators are aware of inadequate decay heat removal and have entered the ONEP for IDHR. By procedure they are directed to initiate ECCS water solid operation.

Locator Files

File Name: OPECSSDC.E2B

Initiator: E2B5H

Event Tree: E (from E2B5H, Seq. 5)

EP (from E2B5H, Seq, 8)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

In this scenario, SDC(B) fails along with all of train B RHR. OPSDC has succeeded and appropriate ONEP has been entered prior to start of OPECS. That is, the operators have diagnosed the loss of SDC(B), and entered the IDHR ONEP. In this scenario the operators do not attempt to restore SDC(B) (the initiator is more than just an isolation), the system has failed. Either there was no LOSP or DV1-2 was successful. The ONEP directs the operators to go ECCS water solid. LPCI(C) and HPCS are available for ECCS. At this point, credit is taken for LPCI only, so OPHIS is set to 1.0.

File Name: OPECSSDC.E2T

Initiator: E2T5H

Event Tree: E (from E2T5H, Seq. 4)

EP (from E2T5H, Seq, 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

In this scenario, SDC(B) fails due to loss of common suction line which renders all of SDC unavailable. OPSDC has succeeded and appropriate ONEP has been entered prior to start of OPECS. That is, the operators have diagnosed the loss of SDC(B), and entered the IDHR ONEP. In this scenario the operators do not attempt to restore SDC(B) (the initiator is more than just an isolation), the system has failed. Either there was no LOSP or DV1-2 was successful. The ONEP directs the operators to go ECCS water solid. LPCI(C) or (B) and HPCS are available for ECCS. At this point, credit is taken for LPCI only, so OPHIS is set to 1.0.

Locator Files

File Name: OPECSSDC.TAB

Initiator: TAB5H

Event Tree: E (from SDC, Seq. 3, from TAB5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	0		HEP 8
OPMSV	1		HEP 9

In this scenario, OPSDC has succeeded and the appropriate ONEPs have been entered prior to OPECS. That is, the control room has diagnosed the loss of SDC in the context of a loss of the available AC bus and entered the IDHR ONEP. With no DV1-2, HPCS is the system available for ECCS water solid operation, rather than LPCI(C).

Since OPECS in this case requires the use of HPCS, OPHIS must be set to 0 (success) when OPECS succeeds.

File Name: OPECSSDC.TDB

Initiator: TDB5H

Event Tree: E (from SDC, Seq. 3, from TDB5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	0		HEP 8
OPMSV	1		HEP 9

In this scenario, OPSDC has succeeded and the appropriate ONEP has been entered prior to start of OPECS. That is, operator has diagnosed loss of SDC in the context of a loss of the available DC bus and entered the IDHR ONEP. With no DC control power, the control room will be required to use HPCS, rather than LPCI for ECCS water solid operation.

Since OPECS in this case requires the use of, OPHIS must be set to 0 (success) when OPECS succeeds.

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Locator Files

File Name: OPECSSDC.TIF

Initiator: TIOF5

Event Tree: E (from SDC, Seq. 3, from TIOF5, Seq. 2)

EP (from SDC, Seq. 7, from TIOF5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

TIOF5 initiator, which is an inadvertent initiation of LPCI. Operators successfully stop injection. Later in the scenario, a random isolation of SDC(B) occurs. OPSDC has succeeded and appropriate ONEP has been entered prior to start of OPECS. That is, operators have diagnosed the loss of SDC(B), attempted a restart with no luck, and entered the IDHR ONEP. By procedure they are directed to initiate ECCS water solid operation.

File Name: OPECSSDC.TIH

Initiator: TIHP5

Event Tree: E (from SDC, Seq. 3, from TIHP5, Seq. 2)

EP (from SDC, Seq. 7, from TIHP5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

TIHP5 initiator, which is an inadvertent initiation of HPCS. HPCS auto-isolates on high level or the operators successfully isolate HPCS. Later in the scenario, a random isolation of SDC(B) occurs. OPSDC has succeeded and appropriate ONEP has been entered prior to start of OPECS. That is, operators have diagnosed the loss of SDC(B), attempted a restart with no luck, and entered the IDHR ONEP. By procedure they are directed to initiate ECCS water solid operation.

Locator Files

File Name: OPECSSDC.TIO

Initiator: TIOP5

Event Tree: E (from SDC, Seq. 3, from TIOP5, Seq. 2)

EP (from SDC, Seq. 7, from TIOP5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

TIOP5 initiator, which is a mismatch between letdown and makeup potentially leading to over-pressurization. Operators successfully control letdown and makeup (LCMK OK). Later in the scenario, a random isolation of SDC(B) occurs. OPSDC has succeeded and appropriate ONEP has been entered prior to start of OPECS. That is, operators have diagnosed the loss of SDC(B), attempted a restart with no luck, and entered the IDHR ONEP. By procedure they are directed to initiate ECCS water solid operation.

File Name: OPECSSDC.TLM

Initiator: TLM5H

Event Tree: E (from SDC, Seq. 3, from TLM5H, Seq. 3)

EP (from SDC, Seq. 7, from TLM5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

TLM5H initiator, which is a loss of CRD (makeup). If a LOSP has occurred, the diesel generators successfully start (DV1-2 OK). Later in the scenario, a random isolation of SDC(B) occurs. The operators have diagnosed the loss of SDC(B), attempted a restart with no luck, and entered the IDHR ONEP prior to start of OPECS (OPSDC has succeeded). By procedure they are directed to initiate ECCS water solid operation.

Locator Files

File Name: OPECSSDC.TRP

Initiator: TRPT5

Event Tree: E (from SDC, Seq. 3, from TRPT5, Seq. 3)

EP (from SDC, Seq. 7, from TRPT5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPECS	0.035	5	HEP 6
OP1SV	0.112	10	HEP 7
OPHIS	1		HEP 8
OPMSV	1		HEP 9

TRPT5 initiator, which is a loss of forced recirculation. If a LOSP has occurred, the diesel generators successfully start (DV1-2 OK). Later in the scenario, a random isolation of SDC(B) occurs. The operators have diagnosed the loss of SDC(B), attempted a restart with no luck, and entered the IDHR ONEP prior to start of OPECS (OPSDC has succeeded). By procedure they are directed to initiate ECCS water solid operation.

File Name: OPFLD.E1B

Initiator: E1B5H

Event Tree: F (from E, Seq. 11, from E1B5H, Seq. 10)

F (from E, Seq. 5, 10, 11, 16, 21, 22,
from E1B5H, Seq. 8)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	1.0		HEP 33

Isolation of SDC is the initiator. OPSDC fails and a loss of all RHR train B is assumed (ECSBF). No LO SP. OPECS succeeds, but insufficient level in SP. Only system assumed available for continuous injection is FW. Thus, we go to F tree for operators initiation of flooding (OPFLD). However, OPFLD cannot succeed in the present context because there is insufficient time allowed to complete FW hookup. Operators only allowed 23 min. for OPFLD.

Locator Files

File Name: OPFLD.E2B

Initiator: E2B5H

Event Tree: F (from E, Seq. 5, 10, 11, 16, 21, 22,
from E2B5H, Seq. 5, 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	1.0		HEP 33

Total loss of SDC is the initiator. OPSDC succeeds or fails, but a loss of all RHR train B is assumed (ECSBF). No LO SP. OPECS succeeds, but LPCI(C) fails to inject or insufficient level in SP. Only system assumed available for continuous injection is FW. (Actually HPCS and CDS would be available, but not used in F tree. They will be asked later. Thus, we go to F tree for operators initiation of flooding (OPFLD). However, OPFLD cannot succeed in the present context because there is insufficient time allowed to complete FW hookup. Operators only allowed 23 min. for OPFLD.

File Name: OPFLD.FNP

Initiator: T1-5

Event Tree: FNP (from HPSWR, Seqs. 2, 5, 7, 40, from SDC, Seq. 9,
from T1-5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	1.0		HEP 33

An LOSP is the initiator, with DV1-2 failing. OPECS succeeds, but the HPCS system fails or there is no level in the SP for HPCS suction. Thus, water solid operation fails. With no train B power, SSWXT unavailable, leaving only FW for flooding. With only 23 minutes available for OPFLD, it was determined that the operators would not be successful in hooking up FW for injection.

Locator Files

File Name: OPFLD.E2B

Initiator: E2B5H

Event Tree: F (from E, Seq. 5, 10, 11, 16, 21, 22,
from E2B5H, Seq. 5, 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	1.0		HEP 33

Total loss of SDC is the initiator. OPSDC succeeds or fails, but a loss of all RHR train B is assumed (ECSBF). No LO SP. OPECS succeeds, but LPCI(C) fails to inject or insufficient level in SP. Only system assumed available for continuous injection is FW. (Actually HPCS and CDS would be available, but not used in F tree. They will be asked later. Thus, we go to F tree for operators initiation of flooding (OPFLD). However, OPFLD cannot succeed in the present context because there is insufficient time allowed to complete FW hookup. Operators only allowed 23 min. for OPFLD.

File Name: OPFLD.FP

Initiator: T1-5

Event Tree: FP (from EP, Seq. 5, 10, 11, 16, 21, 22,
from SDC, Seq. 7, 8, from T1-5, Seq. 3)

FP (from EP, Seq. 5, 10, 11, 22, from LP, Seq. 8, 15,
from SDC, Seq. 5, from T1-5, Seq. 3)

FP (from EAP, Seq. 5, 10, 11, 16, 21, 22,
from LAP, Seq. 8, 15, from ADH, Seq. 6,
from T1-5, Seq. 5)

FP (from RP, Seq. 11, 22, 27, from LP, Seq. 7, 14,
from SDC, Seq. 5, from T1-5, Seq. 3)

FP (from RAP, Seq. 11, 22, 27, from LAP, Seq. 7, 14,
from ADH, Seq. 6, T1-5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28
* OPMSV	1.0		HEP 34
* OP1SV	0.302	10	HEP 5

A LOSP is the initiator. In all sequences the operators eventually attempt to control level with ECCS or go water solid with ECCS. However, all ECCS fails (either the systems or no SP level). The operators have the option of flooding with SSWXT.

- * Use OPMSV and OP1SV values only when coming from the R trees. Ignore when coming from E trees.

Locator Files

File Name: OPFLD.T5A

Initiator: T5A5H

Event Tree: FX (from T5A5H, Seq. 7)

F (from E, Seq. 4, 9, 11, 15, 22, from T5A5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	1.0		HEP 33

Loss of SSW is the initiator. In the FX scenario, a LOSP occurs and HPCSA fails. XTIEB succeeds and OPSDC succeeds. That is, the operators successfully cross-tie the HPCS diesel and realize that SDC has been lost. However, no systems are available for continuous injection (in any form) except FW. Thus, we go to FX tree for the operators initiation of flooding (OPFLD) with FW.

In the sequences that transfer through the E tree, a LOSP has not occurred and the operators recognize the loss of SDC. In the E tree, the operators attempt to initiate ECCS water solid operation with HPCS, but HPCS fails or there is insufficient level in the SP. Transfer to F tree for vessel/containment flooding with FW. SSWXT unavailable.

However, the operator action to initiate flooding (OPFLD) cannot succeed in these sequences because there is insufficient time allowed to complete the FW hookup. OPFLD only allowed 23 min.

File Name: OPFLD.T5D

Initiator: T5D5H

Event Tree: F (from EA, Seq. 5, 10, 11, 16, 21, 22, from

T5D5H
,
Seq.
21 or
22)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Loss of CCW is the initiator. RWCU fails and must be isolated. OPSCD succeeds or fails, OPECS succeeds, but all ECCS fails (either systems or no SP level). The operators have the option of injecting with SSWXT.

Locator Files

File Name: OPFLD.TIA

Initiator: TIA5H

Event Tree: F (from E, Seq. 5, 10, 11, 16, 21, 22,
from TIA5H, Seq. 5)

F (from E, Seq. 5, 10, 11, 16, 21, 22,
from L, Seq. 32, 48, from TIA5H, Seq. 3)

F (from EA, Seq. 5, 10, 11, from TIA5H, Seq 20)

F (from R, Seq. 11, 22, 27, from L, Seq. 31, 47,
from TIA5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28
* OPMSV	1.0		HEP 34
* OP1SV	0.302	10	HEP 5

A loss of IA is the initiator. SDC fails and operators recognize the loss (OPSDC succeeds) or SDC(B) continues to run. Regardless, either OPECS succeeds at some point or OPDHR and OPLEC succeed, but all ECCS fails (either systems or no SP level). The operators may decide to flood with SSWXT.

* Use the these value only when coming from R trees. Ignore when coming from E trees.

File Name: OPFLD2.TIA

Initiator: TIA5H

Event Tree: FP (from EAP, Seq. 5, 10, from LAP, Seq. 8, 15,
from TIA5H, Seq. 22)

F (from E, Seq. 11, from L, Seq. 32, 48,
from TIA5H, Seq. 18)

F (from RA, Seq. 11, 22, from LA, Seq. 31, 47,
from TIA5H, Seq. 18)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28
* OPMSV	1.0		HEP 34
* OP1SV	0.302	10	HEP 5

A loss of IA is the initiator. SDC fails and operators recognize the loss (OPSDC succeeds) or SDC(B) continues to run. Regardless, either OPECS succeeds at some point or OPDHR and OPLEC succeed, but all ECCS fails (either systems or no SP level). The operators may decide to flood with SSWXT.

- * Use the these value only when coming from R trees. Ignore when coming from E trees.

Locator Files

File Name: OPFLDADH.FP

Initiator: T1-5

Event Tree: FP (from EAP, Seq. 5, 10, 11, from ADH, Seq. 8
from T1-5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

LOSP is the initiator. OPSDC succeeds and OPEsucceeds, but all ECCS fails (either the systems or no SP level). The operators have the option of flooding with SSWXT.

File Name: OPFLDADH.TDB

Initiator: TDB5H

Event Tree: F (from EA, Seqs. 4, 9, 11, 15, 20, 22,
from ADH, Seq. 4, from TDB5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	1.0		HEP 33

On ADHR when the DC bus lost. OPSDC either succeeds or fails. Due to the initiator RHR/SDC cannot be started. OPECS succeeds with HPCS, but all ECCS fails (either systems or no SP level). SSWXT is also unavailable, so the operators have the option to flood with FW. However, the time allowed for OPFLD (23 min) is insufficient for aligning the FW system. Thus, OPFLD fails.

Locator Files

File Name: OPFLDE.E1B

Initiator: E1B5H

Event Tree: F (from E, Seq. 5, 10, 11, 16, 21, 22,
from E1B5H, Seq. 5,)

F (from E, Seq. 5, 10, 11, 16, 21, 22,
from L, Seq. 38, from E1B5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Isolation of SDC is the initiator. Eventually the operators attempt to initiate ECCS water solid operation because of IDHR, but all ECCS fails (either the systems or no SP level). Operators must diagnose and flood with SSWXT or FW.

File Name: OPFLDE.E1D

Initiator: E1D5H

Event Tree: F (from EA, Seq. 4, 9, from E1D5H, Seq. 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Isolation of ADH is the initiator. No LO SP. OPSDC succeeds. Operators attempt to restore ADH, but it fails to run. SDC(B) fails to start. OPECS succeeds. The operators initiate HPCS (LPCI unavailable), but HPCS fails to start. The Operators must diagnose the need for flooding and inject with SSWXT.

Locator Files

File Name: OPFLDE.E1T

Initiator: E1T5H

Event Tree: F (from E, Seq. 5, 10, 11, 16, 21, 22,
from E1T5H, Seq. 5, 7, 9)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

An isolation of the common SDC suction line occurs (initially on SDC(B)). The operators successfully recognize the loss of SDC (OPSDC succeeds) or fail to recognize the loss. Regardless, they successfully attempt to initiate ECCS water solid operation (OPECS succeeds). However, either SP level is low or LPCI fails to operate on demand. Operators must diagnose the need to flood containment with SSWXT.

File Name: OPFLDE.E1V

Initiator: E1V5H

Event Tree: F (from EA, Seq. 5, 10, 11, 16, 21, 22,
from E1V5H, Seq. 6, 8, 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

An isolation of the common SDC suction line occurs (initially on ADHRS). The operators successfully recognize the loss of SDC (OPSDC succeeds) or fail to recognize the loss. Regardless, they successfully attempt to initiate ECCS water solid operation (OPECS succeeds). However, either SP level is low or LPCI fails to operate on demand. Operators must diagnose the need to flood vessel/containment with SSWXT.

Locator Files

File Name: OPFLDE.E2D

Initiator: E2D5H

Event Tree: F (from EA, Seq. 4, 9, from E2D5H, Seq. 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Isolation of ADH is the initiator. No LO SP. OPSDC succeeds. Operators attempt to start SDC(B), but it fails. OPECS succeeds. The operators initiate HPCS (all LPCI assumed unavailable), but HPCS fails to start. The operators must diagnose the need for flooding and inject with SSWXT.

File Name: OPFLDE.E2T

Initiator: E2T5H

Event Tree: F (from E, Seq. 5, 10, 11, 16, 21, from E2T5H, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

A complete loss of the common SDC suction line occurs (initially on SDC(B)). The operators successfully recognize the loss of SDC (OPSDC succeeds) and initiate ECCS water solid operation (OPECS succeeds). However, either SP level is low or LPCI fails to operate on demand. Operators must diagnose the need to flood vessel/containment with SSWXT.

Locator Files

File Name: OPFLDE.E2V

Initiator: E2V5H

Event Tree: F (from E, Seq. 5, 10, 11, 16, 21,
from E2V5H, Seq. 4, 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

A complete loss of the common SDC suction line occurs (initially on ADHRS). The operators successfully recognize the loss of SDC or initially fail to do so (OPSDC succeeds or fails). The crew does initiate ECCS water solid operation (OPECS succeeds). However, either SP level is low or LPCI fails to operate on demand. Operators must diagnose the need to flood containment with SSWXT.

File Name: OPFLDE.T5D

Initiator: T5D5H

Event Tree: F (from E, Seq. 5, 10, 11, from T5D5H, Seq. 5)

F (from E, Seq. 5, 10, 11, from L, Seq. 32, 48,
from T5D5H, Seq. 3)

F (from EA, Seq. 5, 10, 11, 16, 21,
from LA, Seq. 32, 48, from T5D5H, Seq. 18, 19)

F (from E, Seq. 5, 10, 11, 16, 21, 22,
from R, Seq. 28, from L, Seq. 31, 47,
from T5D5H, Seq. 3)

F (from EA, Seq. 5, 10, 11, 16, 21, 22,
from RA, Seq. 28, from LA, Seq. 31, 47,
from T5D5H, Seq. 18,)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Loss of CCW is the initiator. Eventually the operators need to initiate ECCS water solid operation (OPECS succeeds), but all ECCS fails (either the systems or no SP level). The operators have the option of flooding with SSWXT.

Locator Files

File Name: OPFLDE.TIF

Initiator: TIOF5

Event Tree: F (from E, Seq. 5, 10, 11, 16, 21, 22,
from TIOF5, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Inadvertent actuation of LPCI initiator. Operators fail to stop injection (OPSLP fails) and SDC isolates on high pressure. Operators attempt to initiate ECCS water solid operation (OPECS succeeds), but LPCI fails to continue to run or there is inadequate level in the SP. With no SDC the operators must diagnose the need to flood containment with SSWXT or FW. MSIVs are closed.

File Name: OPFLDE.TIH

Initiator: TIHP5

Event Tree: F (from E, Seq. 5, 10, 11, 16, 21, 22,
from SDC, Seq. 3, from TIHP5, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Inadvertent actuation of HPCS initiator. Operators fail to stop injection (OPHPC fails) and HPCS auto-isolation fails. SDC isolates on high pressure. Operators attempt to initiate ECCS water solid operation (OPECS succeeds), but LPCI fails to continue to run or there is inadequate level in the SP. With no SDC the operators must diagnose the need to flood containment with SSWXT or FW. MSIVs are closed.

Locator Files

File Name: OPFLDE.TIO

Initiator: TIOP5

Event Tree: F (from E, Seq. 5, 10, from SDC, Seq. 3,
from TIOP5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Mismatch between letdown and makeup initiator. Operators successfully attempt to control level. SDC(B) fails to continue to run. No LO SP. OPSDC succeeds and operators recognize loss of SDC(B) but it fails to restart. OPECS succeeds, but LPCI fails to operate on demand. Operators must diagnose the need to flood vessel/containment with SSWXT.

File Name: OPFLDE.TLM

Initiator: TLM5H

Event Tree: F (from E, Seq. 5, 10, from SDC Seq. 3,
from TLM5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Loss of makeup (CRD) initiator. SDC(B) fails to continue to operate. OPSDC succeeds or fails. The operators attempt to initiate ECCS water solid operation (OPECS). OPECS succeeds, but all ECCS fails (either systems or no SP level). Operators must diagnose the need to inject and flood containment with SSWXT.

Locator Files

File Name: OPFLDE.TRP

Initiator: TRPT5

Event Tree: F (from E, Seq. 5, 10, 11, from SDC, Seq. 3,
from TRPT5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Loss of forced recirculation initiator, followed by a rare loss of SDC(B)). The operators successfully recognize the loss of SDC (OPSDC succeeds) and initiate ECCS water solid operation (OPECS succeeds) per procedure. However, either SP level is too low or LPCI fails to operate on demand. Operators must diagnose the need to flood vessel/containment with SSWXT.

- * Use this value only if a previous value for OP1SV has not been used.

File Name: OPFLDE2.E1D

Initiator: E1D5H

Event Tree: F (from EA, Seq. 10, from LA, Seq. 5, 38,
from E1D5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Isolation of ADH is the initiator. No LOSP. ADHR is restored, but the operators fail to control level after a loss of CRD. Eventually, the operators attempt to initiate ECCS water solid operation (OPECS succeeds), but LPCI fails to start. The operators have the option of flooding the vessel/containment with SSWXT. MSIVs are closed.

Locator Files

File Name: OPFLDE2.E2D

Initiator: E2D5H

Event Tree: F (from EA, Seq. 4, 9, from LA, Seq. 38,
from E2D5H, Seq. 4)

F (from EA, Seq. 4, 9, from R, Seq. 28,
from LA, Seq. 37, from E2D5.I, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

A complete loss of ADHR is the initiator. No LOSP. SDC(B) is started, but the operators fail to control level after a loss of CRD or they attempt to control level with CRD and it failed. Eventually, the operators attempt to initiate ECCS water solid operation (OPECS succeeds), but HPCS fails to start (LPCI(C) unavailable due to the initiator. The operators have the option of flooding the vessel/containment with SSWXT. MSIVs are closed.

File Name: OPFLDE2.H15

Initiator: H1-5H

Event Tree: F (from E, Seq. 5, 10, 11, 16, 21, 22,
from A5ISO, Seq. 1, from H1-5H, Seq.3)
F (from EA, Seq. 5, 10, 11, 29, 34, 35,
from A5ISO, Seq. 6, from H1-5H, Seq. 13)
FP (from EAP, Seq. 5, 10,
from A5ISO, Seq. 7, from H1-5H, Seq. 17)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

The initiator is a diversion to the SP via RHR. The operators fail to isolate SDC before level 3 is reached, but the SDC successfully isolate on the low level signal (SDCIL succeeds). If a LOSP occurs, the diesel successfully starts and loads (DV1-2 succeeds). The operators attempt to initiate ECCS water solid operation per the IDHR ONEP (OPECS succeeds). However, either the SP level is too low or LPCI fails to operate on demand. Operators must diagnose the need to flood vessel/containment with SSWXT. MSIVs are closed.

Locator Files

File Name: OPFLDE2.H15

Initiator: H1-5H

Event Tree: F (from E, Seq. 5, 10, 11, 16, 21, 22,
from A5ISO, Seq. 1, from H1-5H, Seq.3)
F (from EA, Seq. 5, 10, 11, 29, 34, 35,
from A5ISO, Seq. 6, from H1-5H, Seq. 13)
FP (from EAP, Seq. 5, 10,
from A5ISO, Seq. 7, from H1-5H, Seq. 17)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

The initiator is a diversion to the SP via RHR. The operators fail to isolate SDC before level 3 is reached, but the SDC successfully isolate on the low level signal (SDCIL succeeds). If a LOSP occurs, the diesel successfully starts and loads (DV1-2 succeeds). The operators attempt to initiate ECCS water solid operation per the IDHR ONEP (OPECS succeeds). However, either the SP level is too low or LPCI fails to operate on demand. Operators must diagnose the need to flood vessel/containment with SSWXT. MSIVs are closed.

File Name: OPFLDE2.J2

Initiator: J2-5

Event Tree: F (from E, Seq. 5, 10, 11, 22,
from A5ISJ, Seq. 1, from J2-5, Seq.2)

F (from E, Seq. 5, 10, 11, from A5ISJ, Seq. 6,
from J2-5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

A break in the SDC line outside containment is the initiator. The break is isolated with closure of MV 8 or MV 9. SDC and RHR(B) train is lost. Isolation of 8\9 valves occurs with level 3 signal. If a LOSP occurs, the diesels start and load (DV1-2 OK). The operators attempt to initiate ECCS water solid operation per the IDHR ONEP (OPECS succeeds). However, either the SP level is too low or LPCI fails to operate on demand. Operators must diagnose the need to flood vessel/containment with SSWXT. MSIVs are closed.

Locator Files

File Name: OPFLDE2.TIF

Initiator: TIOF5

Event Tree: F (from E, Seq. 5, 10, from SDC Seq. 3,
from TIOF5, Seq. 2)
F (from EA, Seq. 11, from AIAD Seq. 2,
from TIOF5, Seq. 14)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Inadvertent actuation of LPCI initiator. Operators succeed or fail to stop injection (OPSLP succeeds or fails). SDC either isolates on high pressure or a random loss occurs. In either case, the operators attempt to initiate ECCS water solid operation (OPECS succeeds), but LPCI fails to continue to run or there is inadequate level in the SP. With no SDC the operators must diagnose the need to flood vessel/containment with SSWXT or FW. MSIVs are closed.

File Name: OPFLDE2.TIH

Initiator: TIHP5

Event Tree: F (from E, Seq. 5, 10, from SDC Seq. 3,
 from TIHP5, Seq. 2, 4)
 F (from E, Seq. 5, 10, 11, from AISD Seq. 1,
 from TIHP5, Seq. 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Inadvertent actuation of HPCS initiator. Operators succeed or fail to stop injection (OPHPC succeeds or fails). SDC either isolates on high pressure or a random loss occurs. In either case, the operators attempt to initiate ECCS water solid operation (OPECS succeeds), but LPCI fails to continue to run or there is inadequate level in the SP. With no SDC the operators must diagnose the need to flood vessel/containment with SSWXT or FW. MSIVs are closed.

Locator Files

File Name: OPFLDE2.TRP

Initiator: TRPT5

Event Tree: F (from E, Seq. 5, 10, 11, from L, Seq. 16,
from SDC, Seq. 1, from TRPT5, Seq. 3)

F (from EA, Seq. 5, 10, 11, from LA, Seq. 16, 32, 48,
from ADH, Seq. 2, from TRPT5, Seq. 5)

F (from EA, Seq. 5, 10, 11, from LA, Seq. 16,
from ADH, Seq. 1, from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

A loss of forced recirculation is the initiator. SDC continues to run or is restarted. The operators fail to control level to avoid inadequate recirculation between the core and the downcomer. They attempt to initiate ECCS water solid operation (OPECS succeeds) per procedure. However, either the SP level is too low or LPCI fails to operate on demand. Operators must diagnose the need to flood vessel/containment with SSWXT.

File Name: OPFLDE3.TRP

Initiator: TRPT5

Event Tree: F (from EA, Seq. 5, 10, 11, from RA, Seq. 28,
from LA, Seq. 20, 37,
from ADH, Seq. 1, from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

A loss of forced recirculation is the initiator. SDC continues to run or is restarted. The operators attempt to control level with CDS to avoid inadequate recirculation between the core and the downcomer, but CDS fails and OPLEC fails. They operators then attempt to initiate ECCS water solid operation (OPECS succeeds) per procedure. However, either the SP level is too low or LPCI fails to operate on demand. Operators must diagnose the need to flood vessel/containment with SSWXT.

Locator Files

File Name: OPFLDEHY.TRP

Initiator: TRPT5

Event Tree: F (from E, Seq. 5, 10, 11, from ADEP, Seq. 6,
from TRPT5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Loss of forced recirculation initiator during a HYDRO test, followed by a random loss of SDC(B)). The operators had successfully recognized the need for SDC (SDCUI succeeds) and initiated ECCS water solid operation (OPECS succeeds) per procedure when a normal SDC system would not start. However, either SP level is too low or LPCI fails to operate on demand. Operators must diagnose the need to flood containment with SSWXT.

File Name: OPFLDEHY.TRV

Initiator: TORV5

Event Tree: F (from E, Seq. 5, 10, 11, from ADEP, Seq. 6,
from TORV5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

The initiator is an inadvertent stuck open relief valve during a HYDRO test. The operators had successfully recognized the need for SDC (SDCUI succeeds) and initiated ECCS water solid operation (OPECS succeeds) per procedure when a normal SDC system would not start. However, either SP level is too low or LPCI fails to operate on demand. Operators must diagnose the need to flood containment with SSWXT.

Locator Files

File Name: OPFLDEP.E1T

Initiator: E1T5H

Event Tree: FP (from EP, Seq. 5, 10, 11, 16, 21, 22,
from E1T5H, Seq. 14)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

An isolation of the common SDC suction line occurs (initially on SDC(B)), followed at some point by a LO SP. The diesels start (DV1-2 succeeds). The operators successfully recognize the loss of SDC (OPSDC succeeds) but fail to attempt to unisolate. Regardless, they successfully attempt to initiate ECCS water solid operation (OPECS succeeds). However, either SP level is low or LPCI fails to operate on demand. Operators must diagnose the need to flood vessel/containment with SSWXT.

File Name: OPFLDEP2.E1T

Initiator: E1T5H

Event Tree: FP (from EP, Seq. 5, 10, 11, 16, 21, 22,
from LP, Seq. 15, from E1T5H, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

An isolation of the common SDC suction line occurs (initially on SDC(B)), followed at some point by a LOSP. The diesels start (DV1-2 succeeds). The operators successfully recognize the isolation of SDC (OPSDC succeeds) and successfully restore it. The operators initially fail to control level given the loss of forced recirculation, CRD, and RWCU (OPDHR fails.) Eventually they recognize the problem and successfully attempt to initiate ECCS water solid operation (OPECS succeeds). However, either SP level is low or LPCI fails to operate on demand. Operators must diagnose the need to flood vessel/containment with SSWXT.

Locator Files

File Name: OPFLDF.TAB

Initiator: TAB

Event Tree: F (from EA, Seqs. 4, 9, 11, from ADH, Seq. 4,
from TAB5H, Seq. 5)

F (from E, Seqs. 4, 9, 15, 16, 20, 21,
from SDC, Seq. 3, from TAB5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	1.0		HEP 33

A loss of AC bus is the initiator. OPSDC either succeeds or fails and OPECS succeeds, but all ECCS fails (either the systems or no SP level). SSWXT is unavailable, but the operators have the option of flooding with FW. However, there is insufficient time available for aligning FW in OPFLD. Thus, OPFLD set to 1.0 (failure).

File Name: OPFLDF.TDB

Initiator: TDB5H

Event Tree: F (from E, Seqs. 4, 9, 11, 15, 20, 22,
from SDC, Seq. 3, from TDB5H, Seq. 3)

F (from E, Seqs. 4, 9, 11, 15, 20, 22,
from L, Seq. 32, 48,
from SDC, Seq. 1, from TDB5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

A loss of DC bus is the initiator. A random failure of SDC(B) occurs (OPSDC either succeeds or fails), or SDC(B) continues to run and the operators fail to control level (OPDHR fails). Regardless, the operators initiate ECCS water solid operation (OPECS succeeds), but all ECCS fails (either systems or no SP level). SSWXT available because it would continue to run after loss of SDCB. So the operators have the option to flood with SSWXT or FW.

Locator Files

File Name: OPFLDFR.TDB

Initiator: TDB5H

Event Tree: F (from R, Seqs. 11, 22, 27,
 from L, Seq. 31, 47,
 from SDC, Seq. 1, from TIA5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28
OPMSV	1.0		HEP 34
OP1SV	0.302	10	HEP 5

Initially on SDC(B) and a loss of DC bus initiator occurs. SDC(B) continues to run. OPDHR succeeds, but HPCS fails (either the system or no SP level). SSWXT is available because it would continue to be available with SDC(B) still operating. Thus, the operators have option to flood with SSWXT or FW.

File Name: OPFLDHY2.EP

Initiator: T1-5

Event Tree: FP (from RP, Seq. 27, from LP, Seq. 7,
from ADEPP, Seq. 2, from OVPRP, Seq. 4,
from HYDRO, Seq. 6, from T1-5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28
OP1SV	0.302	10	HEP 5

LOSP during HYDRO test is the initiator. DV1-2 succeeds and an SRV opens on safety setpoint and fails to close (SAFEC). Depressurization occurs. In ADEPP tree SDCUI succeeds (8.7 hours for this event) and the operators attempt to align SDC(B). SDC(B) starts. RWCU has auto-isolated. The operators attempt to control level with ECCS (OPDHR and OPLEC succeed), but the SP is empty and HPCS fails for level control. SSWXT is available for vessel/containment flooding.

Locator Files

File Name: OPFLDHY2.TIA

Initiator: TIA5H

Event Tree: F (from R, Seq. 27, from L, Seq. 31,
from ADEP, Seq. 3, from OVPR, Seq. 4,
from HYDRO, Seq. 5, from TIA5H, Seq. 33)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28
OP1SV	0.302	10	HEP 5

A loss of IA during HYDRO test is the initiator. an SRV opens on safety setpoint and fails to close (SAFEC). Depressurization occurs. In ADEP tree SDCUI succeeds (8.7 hours for this event) and the operators initiate SDC(B). RWCU auto-isolates. The operators attempt to control level with ECCS (OPDHR and OPLEC succeed), but the SP is empty and HPCS fails for level control. SSWXT is available for vessel/containment flooding.

File Name: OPFLDHYD.EP

Initiator: T1-5

Event Tree: FP (from E, Seq. 11, from ADEPP, Seq. 4,
from OVPRP, Seq. 4, from HYDRO, Seq. 4,
from T1-5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

LOSP during HYDRO test is the initiator. DV1-2 succeeds and an SRV opens on safety setpoint and fails to close (SAFEC). Depressurization occurs. In ADEPP tree SDCUI succeeds (8.7 hours for this event) and the operators attempt to align SDC. SDC fails to start. RWCU has auto-isolated. Thus, enter E tree and OPECS. The operators attempt to initiate ECCS water solid. OPECS succeeds except there is no water in the SP. SSWXT is available for containment flooding.

Locator Files

File Name: OPFLDHYD.TDB

Initiator: TDB5H

Event Tree: F (from E, Seqs. 4, 9, 11, 15, 20, 22,
from ADEP, Seq. 6, from OVPR, Seq. 4,
from HYDRO, Seq. 5, from TDB5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

Loss of DC bus during HYDRO test. SRV opens on safety setpoint and fail to close (SAFEC). Depressurization occurs. In ADEP tree SDCUI succeeds (8.7 hours for this event). The operators take the necessary steps to initiate ADHR and isolate RWCU, but ADHR fails. Thus, enter E tree and OPECS. OPECS succeeds. The operators attempt water solid with HPCS (at least one SRV open), but all ECCS fails (either systems or no SP level). The operators have option to flood with SSWXT or FW.

File Name: OPFLDHYD.TLM

Initiator: TLM5H

Event Tree: F (from R, Seq. 27, from L, Seq. 37,
from ADEP, Seq. 2, from TLM5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28
OP1SV	0.302	10	HEP 5

Loss of makeup (CRD) initiator occurs during HYDRO test. RWCU continues to run in the recirculation mode. The operators attempt to control level with ECCS, but there is inadequate level in the SP and HPCS fails to operate on demand with suction from the CST. Operators must diagnose the need to flood containment. SSWXT is available. MSIVs are closed during HYDRO.

Locator Files

File Name: OPFLDLER.E1T

Initiator: E1T5H

Event Tree: F (from E, Seq. 5, 10, 11,
from L, Seqs. 5, 32, 38, 48,
from E1T5H, Seq. 3)

F (from R, Seq. 27, from L, Seq. 37, 47
from E1T5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28
* OPMSV	0.01	5	HEP 90
* OP1SV	0.302	10	HEP 5

Isolation of SDC common suction line initiator. Operators unisolate and reestablish SDC(B). At some point CRD fails and either OPDHR succeeds and the operators attempt to control level with ECCS or OPDHR fails and the operators attempt to go ECCS water solid with ECCS (OPECS succeeds). In either scenario, ECCS fails due to failure of the injection systems or inadequate SP level. Operators must diagnose the need to flood containment. SSWXT is available.

* Use only in sequences where coming from the R tree.

File Name: OPFLDLER.TLM

Initiator: TLM5H

Event Tree: F (from E, Seq. 11, from L, Seqs. 5, 38
 from SDC, Seq. 1, from TLM5H, Seq. 3)

 F (from EA, Seq. 11, from LA, Seqs. 5, 38,
 from ADH, Seq. 1, from TLM5H, Seq. 5)

 F (from R, Seq. 11, 22, 27, from L, Seq. 37,
 from SDC, Seq. 1, from TLM5H, Seq. 3)

 F (from RA, Seq. 27, from LA, Seq. 37,
 from ADH, Seq. 1, from TLM5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28
* OPMSV	0.01	5	HEP 90
* OP1SV	0.302	10	HEP 5

Loss of makeup (CRD) initiator. SDC(B) or ADHRS continues to run. Either OPDHR succeeds and the operators attempt to control level with ECCS or OPDHR fails and the operators attempt to go ECCS water solid with ECCS (OPECS succeeds). In either scenario, ECCS fails due to failure of the injection systems or inadequate SP level. Operators must diagnose the need to flood containment. SSWXT is available.

* Use only in sequences where coming from R tree.

Locator Files

File Name: OPFLDP.TIA

Initiator: TIA5H

Event Tree: FP (from EP, Seq. 11, from TIA5H, Seq. 9)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28

A loss of IA is the initiator. OPSDC succeeds and OPECS succeeds. The operators attempt to go ECCS water solid, but all ECCS fails (either systems or no SP level). The operators have the option of flooding with SSWXT.

File Name: OPFLDRM.E1T

Initiator: E1T5H

Event Tree: F (from L, Seq. 4, from E1T5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28
OPMSV	0.01	5	HEP 90
OP1SV	0.302	10	HEP 5

Isolation of SDC common suction line is the initiator. The operators successfully unisolate the common suction line and SDC(B) runs. Operators initially control level (OPDHR succeeds), but adequate level control fails in the long-term (RM-LT fails). Operators must diagnose the need to flood vessel/containment. SSWXT is available.

Locator Files

File Name: OPFLDRM.TLM

Initiator: TLM5H

Event Tree: F (from L, Seqs. 4, from SDC, Seq. 1,
from TLM5H, Seq. 3)

F (from LA, Seq. 4, from ADH, Seq. 1,
from TLM5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28
OPMSV	0.01	5	HEP 90
OP1SV	0.302	10	HEP 5

Loss of makeup (CRD) initiator. SDC(B) or ADHRS continues to run. OPDHR succeeds but the operators fail to provide adequate level control in the long-term (RM-LT fails). Operators must diagnose the need to flood containment. SSWXT is available.

File Name: OPFLDRMH.TLM

Initiator: TLM5H

Event Tree: F (from L, Seq. 4, from ADEP, Seq. 2,
from TLM5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLD	0.138	10	HEP 28
OPMSV	0.01	5	HEP 90
OP1SV	0.302	10	HEP 5

Loss of makeup (CRD) during HYDRO Test. FCIRC and RWCUC continue to run in recirculation mode. OPDHR is operator action to diagnose need to control level so as to avoid a disconnect between the core and the downcomer, which would retard core cooling. OPDHR succeeds but the operators fail to provide adequate level control in the long-term (RM-LT fails). ECCS is assumed unavailable and the operators must diagnose the need to flood containment. SSWXT is available.

Locator Files

File Name: OPFLL.A5

Initiator: A5

Event Tree: FAM (from A5IN, Seq. 6, from A5, Seqs. 2, 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLL	0.01	10	HEP 66
* OPLMS			

In this scenario a large LOCA has occurred. Initially on RHR/SDC(B) or ADHRS for SDC. Since the most likely break inside containment would be in the recirculation line, level 2 would be reached and ECCS would auto-actuate in less than a minute from the break. It was calculated that the operators would be unable to initiate an SPMU dump prior to a too low SP water level (see HEP 65), resulting in the loss of ECCS. With reactor level dropping to 2/3 core height and low SP level signals, EP-2 instructs the operators to use any of several systems for injection/containment flooding and in this context, SSWXT is the only option modeled (FW inadequate). With 38 minutes available prior to core damage, it is likely operators would determine the need for containment flooding with SSWXT.

- * The HEP for operator action OPLMS is not calculated because it only appears when the MSIVs are initially open (ISMSV) which has a probability of $1E-2$. The probability for sequences 02-06 or 06-06 is already at $9.085E-7$ and $8.985E-8$, respectively, and if these values are multiplied by $1E-2$, the results are $9.085E-9$ and $8.985E-10$.

File Name: OPFLL.AHY

Initiator: A5HY

Event Tree: FAM (from A5INH, Seq. 7, from A5HY, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLL	0.01	10	HEP 66

* OPLMS

In this scenario a large LOCA has occurred during HYDRO test. Since the most likely break inside containment would be in the recirculation line, level 2 would be reached and ECCS would auto-actuate in less than a minute from the break. It was calculated that the operators would be unable to initiate an SPMU dump prior to a too low SP water level (see HEP 65), resulting in the loss of ECCS. With reactor level dropping to 2/3 core height and low SP level signals, EP-2 instructs the operators to use any of several systems for injection/containment flooding and in this context, SSWXT is the only option modeled (FW inadequate). With 38 minutes available prior to core damage, it is likely operators would determine the need for containment flooding with SSWXT.

* OPLMS is not asked because MSIVs are closed in HYDRO.

Locator Files

File Name: OPFLL.S15

Initiator: S1-5

Event Tree: FS (from S15IN, Seq. 6, from S1-5, Seq. 2, 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLL	0.01	10	HEP 66
OPSRV	0.004	5	HEP 68
OPMSV	0.011	5	HEP 69

In this scenario an intermediate LOCA has occurred. Since the most likely break inside containment would be in the recirculation line, level 2 would be reached and ECCS would auto-actuate in less than a minute from the break. It was calculated that the operators would be unable to initiate an SPMU dump prior to a too low SP water level (see HEP 65), resulting in the loss of ECCS. With reactor level dropping to 2/3 core height and low SP level signals, EP-2 instructs the operators to use any of several systems for injection/containment flooding and in this context, SSWXT is the only option modeled (FW inadequate). With 38 minutes available prior to core damage, it is likely operators would determine the need for containment flooding with SSWXT. However, in order to avoid repressurizing in the context of an intermediate or small LOCA and to facilitate containment flooding, the operators will need to ensure at least 1 SRV is open (OPSRV). Opening SRVs is indicated in several relevant places in EP-2 and operators have approximately 110 min. to diagnose and accomplish the action. In addition to the procedures, and given the accident, the operators will be carefully monitoring the critical parameters such pressure.

File Name: OPFLL.S1H

Initiator: S1H-5

Event Tree: FS (from S1HIN, Seq. 8, from S1H-5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLL	0.01	10	HEP 66
OPSRV	0.004	5	HEP 68
* OPMSV			

In this scenario an intermediate LOCA has occurred during HYDRO test. Since the most likely break inside containment would be in the recirculation line, level 2 would be reached and ECCS would auto-actuate in less than a minute from the break. It was calculated that the operators would be unable to initiate an SPMU dump prior to a too low SP water level (see HEP 65), resulting in the loss of ECCS. With reactor level dropping to 2/3 core height and low SP level signals, EP-2 instructs the operators to use any of several systems for injection/containment flooding and in this context, SSWXT is the only option modeled (FW inadequate). With 38 minutes available prior to core damage, it is likely operators would determine the need for containment flooding with SSWXT. However, in order to avoid repressurizing in the context of an intermediate or small LOCA and to facilitate containment flooding, the operators will need to ensure at least 1 SRV is open (OPSRV). Opening SRVs is indicated in several relevant places in EP-2 and operators have approximately 110 min. to diagnose and accomplish the action. In addition to the procedures, and given the accident, the operators will be carefully monitoring the critical parameters such pressure.

* OPMSV not asked because MSIVs are closed during HYDRO.

Locator Files

File Name: OPFLL.S25

Initiator: S2-5

Event Tree: FS (from S15NF, Seq. 2, from S1XFR, Seq. 1,
from S2-5, Seq. 11, 22)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLL	0.03	10	HEP 76
OPSRV	0.004	5	HEP 68
OPMSV	0.011	5	HEP 69

In this scenario a small LOCA has occurred and operators fail initially to isolate letdown and provide additional makeup (OPLDM). The vessel would continue to drain and operators would get numerous alarms and indications. Alarms would occur at levels 4 and 3 and SDC cooling would isolate at level 3. In this scenario the operators realize the existence of the break and dump the SPMU in order to provide sufficient level for ECCS. However, the initial level in the SP is low and insufficient water is available to complete ECCS water solid operation per the IDHR ONEP. That is, the water dumping into the drywell from the break would not reach a level high enough to connect with the SP. Operators are instructed by EP-2 to initiate SSWXT and (eventually) to flood containment. In order to avoid repressurizing in the context of an intermediate or small LOCA and to facilitate containment flooding, the operators will need to ensure at least 1 SRV is open (OPSRV). Opening SRVs is indicated in several relevant places in EP-2 and operators have approximately 110 min. to diagnose and accomplish the action. In addition to the procedures, and given the accident, the operators will be carefully monitoring the critical parameters such as pressure. Operators also have 35 min. to close any open MSIVs.

File Name: OPFLL.S2H

Initiator: S2H-5

Event Tree: FS (from S1HNF, Seq. 5, from S1XFH, Seq. 1,
from S2H-5, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLL	0.03	10	HEP 76
OPSRV	0.004	5	HEP 68
* OPMSV			

In this scenario a small LOCA has occurred during HYDRO Test. Operators fail initially to isolate letdown and provide additional makeup (OPLDM), in part because makeup source is unclear (see HEP 67). Thus vessel would continue to draindown and operators would get numerous alarms and indications. Alarms would occur at levels 4 and 3 and SDC cooling would isolate at level 3. In this scenario the operators realize the existence of the break and dump the SPMU in order to provide sufficient level for ECCS. However, the initial level in the SP is low and insufficient water is available to complete ECCS water solid operation per the IDHR ONEP. That is, the water dumping into the drywell from the break would not reach a level high enough to connect with the SP. Operators are instructed by EP-2 to initiate SSWXT and (eventually) to flood containment. In order to avoid repressurizing in the context of an intermediate or small LOCA and to facilitate containment flooding, the operators will need to ensure at least 1 SRV is open (OPSRV). Opening SRVs is indicated in several relevant places in EP-2 and operators have approximately 110 min. to diagnose and accomplish the action. In addition to the procedures, and given the accident, the operators will be carefully monitoring the critical parameters such pressure.

* MSIVs are closed during HYDRO.

Locator Files

File Name: OPFLL.S35

Initiator: S3-5

Event Tree: FS (from S15NF, Seq. 2, from S1XFR, Seq. 1,
from S3-5, Seq. 32)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLL	0.03	10	HEP 76
OPSRV	0.004	5	HEP 68
OPMSV	0.011	5	HEP 69

In this scenario a small-small LOCA has occurred and operators initially fail to isolate the break (ISSSL), to isolate letdown, or to provide additional makeup (OPLDM). The vessel would continue to drain and operators would get numerous alarms and indications. Alarms would occur at levels 4 and 3 and SDC would isolate at level 3. In this scenario the operators realize the existence of the break and dump the SPMU in order to provide sufficient level for ECCS. However, the initial level in the SP is low and insufficient water is available to complete ECCS water solid operation per the IDHR ONEP. That is, the water dumping into the drywell from the break would not reach a level high enough to connect with the SP. Operators are instructed by EP-2 to initiate SSWXT and (eventually) to flood containment. In order to avoid repressurizing in the context of an intermediate or small LOCA and to facilitate containment flooding, the operators will need to ensure at least 1 SRV is open (OPSRV). Opening SRVs is indicated in several relevant places in EP-2 and operators have approximately 110 min. to diagnose and accomplish the action. In addition to the procedures, and given the accident, the operators will be carefully monitoring the critical parameters such as pressure. Operators also have 35 min. to close any open MSIVs.

File Name: OPFLL8.S25

Initiator: S2-5

Event Tree: FS (from S15NF, Seq. 5, from S1XFR, Seq. 1,
from S2-5, Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFLL	0.03	10	HEP 76
OPSRV	0.004	5	HEP 68
OPMSV	0.011	5	HEP 69

In this scenario a small LOCA has occurred and operators fail initially to isolate letdown and provide additional makeup (OPLDM). Thus the vessel would continue to drain and operators would get numerous alarms and indications. Alarms would occur at levels 4 and 3 and SDC cooling would isolate at level 3. In this scenario the operators fail to dump the SPMU in order to provide sufficient level for ECCS. However, given the numerous indications operators would become aware of the need for some form of cooling and makeup. EP-2 would instruct them to provide injection with ECCS or SSWXT. If the operators were concerned about the SP level (they have not yet accomplished SPMU dump), they may decide to use SSWXT and flood containment per EP-2. If SP level is insufficient, the water dumping into the drywell from the break would not reach a level high enough to connect with the SP to achieve ECCS water solid. Operators are instructed by EP-2 to initiate SSWXT and (eventually) to flood containment.

In order to avoid repressurizing in the context of an intermediate or small LOCA and to facilitate containment flooding, the operators will need to ensure at least 1 SRV is open (OPSRV). Opening SRVs is indicated in several relevant places in EP-2 and operators have approximately 110 min. to diagnose and accomplish the action. In addition to the procedures, and given the accident, the operators will be carefully monitoring the critical parameters such pressure. Operators also have 35 min. to close any open MSIVs.

Locator Files

File Name: OPFL8.S2H

Initiator: S2H-5

Event Tree: FS (from S1HNF, Seq. 8, from S1XPH, Seq. 1,
from S2H-5, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPFL8	0.03	10	HEP 76
OPSRV	0.004	5	HEP 68
* OPMSV			

In this scenario a small LOCA has occurred during HYDRO Test. Operators fail initially to isolate letdown and provide additional makeup (OPLDM), in part because makeup source is unclear (see HEP 67). Thus vessel would continue to draindown and operators would get numerous alarms and indications. Alarms would occur at levels 4 and 3 and SDC cooling would isolate at level 3. In this scenario the operators fail to dump the SPMU in order to provide sufficient level for ECCS. However, given the numerous indications operators would become aware of the need for some form of cooling and makeup.

EP-2 would instruct them to provide injection with ECCS or SSWXT. If the operators were concerned about the SP level (they have not yet accomplished SPMU dump), they may opt to use SSWXT and flood containment per EP-2. If SP level is insufficient, the water dumping into the drywell from the break would not reach a level high enough to connect with the SP to achieve ECCS water solid. Operators are instructed by EP-2 to initiate SSWXT and (eventually) to flood containment. In order to avoid repressurizing in the context of an intermediate or small LOCA and to facilitate containment flooding, the operators will need to ensure at least 1 SRV is open (OPSRV). Opening SRVs is indicated in several relevant places in EP-2 and operators have approximately 110 min. to diagnose and accomplish the action. In addition to the procedures, and given the accident, the operators will be carefully monitoring the critical parameters such pressure.

* MSIVs are closed during HYDRO.

File Name: OPHPC.TIH

Initiator: TIHP5

Event Tree: TIHP5

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPHPC	0.106	10	HEP 86

Spurious actuation of HPCS initiator (TIHP5). Operators would get level 7 and level 8 alarms within 1 min. of actuation. HPCS should auto-isolate at level 8. If it fails to auto-isolate, operators will get indications for the failure. In addition, level would be increasing rapidly and operators would check systems likely to allow such level changes. Pump starts and valve openings would be indicated. OPHPC is operator action to detect and stop the inadvertent injection prior to overpressurization.

Locator Files

File Name: OPICT.E1B

Initiator: E1B5H

Event Tree: EC (from E, Seq. 2, 7, 13, 18,
from E1B5H, Seq. 5, 8, 10)

ECP (from EP, Seq. 2, 7, 13, 18,
from E1B5H, Seq. 13, 16)

EC (from E, Seq. 2, 7, 13, 18,
from L, Seq. 5, 16, 32, 48, 38,
from E1B5H, Seq. 3)

ECP (from EP, Seq. 2, 7, 13, 18,
from LP, Seq. 8, 15, from E1B5H, Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
* OPICT	1.0		HEP 71
** OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of SDC(B) is the initiator. If LO SP, DV1-2 OK. In some sequences, OPSDC succeeds or fails. If it succeeds, RESB either succeeds or fails. If RESB succeeds, SDC(B) fails to start, resulting in no SDC. OPECS succeeds--water solid with LPCI(C). SPC and CS are assumed to fail. The operators will need to provide makeup to SP (OPSPM) and makeup to SPMU (or SP).

In other sequences, SDC(B) restarts, but forced recirculation or makeup (CRD) is lost. OPDHR fails, but OPECS succeeds with LPCI(C).

* No time to close containment if open.

** Can vent only if IA and both trains of power are available. If sequence has LO SP or loss of IA or loss of AC bus, OPVNT = 1. For the above sequences, venting is possible only when E1B5H sequences 5 and 8 are used (NO LO SP).

File Name: OPICT.E1D

Initiator: E1D5H

Event Tree: EC (from EA, Seq. 3, 8,
from E1D5H, Seq. 6, 10)

ECP (from EP, Seq. 3, 8,
from E1D5H, Seq. 16)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
* OPICT	1.0		HEP 71
** OPVNT	0.011 or 1	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

A loss of ADHR is the initiator. If a LOSP occurs, DV1-2 OK. OPSDC succeeds and RESAD either succeeds or fails. If RESAD succeeds, ADHR fails to restart. SDC(B) fails if asked. resulting in no SDC. The operators initiate ECCS water solid operation (OPECS succeeds) with HPCS. Given failures of ADHR and SDC(B), LPCI is assumed to be unavailable. SPC and CS are assumed to fail. The operators will need to provide makeup to the SP (OPSPM) and makeup to SPMU (or SP).

- * No time to close containment if open.
- ** Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. For the above sequences, venting is possible only when E1D5H sequences 6 and 10 are used (NO LOSP).

Locator Files

File Name: OPICT.E2B

Initiator: E2B5H

Event Tree: EC (from E, Seq. 2, 7, 13, 18,
from E2B5H, Seq. 5, 6,)

ECP (from EP, Seq. 2, 7, 13, 18,
from E2B5H, Seq. 8, 9)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
* OPICT	1.0		HEP 71
** OPVNT	0.011 or 1	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of SDC(B) is the initiator. If a LOSP occurs, DV1-2 OK. OPSDC succeeds or fails, but no SDC system. OPECS succeeds. Operators go water solid with LPCI(C). SPC and CS are assumed to fail. The operators will need to provide makeup to SP (OPSPM) and makeup to SPMU (or SP).

** Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. For the above sequences, venting is possible only when E2B5H sequences 5 and 6 are used (NO LOSP).

* No time to close containment if open.

File Name: OPICT.E2D

Initiator: E2D5H

Event Tree: EC (from EA, Seq. 3, 8, from E2D5H,
Seq. 6)

ECP (from EAP, Seq. 3, 8, from E2D5H,
Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
* OPICT	1.0		HEP 71
** OPVNT	0.011 or 1	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of ADHR is the initiator. If a LOSP occurs, DV1-2 OK. OPSDC succeeds. SDC(B) fails, resulting in no SDC. OPECS succeeds. The operators go water solid with HPCS. Given failures of ADHR and SDC(B), LPCI is assumed to be unavailable. SPC and CS are assumed to fail. The operators will need to provide makeup to the SP (OPSPM) and makeup to SPMU (or SP).

** Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. For the above sequences, venting is possible only when E1D5H sequence 6 is used (NO LOSP).

* No time to close containment if open.

Locator Files

File Name: OPICT.ECP

Initiator: T1

Event Tree: ECP (from EP, Seq. 2, 7, 13, 18, from SDC, Seq. 7 ,8)

ECP (from EP, Seq. 2, 7, 13, 18, from LP, Seq. 8, 15,
from SDC, Seq. 5)

ECP (from EAP, Seq. 2, 7, 13, 18,
from LAP, Seq. 8, 15, from ADH, Seq. 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

A LOSEP occurs, but DV1-2 succeeds. In some sequences SDC is lost, and the operators recognize the loss (OPSDC succeeds). In others SDC continues to operate, but the operators fail to control level (OPDHR fails). Regardless, the operators go water solid with ECCS. (OPECS succeeds). SPC and CS fail.

With no SPC or CS and water solid with LPCI, the operators will need to provide makeup to the SP (OPSPM) and the operators may also need to provide additional makeup to SPMU or the SP (SPMKP).

File Name: OPICT.ECX

Initiator: T1-5

Event Tree: ECX (from EX, Seq. 2, 5, from SDC, Seq. 12)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

A LOSP is the initiator and DV1-2 fails. SDC(B) is lost and recognized by the operators (OPSDC succeeds). HPCAS fails and a cross-tie of the HPCS diesel generator is indicated (XTIEB succeeds). The operators go water solid with LPCI after the cross-tie is completed. SPC and CS fail. With no SPC or CS and water solid with LPCI, the operators will need to provide makeup to SP (OPSPM) and the operators also may need to provide additional makeup to SPMU or SP (SPMKP).

Locator Files

File Name: OPICT.H15

Initiator: H1-5H

Event Tree: EC1 (from RH1, Seq. 1, 6, 15, 19, 24, 33,
from H1-5H, Seq. 4, 5)

EC1 (from RAH1, Seq. 1, 13,
from H1-5H, Seq. 14)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
* OPICT	1.0		HEP 71
** OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

The initiator is a diversion to the SP via RHR. The operators fail to isolate SDC before level 3 is reached and the SDC valves fail to close on the low level signal (SDCIL fails). An ECCS system auto-starts on low level and the operators successfully control level. At this point, a "backwards" form of ECCS water solid operation is aligned. Water drains to the SP through RHR/SDC and is returned to the vessel through HPCS or LPCI. Since the SDC isolation valves fail to close due to hardware problems, this mode of operation would accomplish the necessary goals as long as the operators accomplish the actions necessary to maintain adequate containment cooling. Since a neither a LOSP nor a loss of IA has occurred in these sequences, venting is possible. Operators will need to provide makeup to SP (OPSPM) with SPMU and additional makeup to SPMU (or SP).

- * No time to close containment if open.
- ** Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1.

File Name: OPICT.T5A

Initiator: T5A5H

Event Tree: EC (from E, Seq. 3, 8, 14, 19,
from T5A5H Seq. 3, 4, 12, 13)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of SSW is the initiator. SDC(B) is lost and OPSDC succeeds or fails. The operators go water solid with HPCS (OPECS succeeds). SPC and CS fail. The operators will need to provide makeup to SP (OPSPM) and makeup to SPMU or the SP (SPMKP).

Locator Files

File Name: OPICT.T5D

Initiator: T5D5H

Event Tree: EC (from EA, Seq. 2, 7, 13, 18,
from T5D5H, Seq. 21, 22)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

A loss of CCW is the initiator. SDC is lost and the operators either recognize the loss initially or not (OPSDC succeeds or fails). Regardless, the operators initiate ECCS water solid operation (OPECS succeeds) with LPCI(C). Since no LOSP and no loss of IA, venting is possible. SPC and CS are assumed to fail. The operators will need to provide makeup to the SP (OPSPM) and makeup to SPMU (or SP).

File Name: OPICT.TAB

Initiator: TAB

Event Tree: EC (from E, Seq. 3, 14, 19, from SDC, Seq. 3,
from TAB5H, Seq. 3)

EC (from E, Seq. 3, 8, from SDC, Seq. 4,
from TAB5H, Seq. 3)

EC (from E, Seq. 3, 8, 14, 19, from ADH, Seq. 4,
from TAB5H, Seq. 5.

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.0 ²	5	HEP 27

Loss of AC bus is the initiator. SDC is lost and OPSDC succeeds or fails. The operators initiate ECCS water solid operation with HPCS (OPECS succeeds). SPC and CS fail. With no SPC or CS and water solid with HPCS, the operators will need to provide makeup to the SP (OPSPM). The operators also may need to provide additional makeup (SPMKP) to SPMU or the SP.

Locator Files

File Name: OPICT.TDB

Initiator: TDB5H

Event Tree: EC (from E, Seq. 3, 8, 14, 19, from SDC, Seq. 3,
from TDB5H, Seq.3)

EC (from E, Seq. 3, 8, 14, 19, from SDC, Seq. 4,
from TDB5H, Seq. 3)

EC (from EA, Seq. 3, 8, 14, 19, from ADH, Seq. 4,
from TDB5H, Seq. 5.

EC (from E, Seq. 3, 8, 14, 19, from L, Seq. 32, 48,
from SDC, Seq. 1, from TDB5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of DC bus is the initiator. SDC is lost and OPSDC succeeds or fails. In some sequences SDC runs, but the operators fail to control level (OPDHR fails). The operators initiate ECCS water solid operation with HPCS (OPECS succeeds). SPC and CS fail. With no SPC or CS and water solid with HPCS, the operators will need to provide makeup to the SP (OPSPM) The operators also may need to provide additional makeup (SPMKP) to SPMU or the SP.

File Name: OPICT.TIA

Initiator: TIA5H

Event Tree: EC (from E, Seq. 2, 7, 13, 18, from TIA5H, Seq. 5)
 EC (from EA, Seq. 2, 7, from TIA5H, Seq. 20)
 EC (from E, Seq. 2, 7, 13, 18, from L, Seq. 32, 48,
 from TIA5H, Seq. 3)
 EC (from EA, Seq. 2, 7, 13, 18, from L, Seq. 32, 48,
 from TIA5H, Seq. 18)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of IA is the initiator. SDC is either lost, continues to run, or is reestablished. If SDC works, the operators fail to control level (OPDHR fails). Regardless, the operators eventually realize the need to initiate ECCS water solid operation with LPCI(C) (OPECS succeeds).

SPC and CS fail. With no SPC or CS and water solid with LPCI, the operators will need to provide makeup to SP with SPMU (OPSPM). The operators will also need to provide additional makeup (SPMKP) to SPMU or directly to the SP).

Assumed cannot vent because of loss of IA. Need both Divs. of power and IA to vent.

Locator Files

File Name: OPICT2.E1B

Initiator: E1B5H

Event Tree: EC (from E, Seq. 2, 7, from N, Seq. 28,
from L, Seq. 31, 47, from E1B5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
* OPICT	1.0		HEP 71
** OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of SDC(B) is the initiator. If LO SP, DV1-2 OK. SDC(B) is restored and starts. CRD is lost and the operators attempt to control level with CDS, but it is unavailable or fails. OPLEC fails. OPECS succeeds--water solid with LPCI(C). SPC and CS are assumed to fail. The operators will need to provide makeup to SP (OPSPM) and makeup to SPMU (or SP).

- * No time to close containment if open.
- ** Can vent only if IA and both trains of power are available. If sequence has LO SP or loss of IA or loss of AC bus, OPVNT = 1.

File Name: OPICT2.E1D

Initiator: E1D5H

Event Tree: EC (from EA, Seq. 2, 7, from LA, Seq. 5, 38,
from E1D5H, Seq. 3)

EC (from EA, Seq. 3, 8, from LA, Seq. 32, 48,
from E1D5H, Seq. 4)

EC (from EA, Seq. 2, 7, from RA, Seq. 28,
from LA, Seq. 31, 37, 47, from E1D5H, Seq. 3)

EC (from EA, Seq. 3, 8, from RA, Seq. 28,
from LA, Seq. 31, 37, 47, from E1D5H, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
* OPICT	1.0		HEP 71
** OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

An isolation ADHR is the initiator. ADHR is restored or it cannot be restored, but SDC(B) is started. CRD is lost. The operators attempt to control level with CDS, but it is unavailable or fails or they initially fail to control level. OPLEC fails. OPECS succeeds--water solid with LPCI(C) or HPCS depending on the sequence. SPC and CS are assumed to fail. The operators will need to provide makeup to SP (OPSPM) and makeup to SPMU (or SP).

- * No time to close containment if open.
- ** Can vent only if IA and both trains of power are available. If sequence has LOSEP or loss of IA or loss of AC bus, OPVNT = 1.

Locator Files

File Name: OPICT2.E2D

Initiator: E2D5H

Event Tree: EC (from EA, Seq. 3, 8, from LA, Seq. 5, 32, 38, 48,
from E2D5H, Seq. 4)

EC (from EA, Seq. 3, 8, from RA, Seq. 28,
from LA, Seq. 31, 37, 47, from E2D5H, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
* OPICT	1.0		HEP 71
** OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

A complete loss of ADHR is the initiator. SDC(B) is started. CRD is lost. The operators attempt to control level with CDS, but it is unavailable or fails or they initially fail to control level. OPLEC fails. OPECS succeeds--water solid with HPCS (LPCI(C) unavailable due to initiator). SPC and CS are assumed to fail. The operators will need to provide makeup to SP (OPSPM) and makeup to SPMU (or SP).

- * No time to close containment if open.
- ** Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1.

File Name: OPICTADH.ECP

Initiator: T1

Event Tree: ECP (from EAP, Seq. 2, 7, from ADH, Seq. 8)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

A LOSP is the initiator. SDC is lost. The operators recognize the loss (OPSDC succeeds), and initiate ECCS water solid operation with LPCI (OPECS succeeds). SPC and CS fail. With no SPC or CS and water solid with LPCI, the operators will need to provide makeup to the SP (OPSPM). The operators may also need to provide additional makeup (SPMKP) to SPMU or the SP.

Locator Files

File Name: OPICTCAU.H15

Initiator: H1-5H

Event Tree: CAUX (from anywhere)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71

Insufficient time is available to close containment.

File Name: OPICTCAU.TIF

Initiator: TIOF5

Event Tree: CAUX (from S, Seq. 1, 2, 3, 4 from E, Seq, 24, 51,

from
TIOF5
,
Seq.
4)

CAUX (from S, Seq. 13, 14, 15, 16,
from OF, Seq. 1, from TIOF5, Seq. 9, 19)
CAUX (from anywhere)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71

Insufficient time is available to close containment.

Locator Files

File Name: OPICTCAU.TIH

Initiator: TIHP5

Event Tree: CAUX (from S, Seq. 13, 14, 15, 16,
 from OF, Seq. 1, from TIHP5, Seq. 16)
 CAUX (from anywhere)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71

Insufficient time is available to close containment.

File Name: OPICTCAU.TRP

Initiator: TRPT5

Event Tree: CAUX (from anywhere)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71

Insufficient time is available to close containment.

Locator Files

File Name: OPICTCAU.XX

Initiator: T1-5

Event Tree: CAUXX (from SX, Seq. 1, from EX, Seq. 35,
from SDC, Seq. 13)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71

Only operator action in CAUXX is to close containment. Cannot do so in available time.

File Name: OPICTE.A5

Initiator: A5

Event Tree: EC (from E, Seq. 2, 7, 13, 18, from A5ISO, Seq. 2, 7,
from A5, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Large LOCA outside containment that isolates. RHR(B) train is lost so SDC(B) gone. Isolation of 8\9 valves occurs with level 3 signal. OPECS succeeds. The operators go water solid with LPCI(C). Since no LOSP and no loss of IA, venting is possible. Operators will need to provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

** Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1.

* No time to close containment if open.

Locator Files

File Name: OPICTE.E1T

Initiator: E1T5H

Event Tree: EC (from E, Seq. 2, 7, 13, 18,
from E1T5H, Seq. 5, 7, 9)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Isolation of common SDC suction line is the initiator. The operators diagnose or initially fail to diagnose the loss of SDC (OPSDC succeeds or fails). The operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

File Name: OPICTE.E1V

Initiator: E1V5H

Event Tree: EC (from EA, Seq. 2, 7, 13, 18,
from E1V5H, Seq. 6, 8, 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Isolation of common SDC suction line is the initiator (initially on ADHRS). The operators diagnose or initially fail to diagnose the loss of SDC (OPSDC succeeds or fails). Regardless, SDC is lost and the operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

Locator Files

File Name: OPICTE.E2T

Initiator: E2T5H

Event Tree: EC (from E, Seq. 2, 7, 13, 18,
from E2T5H, Seq. 4, 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Complete loss of common SDC suction line. The operators diagnose or initially fail to diagnose the loss of SDC (OPSDC succeeds or fails). The operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

File Name: OPICTE.E2V

Initiator: E2V5H

Event Tree: EC (from E, Seq. 2, 7, 13, 18,
from E2V5H, Seq. 4, 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Complete loss of common SDC suction line (initially on ADHRS). The operators diagnose or initially fail to diagnose the loss of SDC (OPSDC succeeds or fails). The operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

Locator Files

File Name: OPICTE.E2V

Initiator: E2V5H

Event Tree: EC (from E, Seq. 2, 7, 13, 18,
from E2V5H, Seq. 4, 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Complete loss of common SDC suction line (initially on ADHRS). The operators diagnose or initially fail to diagnose the loss of SDC (OPSDC succeeds or fails). The operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

File Name: OPICTE.H15

Initiator: H1-5H

Event Tree: EC (from E, Seq. 2, 7,
from RH2, Seq. 1, 10, 23, 29, 38, 51,
from H1-5H, Seq. 5)

EC (from EA, Seq. 2, 7, from RAH2, Seq. 2, 19,
from H1-5H, Seq. 15)

Human Error Events:

		<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
*	OPICT	1.0		HEP 71
**	OPVNT	0.011	5	HEP 25
	OPSPM	0.011	5	HEP 26
	SPMKP	0.032	5	HEP 27

The initiator is a diversion to the SP via RHR. The operators fail to isolate SDC before level 3 is reached and the SDC valves fail to close on the low level signal (SDCIL fails). An ECCS system auto-starts on low level and the operators successfully control level. At this point, a "backwards" form of ECCS water solid operation is aligned. Water drains to the SP through RHR/SDC and is returned to the vessel through HPCS or LPCI. However, in the present sequences, the operators manually close the 8 or 9 valve and initiate ECCS water solid operation per the IDHR ONEP. The operators need to accomplish the actions necessary to maintain adequate containment cooling. Since neither a LOSP nor a loss of IA has occurred in these sequences, venting is possible. Operators will need to provide makeup to SP (OPSPM) with SPMU and additional makeup to SPMU (or SP).

- * No time to close containment if open.
- ** Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1.

Locator Files

File Name: OPICTE.J2

Initiator: J2-5

Event Tree: EC (from E, Seq. 2, 7, from A5ISJ, Seq. 1,
from J2-5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
* OPICT	1.0		HEP 71
** OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

A break in the SDC line outside containment is the initiator. The break is isolated with closure of MV 8 or MV 9. SDC and RHR(B) train is lost. Isolation of 8\9 valves occurs with level 3 signal. OPECS succeeds--water solid with LPCI(C). Since no LOSP and no loss of IA, venting is possible. Operators will need to provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

** Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1.

* No time to close containment if open.

4 of 10

File Name: OPICTE.S15

Initiator: S1-5

Event Tree: EC (from E, Seq. 2, 7, from A5ISO, Seq. 1,
from S1-5, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Intermediate LOCA outside containment that isolates. RHR(B) train is lost so SDC(B) gone. Isolation of 8\9 valves occurs with level 3 signal. OPECS succeeds--water solid with LPCI (C). Since no LOSP and no loss of IA, venting is possible. Operators will need to vent to remove heat build-up in containment. Operators will also need to provide makeup to SP (OPSPM) and makeup to SPMU (or SP). Operators can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. There is insufficient time available to close containment, if it is open.

Locator Files

File Name: OPICTE.S25

Initiator: S2-5

Event Tree: EC (from E, Seq. 2, 7, from A5ISO, Seq. 1,
from S1XFR, Seq. 3, from S2-5, Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Small LOCA outside containment that isolates. RHR(B) train is lost so SDC(B) gone. Isolation of 8\9 valves occurs with level 3 signal. OPECS succeeds--water solid with LPCI (C). Since no LOSP and no loss of IA, venting is possible. (See OPICT.ECP and HEP 25 for details). Operators will need to vent to remove heat build-up in containment. Operators will also need to provide makeup to SP (OPSPM) and makeup to SPMU (or SP). Operators can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. There is insufficient time available to close containment, if it is open.

File Name: OPICTE.S2H

Initiator: S2H-5

Event Tree: EC (from E, Seq. 2, 7, from A5ISH, Seq. 2,
from S1XFH, Seq, 3, from S2H-5, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Small LOCA outside containment that isolates. RHR(B) train is lost so SDC(B) gone. Isolation of 8\9 valves occurs with level 3 signal. OPECS succeeds--water solid with LPCI (C). Since no LOSP and no loss of IA, venting is possible. (See OPICT.ECP and HEP 25 for details). Operators will need to vent to remove heat build-up in containment. Operators will also need to provide makeup to SP (OPSPM) and makeup to SPMU (or SP). Operators can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC b's, OPVNT = 1. There is insufficient time available to close containmen , if it is open.

Locator Files

File Name: OPICTE.TIF

Initiator: TIOF5

Event Tree: EC (from E, Seq. 2, 7, 13, 18, from TIOF5, Seq. 4)
ECP (from EP, Seq. 2, 7, from TIOF5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011 or 1.0	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Inadvertent actuation of LPCI initiator. Operators fail to stop LPCI in time allowed for OPSLP (< 7 min.). SDC isolates on high pressure. Operators initiate ECCS water solid operation with LPCI which is already injecting (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

However, can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

File Name: OPICTE.TIO

Initiator: TIOP5

Event Tree: EC (from E, Seq. 2, 7, from SDC, Seq. 3,
from TIOP5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Mismatch between letdown and makeup initiator. SDC(B) fails to continue to run. OPSDC succeeds. OPECS succeeds--water solid with LPCI(C). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

Locator Files

File Name: OPICTE.TLM

Initiator: TLM5H

Event Tree: EC (from E, Seq. 2, 7, from SDC, Seq. 3,
from TLM5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of makeup (CRD) initiator. SDC(B) fails to continue to run and the operators diagnose the loss of SDC (OPSDC succeeds). The operators initiate water solid operation with LPCI(C) (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

File Name: OPICTE.TRP

Initiator: TRPT5

Event Tree: EC (from E, Seq. 2, 7, 13, 18, from SDC, Seq. 3,
from TRPT5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of forced recirculation initiator. At some point after the initiator a random loss of SDC(B) occurs. The operators diagnose or initially fail to diagnose the loss of SDC (OPSDC succeeds or fails). The operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

Locator Files

File Name: OPICTE2.E1T

Initiator: E1T5H

Event Tree: EC (from E, Seq. 2, 7, 13, 18, from AISD, Seq. 1,
from L, Seq. 7, 40, from E1T5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Isolation of common SDC suction line is the initiator. The operators diagnose the loss of SDC, unisolate the common suction line, and restore SDC(B) (OPSDC succeeds). CRD continues to run and the operators fail to control level in the long-term, resulting in auto-isolation of SDC on high pressure. The operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

File Name: OPICTE2.E1V

Initiator: E1V5H

Event Tree: EC (from EA, Seq. 2, 7, 13, 18, from RA, Seq. 28,
from, LA, Seq. 37, from E1V5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Isolation of common SDC suction line is the initiator (initially on ADHRS). The operators diagnose the loss of ADHR, unisolate the SDC suction line, and reestablish ADHR. With a later loss of CRD, they attempt to control level with CDS, but it fails to operate. The operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

Locator Files

File Name: OPICTE2.J2

Initiator: J2-5

Event Tree: EC (from E, Seq. 2, 7, 13, 18, from A5ISJ, Seq. 1,
from J2-5, Seq. 2)

EC (from E, Seq. 2, 7, 13, 18, from A5ISJ, Seq. 6,
from J2-5, Seq. 2)

ECP (from EP, Seq. 2, 7, from A5ISJ, Seq. 2,
from J2-5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
* OPICT	1.0		HEP 71
** OPVNT	1.0 or 0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

A break in the SDC line outside containment is the initiator. The break is isolated with closure of MV 8 or MV 9. SDC and RHR(B) train is lost. Isolation of 8\9 valves occurs with level 3 signal. OPECS succeeds-- water solid with LPCI(C). If a LOSP occurs, the diesels start and load (DV1-2 OK). Operators will need to vent, if possible, and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

** Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1.

* No time to close containment if open.

File Name: OPICTE2.TIF

Initiator: TIOF5

Event Tree: EC (from E, Seq. 2, 7, from SDC Seq. 3,
 from TIOF5, Seq. 2)
 EC (from EA, Seq. 2, 7, 18, from AIAD, Seq. 2,
 from TIOF5, Seq. 14)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Inadvertent actuation of LPCI initiator. Operators succeed or fail to stop LPCI in time allowed for OPSLP (< 7 min.). SDC isolates on high pressure. At some point the operators detect the loss of SDC and initiate ECCS water solid operation with LPCI which is already injecting (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

However, can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

Locator Files

File Name: OPICTE2.TIH

Initiator: TIHP5

Event Tree: EC (from E, Seq. 2, 7, from SDC Seq. 3,
from TIHP5, Seq. 2, 4)
EC (from E, Seq. 2, 7, 13, 18, from AISD, Seq. 1,
from TIHP5, Seq. 6)
EC (from EA, Seq. 2, 7, 18, from AIAD, Seq. 2,
from TIHP5, Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Inadvertent actuation of HPCS initiator. Auto-isolation of HPCS at level 8 fails or succeeds or the operators succeed or fail to stop HPCS in time allowed for OPHPC (< 7 min.). SDC isolates on high pressure. At some point the operators detect the loss of SDC, isolate HPCS, and initiate ECCS water solid operation with LPCI (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

However, can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

File Name: OPICTE2.TIO

Initiator: TIOP5

Event Tree: EC (from EA, Seq. 2, 7, from ADH, Seq. 2,
from TIOP5, Seq. 9)

EC (from E, Seq. 2, 7, from AISD, Seq. 1,
from TIOP5, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Mismatch between letdown and makeup initiator. Operators fail to control level (LCMK) and SDC(B) or ADHR isolates on high pressure. OPECS succeeds--water solid with LPCI(C). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

Locator Files

File Name: OPICTE3.TIF

Initiator: TIOF5

Event Tree: EC (from E, Seq. 2, 7, from L, Seq. 5, 32, 38, 48,
from SDC Seq. 1, from TIOF5, Seq. 2)
EC (from EA, Seq. 2, 7, from LA, Seq. 38,
from ADH, Seq. 1, from TIOF5, Seq. 3)
ECP (from EP, Seq. 2, 7, from LP, Seq. 8, 15,
from SDC, Seq. 5, from TIOF5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
* OPVNT	0.011 or 1.0	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Inadvertent actuation of LPCI initiator. Operators succeed or fail to stop LPCI in time allowed for OPSLP (< 7 min.). If a LOSP occurs, DV1-2 succeeds. SDC continues to run, but the operators fail to recognize inadequate core to downcomer recirculation and therefore fail to control level to avoid functional loss of SDC. At some point the operators detect the loss of SDC and initiate ECCS water solid operation with LPCI, which is either already injecting or is available (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

- * However, can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

File Name: OPICTE3.TIH

Initiator: TIHP5

Event Tree: EC (from E, Seq. 2, 7, from L, Seq. 5, 32, 38, 48,
 from SDC Seq. 1, from TIHP5, Seq. 2, 4)
 ECP (from EP, Seq. 2, 7, from LP, Seq. 8, 15,
 from SDC, Seq. 5, from TIHP5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
* OPVNT	0.011 or 1.0	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Inadvertent actuation of HPCS initiator. HPCS auto-isolates at level 8 (HPCAO) or the operators recover a failure of the auto-isolation (OPHPC). If a LOSP occurs, DV1-2 succeeds. SDC continues to run, but the operators fail to recognize inadequate core to downcomer recirculation and therefore fail to control level to avoid functional loss of SDC. At some point the operators detect the loss of SDC and initiate ECCS water solid operation with LPCI, which is either already injecting or is available (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

- * However, can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

Locator Files

File Name: OPICTE3.TRP

Initiator: TRPT5

Event Tree: EC (from E, Seq. 2, 7, 13, 18,
from L, Seq. 16, 21, 25, 32, 38, 48,
from SDC Seq. 1, from TRPT5, Seq. 3)
EC (from EA, Seq. 2, 7, 13, 18,
from LA, Seq. 16, 21, 38,
from ADH, Seq. 1, from TRPT5, Seq. 5)
EC (from EA, Seq. 2, 7,
from LA, Seq. 16, 32, 48,
from ADH, Seq. 2, from TRPT5, Seq. 5)
ECP (from EP, Seq. 2, 7, from LP, Seq. 8, 15,
from SDC, Seq. 5, from TRPT5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
* OPVNT	0.011 or 1.0	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

A loss of forced recirculation is the initiator. If a LOSP occurs, the diesel starts and loads (DV1-2 succeeds). SDC continues to run or is restarted, but the operators fail to recognize inadequate core to downcomer recirculation and therefore fail to control level to avoid functional loss of SDC. At some point the operators detect the loss of SDC and initiate ECCS water solid operation with LPCI (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP). Insufficient time is available to close containment if it is open.

- * Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Thus, in ECP tree, OPVNT = 1.0.

File Name: OPICTE4.TRP

Initiator: TRPT5

Event Tree: EC (from EA, Seq. 2, 7, from RA, Seq. 28,
from LA, Seq. 20, 37,
from ADH, Seq. 1, from TRPT5, Seq. 5)

EC (from E, Seq. 2, 7, from R, Seq. 28,
from L, Seq. 20, 37,
from ADEP, Seq. 2, from TRPT5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

A loss of forced recirculation is the initiator. SDC continues to run or is restarted, and the operators recognize inadequate core to downcomer recirculation and attempt to control level with CDS (OPDHR succeeds). CDS fails and insufficient time was available in OPDHR to attempt an ECCS system (OPLEC fails). The operators have detected the loss of SDC and initiate ECCS water solid operation with LPCI (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP). Insufficient time is available to close containment if it is open.

- * Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Thus, in ECP tree, OPVNT = 1.0.

Locator Files

File Name: OPICTEC2.TIA

Initiator: TIA5H

Event Tree: ECP (from EP, Seq. 2, 7, from LP, Seq. 8, 15,
from TIA5H, Seq. 7)

ECP (from EAP, Seq. 2, 7, from LAP, Seq. 8, 15,
from TIA5H, Seq. 22)

EC (from EA, Seq. 2, 7, 13, 18, from LA, Seq. 32, 48,
from TIA5H, Seq. 18)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

A loss of IA is the initiator. If at some point a LOSP also occurs, the diesels start and load (DV1-2 OK). SDC(B) runs, but the operators fail to control level. The operators initiate ECCS water solid operation with LPCI (OPECS succeeds). SPC and CS fail. With no SPC or CS and water solid with LPCI, the operators will need to provide makeup to SP (OPSPM). They will also need to provide additional makeup (SPMKP) to SPMU or the SP. Cannot vent.

File Name: OPICTECP.TIA

Initiator: TIA5H

Event Tree: ECP (from EP, Seq. 2, 7, from TIA5H, Seq. 9)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

A loss of IA is the initiator. SDC(B) is lost and OPSDC succeeds. The operators initiate ECCS water solid operation with LPCI (OPECS succeeds). SPC and CS fail. With no SPC or CS and water solid with LPCI, the operators will need to provide makeup to SP (OPSPM). They will also need to provide additional makeup (SPMKP) to SPMU or the SP.

Locator Files

File Name: OPICTEHY.TRP

Initiator: TRPT5

Event Tree: EC (from E, Seq. 2, 7, 13, 18, from ADEP, Seq. 6,
from TRPT5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of forced recirculation initiator during HYDRO test. The operators diagnose the need for SDC, but none of the usual SDC systems will run. The operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

File Name: OPICTEHY.TRV

Initiator: TORV5

Event Tree: EC (from E, Seq. 2, 7, 13, 18, from ADEP, Seq. 6,
from TORV5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

The initiator is an inadvertent stuck open relief valve during a HYDRO test. The operators diagnose the need for SDC, but none of the usual SDC systems will run. The operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

Locator Files

File Name: OPICTEP.E1T

Initiator: E1T5H

Event Tree: ECP (from EP, Seq. 2, 7, 13, 18,
from E1T5H, Seq. 14)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Isolation of common SDC suction line (initially on SDC(B)). The operators diagnose the loss of SDC (OPSDC succeeds), but fail to try to restore the isolated line. A LOSP occurs at some point after the initiator the diesels start. The operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if have IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

File Name: OPICTEP.E1V

Initiator: E1V5H

Event Tree: ECP (from EAP, Seq. 2, 7, 13, 18,
from E1V5H, Seq. 15)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Isolation of common SDC suction line (initially on ADHRS). The operators diagnose the loss of SDC (OPSDC succeeds), but fail to try to restore the isolated line. A LOSP occurs at some point after the initiator, but the diesels start. The operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if have IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

Locator Files

File Name: OPICTEP.E2T

Initiator: E2T5H

Event Tree: ECP (from EP, Seq. 2, 7, 13, 18,
from E2T5H, Seq. 4, 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Complete loss of common SDC suction line (initially on SDC(B)). The operators diagnose or initially fail to diagnose the loss of SDC (OPSDC succeeds or fails). A LOSP occurs at some point after the initiator. The operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if have IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

File Name: OPICTEP.E2V

Initiator: E2V5H

Event Tree: ECP (from EP, Seq. 2, 7, 13, 18,
from E2V5H, Seq. 4, 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Complete loss of common SDC suction line (initially on ADHRS). The operators diagnose or initially fail to diagnose the loss of SDC (OPSDC succeeds or fails). A LOSEP occurs at some point after the initiator. The operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if have IA and both trains of power are available. If sequence has LOSEP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

Locator Files

File Name: OPICTEP.TRP

Initiator: TRPT5

Event Tree: ECP (from EP, Seq. 2, 7, 13, 18, from SDC, Seq. 7,
from TRPT5, Seq. 3)
ECP (from EAP, Seq. 2, 7, from ADH, Seq. 8,
from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of forced recirculation initiator. A LOSP occurs at some point after the initiator. SDC(B) fails to start or restart after the LOSP. The operators diagnose the loss of SDC (OPSDC succeeds). The operators successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if have IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

File Name: OPICTEP2.E1T

Initiator: E1T5H

Event Tree: ECP (from EP, Seq. 2, 7, 13, 18,
from LP, Seq. 8, 15, from E1T5H, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Isolation of common SDC suction line (initially on SDC(B)). The operators diagnose the loss of SDC (OPSDC succeeds) and successfully restore. A LOSP occurs at some point after the initiator and the diesels start. The operators initially fail to control level (OPDHR fails). The operators successfully initiate ECCS water solid operation with LPCI(C) in response to the functional loss of SDC (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if have IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

Locator Files

File Name: OPICTEP2.E1V

Initiator: E1V5H

Event Tree: ECP (from EP, Seq. 2, 7, 13, 18,
from LP, Seq. 8, 15, from E1V5H, Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Isolation of common SDC suction line (initially on ADHR). The operators diagnose the loss of SDC (OPSDC succeeds), successfully unisolate the line, and start SDC(B). A LOSEP occurs at some point after the initiator and the diesels start. The operators initially fail to control level (OPDHR fails). The operators successfully initiate ECCS water solid operation with LPCI(C) in response to the functional loss of SDC (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if have IA and both trains of power are available. If sequence has LOSEP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

File Name: OPICTES.S25

Initiator: S2-5

Event Tree: ECAC (from ES, Seq. 2, from S15NF, Seq. 1,
S1XFR, Seq. 1, from S2-5, Seq. 11, 22)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
SPMKP	0.032	5	HEP 27

Small LOCA inside containment that does not immediately isolate. Operators fail initially to control makeup and isolate letdown. Alarms will sound at level 4 and 3 and SDC will isolate at level 3. Operators eventually diagnose loss of level and SDC and restore and dump SPMU to provide additional water for ECCS. OPECCs succeeds--water solid with LPCI (C). Since no LOSP and no loss of IA, venting is possible. (See OPICT.ECP and HEP 25 for details). Operators will need to provide additional makeup to the SP (SPMKP) either by refilling SPMU or directly to the SP.

Operators can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

Locator Files

File Name: OPICTES.S2H

Initiator: S2H-5

Event Tree: ECAC (from ES, Seq. 2, from S1HNF, Seq. 2,
S1XFH, Seq. 1, from S2H-5, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
SPMKP	0.032	5	HEP 27

Small LOCA inside containment (during hydro) that does not immediately isolate. Operators fail initially to control makeup and isolate letdown. Alarms will sound at level 4 and 3 and SDC will isolate at level 3. Operators eventually diagnose loss of level and SDC and restore and dump SPMU to provide additional water for ECCS. OPECCs succeeds--water solid with LPCI (C). Since no LOSP and no loss of IA, venting is possible. Operators will need to vent to remove heat build-up in containment (See OPICT.ECP and HEP 25 for details). Operators will need to provide additional makeup to the SP (SPMKP) either by refilling SPMU or directly to the SP.

Operators can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

File Name: OPICTES.S35

Initiator: S3-5

Event Tree: ECAC (from ES, Seq. 2, from S15NF, Seq. 1,
S1XFR, Seq. 1, from S3-5, Seq. 32)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
SPMKP	0.032	5	HEP 27

Small-small LOCA inside containment. Operators fails to isolate the leak and also fail initially to control makeup and isolate letdown. Alarms will sound at level 4 and 3 and SDC will isolate at level 3. Operators eventually diagnose loss of level and SDC and restore and dump SPMU to provide additional water for ECCS. OPECCs succeeds--water solid with LPCI (C). Since no LOSP and no loss of IA, venting is possible. (See OPICT.ECP and HEP 25 for details). Operators will need to provide additional makeup to the SP (SPMKP) either by refilling SPMU or directly to the SP.

Operators can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

Locator Files

File Name: OPICTF.AHY

Initiator: A5HY

Event Tree: FCAC (from FAM, Seq. 1, from A5HIN, Seq. 7,
from A5HY, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

Large inside containment during HYDRO. Isolation of 8\9 valves occurs with level 3 signal. OPSPM fails. Operators flood containment with SSWXT. Since no LOSP and no loss of IA, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT). In this scenario, operators have 54 hours to vent. Long term opening of containment (OPCMT) , if closed or venting fails, is also called for in 54 hours. Since mission time is 24 hours, failure probability for these events is set to 0.

No time to close containment if open.

File Name: OPICTF.S15

Initiator: S1-5

Event Tree: FCAC (from FS, Seq. 1, from S15IN, Seq. 6,
from S1-5, Seq. 2, 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

Intermediate LOCA inside containment. Isolation of 8\9 valves occurs with level 3 signal. OPSPM fails. Operators flood containment with SSWXT. Since no LOSP and no loss of IA, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT). In this scenario, operators have 54 hours to vent. Long term opening of containment (OPCMT) , if closed or venting fails, is also called for in 54 hours. Since mission time is 24 hours, failure probability for these events is set to 0.

No time to close containment if open.

Locator Files

File Name: OPICTF.S15

Initiator: S1-5

Event Tree: FCAC (from FS, Seq. 1, from S15IN, Seq. 6,
from S1-5, Seq. 2, 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

Intermediate LOCA inside containment. Isolation of 8\9 valves occurs with level 3 signal. OPSPM fails. Operators flood containment with SSWXT. Since no LOSP and no loss of IA, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT). In this scenario, operators have 54 hours to vent. Long term opening of containment (OPCMT) , if closed or venting fails, is also called for in 54 hours. Since mission time is 24 hours, failure probability for these events is set to 0.

No time to close containment if open.

File Name: OPICTF.S1H

Initiator: S1H-5

Event Tree: FCAC (from FS, Seq. 1, from S1HIN, Seq. 9,
from S1H-5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

Intermediate LOCA inside containment. Isolation of 8\9 valves occurs with level 3 signal. OPSPM fails. Operators flood containment with SSWXT. Since no LOSP and no loss of IA, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT). In this scenario, operators have 54 hours to vent. Long term opening of containment (OPCMT) , if closed or venting fails, is also called for in 54 hours. Since mission time is 24 hours, failure probability for these events is set to 0.

No time to close containment if open.

Locator Files

File Name: OPICTF.S25

Initiator: S2-5

Event Tree: FCAC (from FS, Seq. 1, from S15NF, Seq. 2, 5,
from S1XFH, Seq. 1, from S2-5, Seq. 11, 22)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

Small LOCA inside containment. Isolation of 8\9 valves occurs with level 3 signal. OPSPM fails or SP had insufficient level. Operators flood containment with SSWXT. Since no LOSP and no loss of IA, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT). In this scenario, operators have 54 hours to vent. Long term opening of containment (OPCMT) , if closed or venting fails, is also called for in 54 hours. Since mission time is 24 hours, failure probability for these events is set to 0.

No time to close containment if open.

File Name: OPICTF.S2H

Initiator: S2H-5

Event Tree: FCAC (from FS, Seq. 1, from S1HIN, Seq. 5, 8,
from S1XFH, Seq. 1, from S2H-5, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

Small LOCA inside containment. Isolation of 8\9 valves occurs with level 3 signal. OPSPM fails or SP had insufficient level. Operators flood containment with SSWXT. Since no LOSP and no loss of IA, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT). In this scenario, operators have 54 hours to vent. Long term opening of containment (OPCMT) , if closed or venting fails, is also called for in 54 hours. Since mission time is 24 hours, failure probability for these events is set to 0.

No time to close containment if open.

Locator Files

File Name: OPICTF.S35

Initiator: S3-5

Event Tree: FCAC (from FS, Seq. 1, from S15NF, Seq. 1,
from S1XFH, Seq. 1, from S3-5, Seq. 32)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

Small-small LOCA inside containment. Operators fail to isolate the leak (ISSSL) and also fail initially to provide makeup and control letdown. Isolation of 8\9 valves occurs with level 3 signal. OPSPM fails or SP had insufficient level. Operators flood containment with SSWXT. Since no LOSP and no loss of IA, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT). In this scenario, operators have 54 hours to vent. Long term opening of containment (OPCMT) , if closed or venting fails, is also called for in 54 hours. Since mission time is 24 hours, failure probability for these events is set to 0.

No time to close containment if open.

File Name: OPICTF.S35

Initiator: S3-5

Event Tree: FCAC (from FS, Seq. 1, from S15NF, Seq. 1,
from S1XFH, Seq. 1, from S3-5, Seq. 32)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

Small-small LOCA inside containment. Operators fail to isolate the leak (ISSSL) and also fail initially to provide makeup and control letdown. Isolation of 8\9 valves occurs with level 3 signal. OPSPM fails or SP had insufficient level. Operators flood containment with SSWXT. Since no LOSP and no loss of IA, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT). In this scenario, operators have 54 hours to vent. Long term opening of containment (OPCMT) , if closed or venting fails, is also called for in 54 hours. Since mission time is 24 hours, failure probability for these events is set to 0.

No time to close containment if open.

Locator Files

File Name: OPICTF.TIF

Initiator: TIOF5

Event Tree: FC (from F, Seq. 1, from E, Seq. 11,
from TIOF5, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

Inadvertent actuation of LPCI initiator. Operators initially fail to stop the LPCI injection and SDC isolates on high pressure. Operators diagnose the need to initiate ECCS water solid operation but the SP is empty. The operators decide to flood containment with SSWXT and are successful. Since power and IA are available in these sequences, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT). In this scenario, operators have 54 hours to vent. In addition, long term opening of containment (OPCMT) (if it is closed or venting fails), is also called for in 54 hours. Since mission time is 24 hours, failure probability for these events is set to 0.

Insufficient time is available to close containment if it is open.

File Name: OPICTF2.H15

Initiator: H1-5H

Event Tree: FC (from F, Seq. 1, from E, Seq. 5, 10, 11,
from A5ISO, Seq. 1, from H1-5H, Seq. 3)

FC (from F, Seq. 4, from E, Seq. 22,
from A5ISO, Seq. 1, from H1-5H, Seq. 3)

FC (from F, Seq. 1, from EA, Seq. 5, 10, 11,
from A5ISO, Seq. 6, from H1-5H, Seq. 13)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

The initiator is a diversion to the SP via RHR. The diversion is isolated on low level and SDC is lost. The operators attempt to initiate ECCS water solid operation but either LPCI fails or the SP is empty. The operators decide to flood containment with SSWXT and are successful. Since power and IA are available in these sequences, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT).

- * In this scenario, operators have 54 hours to vent (OPVNT). In addition, long term opening of containment (OPCMT) (if it is closed or venting fails), is also called for in 54 hours. Since mission time is 24 hours, sequences with these events to not have to be analyzed.

Insufficient time is available to close containment (OPICT) if it is open.

Locator Files

File Name: OPICT2F.TIF

Initiator: TIOF5

Event Tree: FC (from F, Seq. 1, from EA, Seq. 11,
from AIAD, Seq. 2, from TIOF5, Seq. 14)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

Inadvertent actuation of LPCI initiator. Operators initially fail to stop the LPCI injection and SDC isolates on high pressure. Operators diagnose the need to initiate ECCS water solid operation but the SP is empty. The operators decide to flood containment with SSWXT and are successful. Since power and IA are available in these sequences, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT). In this scenario, operators have 54 hours to vent. In addition, long term opening of containment (OPCMT) (if it is closed or venting fails), is also called for in 54 hours. Since mission time is 24 hours, failure probability for these events is set to 0.

Insufficient time is available to close containment if it is open.

File Name: OPICT2F.TIF

Initiator: TIOF5

Event Tree: FC (from F, Seq. 1, from EA, Seq. 11,
from AIAD, Seq. 2, from TIOF5, Seq. 14)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

Inadvertent actuation of LPCI initiator. Operators initially fail to stop the LPCI injection and SDC isolates on high pressure. Operators diagnose the need to initiate ECCS water solid operation but the SP is empty. The operators decide to flood containment with SSWXT and are successful. Since power and IA are available in these sequences, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT). In this scenario, operators have 54 hours to vent. In addition, long term opening of containment (OPCMT) (if it is closed or venting fails), is also called for in 54 hours. Since mission time is 24 hours, failure probability for these events is set to 0.

Insufficient time is available to close containment if it is open.

Locator Files

File Name: OPICT2F.TIH

Initiator: TIHP5

Event Tree: FC (from F, Seq. 1, from E, Seq. 11,
from AISD, Seq. 1, from TIHP5, Seq. 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

Inadvertent actuation of HPCS initiator. HPCS auto-isolation fails and the operators initially fail to stop the HPCS injection. SDC isolates on high pressure. Operators eventually diagnose the need to stop HPCS and initiate ECCS water solid operation but the SP is empty. The operators decide to flood containment with SSWXT and are successful. Since power and IA are available in these sequences, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT). In this scenario, operators have 54 hours to vent. In addition, long term opening of containment (OPCMT) (if it is closed or venting fails), is also called for in 54 hours. Since mission time is 24 hours, failure probability for these events is set to 0.

Insufficient time is available to close containment if it is open.

File Name: OPICT2F.TRP

Initiator: TRPT5

Event Tree: FC (from F, Seq. 1, from E, Seq. 11,
from SDC, Seq. 3, from TRPT5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

A loss of forced recirculation is the initiator. SDC fails and the operators recognize the loss (OPSDC succeeds. The operators attempt to initiate ECCS water solid operation but the SP is empty. The operators decide to flood containment with SSWXT and are successful. Since power and IA are available in these sequences, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT). In this scenario, operators have 54 hours to vent. In addition, long term opening of containment (OPCMT) (if it is closed or venting fails), is also called for in 54 hours. Since mission time is 24 hours, failure probability for these events is set to 0.

Insufficient time is available to close containment if it is open.

Locator Files

File Name: OPICTF3.TRP

Initiator: TRPT5

Event Tree: FC (from F, Seq. 1, from E, Seq. 5, 10, 11,
from L, Seq. 16, from SDC, Seq. 1,
from TRPT5, Seq. 3)

FC (from F, Seq. 1, from EA, Seq. 5, 10, 11,
from LA, Seq. 16, 32, 48, from ADH, Seq. 1, 2,
from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	0		HEP 73

A loss of forced recirculation is the initiator. SDC continues to run or is started, but the operators fail to realize the potential for a disconnect between the core and the downcomer and the resulting functional loss of SDC (OPDHR fails). The control room eventually decides to initiate ECCS water solid operation (OPECS successful), but either the ECCS systems fail or the SP is empty. The operators decide to flood containment with SSWXT and are successful. Since power and IA are available in these sequences, venting is possible. Operators will need to vent to remove heat build-up in containment (OPVNT). In this scenario, operators have 54 hours to vent. In addition, long term opening of containment (OPCMT) (if it is closed or venting fails), is also called for in 54 hours. Since mission time is 24 hours, failure probability for these events is set to 0.

Insufficient time is available to close containment if it is open.

File Name OPICTFC.TIA

Initiator: TIA5H

Event Tree: FC (from F, Seq. 1, from anywhere else)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0		HEP 25
OPCMT	Success		HEP 73

54 hours are allowed for OPVNT and OPCMT. Since mission time is only 24 hrs., all sequences with these events can be dropped, i.e., not analyzed.

Locator Files

File Name: OPICTHY2.ECP

Initiator: T1-5

Event Tree: ECP (from EP, Seq. 2, 7, from LP, Seq. 8,
from ADEPP, Seq. 2, from OVPRP, Seq. 4,
from HYDRO, Seq. 6, from T1-5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

LOSP during HYDRO test is the initiator. DV1-2 succeeds, and SDC(B) restarts on demand. RWCU auto-isolates. The operators fail to diagnose the need for level control (OPDHR fails), but do realize the functional loss of SDC and enter the ONEP for IDHR. They successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

File Name: OPICTHY2.TRV

Initiator: TORV5

Event Tree: EC (from E, Seq. 2, 7, from R, Seq. 28,
from L, Seq. 37, from ADEP, Seq. 2,
from TORV5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

An inadvertent stuck open relief valve during a HYDRO test is the initiator. RWCU continues to run in recirculation mode. CRD fails, but the operators attempt to control level with CDS (OPDHR succeeds). Thus, they are aware of the need for adequate cooling, but CDS fails to start on demand. It is assumed that the operators have entered the IDHR ONEP. Level control with ECCS (OPLEC in R tree) fails because time available was spent in OPDHR initiating CDS. The operators successfully initiate LPCI(C) from the control room perform related ECCS water solid actions (OPECS succeeds). The operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LO SP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment, if it is open.

Locator Files

File Name: OPICTHYD.ECP

Initiator: T1-5

Event Tree: ECP (from EP, Seq. 2, 7, 13, 18,
from ADEPP, Seq. 4, 6,
from OVPRP, Seq. 4, from HYDRO, Seq. 6,
from T1-5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

LOSP is the initiator. DV1-2 succeeds, but SDC fails to restart on demand or the operators fail to align SDC. A HYDRO test is in progress. RWCU auto-isolates. The operators diagnose the need for level control and SDC and enter the ONEP for IDHR. They successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

File Name: OPICTHYD.ECP

Initiator: T1-5

Event Tree: ECP (from EP, Seq. 2, 7, 13, 18,
from ADEPP, Seq. 4, 6,
from OVPRP, Seq. 4, from HYDRO, Seq. 6,
from T1-5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

LOSP is the initiator. DV1-2 succeeds, but SDC fails to restart on demand or the operators fail to align SDC. A HYDRO test is in progress. RWCU auto-isolates. The operators diagnose the need for level control and SDC and enter the ONEP for IDHR. They successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) if possible and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

Locator Files

File Name: OPICTHYD.T5D

Initiator: T5D5H

Event Tree: EC (from E, Seq. 2, 7, 13, 18,
from L, Seq. 32, 48, from ADEP, Seq 3,
from OVPR, Seq. 4, from HYDRO, Seq. 5,
from T5D5H, Seq. 34)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of CCW during HYDRO test. An SRV opens on safety setpoint and fail to close (SAFEC). Depressurization occurs. In ADEP tree, SDCUI succeeds (8.7 hours for this event). The operators take necessary steps to initiate SDC(B) and isolate RWC. In the L tree, operators fail to recognize potential disconnect between core and downcomer and fail to initiate makeup (OPDHR fails). Thus, enter E tree and OPECS succeeds. The operators go water solid with LPCI(C) and at least one SRV is open. Since no LOSP and no loss of IA, venting is possible. SPC and CS are assumed to fail. The operators will need to provide makeup to SP (OPSPM) and makeup (SPMKP) to SPMU (or SP).

File Name: OPICTHYD.TAB

Initiator: TAB5H

Event Tree: EC (from E, Seq. 3, 8,
from ADEP, Seq 6,
from OVPR, Seq. 4, from HYDRO, Seq. 5,
from TAB5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of AC bus during HYDRO test. SRV opens on safety setpoint and fail to close (SAFEC). Depressurization occurs. In ADEP tree SDCUI succeeds (8.7 hours for this event). The operators take necessary steps to initiate SDC(B) and isolate RWCU, but SDC(B) fails. Thus, enter E tree and OPECS succeeds. The operators initiate ECCS water solid with HPCS and at least one SRV is open. With loss of bus, venting is not possible. SPC and CS are assumed to fail. The operators will need to provide makeup to SP (OPSPM) and makeup to SPMU (or SP).

Locator Files

File Name: OPICTHYD.TDB

Initiator: TDB5H

Event Tree: EC (from E, Seq. 3, 8,
from ADEP, Seq 6,
from OVPR, Seq. 4, from HYDRO, Seq. 5,
from TDB5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of DC bus during HYDRO test. An SRV opens on safety setpoint and fails to close (SAFEC). Depressurization occurs. In ADEP tree SDCUI succeeds (8.7 hours for this event). The operators take the necessary steps to initiate ADHR and isolate RWCU, but ADHR fails. Thus, enter E tree and OPECS succeeds. The operators initiate ECCS water solid operation with HPCS and at least one is SRV open. With a loss of bus, venting is not possible. SPC and CS are assumed to fail. The operators will need to provide makeup to SP (OPSPM) and makeup to SPMU or the SP (SPMKP).

File Name: OPICTHYD.TIA

Initiator: TIA5H

Event Tree: EC (from E, Seq. 2, 7, 13, 18,
from L, Seq. 32, 48, from ADEP, Seq 3,
from OVPR, Seq. 4, from HYDRO, Seq. 5,
from TIA5H, Seq. 33)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	1.0	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

A loss of IA occurs during a HYDRO test. An SRV opens on safety setpoint and fail to close (SAFEC). Depressurization occurs. In ADEP tree, SDCUI succeeds (8.7 hours for this event). The operators take necessary steps to initiate SDC(B) and isolate RWCU. In the L tree, operators fail to recognize potential disconnect between core and downcomer and fail to initiate makeup (OPDHR fails). Thus, enter E tree and OPECS succeeds. The operators go water solid with LPCI(C) and at least one SRV is open. With the loss of IA, venting is not possible. SPC and CS are assumed to fail. The operators will need to provide makeup to SP (OPSPM) and makeup (SPMKP) to SPMU (or SP).

Locator Files

File Name: OPICTHYD.TLM

Initiator: TLM5H

Event Tree: EC (from E, Seq. 2, 7, from L, Seq. 5, 38,
from ADEP, Seq. 2, from TLM5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of makeup (CRD) initiator. A HYDRO test is in progress. RWCU continues to run in the recirculation mode. The operators fail to attempt to control level which results in inadequate decay heat removal (OPDHR fails). The operators eventually diagnose the need for level control and SDC and enter the ONEP for IDHR. They successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

File Name: OPICTISO.H15

Initiator: H1-5H

Event Tree: EC (from E, Seq. 2, 7, 13, 18
 from A5ISO, Seq. 1, from H1-5H, Seq. 3)
 EC (from EA, Seq. 2, 7, 26, 31,
 from A5ISO, Seq. 6, from H1-5H, Seq. 13)
 ECP (from EP, Seq. 2, 7, from A5ISO, Seq. 2,
 from H1-5H, Seq. 7)

Human Error Events:

		<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
*	OPICT	1.0		HEP 71
**	OPVNT	0.011 or 1.0	5	HEP 25
	OPSPM	0.011	5	HEP 26
	SPMKP	0.032	5	HEP 27

The Initiator is a diversion to the SP via RHR. The operators fail to isolate SDC before level 3 is reached, but the SDC successfully isolate on the low level signal (SDCIL succeeds). If a LOSP occurs, the diesel successfully starts and loads (DV1-2 succeeds). The operators initiate ECCS water solid operation per the IDHR ONEP (OPECS succeeds). The operators need to accomplish the actions necessary to maintain adequate containment cooling. Since an LOSP has occurred in some sequences, venting will not be possible for those sequences. Operators will need to provide makeup to SP (OPSPM) with SPMU and additional makeup to SPMU (or SP).

- * No time to close containment if open.
- ** Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1.

Locator Files

File Name: OPICTLCI.T5D

Initiator: T5D5H

Event Tree: EC (from E, Seq. 2, 7, 13, 18, from L, Seq. 32, 48,
from T5D5H Seq. 3)

EC (from EA, Seq. 2, 7, 13, 18, from LA, Seq. 32, 48,
from T5D5H, Seq. 18, 19)

EC (from E, Seq. 2, 7, 13, 18 from R, Seq 28,
from L, Seq. 31, 47, from T5D5H, Seq. 3)

EC (from EA, Seq. 2, 7, 13, 18 from RA, Seq 28,
from LA, Seq. 31, 47, from T5D5H, Seq. 18)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

A loss of CCW is the initiator. SDC(B) or ADHR continues to run. OPDHR fails or succeeds (but if it succeeds, CDS fails). Regardless, the operators initiate ECCS water solid operation with LPCI. SPC and CS fail. The operators will need to vent if containment closed and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

File Name: OPICTLE.E1T

Initiator: E1T5H

Event Tree: EC (from E, Seq. 2, 7,
from L, Seq. 5, 16, 21, 32, 38, 48,
from E1T5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Isolation of SDC common suction line is the initiator. The operator unisolates SDC and reestablishes SDC(B). At some later point CRD fails and/or forced recirculation is lost and/or RWCU fails. The operators fail to attempt to control level which results in inadequate decay heat removal (OPDHR fails). The operators diagnose the need for level control and SDC and enter the ONEP for IDHR. They successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

Locator Files

File Name: OPICTLE.E1T

Initiator: E1T5H

Event Tree: EC (from E, Seq. 2, 7,
from L, Seq. 5, 16, 21, 32, 38, 48,
from E1T5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Isolation of SDC common suction line is the initiator. The operator unisolates SDC and reestablishes SDC(B). At some later point CRD fails and/or forced recirculation is lost and/or RWCU fails. The operators fail to attempt to control level which results in inadequate decay heat removal (OPDHR fails). The operators diagnose the need for level control and SDC and enter the ONEP for IDHR. They successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

File Name: OPICTLE.E1V

Initiator: E1V5H

Event Tree: EC (from EA, Seq. 2, 7,
from LA, Seq. 5, 16, 21, 32, 38, 48,
from E1V5H, Seq. 3, 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Isolation of SDC common suction line is the initiator. The operator unisolates SDC and reestablishes ADHR or SDC(B). At some later point CRD fails and/or forced recirculation is lost and/or RWCU fails. The operators fail to attempt to control level which results in inadequate decay heat removal (OPDHR fails). The operators eventually diagnose the need for level control and SDC and enter the ONEP for IDHR. They successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

Locator Files

File Name: OPICTLE.TLM

Initiator: TLM5H

Event Tree: EC (from E, Seq. 2, 7, from L, Seq. 5, 32, 38, 48,
from SDC, Seq. 1, from TLM5H, Seq. 3)

EC (from EA, Seq. 2, 7, from LA, Seq. 5, 38,
from ADH, Seq. 1, from TLM5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPICT	1.0		HEP 71
OPVNT	0.011	5	HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

Loss of makeup (CRD) initiator. SDC(B) or ADHRS continues to run. The operators fail to attempt to control level which results in inadequate decay heat removal (OPDHR fails). The operators diagnose the need for level control and SDC and enter the ONEP for IDHR. They successfully initiate ECCS water solid operation with LPCI(C) (OPECS succeeds). SPC and CS are assumed to fail. Operators will need to vent to remove heat buildup in containment (OPVNT) and provide makeup to SP (OPSPM) and makeup to SPMU or SP (SPMKP).

Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1. Insufficient time is available to close containment if it is open.

File Name: OPICTNPE.H15

Initiator: H1-5H

Event Tree: EC (from E, Seq. 2, 7,
from RH2, Seq. 1, 29, from H1-5H, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
* OPICT	1.0		HEP 71
** OPVNT	1.0		HEP 25
OPSPM	0.011	5	HEP 26
SPMKP	0.032	5	HEP 27

The initiator is a diversion to the SP via RHR. The operators fail to isolate SDC before level 3 is reached and the SDC valves fail to close on the low level signal (SDCIL fails). A LOSP occurs and the diesel fails to start (DV1-2 fails). HPCS succeeds and the operators successfully control level (LCHPC succeeds). At this point, a "backwards" form of ECCS water solid operation is aligned. Water drains to the SP through RHR/SDC and is returned to the vessel through HPCS or LPCI. However, in the present sequences, the operators manually close the 8 or 9 valve and initiate ECCS water solid operation per the IDHR ONEP. The operators need to accomplish the actions necessary to maintain adequate containment cooling. With the loss of power, venting is assumed to fail. The operators will need to provide makeup to SP (OPSPM) with SPMU and additional makeup to SPMU (or SP).

- * No time to close containment if open.
- ** Can vent only if IA and both trains of power are available. If sequence has LOSP or loss of IA or loss of AC bus, OPVNT = 1.

Locator Files

File Name: OPL1L.H15

Initiator: H1-5H

Event Tree: H1-5H

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPL1L	1.0		HEP 110
OPL1S	1.0		HEP 110
OPL2L	1.0		HEP 110

OPL1L and OPL1S involve operator action to isolate either a large or small diversion to the SP before level 3 is reached and before level drops to a point that makeup cannot restore level for SDC.

T-H calculations allowed 23 sec. for OPL1L (large diversion) and 3.8 min. for OPL1S (small diversion). Operators will receive alarm at level 4 to indicate level going down. However, it must be assumed that at least some time will be required to determine that the rate level is dropping is significant. The operators must then diagnose where the diversion is located and how to stop it. That is, operators would have to scan the positions of many valves and determine where the diversion lies (which ones should be closed and which ones should be open) and how to respond. Realistically, the operators would probably isolate both letdown and SDC fairly soon since they are likely choices for the level loss. However, with a maximum of 3.8 min., insufficient time is available to assume much will be done. Thus, both OPL1L and OPL1S are assumed to fail.

OPL2L is similar except that the operators must isolate a large diversion after level 3 is reached and the auto-isolation signal for 8 and 9 valve fails. While level 3 would be alarmed, operators would have to ID diversion and/or failure of 8 and 9 and ensure they get closed. The 3.5 min. assumed to be available for this task was assumed to be insufficient and OPL2L was assumed to fail in this scenario.

File Name: OPLCHPLP.H15

Initiator: H1-5H

Event Tree: RH1 (from H1-5H Seq. 4)
 RH2 (from H1-5H Seq. 5, 10)
 RAH1 (from H1-5H Seq. 14)
 RAH2 (from H1-5H Seq. 15)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
LCHPC	0.051	10	HEP 111
LC-LP	0.051	10	HEP 111
OPRHP	1.0		HEP 111
ISO89	0.012	5	HEP 113

The initiator is a diversion through RHR/SDC to the SP. Vessel inventory decreases to level 3, but the auto-isolation of SDC fails. At level 2 HPCS auto-starts and if it fails, LPCI will auto-start. LCHPC and LC-LP are the operator actions to control level to avoid vessel overpressurization or overfill.

If HPCS auto-starts and the operators fail to control level (LCHPC fails), HPCS should auto-isolate at level 8. If it does, OPRHP asks whether the operators will recognize the problem and take manual control of HPCS. However, at this point in the scenario, the operators have not done anything correctly and only approximately 3.8 min. are allowed for OPRHP. Thus, OPRHP is assumed to fail and the auto-start of LPCI is asked.

For the sequences where the auto-isolation logic for SDC failed (RHRIL fails) rather than a hardware related failure of the valves to close (SDCIL), ISO89 is asked if HPCS or LPCI is started and successfully controlled. ISO89 is the operator action to manually isolate SDC. This would be the natural thing to do and they would then be in position to initiate ECCS water solid operation. However, they are already in sort of a "backwards" mode of water solid operation in their present alignment and could continue in this mode as long as they eventually provided makeup to the SP.

Locator Files

File Name: OPLCRL31.TIA

Initiator: TIA5H

Event Tree: R (from L, Seq 31 or 47, from TIA5H Seq. 3)

RP (from LP, Seq. 7 or 14, from TIA5H, Seq. 7)

RA (from LA, Seq. 31, 47, from TIA5H, Seq. 18)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

A loss of IA and in some cases a LOSEP. DV1-2 succeeds. RWCU auto-isolates when power or IA is lost. CRD is gone. OPSDC succeeds and SDC(B) runs. OPDHR succeeds and CDS is unavailable. OPLEC is completely dependent on OPDHR which involves diagnosing the need for makeup.

It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, the actions are assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

When power or IA is lost, RWCU isolates automatically, resulting in little drain down. Thus, the 10 min. allowed for OPDHR (and therefore OPLEC) is very conservative. Consequently, in sequences where power or IA is lost, credit was taken for operators initiating both LPCI and HPCS if one of them failed to start due to hardware.

File Name: OPLDM.S25

Initiator: S2-5

Event Tree: S2-5

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLDM	1.0		HEP 67

A small LOCA is the initiator. OPLDM is the operator action to isolate letdown and increase flow with CDS before level 3 isolation of SDC. CRD alone is inadequate because the flow may not match the break and in any case they will need more makeup to provide adequate recirculation. Thus, makeup and SDC are needed. The problem is that CDS injects through the feedwater line which is also the injection path for SDC(B). Telephone interviews with plant personnel indicated that while there were no interlocks to prevent injection with both systems, no one knew what the affect might be. Given no procedures or training for this and very little time, the HEP for OPLDM was set to 1.0 (failure).

Locator Files

File Name: OPLDM.S2H

Initiator: S2-H5

Event Tree: S2-H5

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLDM	1.0		HEP 67

A small LOCA during a HYDRO test is the initiator. OPLDM is the operator action to isolate letdown and increase flow with CDS before level 3 isolation of SDC. CRD alone is inadequate because the flow may not match the break and in any case they will need more makeup to provide adequate recirculation. Thus, makeup and SDC are needed. The problem is that CDS injects through the feedwater line which is also the injection path for SDC(B). Telephone interviews with plant personnel indicated that while there were no interlocks to prevent injection with both systems, no one knew what the affect might be. Given no procedures or training for this and very little time, the HEP for OPLDM was set to 1.0 (failure).

File Name: OPLEC.TDB

Initiator: TDB5H

Event Tree: R (from L, Seq 31, 47, from SDC, Seq. 1,
from TDB5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23

The initiator is a loss of a DC Bus. SDC(B) continues to run, but CDS is unavailable. OPLEC is completely dependent on OPDHR, which involves diagnosing need for makeup with, in these cases, an ECCS system. Thus, if OPDHR succeeds, then OPLEC succeeds.

Since LPCI is unavailable, HPCS is the only ECCS system available. It was assumed that if HPCS was selected and initiated for injection to increase level, the operators would control level. That is, they are assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. Essentially, it was assumed that if they diagnose the need for HPCS, they will know the injection rates and not simply walk away.

Locator Files

File Name: OPLECHYD.T5D

Initiator: T5D5H

Event Tree: R (from L, Seqs. 31, 47, from ADEP, Seq. 3,
from OVPR, Seq. 4, from HYDRO, Seq. 5,
from T5D5H, Seq. 34)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

In the loss of CCW during HYDRO scenario, OPDHR is preceded by SDCUI which entails operator isolation of RWCU etc. and initiation of SDC(B). The operators have 8.7 hours to diagnose and accomplish the task. Thus, OPDHR requires the operators to diagnose the potential disconnect between the core and the downcomer and initiate some form of makeup. OPLEC (initiate ECCS system for makeup) is completely dependent on OPDHR in this case and must occur in the same time period (10 minutes). Since letdown is already isolated, this scenario is similar to that when a loss of power occurs and letdown isolates automatically. The result is very slow drain down. Thus, the 10 min. allowed for OPDHR and therefore OPLEC is very conservative. Therefore, as in the case where power is lost, credit is taken for the operators trying a second makeup system if the first is lost. CDS is unavailable. The operators are given credit for initiating an ECCS systems LPCI or HPCS. That is, if OPDHR succeeds, OPLEC also succeeds and credit is taken for both LPCI and HPCS if one of them fails due to hardware problems or unavailability.

It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, the actions are assumed to be completely dependent. If the operators selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

File Name: OPLECHYD.T5D

Initiator: T5D5H

Event Tree: R (from L, Seqs. 31, 47, from ADEP, Seq. 3,
from OVPR, Seq. 4, from HYDRO, Seq. 5,
from T5D5H, Seq. 34)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

In the loss of CCW during HYDRO scenario, OPDHR is preceded by SDCUI which entails operator isolation of RWCU etc. and initiation of SDC(B). The operators have 8.7 hours to diagnose and accomplish the task. Thus, OPDHR requires the operators to diagnose the potential disconnect between the core and the downcomer and initiate some form of makeup. OPLEC (initiate ECCS system for makeup) is completely dependent on OPDHR in this case and must occur in the same time period (10 minutes). Since letdown is already isolated, this scenario is similar to that when a loss of power occurs and letdown isolates automatically. The result is very slow drain down. Thus, the 10 min. allowed for OPDHR and therefore OPLEC is very conservative. Therefore, as in the case where power is lost, credit is taken for the operators trying a second makeup system if the first is lost. CDS is unavailable. The operators are given credit for initiating an ECCS systems LPCI or HPCS. That is, if OPDHR succeeds, OPLEC also succeeds and credit is taken for both LPCI and HPCS if one of them fails due to hardware problems or unavailability.

It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, the actions are assumed to be completely dependent. If the operators selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

Locator Files

File Name: OPLECHYD.TLM

Initiator: TLM5H

Event Tree: R (from L, Seq. 31, 37, 47, from ADEP, Seq. 2, 3,
from TLM5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

Loss of makeup (CRD) during HYDRO Test is the initiator. OPLEC is completely dependent on OPDHR. SDC(B) is successfully aligned (SDCUI succeeds) or RWCU continues to operate in the recirculation mode. ECCS can be used for level control, as can CDS in the case where RWCU continues to run in recirculation mode. In all these scenarios where ample time (2 to 8 hours) was allowed to address the situation and OPDHR succeeds, it was assumed that if CDS was tried but it failed, adequate time would be available to start an ECCS system. Thus, if OPDHR succeeds, then OPLEC (which is initiation of ECCS for level control) will also succeed. It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, initiating and controlling level were assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

File Name: OPLECLAP.RAP

Initiator: T1-5

Event Tree: RAP (from LAP, Seq 7, 14, from ADH Seq. 6,
from T1-5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

The initiator is a LOSEP, with DV1-2 succeeding. SDC(B) runs. RWCU auto-isolates when power or IA is lost. CRD is gone. OPSDC succeeds and SDC(B) runs. OPDHR succeeds and CDS is unavailable. OPLEC is completely dependent on OPDHR which involves diagnosing the need for makeup.

It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, the actions are assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

When power is lost, RWCU isolates automatically, resulting in little drain down. Thus, the 10 min. allowed for OPDHR (and therefore OPLEC) is very conservative. Consequently, in sequences where power is lost, credit was taken for operators initiating both LPCI and HPCS if one of them failed to start due to hardware.

Locator Files

File Name: OPLECLHY.TRP

Initiator: TRPT5

Event Tree: R (from L, Seq. 20, 37, from ADEP, Seq. 2,
from TRPT5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	1.0		HEP 23

In the loss of forced recirculation during a HYDRO test scenario, RWCU continues to run in a recirculation mode. OPDHR involves diagnosing the potential disconnect between the core and the downcomer which would lead to a functional loss of SDC. The operators make the correct diagnosis and attempt to initiate CDS for makeup, but CDS fails. Given all the necessary choices and actions to accomplish in OPDHR, no time would be left for initiating ECCS systems in this scenario (OPLEC), which has to be done in the same time period as OPDHR (10 min.). ECCS is asked in E tree when transfer from R tree.

File Name: OPLECLHY.TRV

Initiator: TORV5

Event Tree: R (from L, Seq. 37, from ADEP, Seq. 2,
from TORV5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	1.0		HEP 23

An inadvertent stuck open relief valve during a HYDRO test is the initiator. RWCU continues to run in a recirculation mode. OPDHR involves diagnosing the potential disconnect between the core and the downcomer which would lead to a functional loss of SDC. The operators make the correct diagnosis and attempt to initiate CDS for makeup, but CDS fails. Given all the necessary choices and actions to accomplish in OPDHR, no time would be left for initiating ECCS systems in this scenario (OPLEC), which has to be done in the same time period as OPDHR (10 min.). ECCS is asked in E tree when transfer from R tree.

Locator Files

File Name: OPLECLLA.E1V

Initiator: E1V5H

Event Tree: RA (from IA, Seq. 20, 37, from E1V5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	1.0		HEP 23

In this isolation of SDC common suction line scenario, SDC is unisolated and ADHRS restarts. OPDHR involves isolating RWCU (which continues to run) and diagnosing the potential disconnect between the core and the downcomer which would lead to a functional loss of SDC. The operators make the correct diagnosis and attempt to initiate CDS for makeup, but CDS fails. Given all the necessary choices and actions to accomplish in OPDHR, no time would be left for initiating ECCS systems in this scenario (CPLEC), which has to be done in the same time period as OPDHR (10 min.). ECCS is asked in EA when transfer from RA tree.

File Name: OPLECLLA.T5D

Initiator: T5D5H

Event Tree: R (from L, Seqs.20, 31, 47, from T5D5H, Seqs. 3, 7)

RA (from LA, Seq. 20, 31, 47, from T5D5H, Seqs. 18, 19)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	1.0		HEP 23

In this loss of CCW scenario, OPDHR involves realizing the loss of CCW and isolating CRD and RWCU (they both are lost on loss of CCW). The operators must also diagnose the potential loss of connection between the core and the downcomer. They then need to initiate some form of makeup. CDS is logical choice, but CDS fails. Given all the necessary choices and actions to accomplish OPDHR, no time would be left for initiating ECCS systems in this scenario (OPLEC), which has to be done in the same time period as OPDHR (10 min.).

Locator Files

File Name: OPLECLLA.TRP

Initiator: TRPT5

Event Tree: RA (from LA, Seq. 20, 37, from ADH, Seq. 1,
from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	1.0		HEP 23

In the loss of forced recirculation scenario, ADHR continues to run. OPDHR involves isolating RWCU (which continues to run) and diagnosing the potential disconnect between the core and the downcomer which would lead to a functional loss of SDC. The operators make the correct diagnosis and attempt to initiate CDS for makeup, but CDS fails. Given all the necessary choices and actions to accomplish in OPDHR, no time would be left for initiating ECCS systems in this scenario (OPLEC), which has to be done in the same time period as OPDHR (10 min.). ECCS is asked in EA when transfer from RA tree.

File Name: OPLECLP7.RP

Initiator: T1-5

Event Tree: RP (from LP, Seq 7, from SDC Seq. 5,
from T1-5, Seq. 3)

RP (from LP, Seq 14, from SDC Seq. 5,
from T1-5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

The initiator is a LOSEP, with DV1-2 succeeding. SDC(B) runs. RWCU auto-isolates when power or IA is lost. CRD is gone. OPSDC succeeds and SDC(B) runs. OPDHR succeeds and CDS is unavailable. OPLEC is completely dependent on OPDHR which involves diagnosing the need for makeup.

It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the ops. would control level. That is, the actions are assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

When power is lost, RWCU isolates automatically, resulting in little drain down. Thus, the 10 min. allowed for OPDHR (and therefore OPLEC) is very conservative. Consequently, in sequences where power is lost, credit was taken for operators initiating both LPCI and HPCS if one of them failed to start due to hardware.

Locator Files

File Name: OPLECLP7.RP

Initiator: T1-5

Event Tree: RP (from LP, Seq 7, from SDC Seq. 5,
from T1-5, Seq. 3)

RP (from LP, Seq 14, from SDC Seq. 5,
from T1-5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

The initiator is a LOSEP, with DV1-2 succeeding. SDC(B) runs. RWCU auto-isolates when power or IA is lost. CRD is gone. OPSDC succeeds and SDC(B) runs. OPDHR succeeds and CDS is unavailable. OPLEC is completely dependent on OPDHR which involves diagnosing the need for makeup.

It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the ops. would control level. That is, the actions are assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

When power is lost, RWCU isolates automatically, resulting in little drain down. Thus, the 10 min. allowed for OPDHR (and therefore OPLEC) is very conservative. Consequently, in sequences where power is lost, credit was taken for operators initiating both LPCI and HPCS if one of them failed to start due to hardware.

File Name: OPLECLR.E1B

Initiator: E1B5H

Event Tree: R (from L, Seqs. 20, 31, 37, 47, from E1B5H, Seqs. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	1.0		HEP 23

An isolation of SDC(B) is the initiator. SDC(B) is restarted. OPDHR involves isolating RWCU and the operators must also diagnose the potential loss of connection between the core and the downcomer. They then need to initiate some form of makeup. CDS is logical choice, but CDS fails. Given all the necessary choices and actions to accomplish OPDHR, no time would be left for initiating ECCS systems in this scenario (OPLEC) which has to be done in same time period as OPDHR (10 min.).

Locator Files

File Name: OPLECLR.E1D

Initiator: E1D5H

Event Tree: RA (from LA, Seqs. 31, 37, 47, from E1D5H, Seqs. 3, 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	1.0		HEP 23

An isolation of ADHR is the initiator. ADHR or SDC(B) is restarted. OPDHR involves isolating RWCU. The operators must also diagnose the potential loss of connection between the core and the downcomer. They then need to initiate some form of level control (makeup). CDS is logical choice, but it fails. Given all the necessary choices and actions to accomplish OPDHR, no time would be left for initiating ECCS (HPCS) systems (OPLEC) in this scenario. OPLEC must be done in the same time period as OPDHR (10 min.).

File Name: OPLECLR.E1T

Initiator: E1T5H

Event Tree: R (from L, Seqs. 20, 31, 37, 47, from E1T5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC'-LP	0		HEP 23

Isolation of SDC common suction line. SDC(B) restarted. OPDHR involves isolating RWCU. Operators must also diagnose loss of connection between core and downcomer. They then need to initiate some form of makeup. CDS is unavailable when SDC(B) is operating. ECCS becomes the system of choice for controlling level. Thus, if OPDHR succeeds, OPLEC, which is controlling level with ECCS, must also succeed. OPLEC has to be done in same time period as OPDHR (10 min.).

Locator Files

File Name: OPLECLR.E1V

Initiator: E1V5H

Event Tree: RA (from LA, Seqs. 20, 31, 37, 47, from E1V5H, Seq. 4)
RAP (from LAP, Seqs. 7, 14, from E1V5H, Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

Isolation of SDC common suction line. SDC(B) started after unisolation of SDC and a failure of ADHRS to restart. OPDHR involves isolating RWCU. Operators must also diagnose loss of connection between core and downcomer. They then need to initiate some form of makeup. CDS is unavailable when SDC(B) is operating. ECCS becomes the system of choice for controlling level. Thus, if OPDHR succeeds, OPLEC, which is controlling level with ECCS, must also succeed. OPLEC has to be done in same time period as OPDHR (10 min.).

File Name: OPLECLR.E2D

Initiator: E2D5H

Event Tree: RA (from LA, Seqs. 31, 37, 47, from E2D5H, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	1.0		HEP 23

A complete loss of ADHR is the initiator. SDC(B) is started. OPDHR involves isolating RWCU. The operators must also diagnose the potential loss of a connection between the core and the downcomer. They then need to initiate some form of level control (makeup). CDS is the logical choice. CDS fails. Given all the necessary choices and actions to accomplish OPDHR, no time would be left for initiating ECCS (OPLEC). OPLEC has to be done in same time period as OPDHR (10 min.).

Locator Files

File Name: OPLECLR.TRV

Initiator: TORV5

Event Tree: R (from L, Seqs. 31, 37, 47, from ADEP, Seq. 3,
 from TORV5, Seq. 3)
 RP (from LP, Seqs. 7, 14, from ADEPP, Seq. 2,
 from TORV5, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

The initiator is an inadvertent stuck open relief valve during a HYDRO test. The vessel depressurizes and the operators establish SDC(B). If a LOSP occurs, a diesel starts and loads (DV1-2 succeeds). OPDHR involves isolating RWCU. Operators must also diagnose loss of connection between core and downcomer. They then need to initiate some form of makeup. CDS is unavailable when SDC(B) is operating. ECCS becomes the system of choice for controlling level. Thus, if OPDHR succeeds, OPLEC, which is controlling level with ECCS, must also succeed. OPLEC has to be done in same time period as OPDHR (10 min.). If the operators initiate HPCS or LPCI it is assumed that they will control level.

File Name: OPLECR.TIF

Initiator: TIOF5

Event Tree: R (from L, Seq. 20, 31, 37, 47, from SDC Seq. 1,
from TIOF5, Seq. 2)

RA (from LA, Seq. 31, 37, 47, from ADH Seq. 1, 2,
from TIOF5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

The initiator is an inadvertent actuation of LPCI. The operators successfully stop injection from LPCI (OPSLP succeeds). At some point later, CRD fails, and in some cases RWCU and forced recirculation fail. SDC(B) or ADHRS continue to provide SDC. The operators successfully control level (OPDHR succeeds) to prevent a disconnect between the core and the downcomer. OPLEC is completely dependent on OPDHR. Since RHR/SDC or ADHRS continues to run, ECCS will be the logical choice for level control. Thus, if OPDHR succeeds, then OPLEC (which is initiation of ECCS for level control) will also succeed. It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, initiating and controlling level were assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

Locator Files

File Name: OPLECR.TIH

Initiator: TIHP5

Event Tree: R (from L, Seq. 20, 31, 37, 47, from SDC Seq. 1,
from TIHP5, Seq. 2, 4)

RA (from LA, Seq. 31, 37, 47, from ADH Seq. 1, 2,
from TIHP5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

The initiator is an inadvertent actuation of HPCS. Either HPCS auto-isolates on level 8 or the operators successfully stop HPCS injection (OPHPC succeeds). At some point later, CRD fails, and in some cases RWCU and forced recirculation fail. SDC(B) or ADHRS continue to provide SDC. The operators successfully control level (OPDHR succeeds) to prevent a disconnect between the core and the downcomer. OPLEC is completely dependent on OPDHR. Since RHR/SDC or ADHRS continues to run, ECCS will be the logical choice for level control. Thus, if OPDHR succeeds, then OPLEC (which is initiation of ECCS for level control) will also succeed. It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, initiating and controlling level were assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

File Name: OPLECR.TIO

Initiator: TIOP5

Event Tree: R (from L, Seq. 31, 47, from SDC Seq. 1,
from TIOP5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

Mismatch between letdown and makeup is the initiator. OPLEC is completely dependent on OPDHR. Since RHR/SDC continues to run, ECCS will be the logical choice for level control. Thus, if OPDHR succeeds, then OPLEC (which is initiation of ECCS for level control) will also succeed. It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, initiating and controlling level were assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

When power is lost, RWCU isolates automatically, resulting in little drain down. Thus, the 10 min. allowed for OPDHR (and therefore OPLEC) is very conservative. Consequently, in sequences where power is lost (and other isolation of RWCU sequences), credit was taken for operators initiating both LPCI and HPCS if one of them failed to start due to hardware failure.

Locator Files

File Name: OPLECR.TRP

Initiator: TRPT5

Event Tree: R (from L, Seq. 20, 31, 37, 47, from SDC Seq. 1,
from TRPT5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

Loss of forced recirculation is the initiator. OPLEC is completely dependent on OPDHR. Since RHR/SDC continues to run, ECCS will be the logical choice for level control. Thus, if OPDHR succeeds, then OPLEC (which is initiation of ECCS for level control) will also succeed. It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, initiating and controlling level were assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

File Name: OPLECRA.TRP

Initiator: TRPT5

Event Tree: RA (from LA, Seq. 20, 31, 37, 47, from ADHR Seq. 2,
from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

Loss of forced recirculation is the initiator. OPLEC is completely dependent on OPDHR. Since the operators have established RHR/SDC(B) after a loss of ADHR, ECCS will be the logical choice for level control CDS not viable with SDC(B) in operation. Thus, if OPDHR succeeds, then OPLEC (which is the initiation of ECCS for level control) will also succeed. It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, initiating and controlling level were assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

Locator Files

File Name: OPLECRAP.E1D

Initiator: E1D5H

Event Tree: RAP (from LAP, Seq 7, 14, from E1D5H Seq. 14)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
* LCHPC	0		HEP 23
* LC-LP	0		HEP 23

ADHR isolates. A LOSP occurs, but DV1-2 OK,. The operators recognize the loss of SDC (OPSDC succeeds). SDC(B) is started. OPDHR succeeds with HPCS. Assumed HPCS choice because SDC(B) is running. OPLEC is completely dependent on OPECS in this case.

It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, they are assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

- * Since LPCI (C) unavailable and SDC(B) running, only credit for HPCS is allowed.

File Name: OPLECRAP.T5D

Initiator: T5D5H

Event Tree: RAP (from LAP, Seq 14, from T5D5H, Seq. 23)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

A loss of CCW is the initiator A LOSP occurs, but DV1-2 succeeds. RWCU auto-isolates. CRD is gone. OPSDC succeeds and SDC(B) runs. OPDHR succeeds, but CDS is unavailable. OPLEC is completely dependent on OPDHR which involves diagnosing the need for makeup.

It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, the actions are assumed to be completely dependent. If the operators selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

When power is lost, RWCU isolates automatically, resulting in little drain down. Thus, the 10 min. allowed for OPDHR (and therefore OPLEC) is very conservative. Consequently, in sequences where power is lost, credit was taken for operators initiating both LPCI and HPCS if one of them failed to start due to hardware.

Locator Files

File Name: OPLECRAP.TIA

Initiator: TIA5H

Event Tree: RAP (from LAP, Seq 7, 14, from TIA5H, Seq. 22)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

A loss of IA and at some point a LO SP. RWCU auto-isolates. CRD is gone. OPSDC succeeds and SDC(B) runs. OPDHR succeeds and CDS is unavailable. OPLEC is completely dependent on OPDHR which involves diagnosing the need for makeup.

It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the ops. would control level. That is, the actions are assumed to be completely dependent. If the operators selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

When power is lost, RWCU isolates automatically, resulting in little drain down. Thus, the 10 min. allowed for OPDHR (and therefore OPLEC) is very conservative. Consequently, in sequences where power is lost, credit was taken for operators initiating both LPCI and HPCS if one of them failed to start due to hardware.

File Name: OPLECRHY.TRP

Initiator: TRPT5

Event Tree: R (from L, Seq. 20, 31, 37, 47, from ADEP, Seq. 3,
 from TRPT5, Seq. 7)
 . RP (from LP, Seq. 7, from ADEPP, Seq. 2,
 from TRPT5, Seq. 8)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

Loss of forced recirculation during a HYDRO test is the initiator. OPLEC is completely dependent on OPDHR. Since RHR/SDC continues to run, ECCS will be the logical choice for level control. Thus, if OPDHR succeeds, then OPLEC (which is initiation of ECCS for level control) will also succeed. It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, initiating and controlling level were assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

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Locator Files

File Name: OPLECRP.E1B

Initiator: E1B5H

Event Tree: RP (from LP, Seq 7, 14 from, E1B5H Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

An isolation of SDC(B) is the initiator. A LOSP occurs, but DV1-2 succeeds. The operators recognize the loss of SDC (OPSDC succeeds) and SDC(B) is restarted. OPDHR succeeds. OPLEC is completely dependent on OPECS in this case (CDS unavailable).

It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, they are assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

When power is lost, RWCU isolates automatically, resulting in little drain down. Thus, the 10 min. allowed for OPDHR (and therefore OPLEC) is very conservative. Consequently, in sequences where power is lost, credit was taken for operators initiating both LPCI and HPCS if one of them failed to start due to hardware.

File Name: OPLECRP.E1T

Initiator: E1T5H

Event Tree: RP (from LP, Seqs. 7, 14, from E1T5H, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

Isolation of SDC common suction line. SDC(B) restarted. OPDHR involves diagnosing loss of connection between core and downcomer. They then need to initiate some form of makeup. CDS is unavailable when SDC(B) is operating. ECCS becomes the system of choice for controlling level. Thus, if OPDHR succeeds, OPLEC, which is controlling level with ECCS, must also succeed. OPLEC has to be done in same time period as OPDHR (10 min.).

Locator Files

File Name: OPLECRP.T5D

Initiator: T5D5H

Event Tree: RP (from LP, Seq 7, 14, from T5D5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

Loss of CCW is the initiator. A LOSP occurs, but DV1-2 succeeds. RWCU auto-isolates. CRD is gone, but SDC(B) runs. OPDHR succeeds and CDS is unavailable. OPLEC is completely dependent on OPDHR which involves diagnosing the need for level control (makeup).

It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, the actions are assumed to be completely dependent. If the operators selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

When power is lost, RWCU isolates automatically, resulting in little drain down. Thus, the 10 min. allowed for OPDHR (and therefore OPLEC) is very conservative. Consequently, in sequences where power is lost, credit was taken for operators initiating both LPCI and HPCS if one of them failed to start due to hardware.

File Name: OPLECRP.TIF

Initiator: TIOF5

Event Tree: RP (from LP, Seq. 7, 14, from SDC, Seq. 5,
from TIOF5 Seq. 2)

RAP (from LAP, Seq 14, from ADH, Seq. 6,
from TIOF5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

In this inadvertent actuation of LPCI scenario, the operators successfully stop LPCI injection. A LOSP occurs at some time after the initiator, but the diesel generators start (DV1-2 OK). SDC(B) (or ADHRS) either continues to run or is successfully restarted. RWCU auto-isolates with the LOSP. CRD fails at some point. Operators successfully attempt to control level with an ECCS system (OPDHR succeeds). OPLEC is completely dependent on OPDHR in this case. Thus, OPLEC should be set to 0 (success) in these scenarios.

It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, they are assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

- * When power is lost, RWCU isolates automatically, resulting in little drain down. Thus, the 10 min. allowed for OPDHR (and therefore OPLEC) is very conservative. Consequently, in sequences where power is lost, credit was taken for operators initiating both LPCI and HPCS if one of them failed to start due to hardware.

Locator Files

File Name: OPLECRP.TIH

Initiator: TIHP5

Event Tree: RP (from LP, Seq. 7, 14, from SDC, Seq. 5,
from TIHP5 Seq. 2, 4)

RAP (from LAP, Seq 14, from ADH, Seq. 6,
from TIHP5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

In this inadvertent actuation of HPCS scenario, either HPCS auto-isolates on level 8 or the operators successfully stop HPCS injection (OPHPC succeeds). A LOSP occurs at some time after the initiator, but the diesel generators start (DV1-2 OK). SDC(B) (or ADHRS) either continues to run or is successfully restarted. RWCU auto-isolates with the LOSP. CRD fails at some point. Operators successfully attempt to control level with an ECCS system (OPDHR succeeds). OPLEC is completely dependent on OPDHR in this case. Thus, OPLEC should be set to 0 (success) in these scenarios.

It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, they are assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

- * When power is lost, RWCU isolates automatically, resulting in little drain down. Thus, the 10 min. allowed for OPDHR (and therefore OPLEC) is very conservative. Consequently, in sequences where power is lost, credit was taken for operators initiating both LPCI and HPCS if one of them failed to start due to hardware.

File Name: OPLECRP.TLM

Initiator: TLM5H

Event Tree: R (from L, Seq. 31, 37, 47, from SDC, Seq. 1,
from TLM5H Seq. 3)

RP (from LP, Seq 7, 14, from SDC, Seq. 5,
from TLM5H Seq. 3)

RA (from LA, Seq 37, from ADH, Seq. 1,
from TLM5H Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

Loss of makeup (CRD) initiator. In one scenario, a LOSP occurs at some time after the initiator, but the diesel generators start (DV1-2 OK). SDC(B) or ADHRS either continues to run or is successfully restarted. Operators successfully attempt to control level with an ECCS system (OPDHR succeeds). OPLEC is completely dependent on OPECS in this case. Thus, OPLEC should be set to 0 (success) in these scenarios.

It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, they are assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If the used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

- * When power is lost, RWCU isolates automatically, resulting in little drain down. Thus, the 10 min. allowed for OPDHR (and therefore OPLEC) is very conservative. Consequently, in sequences where power is lost, credit was taken for operators initiating both LPCI and HPCS if one of them failed to start due to hardware.

Locator Files

File Name: OPLECRP.TRP

Initiator: TRPT5

Event Tree: RP (from LP, Seq. 7, 14, from SDC Seq. 5,
 from TRPT5, Seq. 3)
 RAP (from LAP, Seq. 7, 14, from ADH Seq. 6,
 from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPLEC	0		HEP 23
LCHPC	0		HEP 23
LC-LP	0		HEP 23

Loss of forced recirculation is the initiator followed at some point by a LO SP. A diesel starts ((DV1-2 succeeds). The operators successfully control level (OPDHR succeeds). OPLEC is completely dependent on OPDHR. Since RHR/SDC continues to run or is started, ECCS will be the logical choice for level control. Thus, if OPDHR succeeds, then OPLEC (which is initiation of ECCS for level control) will also succeed. It was assumed that if either HPCS or LPCI were selected and initiated for injection to increase level, the operators would control level. That is, initiating and controlling level were assumed to be completely dependent. If they selected HPCS, then LCHPC will be successful. If they used LPCI, then LC-LP will be successful. Essentially, it was assumed that if they diagnose the need for LPCI or HPCS, they will know the injection rates and not simply walk away.

When a LO SP occurs, the time for OPDHR would be much longer than the 10 min. assumed for the event. Thus, credit can be taken for operators attempting to initiate HPCS if LPCI fails to start.

File Name: OPNCF.TRP

Initiator: TRPT5

Event Tree: TRPT5

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPNCF	0.006	10	HEP 83

TRPT5 initiator is loss of forced recirculation. In this scenario it occurs during a HYDRO Test. Over time the vessel will begin to pressurize and temperature will begin to increase. If decay heat removal is inadequate using CRD as makeup and RWCU as letdown, then operators will want to depressurize in order to be able to control decay heat removal. Can depressurize in any number of ways, e.g., stop CRD and increase makeup, open SRV etc. Operators have 8.7 hours to accomplish this action.

Locator Files

File Name: OPSDC.ADH

Initiator: T1-5

Event Tree: ADH (from T1-5, Seq. 5)

Human Error Event:

	<u>Mean HEP</u>	<u>EF</u>	<u>Code#</u>
OPSDC	0.046	10	HEP 2

The initiator is a LOSP with a successful diesel generator start (DV1-2 succeeds). Operators were initially using the ADHRS for SDC. OPSDC in this scenario involves the operators detecting the loss of the operating ADHRS and diagnosing the need for an alternative mode of SDC. Upon entering the IDHR ONEP, the operators are instructed to initiate any standby sources of SDC. In this case RHR/SDC(B) may be available and will be initiated per SOI 04-1-01-E12-1.

File Name: OPSDC.E2B

Initiator: E2B5H

Event Tree: E2B5H

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSDC	8.5E-4	30	HEP 1
OPSDC (XTIEB case)	0.6	10	HEP 20

Loss of SDC(B) (not just isolation) is the initiator. In this scenario the operators must diagnose the loss of SDC(B). In some sequences (no LOSP), the diagnosis will be based solely on the alarms associated with the specific loss of SDC(B), i.e., low flow, pump trip due to loss of suction etc. In other relevant (non-XTIEB) sequences, a LOSP will occur sometime after the initiator and DV1-2 will succeed.

For the sequences where the operators must cross-tie the HPCS diesel generator to the B train (LOSP and DV1-2 fails with HPCS unavailable), OPSDC is very different. In these scenarios, OPSDC involves diagnosing the likelihood that SDC(B) will isolate on 135 psi when XTIEB is completed (and thus not be available) and then entering the relevant ONEP to prepare for going water solid (OPECS). If the control room fails to make this diagnosis in the time available for OPSDC, the time available for OPECS might not be used appropriately. That is, the operators could simply waste the time for OPSDC and OPECS with the notion that they will restart SDC(B) when they get the XTIEB done and then not have any time for diagnosing and carrying-out the actions related to OPECS (starting low pressure system (LPCI (C)) and opening SRVs etc.). As indicated by the HEP for OPSDC (see HEP 20), the correct diagnosis is non-trivial.

Locator Files

File Name: OPSDC.E2B

Initiator: E2B5H

Event Tree: E2B5H

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSDC	8.5E-4	30	HEP 1
OPSDC (XTIEB case)	0.6	10	HEP 20

Loss of SDC(B) (not just isolation) is the initiator. In this scenario the operators must diagnose the loss of SDC(B). In some sequences (no LOSP), the diagnosis will be based solely on the alarms associated with the specific loss of SDC(B), i.e., low flow, pump trip due to loss of suction etc. In other relevant (non-XTIEB) sequences, a LOSP will occur sometime after the initiator and DV1-2 will succeed.

For the sequences where the operators must cross-tie the HPCS diesel generator to the B train (LOSP and DV1-2 fails with HPCS unavailable), OPSDC is very different. In these scenarios, OPSDC involves diagnosing the likelihood that SDC(B) will isolate on 135 psi when XTIEB is completed (and thus not be available) and then entering the relevant ONEP to prepare for going water solid (OPECS). If the control room fails to make this diagnosis in the time available for OPSDC, the time available for OPECS might not be used appropriately. That is, the operators could simply waste the time for OPSDC and OPECS with the notion that they will restart SDC(B) when they get the XTIEB done and then not have any time for diagnosing and carrying-out the actions related to OPECS (starting low pressure system (LPCI (C)) and opening SRVs etc.). As indicated by the HEP for OPSDC (see HEP 20), the correct diagnosis is non-trivial.

File Name: OPSDC.E2T

Initiator: E2T5H

Event Tree: E`T5H

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSDC	8.5E-4	10	HEP 1
OPSDC (XTIEB case)	0.6	10	HEP 20

Loss of SDC(B) common suction line (not just isolation) is the initiator (E2T5H). In this scenario the operators must diagnose the loss of SDC(B). In some sequences (no LOSP), the diagnosis will be based solely on the alarms associated with the specific loss of SDC(B), i.e., low flow, pump trip due to loss of suction etc. In other relevant (non-XTIEB) sequences, a LOSP will occur sometime after the initiator and DV1-2 will succeed.

For the sequences where the operators must cross-tie the HPCS diesel generator to the B train (LOSP and DV1-2 fails with HPCS unavailable), OPSDC is very different. In these scenarios, OPSDC involves diagnosing the likelihood that SDC(B) will isolate on 135 PSI when XTIEB is completed (and thus not be available) and then entering the relevant ONEP to prepare for going water solid (OPECS). If the control room fails to make this diagnosis in the time available for OPSDC, the time available for OPECS might not be used appropriately. That is, the operators could simply waste the time for OPSDC and OPECS with the notion that they will restart SDC(B) when they get the XTIEB done and then not have any time for diagnosing and carrying-out the actions related to OPECS (starting low pressure system (LPCI (C)) and opening SRVs etc.). As indicated by the HEP for OPSDC (see HEP 20), the correct diagnosis is non-trivial.

Locator Files

File Name: OPSDC.E2V

Initiator: E2V5H

Event Tree: E2V5H

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSDC	0.046	10	HEP 2
OPSDC (XTIEB case)	0.6	10	HEP 20

Loss of SDC common suction line (not just isolation) is the initiator (E2V5H). In this scenario the operators must diagnose the loss of ADHRS. In some sequences (no LOSP), the diagnosis will be based solely on the alarms associated with the specific loss of the ADHRS, i.e., low flow, pump trip due to loss of suction etc. In other relevant (non-XTIEB) sequences, a LOSP will occur sometime after the initiator and DV1-2 will succeed. Since all SDC is assumed unavailable with this initiator, initiation of SDC(B) would not be possible. However, the operators must be able to diagnose the nature of the problem and they may very well try to initiate SDC(B) per procedure if the nature of the failure is not clear. Thus, initiation of SDC(B) was assumed to be part of the action as in other similar cases where the operators were initially on ADHRS, e.g., E2D5H.

For the sequences where the operators must cross-tie the HPCS diesel generator to train B (a LOSP occurs and DV1-2 fails with HPCS unavailable), OPSDC is very different. In these scenarios, OPSDC involves diagnosing the likelihood that SDC(B) will be isolated on 135 psi when the cross-tie (XTIEB) is completed (and thus not be available) and then entering the IDHR ONEP to prepare for going water solid (OPECS). If the control room fails to make this diagnosis in the time available for OPSDC, the time available for OPECS might not be used appropriately. That is, the operators could simply waste the time for OPSDC and OPECS with the notion that they will start SDC(B) when they get the XTIEB done and then not have any time for diagnosing and carrying-out the actions related to OPECS (starting low pressure system (LPCI (C) or (B) and opening SRVs etc.). As indicated by the HEP for OPSDC (see HEP 20), the correct diagnosis is non-trivial.

File Name: OPSDC.SDC

Initiator: T1-5

Event Tree: SDC (from T1-5, Seq.3)

Human Error Events:

	<u>Mean HEP</u>	<u>EF</u>	<u>Code#</u>
OPSDC	8.5E-4	30	HEP 1

OPSDC in this scenario involves the operators detecting the loss of the operating RHR/SDC loop and entering the Inadequate Decay Heat Removal ONEP. In this case, SDC(B) initially isolates due to a LOSP and the action entails a simple attempt to restart the system from the control room. The analysis assumes that the A train of RHR is out for maintenance and that ADHRS will be inadequate at this point in the shutdown. It was assumed that if the operators detected the loss of the operating SDC loop in the given context of being in shutdown with no other SDC loop available, they would enter the appropriate ONEP. Thus, complete dependence was assumed between determining the loss of the operating SDC system and entering the appropriate ONEP. It was also assumed that if the control room diagnoses the loss of SDC, they will attempt a restart of SDC(B) and determine whether or not it successfully restarts.

Locator Files

File Name: OPSDC.T5A

Initiator: T5A5H

Event Tree: T5A5H

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
* OPSDC	8.5E-4	30	HEP 1

A loss of SSW will result in numerous indications and alarms if it fails or performance is reduced. The ONEP for loss of SSW notes the resulting loss of RHR/SDC(B). Loss of SDC(B) will also be alarmed.

A loss of ADH is random in this scenario, but SDC(B) will not be available. Thus, in both the RHR and ADH branches of T5A5H, the operators need only diagnose the need and pull the ONEPs for loss of SSW and IDHR. An attempt to align SDC(B) is not indicated.

- * In this scenario, the HEP for OPSDC will not differ for the case where the HPCS diesel generator must be cross-tied (XTIEB succeeds case), as it has in other sequences. Given the loss of SSW, the operators will not need to be concerned about isolation of SDC at 135 psi, SDC will not be available anyway. Thus, they just need to diagnose the situation and pull the relevant procedures as in HEP 1.

File Name: OPSDC.T5D

Initiator: T5D5H

Event Tree: T5D5H

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
<u>RHR LOOP B Sequences</u>			
OPSDC (No XTIEB)	8.5E-4	30	HEP 1
OPSDC (With XTIEB success)	0.6	10	HEP 20
<u>ADHR Sequences</u>			
OPSDC (No XTIEB)	0.046	10	HEP 2
OPSDC (With XTIEB success)	0.6	10	HEP 20

The loss of CCW initiator does not have a direct affect on RHR/SDC or ADHRS. Thus, the operators are detecting random losses of the operating SDC system or losses due to a LOSP that has occurred sometime after the initiating event. Thus, the HEPs are the same as in similar cases.

Locator Files

File Name: OPSDC.TAB

Initiator: TAB5H

Event Tree: SDC (from TAB5H, Seq.3)

ADH (from TAB5H, Seq. 5)

Human Error Event:

	<u>Mean HEP</u>	<u>EF</u>	<u>Code#</u>
OPSDC	8.5E-4	30	HEP 1

OPSDC in this case includes the operators detecting loss of operating SDC (RHR or ADHRS) loop in the context of loss of AC bus(es) and entering the ONEP for IDHR. It was assumed that if the operators detected the loss of the all SDC in the given context of being in shutdown with the loss of the AC bus and no other normal SDC loop available, they would enter the appropriate ONEP. Thus, complete dependence was assumed between determining the loss of the operating SDC system (in context of loss of AC bus) and entering the appropriate ONEP. With the loss of the AC bus, numerous indications would occur and in the shutdown context, maintaining SDC would clearly be a concern.

File Name: OPSDC.TIF

Initiator: TIOF5

Event Tree: SDC (from TIOF5, Seq. 2)
 ADH (from TIOF5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSDC (SDC)	8.5E-4	10	HEP 1
OPSDC (ADH)	0.046	10	HEP 2
OPSDC (preceded by XTIEB)	0.6	10	HEP 20

TIOF5 initiator, which is an inadvertent actuation of LPCI. The operators successfully stop injection, but at some point later a loss of the operating SDC system (RHR/SDC or ADHRS) occurs. OPSDC is the operator action to diagnose the loss of SDC.

Locator Files

File Name: OPSDC.TIH

Initiator: TIHP5

Event Tree: SDC (from TIHP5, Seq. 2, 4)
 ADH (from TIHP5, Seq. 3, 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSDC (SDC)	8.5E-4	10	HEP 1
OPSDC (ADH)	0.046	10	HEP 2
OPSDC (preceded by XTIEB)	0.6	10	HEP 20

TIHP5 initiator, which is an inadvertent actuation of HPCS. Either the auto-isolation at level 8 (HPCAO) or the control room (OPHPC) successfully stops injection, but at some point later a loss of the operating SDC system (RHR/SDC or ADHRS) occurs. OPSDC is the operator action to diagnose the loss of SDC.

File Name: OPSDC.TIO

Initiator: TIOP5

Event Tree: SDC (from TIOP5, Seq. 2)
 ADH (from TIOP5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSDC (SDC)	8.5E-4	10	HEP 1
OPSDC (ADH)	0.046	10	HEP 2
OPSDC (preceded by XTIEB)	0.6	10	HEP 20

TIOP initiator. Mismatch between letdown and makeup resulting in over-pressurization. Initiator is generally assumed to result from an isolation or at least partial isolation of RWCU. With letdown isolated and makeup continuing to run, level and pressure will begin to increase. Operators will get an alarm at level 8 and may receive additional pressure related alarms. In addition, operators have approximately 2 and one-half hours to detect the problem and control makeup (LCMK). In this time period level and pressure would be monitored. If LCMK succeeds, transfer to SDC or ADH tree depending on initial SDC (RHR or ADHRS). With LCMK success, operator actions are identical to those in other transients, e.g., T1.

Locator Files

File Name: OPSDC.TLM

Initiator: TLM5H

Event Tree: SDC (from TLM5H, Seq. 3)
 ADH (from TLM5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSDC (SDC)	8.5E-4	10	HEP 1
OPSDC (ADH)	0.046	10	HEP 2
OPSDC (preceded by XTIEB)	0.6	10	HEP 20

TLM5H initiator. Loss of makeup (CRD) initiator, followed by a loss of SDC (SDC(B) or ADHRS). In addition to the pump trip alarms for loss of CRD, operators will probably get alarms for SDC pump trip, low flow alarms, and low level alarms. In addition, vessel temperature will begin to increase. Operators will enter the IDHR ONEP under these conditions.

File Name: OPSDC.TRP

Initiator: TRPT5

Event Tree: SDC (from TRPT5, Seq. 3)
 ADH (from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSDC (SDC)	8.5E-4	10	HEP 1
OPSDC (ADH)	0.046	10	HEP 2
OPSDC (preceded by XTIEB)	0.6	10	HEP 20

TRPT5 initiator. A loss of forced recirculation occurs and is followed at some point by a loss of the operating SDC system (RHR/SDC or ADHRS). In some sequences a LOSP occurs but DV1-2 succeeds.

Locator Files

File Name: OPSDCADH.E2D

Initiator: E2D5H

Event Tree: E2D5H

Human Error Event:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code #</u>
OPSDC	0.046	10	HEP 2
OPSDC (XTIEB Case)	0.6	10	HEP 20

Loss of ADHR system is the initiator. In this scenario the operators must detect the loss of ADHRS, diagnose the need for an alternative mode of SDC (i.e. the operators enter the IDHR ONEP), and attempt to initiate a standby source of SDC, per SOI 04-1-01-E12-1. In sequences with no LOSEP, the diagnosis will be based solely on the alarms associated with the specific loss of ADHRS, i.e., low flow, pump trip due to loss of suction etc. In other relevant (non-XTIEB) sequences, a LOSEP will occur sometime after the initiator and DV1-2 will succeed. With the loss of ADHR and success of DV1-2, it was assumed that the operators would try to start SDC(B) per procedure.

For the sequences where a cross-tie of the diesel generators is asked and XTIEB succeeds, the operators must recognize that once XTIEB is complete, it will be likely that SDC(B) will have isolated (or will isolate) due to the rising pressure, on 135 psi. The operators should be planning for use of some other means of SDC. In this case, LPCI (B) will be the only available ECCS system. LPCI(C) and HPCS are gone. LPCI(C) is assumed unavailable because it shares common piping with ADHRS which has been lost.

File Name: OPSDCADH.TIA

Initiator: TIA5H

Event Tree: TIA5H (For ADHRS branches of TIA5H, except when
XTIEB succeeds)

Human Error Event:

	<u>Mean HEP</u>	<u>EF</u>	<u>Code#</u>
OPSDC	0.046	10	HEP 2

The initiator is a loss of Instrument Air. If a LOSP occurs, a diesel generator successfully starts (DV1-2). Operators were initially using the ADHRS for SDC. OPSDC in this scenario involves the operators detecting the loss of the operating ADHRS and diagnosing the need for an alternative mode of SDC. Upon entering the IDHR ONEP, the operators are instructed to initiate any standby sources of SDC. In this case RHR/SDC(B) may be available and will be initiated per SOI 04-1-01-E12-1.

Locator Files

File Name: OPSDCSDC.TIA

Initiator: TIA5H

Event Tree: TIA5H (For RHR Loop B branches of TIA5H, except when XTIEB succeeds)

Human Error Event:

	<u>Mean HEP</u>	<u>EF</u>	<u>Code#</u>
OPSDC	8.5E-4	30	HEP 1

In this scenario the operators must detect a loss of the operating RHR/SDC loop, which has occurred sometime after a loss of IA, and enter the IDHR ONEP. The loss of SDC is either random or due to a LOSEP with DV1-2 successful. It was assumed that if the operators detected the loss of the operating SDC loop in the given context of being in shutdown with no other SDC loop available, they would enter the appropriate ONEP. Thus, complete dependence was assumed between determining the loss of the operating SDC system and entering the appropriate ONEP. In addition, in the case of a LOSEP, it was also assumed that if the control room diagnoses the loss of SDC, they will attempt a restart of SDC(B) (a simple task at control panel).

File Name: OPSLP.TIF

Initiator: TIOF5

Event Tree: TIOF5

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSLP	0.106	10	HEP 86

Spurious actuation of LPCI or LPCS initiator (TIOF5). Operators would get level 7 and level 8 alarms within 1 min. of actuation. Level would be increasing rapidly and operators would check systems likely to allow such level changes. Pump starts and valve openings would be indicated. OPSLP is operator action to detect and stop the inadvertent injection prior to overpressurization.

Locator Files

File name: OPSOF.E1B

Initiator: E1B5H

Event Tree: OF (from E, Seq. 50, from E1B5H, Seq. 5, 8, 10)

OF (from E, Seq. 50, from L, Seq. 38,
from E1B5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

An isolation of the operating SDC system occurs. For some sequences SDC(B) fails to restart on demand. OPECS succeeds, but the operators fail to check closed MSIVs (in the 4 min. allowed during OPECS). In other sequences SDC(B) restarts, but loss of forced recirculation, RWCU and/or CRD require operators to control level, but they fail (OPDHR fails). Water will begin to flood down steam lines. OPSOF asks whether or not the operators will stop any flooding through the main steam lines. The operators must terminate injecting system and close MSIVs.

File Name: OPSOF.E1T

Initiator: E1T5H

Event Tree: OF (from E, Seq. 50, from E1T5H, Seq. 5, 7, 9)
 OFF (from EP, Seq. 50, from E1T5H, Seq. 14)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

An isolation of the SDC common suction line is the initiator. Operators recognize or initially fail to recognize the loss of SDC (OPSDC succeeds or fails). Eventually they recognize the loss and attempt to initiate ECCS water solid operation (OPECS succeeds), but MSIVs are open. OPSOF is operator action to stop flooding down open main steam lines and 20 min. is available for this task. In addition to the existing alarms, operators may get additional alarms from steam line drain valves etc. and would get low SP alarm eventually.

Locator Files

File Name: OPSOF.E1V

Initiator: E1V5H

Event Tree: OF (from EA, Seq. 80, from E1V5H, Seq. 6, 8, 10)
OFP (from EAP, Seq. 50, from E1V5H, Seq. 15)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

An isolation of the SDC common suction line is the initiator (initially on ADHRS). Operators recognize or initially fail to recognize the loss of SDC (OPSDC succeeds or fails). Eventually they recognize the loss and attempt to initiate ECCS water solid operation (OPECS succeeds), but MSIVs are open. OPSOF is operator action to stop flooding down open main steam lines and 20 min. is available for this task. In addition to the existing alarms, operators may get additional alarms from steam line drain valves etc. and would get low SP alarm eventually.

File name: OPSOF.E2B

Initiator: E2B5H

Event Tree: OF (from E, Seq. 50, from E2B5H, Seq. 5, 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

A loss of the operating SDC system occurs. The operators initiate ECCS water solid operation (OPECS succeeds), but the operators fail to check closed open MSIVs (in the 4 min. allowed during OPECS). Water will begin to flood down the steam lines. OPSOF asks whether or not the operators will stop any flooding through the main steam lines. The operators must terminate the injecting system and close MSIVs.

Locator Files

File name: OPSOF.E2B

Initiator: E2B5H

Event Tree: OF (from E, Seq. 50, from E2B5H, Seq. 5, 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

A loss of the operating SDC system occurs. The operators initiate ECCS water solid operation (OPECS succeeds), but the operators fail to check closed open MSIVs (in the 4 min. allowed during OPECS). Water will begin to flood down the steam lines. OPSOF asks whether or not the operators will stop any flooding through the main steam lines. The operators must terminate the injecting system and close MSIVs.

File Name: OPSOF.E2T

Initiator: E2T5H

Event Tree: OF (from E, Seq. 50, from E2T5H, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

Complete loss of the SDC common suction line initiator. Operators recognize the loss of SDC (OPSDC succeeds) and attempt to initiate ECCS water solid operation (OPECS succeeds), but MSIVs are open. OPSOF is operator action to stop flooding down open main steam lines and 20 min. is available for this task. In addition to the existing alarms, operators may get additional alarms from steam line drain valves etc. and would get low SP alarm eventually.

Locator Files

File Name: OPSOF.E2V

Initiator: E2V5H

Event Tree: OF (from EA, Seq. 80, from E2V5H, Seq. 4, 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

Complete loss of the SDC common suction line initiator (initially on ADHRS). Operators either recognize or fail to recognize the loss of SDC (OPSDC succeeds or fails), but eventually they do attempt to initiate ECCS water solid operation (OPECS succeeds). MSIVs are open. OPSOF is operator action to stop flooding down open main steam lines and 20 min. is available for this task. In addition to the existing alarms, operators may get additional alarms from steam line drain valves etc. and would get low SP alarm eventually.

File Name: OPSOF.H15

Initiator: H1-5H

Event Tree: OF (from E, Seq. 50, from A5ISO, Seq. 1,
from H1-5H, Seq. 3)

OF (from EA, Seq. 80, from A5ISO, Seq. 6,
from H1-5H, Seq. 13)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

The initiator is a diversion to the SP via RHR. The operators fail to isolate SDC before level 3 is reached, but the SDC valves successfully isolate on the low level signal (SDCIL succeeds). The operators initiate ECCS water solid operation per the IDHR ONEP (OPECS succeeds). but MSIVs are open. OPSOF is operator action to stop flooding down open main steam lines and 20 min. is available for this task. In addition to increasing level alarms, operators may get additional alarms from steam line drain valves etc. and would get low SP alarm eventually.

Locator Files

File Name: OPSOF.J2

Initiator: J2-5

Event Tree: OF (from E, Seq. 50, from A5ISJ, Seq. 1, 6,
from J2-5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

A break in the SDC line outside containment is the initiator. The break is isolated with closure of MV 8 or MV 9. SDC and RHR(B) train is lost. Isolation of 8\9 valves occurs with level 3 signal. If a LOSP occurs, the diesels start and load (DV1-2 OK). The operators initiate ECCS water solid operation per the IDHR ONEP (OPECS succeeds). but MSIVs are open. OPSOF is operator action to stop flooding down open main steam lines and 20 min. is available for this task. In addition to increasing level alarms, operators may get additional alarms from steam line drain valves etc. and would get low SP alarm eventually.

File name: OPSOF.OFP

Initiator: T1-5

Event Tree: OFP (from EP, Seq. 50, from SDC, Seq. 7, 8,
from T1-5, Seq. 3)

OFP (from EP, Seq. 50, from LP, Seq. 8, 15,
from SDC, Seq. 5, from T1-5, Seq. 3)

OFP (from EAP, Seq. 80, from LAP, Seq. 8, 15,
from ADH, Seq. 6, from T1-5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

LOSP is the initiator. The operators initiate ECCS water solid operation (OPECS succeeds), but the operators fail to check closed open MSIVs (in the 4 min. allowed during OPECS). Water will begin to flood down steam lines. OPSOF asks whether or not the operators will stop the flooding through the MSIVs.

Locator Files

File name: OPSOF.T5A

Initiator: T5A5H

Event Tree: OF (from E, Seq. 50, from T5A5H, Seq. 3, 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

The initiator is a loss of SSW. The operators initiate ECCS water solid operation (OPECS succeeds), but the operators fail to check closed any open MSIVs (in the 4 min. allowed during OPECS). Water will begin to flood down the steam lines. OPSOF asks whether or not the operators will stop flooding through the MSIVs.

File name: OPSOF.T5D

Initiator: T5D5H

Event Tree: OFP (from EA, Seq. 80, T5D5H, Seq. 21 or 22)

OF (from E Seq. 50 , from L, Seq. 32, 48,
from T5D5H, Seq. 3.)

OF (from EA, Seq. 80, from LA, Seq. 32, 48,
from T5D5H, Seq. 18)

OF (from E, Seq. 50, from R, Seq. 28,
from L, Seq. 31, 47,
from T5D5H, Seq. 3)

OF (from EA, Seq. 80, from RA, Seq. 28,
from LA, Seq. 31, 47,
from T5D5H, Seq. 18)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

Loss of CCW is the initiator. The operators initiate ECCS water solid operation (OPECS succeeds), but the operators fail to check closed open MSIVs (in the 4 min. allowed during OPECS). Water will begin to flood down steam lines. OPSOF asks whether or not the operators will stop the flooding through the MSIVs.

Locator Files

File name: OPSOF.TAB

Initiator: TAB5H

Event Tree: OFF (from EA, Seq. 80, from ADH, Seq. 4,
from TAB5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

A loss of an AC bus is the initiator. The operators initiate ECCS water solid operation (OPECS succeeds), but the operators fail to check closed open MSIVs (in the 4 min. allowed during OPECS). Water will begin to flood down steam lines. OPSOF asks whether or not the operators will stop the flooding through the MSIVs.

File name: OPSOF.TDB

Initiator: TDB5H

Event Tree: OF (from EA, Seq. 80, from ADH, Seq. 4,
from TDB5H, Seq. 5)

OF (from E, Seq. 50, from L, Seq. 32, 48,
from SDC, Seq. 1, from TDB5H, Seq. 3)

OF (from F, Seq. 18, from R, Seq. 11, 22,
from L, Seq. 31, 47, from SDC, Seq. 1,
from TDB5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

A loss of a DC bus is the initiator. The operators initiate ECCS water solid operation (OPECS succeeds), but the operators fail to check closed open MSIVs (in the 4 min. allowed during OPECS). Water will begin to flood down steam lines. OPSOF asks whether or not the operators will stop the flooding through the MSIVs. In another sequence covered by the above, SDC continues to run, the operators successfully attempt to control level (OPDHR succeeds) with HPCS, but it fails. The operators decide to flood with SSWXT, but they fail to close any open MSIVs, which were assumed to be initially open in this sequence. Water will begin to flood down the steam lines.

Locator Files

File name: OPSOF.TIA

Initiator: TIA5H

Event Tree: OFP (from EP, Seq. 50, from TIA5H, Seq. 5)

OF (from EA, Seq. 80, from TIA5H, Seq. 20

OF (from E, Seq. 50, from L, Seq. 32,
from TIA5H, Seq. 3

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

Loss of IA is the initiator. The operators initiate ECCS water solid operation (OPECS succeeds), but the operators fail to check closed open MSIVs (in the 4 min. allowed during OPECS). Water will begin to flood down steam lines. OPSOF asks whether or not the operators will stop the flooding through the MSIVs.

File Name: OPSOF.TIF

Initiator: TIOF5

Event Tree: OF (from TIOF5, Seq. 9, 19)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

Spurious actuation of LPCI or LPCS initiator (TIOF5) and operators fail to respond in time allowed (OPSLP fails). Operators would get level 7 and level 8 alarms within 1 min. of actuation and these would continue to alarm until responded to. OPSOF is operator action to stop flooding down open main steam lines and 20 min. is available for this task. In addition to the existing alarms, may get additional alarms from steam line drain valves and would get low SP alarm eventually. Core level would continue to increase rapidly and operators would check systems likely to allow such level changes. Pump starts and valve openings would be indicated.

Locator Files

File Name: OPSOF.TIH

Initiator: TIHP5

Event Tree: OF (from TIHP5, Seq. 16)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

Spurious actuation of HPCS initiator (TIHP5). Auto-isolation of HPCS at level 8 fails and operators fail to respond in time allowed (OPHPC fails). Operators would get level 7 and level 8 alarms within 1 min. of actuation and these would continue to alarm until responded to. OPSOF is operator action to stop flooding down open main steam lines and 20 min. is available for this task. In addition to the existing alarms, may get additional alarms from steam line drain valves and would get low SP alarm eventually. Core level would continue to increase rapidly and operators would check systems likely to allow such level changes. Pump starts and valve openings would be indicated.

File Name: OPSOF.TLM

Initiator: TLM5H

Event Tree: OF (from E, Seq. 50, from L, Seq. 5, 38,
from SDC, Seq. 1, from TLM5H, Seq. 3)

OF (from EA, Seq. 80, from LA, Seq. 5, 38,
from ADH, Seq. 1, from TLM5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

Loss of the makeup (CRD) initiator. SDC continues to run after the initiating event. The operators initially fail to control level (OPDHR fails), but do attempt to initiate ECCS water solid operation (OPECS succeeds). MSIVs are open. OPSOF is operator action to stop flooding down open main steam lines and 20 min. is available for this task. In addition to the existing alarms, operators may get additional alarms from steam line drain valves etc. and would get low SP alarm eventually.

Locator Files

File Name: OPSOF.TRP

Initiator: TRPT5

Event Tree: OF (from E, Seq. 50, from SDC, Seq. 3,
 from TRPT5, Seq. 3)
 OF (from E, Seq. 50, from L, Seq. 16,
 from SDC, Seq. 1, from TRPT5, Seq. 3)
 OF (from EA, Seq. 80, from LA, Seq 16,
 from ADH, Seq. 1, from TRPT5, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

Loss of forced recirculation is the initiator. SDC is lost or continues to run. If SDC continues to run, the operators initially fail to control level. If SDC fails, the operators recognize the loss of SDC (OPSDC succeeds). In either case, the control room attempts to initiate ECCS water solid operation (OPECS succeeds), but MSIVs are open. OPSOF is operator action to stop flooding down open main steam lines and 20 min. is available for this task. In addition to the existing alarms, operators may get additional alarms from steam line drain valves etc. and would get low SP alarm eventually.

File Name: OPSOF2.E1T

Initiator: E1T5H

Event Tree: OF (from E, Seq. 50, from L, Seq. 5, 32, 38, 48,
from E1T5H, Seq. 3)
OFP (from EP, Seq. 50, from LP, Seq. 8, 15,
from E1T5H, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

An isolation of the SDC common suction line is the initiator (initially on SDC(B)). For some sequences, a LO SP also occurs at some point, but the diesels start (DV1-2 succeeds). The operators recognize the loss of SDC (OPSDC succeeds) and unisolate SDC (RESCS succeeds). SDC(B) runs but forced recirculation, CRD, and/or RWCU fail and the operators fail to control level (OPDHR fails). Eventually they recognize the need for SDC and attempt to initiate ECCS water solid operation (OPECS succeeds), but MSIVs are open. OPSOF is operator action to stop flooding down open main steam lines and 20 min. is available for this task. In addition to the existing alarms, operators may get additional alarms from steam line drain valves etc. and would get low SP alarm eventually.

Locator Files

File name: OPSOF2.TIA

Initiator: TIA5H

Event Tree: OF (from EA, Seq. 80, from LA, Seq. 32, 48,
from TIA5H, Seq. 18)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

Loss of IA is the initiator. ADHR is lost. SDC(B) starts, but the operators fail to control level (OPDHR fails). The operators initiate ECCS water solid operation (OPECS succeeds) per procedure, but the operators fail to check closed open MSIVs. Water will begin to flood down the steam lines. OPSOF asks whether or not the operators will stop the flooding through the MSIVs.

File name: OPSOF9.TIA

Initiator: TIA

Event Tree: OFP (from EP, Seq. 50, from TIA5H, Seq. 9

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSOF	0.05	10	HEP 30

Loss of IA is the initiator. The operators initiate ECCS water solid operation (OPECS succeeds), but the operators fail to check closed open MSIVs (in the 4 min. allowed during OPECS). Water will begin to flood down steam lines. OPSOF asks whether or not the operators will stop the flooding through the MSIVs.

Locator Files

File Name: OPSPM.A5

Initiator: A5

Event Tree: A5IN

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSPM	1.0		HEP 65

OPSPM is the operator action to provide a dump of SPMU in the context of a large or intermediate LOCA. Reactor level has dropped rapidly and ECCS pumps are initiated automatically. The operators have only 13 min. to realize what is happening and initiate the SPMU dump before ECCS isolates on low SP level. The problem is that during LP&S the SPMU system is made unavailable by opening the breakers for the SPMU valves and placing the mode switch in refuel etc. This is done to prevent an inadvertent dump during the time people are likely to be inside secondary containment. Thus, operators are faced with a large or intermediate LOCA and will be required to perform an action outside the control room in the Auxiliary building. Operators will have to travel to one of two rooms to close the relevant breakers (they should be red tagged) and return the mode switch etc. to the appropriate position in the control room. It was judged that in the context of a large or intermediate LOCA, 13 min. would most likely be an insufficient amount of time to make the correct diagnosis and accomplish the actions. The instructions for dumping SPMU are not reached until very late in EP-2 and the procedures do not "directly and immediately" address the situation in the context of LPS. Thus, the upper bound value from Table 8-1 of ASEP would have to be used. Even if it is generously assumed that the breakers could be closed in 5 min., 8 min. for diagnosis produces an HEP of 1.0.

File Name: OPSPM.AHY

Initiator: A5HY

Event Tree: A5INH

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSPM	1.0		HEP 65

OPSPM is the operator action to provide a dump of SPMU in the context of a large or intermediate LOCA during HYDRO Test. Reactor level has dropped rapidly and ECCS pumps are initiated automatically. The operators have only 13 min. to realize what is happening and initiate the SPMU dump before ECCS isolates on low SP level. The problem is that during LP&S the SPMU system is made unavailable by opening the breakers for the SPMU valves and placing the mode switch in refuel etc. This is done to prevent an inadvertent dump during the time people are likely to be inside secondary containment. Thus, operators are faced with a large or intermediate LOCA and will be required to perform an action outside the control room in the Auxiliary building. Operators will have to travel to one of two rooms to close the relevant breakers (they should be red tagged) and return the mode switch etc. to the appropriate position in the control room. It was judged that in the context of a large or intermediate LOCA, 13 min. would most likely be an insufficient amount of time to make the correct diagnosis and accomplish the actions. The instructions for dumping SPMU are not reached until very late in EP-2 and the procedures do not "directly and immediately" address the situation in the context of LPS. Thus, the upper bound value from Table 8-1 of ASEP would have to be used. Even if it is generously assumed that the breakers could be closed in 5 min., 8 min. for diagnosis produces an HEP of 1.0.

Locator Files

File Name: OPSPM.S1H

Initiator: S1H-5

Event Tree: S1HIN

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSPM	1.0		HEP 65

OPSPM is the operator action to provide a dump of SPMU in the context of a large or intermediate LOCA during HYDRO Test. Reactor level has dropped rapidly and ECCS pumps are initiated automatically. The operators have only 13 min. to realize what is happening and initiate the SPMU dump before ECCS isolates on low SP level. The problem is that during LPS the SPMU system is made unavailable by opening the breakers for the SPMU valves and placing the mode switch in refuel etc. This is done to prevent an inadvertent dump during the time people are likely to be inside secondary containment. Thus, operators are faced with a large or intermediate LOCA and will be required to perform an action outside the control room in the Auxiliary building. Operators will have to travel to one of two rooms to close the relevant breakers (they should be red tagged) and return the mode switch etc. to the appropriate position in the control room. It was judged that in the context of a large or intermediate LOCA, 13 min. would most likely be an insufficient amount of time to make the correct diagnosis and accomplish the actions. The instructions for dumping SPMU are not reached until very late in EP-2 and the procedures do not "directly and immediately" address the situation in the context of LPS. Thus, the upper bound value from Table 8-1 of ASEP would have to be used. Even if it is generously assumed that the breakers could be closed in 5 min., 8 min. for diagnosis produces an HEP of 1.0.

File Name: OPSPM.S25

Initiator: S2-5

Event Tree: S15NF (from S1XFR, Seq. 1, from S2-5, Seq. 11, 22)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSPM	0.047	10	HEP 70

OPSPM is the operator action to initiate SPMU in the context of a small LOCA inside containment. Reactor level has dropped and ECCS pumps will initiate automatically at level 2. The operators have at least 45 min. to realize what is happening and restore SPMU before ECCS isolates on low SP level. Several alarms will sound to indicate that level is dropping. One problem is that during LP&S the SPMU system is made unavailable by opening the breakers for the SPMU valves and placing the mode switch in refuel etc. This is done to prevent an inadvertent dump during the time people are likely to be inside secondary containment. Thus, operators will be required to perform an action outside the control room in the Auxiliary Building. Operators will have to travel to one of two rooms to close the relevant breakers (they should be red tagged) and return the mode switch etc. to the appropriate position in the control room. Once the SPMU system is restored to normal, the dump will occur automatically. The instructions for dumping SPMU in this context will be found by the operators in EP-2 and EP-3. While the procedures do not point out the need to restore, the status of the SPMU valves will be indicated by red tags in the control room. With the time available the EPs will (eventually, if not directly) lead the operators to the appropriate actions.

Locator Files

File Name: OPSPM.S2H

Initiator: S2H-5

Event Tree: S1HNF (from S1XFR, Seq. 1, from S2H-5, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSPM	0.047	10	HEP 70

OPSPM is the operator action to provide a dump of SPMU in the context of a small LOCA inside containment during HYDRO test. Reactor level has dropped and ECCS pumps will initiate automatically at level 2. The operators have at least 45 min. to realize what is happening and restore SPMU before ECCS isolates on low SP level. Several alarms will sound to indicate that level is dropping. One problem is that in LPS the SPMU system is made unavailable by opening the breakers for the SPMU valves and placing the mode switch in refuel etc. This is done to prevent an inadvertent dump during the time people are likely to be inside secondary containment. Thus, operators will be required to perform an action outside the control room in the Auxiliary Building. Operators will have to travel to one of two rooms to close the relevant breakers (they should be red tagged) and return the mode switch etc. to the appropriate position in the control room. Once the SPMU system is restored to normal, the dump will occur automatically. The instructions for dumping SPMU in this context will be found by the operators in EP-2 and EP-3. While the procedures do not point out the need to restore, the status of the SPMU valves will be indicated by red tags in the control room. With the time available the EPs will (eventually, if not directly) lead the operators to the appropriate actions.

File Name: OPSPM.S35

Initiator: S3-5

Event Tree: S15NF (from S1XFR, Seq. 1, from S3-5, Seq. 32)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSPM	0.047	10	HEP 70

In this scenario, a small-small LOCA has occurred and the operators have failed to isolate the leak (ISSSL) and have also failed to isolate letdown or increase makeup. However, SDC will isolate and other alarms will sound. OPSPM is the operator action to restore SPMU in the context of a small-small LOCA inside containment (recirculation line break). Reactor level has dropped and ECCS pumps will initiate automatically at level 2. The operators have at least 45 min. to realize what is happening and restore SPMU before ECCS isolates on low SP level. Several alarms will sound to indicate that level is dropping. One problem is that in LPS the SPMU system is made unavailable by opening the breakers for the SPMU valves and placing the mode switch in refuel etc. This is done to prevent an inadvertent dump during the time people are likely to be inside secondary containment. Thus, operators will be required to perform an action outside the control room in the Auxiliary Building. Operators will have to travel to one of two rooms to close the relevant breakers (they should be red tagged) and return the mode switch etc. to the appropriate position in the control room. Once the SPMU system is restored to normal, the dump will occur automatically. The instructions for dumping SPMU in this context will be found by the operators in EP-2 and EP-3. While the procedures do not point out the need to restore, the status of the SPMU valves will be indicated by red tags in the control room. With the time available the EPs will lead the operators to the appropriate actions.

Locator Files

File Name: OPSPM.S3H

Initiator: S3H-5

Event Tree: S1HNF (from S1XFH, Seq. 1, from S3H-5, Seq. 23)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSPM	0.047	10	HEP 70

In this scenario, a small-small LOCA has occurred during HYDRO and the operators have failed to isolate the leak (ISSSL) and have also failed to isolate letdown or increase makeup. However, SDC will isolate and other alarms will sound. OPSPM is the operator action to restore SPMU in the context of a small-small LOCA inside containment (recirculation line break). Reactor level has dropped and ECCS pumps will initiate automatically at level 2. The operators have at least 45 min. to realize what is happening and restore SPMU before ECCS isolates on low SP level. Several alarms will sound to indicate that level is dropping. One problem is that in LPS the SPMU system is made unavailable by opening the breakers for the SPMU valves and placing the mode switch in refuel etc. This is done to prevent an inadvertent dump during the time people are likely to be inside secondary containment. Thus, operators will be required to perform an action outside the control room in the Auxiliary Building. Operators will have to travel to one of two rooms to close the relevant breakers (they should be red tagged) and return the mode switch etc. to the appropriate position in the control room. Once the SPMU system is restored to normal, the dump will occur automatically. The instructions for dumping SPMU in this context will be found by the operators in EP-2 and EP-3. While the procedures do not point out the need to restore, the status of the SPMU valves will be indicated by red tags in the control room. With the time available, the EPs should lead the operators to the appropriate actions.

File Name: OPSTE51.A5

Initiator: A5

Event Tree: S (from E, Seq. 51, from A5ISO, Seq. 1,
from A5, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of SDC as result of large LOCA outside containment which isolates. LOSP or no LOSP with DV1-2 OK. OPECS fails. Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by the IDHR procedure, given the loss of SDC. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE51.E1B

Initiator: E1B5H

Event Tree: S (from E, Seq. 51, from E1B5H, Seq. 5, 8, 10)

SP (from EP, Seq. 51, from E1B5H, Seq 13)

S (from E, Seq. 51, from L, Seq. 5, 32, 38, 48,
from E1B5H, Seq. 3)

SP (from EP, Seq. 51, from LP, Seq. 15,
from E1B5H, Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

An isolation of SDC(B) is the initiator. If a LOSP occurs, the diesel starts and loads (DV1-2 succeeds). The operators may recognize the initial loss of SDC and attempt to restore it some sequences, but they fail to control level (OPDHR fails) and fail to initiate ECCS water solid operation (OPECS fails). These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam the vessel (a non-proceduralized action). Credit is taken for deciding to steam at high pressure in the P tree, for which there is significantly more time available.

File Name: OPSTE51.E1T

Initiator: E1T5H

Event Tree: S (from E, Seq. 51, from E1T5H, Seq. 5, 7, 9)
SP (from EP, Seq. 51, from E1T5H, Seq. 14)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

An isolation of the SDC common suction line occurs (initially on SDC(B)). Operators either succeed or fail to initially diagnose the loss of SDC (OPSDC succeeds or fails), but in either case they fail to initiate ECCS water solid operation per IDHR ONEP (failure of OPECS). Since these activities are clearly called out by the IDHR procedure given the loss of SDC, the lack of action by the operators indicates no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for these scenarios.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE51.E1V

Initiator: E1V5H

Event Tree: S (from EA, Seq. 81, from E1V5H, Seq. 6, 8, 10)
SP (from EAP, Seq. 51, from E1V5H, Seq. 15)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

An isolation of the SDC common suction line occurs (initially on ADHRS. Operators either succeed or fail to initially diagnose the loss of SDC (OPSDC succeeds or fails), but in either case they fail to initiate ECCS water solid operation per IDHR ONEP (failure of OPECS). Since these activities are clearly called out by the IDHR procedure given the loss of SDC, the lack of action by the operators indicates no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for these scenarios.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE51.E2B

Initiator: E2B5H

Event Tree: S (from E, Seq. 51, from E2B5H, Seq. 5, 6)

SP (from EP, Seq. 51, from E2B5H, Seq 8, 9)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

A loss of SDC(B) is the initiator. If a LO SP occurs, the diesel starts and loads (DV1-2 succeeds). The operators may recognize the initial loss of SDC and attempt to restore it some sequences, but they fail to control level (OPDHR fails) and fail to initiate ECCS water solid operation (OPECS fails). These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam the vessel (a non-proceduralized action). Credit is taken for deciding to steam at high pressure in the P tree, for which there is significantly more time available.

Locator Files

File Name: OPSTE51.E2T

Initiator: E2T5H

Event Tree: S (from E, Seq. 51, from E2T5H, Seq. 4, 5)
 S (from EP, Seq. 51, from E2T5H, Seq. 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Complete loss of SDC common suction line (initially on SDC(B)). Operators either succeed or fail to initially diagnose the loss of SDC (OPSDC succeeds or fails), but in either case they fail to initiate ECCS water solid operation per IDHR ONEP (failure of OPECS). Since these activities are clearly called out by the IDHR procedure given the loss of SDC, the lack of action by the operators indicates no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for these scenarios.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE51.E2V

Initiator: E2V5H

Event Tree: S (from E, Seq. 51, from E2V5H, Seq. 4, 5)
S (from EP, Seq. 51, from E2V5H, Seq. 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Complete loss of SDC common suction line (initially on ADHRS). Operators either succeed or fail to initially diagnose the loss of SDC (OPSDC succeeds or fails), but in either case they fail to initiate ECCS water solid operation per IDHR ONEP (failure of OPECS). Since these activities are clearly called out by the IDHR procedure given the loss of SDC, the lack of action by the operators indicates no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for these scenarios.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE51.J2

Initiator: J2-5

Event Tree: S (from E, Seq. 51, from A5ISJ, Seq. 1,
from J2-5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of SDC as result of break in SDC line outside containment which isolates (MV 8 or MV 9 isolates). A LOSEP does not occur. OPECS fails. Failure of OPECS in this instance implies an operator failure to provide makeup with ECCS and go water solid. These activities are clearly called out by the IDHR procedure, given the loss of SDC. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam which is a non-proceduralized action. Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE51.S15

Initiator: S1-5

Event Tree: S (from E, Seq. 51, from A5ISO, Seq. 1,
from S1-5, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of SDC as result of intermediate LOCA outside containment which isolates. LOSP or no LOSP with DV1-2 OK. OPECS fails. Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by the IDHR procedure, given the loss of SDC and initial loss of makeup. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam. Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE51.S25

Initiator: S2-5

Event Tree: S (from A, Seq. 51, from A5ISO, Seq. 1,
from S1XFR, Seq. 3, from S2-5, Seq. 11

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of SDC as the result of a small LOCA outside containment, which isolates. LOSP or no LOSP with DV1-2 OK. OPECS fails. Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by the IDHR procedure, given the loss of SDC and initial loss of makeup. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE51.S2H

Initiator: S2H-5

Event Tree: S (from E, Seq. 51, from A5ISH, Seq. 3,
from S1XFR, Seq. 3, from S2H-5, Seq. 10

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of SDC during HYDRO Test as the result of a small LOCA outside containment, which isolates. LOSP or no LOSP with DV1-2 OK. OPECS fails. Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by the IDHR procedure, given the loss of SDC and initial loss of makeup. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis

Locator Files

File Name: OPSTE51.T5A

Initiator: T5A5H

Event Tree: S (from E, Seq. 51, from T5A5H, Seq. 3, 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

A loss of SSW is the initiator. The operators may recognize the initial loss of SDC, but no normal means of SDC are available. They fail to initiate ECCS water solid operation (OPECS fails). These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam the vessel (a non-proceduralized action). Credit is taken for deciding to steam at high pressure in the P tree, for which there is significantly more time available.

File Name: OPSTE51.T5D

Initiator: T5D5H

Event Tree: S (from E, Seq. 51, from T5D5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of CCW is the initiator along with a random failure of SDC(B). OPSDC succeeds, but OPECS fails. Failure of OPECS in this instance implies a failure to isolate RWCU and a failure to initiate ECCS water solid operation. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario. See OPSTHS35.T5D for continuation sequences.

Locator Files

File Name: OPSTE51.TIA

Initiator: TIA5H

Event Tree: S (from E, Seq. 51, from TIA5H, Seq. 5)

S (from E, Seq. 51, from L, Seq. 32, 48,
from TIA5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of IA is the initiator. No LOSP. Random failure of SDC(B) and OPSDC succeeds or SDC(B) continues to run and OPDHR fails. Regardless, the operators fail to accomplish OPECS. Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE51.TRP

Initiator: TRPT5

Event Tree: S (from E, Seq. 51, from SDC, Seq. 3,
 from TRPT5, Seq. 3)
 SP (from EP, Seq. 51, from SDC, Seq. 7,
 from TRPT5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of forced recirculation initiator followed by a random loss of SDC or a LOSP and a failure of SDC to restart when the diesel start (DV1-2 succeeds). The operators succeed in diagnosing the loss of SDC (OPSDC succeeds), but they fail to initiate ECCS water solid operation per the IDHR ONEP (failure of OPECS). Since these activities are clearly called out by the IDHR procedure given the loss of SDC, the lack of action by the operators indicates no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for these scenarios.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE512.E1B

Initiator: E1B5H

Event Tree: S (from E, Seq. 51, from L, Seq. 31, 37, 47,
from R, Seq. 28, from E1B5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

An isolation of SDC(B) is the initiator. If a LOSP occurs, the diesel starts and loads (DV1-2 succeeds). The operators recognize the initial loss of SDC and restore it. They attempt to control level with CDS, but it fails or is unavailable. They fails to control level with ECCS due to insufficient time (OPLEC fails). The operators fail to initiate ECCS water solid operation (OPECS fails). These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam the vessel (a non-proceduralized action). Credit is taken for deciding to steam at high pressure in the P tree, for which there is significantly more time available.

File Name: OPSTE512.E1T

Initiator: E1T5H

Event Tree: S (from E, Seq. 51, from L, Seq. 5, 21, 16, 32, 38, 48,
 from E1T5H, Seq. 3)
 S (from EP, Seq. 51, from LP, Seq. 8, 15,
 from E1T5H, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

An isolation of the SDC common suction line occurs (initially on SDC(B). At some point a LOSP also occurs, but the diesels successfully start (DV1-2 succeeds). The operators diagnose the loss of SDC (OPSDC succeeds), unisolate SDC, and reestablish SDC(B). Forced recirculation, CRD, and/or RWCU are lost. The operators fail to recognize the need for makeup (OPDHR fails) and also fail to initiate ECCS water solid operation per IDHR ONEP (failure of OPECS). Since these activities are clearly called out by the IDHR procedure given the functional loss of SDC, the lack of action by the operators indicates no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for these scenarios.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE512.E1V

Initiator: E1V5H

Event Tree: S (from EA, Seq. 81,
from LA, Seq. 5, 21, 16, 32, 38, 48,
from E1V5H, Seq. 3, 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

An isolation of the SDC common suction line occurs (initially on ADHR. The operators diagnose the loss of SDC (OPSDC succeeds), unisolate SDC, and reestablish ADHR. Forced recirculation, CRD, and/or RWCU are lost. The operators fail to recognize the need for makeup (OPDHR fails) and also fail to initiate ECCS water solid operation per IDHR ONEP (failure of OPECS). Since these activities are clearly called out by the IDHR procedure given the functional loss of SDC, the lack of action by the operators indicates no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for these scenarios.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE512.J2

Initiator: J2-5

Event Tree: S (from E, Seq. 51, from A5ISJ, Seq. 6,
from J2-5, Seq. 2)

SP (from EP, Seq. 29, from A5ISJ, Seq. 2,
from J2-5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of SDC as result of break in SDC line outside containment which isolates (MV 8 or MV 9 isolates). If a LOSP occurs, the diesels start and load (DV1-2 OK). OPECS fails. Failure of OPECS in this instance implies an operator failure to provide makeup with ECCS and go water solid. These activities are clearly called out by the IDHR procedure, given the loss of SDC. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam which is a non-proceduralized action. Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE512.TIF

Initiator: TIOF5

Event Tree: S (from E, Seq. 51, from SDC, Seq. 3,
from TIOF5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Inadvertent actuation of LPCI occurs and operators successfully stop the overfill in the time allowed (OPSLP succeeds). MSIVs are closed. Either SDC isolates on high pressure or a random failure of SDC occurs. Regardless, the operators fail to initiate ECCS water solid operation per IDHR ONEP (failure of OPECS). Since these activities are clearly called out by the IDHR procedure given the loss of SDC, the lack of action by the operators indicates no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE513.TIF

Initiator: TIOF5

Event Tree: S (from E, Seq. 51, from L, Seq. 5, 32, 38, 48,
 from SDC Seq. 1, from TIOF5, Seq. 2)
 S (from EA, Seq. 81, from LA, Seq. 5, 38,
 from ADH Seq. 1, from TIOF5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Inadvertent actuation of LPCI occurs and operators successfully stop the overfill in the time allowed (OPSLP succeeds). MSIVs are closed. SDC continues to run. CRD fails as does forced recirculation and/or RWCU. The operators fail to recognize the inadequate core-to-downcomer recirculation and fail to control level. With the functional loss of SDC, they should initiate ECCS water solid operation per IDHR ONEP, but they fail to do so (failure of OPECS). Since these activities are clearly called out by the IDHR procedure given the loss of SDC, the lack of action by the operators indicates no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE513.TIH

Initiator: TIHP5

Event Tree: S (from E, Seq. 51, from L, Seq. 5, 32, 38, 48,
from SDC Seq. 1, from TIHP5, Seq. 2, 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Inadvertent actuation of HPCS occurs and either HPCS auto-isolates on level 8 (HPCAO) or the operators successfully recover an auto-isolation failure and stop HPCS (OPHPC). MSIVs are closed. SDC continues to run. CRD fails as does forced recirculation and/or RWCU. The operators fail to recognize the inadequate core-to-downcomer recirculation and fail to control level. With the functional loss of SDC, they should initiate ECCS water solid operation per IDHR ONEP, but they fail to do so (failure of OPECS). Since these activities are clearly called out by the IDHR procedure given the loss of SDC, the lack of action by the operators indicates no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE51H.EP

Initiator: T1-5

Event Tree: SP (from EP, Seq. 51, from ADEPP, Seq. 4,
from OVPRP, Seq. 4, from HYDRO, Seq. 6,
from T1-5, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

LOSP during HYDRO test is the initiator. DV1-2 succeeds. An SRV opens on safety setpoint and fails to close (SAFEC). Depressurization occurs. In ADEPP tree SDCUI succeeds (8.7 hours for this event). The operators take the necessary steps (see SDCUI.TDB) align SDC, but it fails to start. Thus, enter E tree and OPECS. The operators fail to initiate ECCS water solid (OPECS fails). These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE51P.TIA

Initiator: TIA

Event Tree: SP (from EP, Seq. 51, from TIA5H, Seq. 9)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

A loss of IA is the initiator. A LOSP occurs at some point, but the diesel starts and loads (DV1-2 OK). A random failure of SDC(B) occurs and OPSDC succeeds. However, the operators fail to initiate ECCS water solid operation (OPECS fails). These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE52.T5A

Initiator: T5A5H

Event Tree: SNP (from HPSWR, Seq. 52, from T5A5H, Seq. 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of SSW initiator. A LOSP occurs at some point and the diesel fails to start (DV1-2 fails). SDC, LPCI, and SSWXT etc., are gone, but HPCS is available. However, OPECS fails. Failure of OPECS in this instance implies a failure to provide makeup with HPCS (only ECCS system available) and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE581.H15

Initiator: H1-5H

Event Tree: S (from E, Seq. 51, from A5ISO, Seq. 1,
from H1-5H, Seq. 3)

S (from EA, Seq. 81, from A5ISO, Seq. 6
from H1-5H, Seq. 13)

SP (from EP, Seq. 51, from A5ISO, Seq. 2
from H1-5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

The initiator is a diversion to the SP via RHR that isolates. If a LOSP occurs, the diesel starts and loads (DV1-2 succeeds). SDC is lost on level 3. The operators fail to initiate ECCS water solid operation per IDHR ONEP (failure of OPECS). Since these activities are clearly called out by the IDHR procedure given the loss of SDC, the lack of action by the operators indicates no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE581.TLM

Initiator: TLM5H

Event Tree: S (from E, Seq. 51, from L, Seq. 5, 14, 32, 38, 48,
from SDC, Seq. 1, from TLM5H, Seq. 3)

S (from EA, Seq. 81, from LA, Seq. 5, 38,
from ADH, Seq. 1, from TLM5H, Seq. 5)

S (from E, Seq. 51, from L, Seq. 5, 38,
from ADEP, Seq. 2, from TLM5H, Seq. 7)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of makeup (CRD) initiator. Crew either is or is not conducting a HYDRO test. SDC or RWCU in recirculation mode continue to operate. The operators fail to control level (OPDHR fails) and they fail to initiate ECCS water solid operation per IDHR ONEP (failure of OPECS). Since these activities are clearly called out by the IDHR procedure given that SDC would be functionally lost due to the disconnect between the core and the downcomer occurring from loss of level, the lack of action by the operators indicates no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE581.TRP

Initiator: TRPT5

Event Tree: S (from E, Seq. 51,
 from L, Seq. 16, 21, 25, 32, 38, 48,
 from SDC, Seq. 1, from TRPT5, Seq. 3)

 S (from EA, Seq. 81, from LA, Seq. 16, 21, 38,
 from ADH, Seq. 1, from TRPT5, Seq. 5)

 SP (from EP, Seq. 51, from LP, Seq. 8, 15,
 from SDC, Seq. 5, from TRPT5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

A loss of forced recirculation is the initiator. If a LOSP occurs, the diesel starts and loads (DV1-2 succeeds). SDC continues to run or is restarted. The operators fail to control level (OPDHR fails) and they fail to initiate ECCS water solid operation per IDHR ONEP (failure of OPECS). Since these activities are clearly called out by the IDHR procedure given that SDC would be functionally lost due to the disconnect between the core and the downcomer occurring from loss of level, the lack of action by the operators indicates no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE5H.SP

Initiator: T1-5

Event Tree: S (from EP, Seq. 51, from LP, Seq. 8,
from ADEPP, Seq. 2, from OVPRP, Seq. 4,
from HYDRO, Seq. 6, from T1-5, Seq. 7)

Human Error Events:

	<u>Mean HEPS</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

LOSP initiator during HYDRO test. SRV opens on safety setpoint and fail to close (SAFEC). Depressurization occurs. In ADEPP tree, the operators initiate SDC (SDCUI succeeds, 8.7 hours for this event), and isolate RWCU. The operators need to control level but fail to do (OPDHR fails). They also fail to accomplish the OPECS action, which implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE81.E1D

Initiator: E1D5H

Event Tree: S (from EA, Seq. 81, from E1D5H, Seq. 6, 12)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

An isolation of ADHR is the initiator. OPSDC succeeds or fails. If it succeeds, RESAD attempted, but ADHR fails on demand. Operators attempt to start SDC(B), but it fails. OPECS also fails. Failure of OPECS in this instance implies a failure provide makeup with ECCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis. .

File Name: OPSTE81.E2D

Initiator: E2D5H

Event Tree: S (from EA, Seq. 81, from E2D5H, Seq. 6)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

A loss of ADHR is the initiator. No LOSP. OPSDC succeeds and the operators attempt to start SDC(B), but it fails. The operators fail to accomplish OPECS. Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE81.SP

Initiator: T1-5

Event Tree: SP (from EAP, Seq. 81, from ADH, Seq. 8 ,9,
from T1-5, Seq. 5)

SP (from EP, Seq. 51, from SDC, Seq. 7, 8,
from T1-5, Seq. 3)

SP (from EP, Seq. 51, from LP, Seq. 8, 15,
from SDC, Seq. 5, from T1-5, Seq. 3)

SP (from EAP, Seq. 81, from LAP, Seq. 8, 15,
from ADH, Seq. 6, from T1-5, Seq. 5)

SNP (from HPSWR, Seq. 52, from SDC, Seq.9,
from T1-5, Seq. 3)

SNP (from HPSWA, Seq. 83, from ADH Seq. 10,
from T1-5, Seq. 5)

Human Error Events:

	<u>Mean HEPS</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

A LOSP is the initiator. ADHR is lost with the initiator or a random failure of SDC(B) occurs or SDC(B) continues to run. OPSDC succeeds or fails and OPDHR fails when asked. Regardless, the operators fail to accomplish OPECS. Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE81.T5D

Initiator: T5D5H

Event Tree: S (from EA, Seq. 81, from T5D5H, Seq. 21 or 22)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 41

A loss of CCW initiator. No LO SP. A random failure of ADHR occurs and SDC(B) fails to start. OPSDC succeeds or fails, but OPECS fails. Failure of OPECS in this instance implies a failure to isolate RWCU and provide makeup with ECCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) may be taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE81.TIA

Initiator: TIA5H

Event Tree: S (from EA, Seq. 81, from TIA5H, Seq. 20, 21)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of IA is the initiator. No LO SP. ADHR is lost. If OPSDC succeeds, SDC(B) fails to start. Regardless, the operators fail to accomplish OPECS. Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE812.E1D

Initiator: E1D5H

Event Tree: S (from EA, Seq. 81, from LA, Seq. 5, 38,
from E1D5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

An isolation of ADHR is the initiator. OPSDC succeeds and ADHR is unisolated, but the operators fail to control level after a loss of CRD. With the functional loss of SDC, initiation of ECCS water solid operation is indicated, but OPECS fails. Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE812 E2D

Initiator: E2D5H

Event Tree: S (from EA, Seq. 81, from LA, Seq. 38,
from E2D5H, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

An complete loss of ADHR is the initiator. OPSDC succeeds and SDC(B) is started. The operators fail to control level after a loss of CRD (OPDHR fails). With the functional loss of SDC, initiation of ECCS water solid operation is indicated, but OPECS fails. Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE812.TIA

Initiator: TIA5H

Event Tree: S (from EA, Seq. 81, from LA, Seq. 32, 48,
from TIA5H, Seq. 18)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of IA is the initiator. No LOSP. ADHR is lost. SDC(B) is started, but the operators fail to control level (OPDHR fails). The operators then fail to accomplish OPECS. Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE851.T5D

Initiator: T5D5H

Event Tree: S (from EA, Seq. 81, from LA, Seq. 32, 48 ,
from T5D5H, Seq. 18, 19)

S (from E, Seq. 51, from L, Seq. 32, 48,
from T5D5H, Seq. 3)

S (from EP, Seq. 51, from LP, Seq. 8, 15,
from T5D5H, Seq. 7)

S (from E, Seq. 51, from R, Seq. 28,
from L, Seq. 31, 47, from T5D5H, Seq. 3)

S (from EA, Seq. 81, from RA, Seq. 28,
from LA, Seq. 31, 47, from T5D5H, Seq. 18)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of CCW is the initiator. No LOSP. ADHR or SDC(B) continues to run. OPDHR succeeds or fails, but if it succeeds, CDS fails. Regardless, the operators fail to accomplish OPECS. Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTE851.TAB

Initiator: TAB5H

Event Tree: S (from E, Seq. 51, from SDC, Seq. 3, 4,
from TAB5H, Seq. 3)

S (from EA, Seq. 81, from ADH, Seq. 4,
from TAB5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of AC bus is the initiator. SDC(B) or ADHR fails. OPSDC succeeds or fails, but OPECS fails. Failure of OPECS in this instance implies a failure to provide makeup with HPCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE851.TAB

Initiator: TAB5H

Event Tree: S (from E, Seq. 51, from SDC, Seq. 3, 4,
from TAB5H, Seq. 3)

S (from EA, Seq. 81, from ADH, Seq. 4,
from TAB5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of AC bus is the initiator. SDC(B) or ADHR fails. OPSDC succeeds or fails, but OPECS fails. Failure of OPECS in this instance implies a failure to provide makeup with HPCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

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6 of 10

File Name: OPSTE851.TDB

Initiator: TDB5H

Event Tree: S (from E, Seq. 51, from SDC, Seq. 3, 4,
from TDB5H, Seq. 3)

S (from EA, Seq. 81, from ADH, Seq. 4, 5,
from TDB5H, Seq. 5)

S (from E, Seq. 51, from L, Seq. 32, 48,
from SDC, Seq. 3, from TDB5H, Seq. 1)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of DC bus is the initiator. SDC(B) or ADHR fails or SDC(B) continues to run. OPSDC succeeds or fails and OPDHR fails when asked. OPECS fails. Failure of OPECS in this instance implies a failure to provide makeup with HPCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTE851.TDB

Initiator: TDB5H

Event Tree: S (from E, Seq. 51, from SDC, Seq. 3, 4,
from TDB5H, Seq. 3)

S (from EA, Seq. 81, from ADH, Seq. 4, 5,
from TDB5H, Seq. 5)

S (from E, Seq. 51, from L, Seq. 32, 48,
from SDC, Seq. 3, from TDB5H, Seq. 1)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

Loss of DC bus is the initiator. SDC(B) or ADHR fails or SDC(B) continues to run. OPSDC succeeds or fails and OPDHR fails when asked. OPECS fails. Failure of OPECS in this instance implies a failure to provide makeup with HPCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) is taken in the P tree, where substantially more time is available to make the correct diagnosis.

File Name: OPSTEP51.T5D

Initiator: T5D5H

Event Tree: SP (from EP, Seq. 51, from T5D5H, Seq. 9)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTM	1.0		HEP 49

A loss of CCW is the initiator. A random failure of SDC(B) occurs. OPSDC succeeds, but OPECS fails. RWCU auto-isolates on loss of power. Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam (a non-proceduralized action). Thus, OPSTM fails for this scenario.

Credit for steaming (at high pressure) may be taken in the P tree, where substantially more time is available to make the correct diagnosis.

Locator Files

File Name: OPSTH.A5

Initiator: A5

Event Tree: P (from S, Seq. 35, from E, Seq. 51,
from A5ISO, Seq. 1, from A5, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTH	0.025	5	HEP 42

A large LOCA is initiator. SDC(B) fails. Break is isolated, as is the low pressure piping (8/9 valves isolated at level 3). OPECS fails. OPSTM fails for any number of possible reasons, but mainly because of OPECS failure. If OPECS fails, something is wrong and hard to give credit for OPSTM. This sends us to the P tree. Operators could steam on safety set point of 1SRV. OPSTH is steaming at high pressure (CRD or HPCS) and the operators have 4 hours for this task. CRD should be available, as well as other systems.

File Name: OPSTH.E1B

Initiator: E1B5H

Event Tree: P (from S, Seq. 35, from E, Seq. 51,
from L, Seq. 5, 32, 38, 48, from E1B5H, Seq. 3)

PP (from SP, Seq. 35, from EP, Seq. 51,
from LP, Seq. 8, 15, from E1B5H, Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	1.0		HEP 41
OPSTH	0.025	5	HEP 42

A isolation of SDC(B) is the initiator. If a LOSP occurs, the diesels start and load (DV1-2). SDC(B) is restored and runs, but the operators fail to control level after losses of CRD (OPDHR fails). Regardless, they fail to initiate ECCS water solid operation per the IDHR ONEP (OPECS fails). The operators fail to steam at low pressure (OPSTM fails) and the P tree is entered. OPIS is the operator action to isolate the SDC low pressure piping if the auto-isolation at 135 psi fails. OPIS must occur in the same time period as OPSTM. If OPECS fails in the current context, something is wrong and it is difficult to give credit for OPSTM or OPIS in the time available. If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get low level isolations (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

Locator Files

File Name: OPSTH.J2

Initiator: J2-5

Event Tree: P (from S, Seq. 35, from E, Seq. 51,
from A5ISJ, Seq. 1, from J2-5, Seq. 2)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTH	0.025	5	HEP 42

Break in SDC line outside containment is the initiator. Break is isolated, as is the low pressure piping (8/9 valves isolate at level 3). OPECS fails. OPSTM fails for any number of possible reasons, but mainly because of OPECS failure. If OPECS fails, something is wrong and hard to give credit for OPSTM (a non-proceduralized action). This sends us to the P tree. Operators could steam on safety set point of 1SRV. OPSTH is steaming at high pressure (CDR or HPCS) and the operators have 4 hours for this task.

File Name: OPSTH.PP

Initiator: T1-5

Event Tree: PP (from SP, Seq. 29, from EP, Seq. 51,
from SDC, Seq. 7, 8, from T1-5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	1.0		HEP 41
OPSTH	0.025	5	HEP 42

A LOSEP is the initiator. SDC(B) fails. The operators either recognize the loss of SDC or initially fail to do so (OPSDC succeeds or fails). Regardless, they fail to initiate ECCS water solid operation per the IDHR ONEP (OPECS fails). The operators fail to steam at low pressure (OPSTM fails) and the P tree is entered. OPIS is the operator action to isolate the SDC low pressure piping if the auto-isolation at 135 psi fails. OPIS must occur in the same time period as OPSTM. If OPECS fails in the current context, something is wrong and it is difficult to give credit for OPSTM or OPIS in the time available. If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get low level isolations (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

Locator Files

File Name: OPSTH.PX

Initiator: T1-5

Event Tree: PX (from SX, Seq. 23, from EX, Seq. 35,
from SDC, Seq. 13, from T1-5, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	1.0		HEP 41
OPSTH	0.025	5	HEP 42

A LOSP is the initiator. The diesels fail to start (DV1-2 fails) and HPCSA fails. The operators successfully cross-tie the HPCS diesel to train B (XTIEB succeeds). OPSDC, OPECS, and OPSTM fails. Because of complexities in the cross-tie in regards to OPSDC and OPECS (see HEP 20) the operators were given credit for attempting to steam, but they failed to do so. This sends us to the PX tree. OPIS is the operator action to isolate the SDC low pressure piping if the auto-isolation at 135 psi fails. OPIS must occur in the same time period as OPSTM. If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get a low level isolation (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could decide to steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

File Name: OPSTH.S15

Initiator: S1-5

Event Tree: P (from S, Seq. 35, from E, Seq. 51,
from A5ISO, Seq. 1, from S1-5, Seq. 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTH	0.025	5	HEP 42
* OPIS	0		HEP 57

Intermediate LOCA outside containment is the initiator. The break is isolated, as is SDC(B) or ADHRS (at level 3). The operators fail to initiate ECCS water solid operation as prescribed by procedure (OPECS fails). OPSTM fails for any number of possible reasons, but mainly because of OPECS failure. If OPECS fails (operators fail to follow IDHR ONEP), something is wrong and hard to give credit for OPSTM. This sends us to the P tree. Operators could steam on safety set point of 1SRV. OPSTH is steaming at high pressure (CRD or HPCS) and the operators have 4 hours for this task.

* OPIS set to 0 since SDC is already isolated from low level.

Locator Files

File Name: OPSTH.S25

Initiator: S2-5

Event Tree: P (from S, Seq. 35, from E, Seq. 51,
from A5ISO, Seq. 1, From S1XFR, Seq. 3,
from S2H-5, Seq. 11)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTH	0.025	5	HEP 42
* OPIS	0		HEP 57

A small LOCA outside containment is the initiator. The break is isolated, as is SDC(B) or ADHRS (at level 3). OPECS fails. OPSTM fails for any number of possible reasons, but mainly because of OPECS failure. If OPECS fails (operators fail to follow IDHR ONEP), something is wrong and hard to give credit for OPSTM. This sends us to the P tree. Operators could steam on safety set point of 1SRV. OPSTH is steaming at high pressure (CRD or HPCS) and the operators, have 4 hours for this task.

* OPIS set to 0 since SDC is already isolated from low level.

File Name: OPSTH.S2H

Initiator: S2H-5

Event Tree: P (from S, Seq. 35, from E, Seq. 51,
from A5ISH, Seq. 3, From S1XFH, Seq. 3,
from S2H-5, Seq. 10)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPSTH	0.025	5	HEP 42

A small LOCA outside containment is the initiator. The break is isolated, as is SDC(B) or ADHRS (at level 3). OPECS fails. OPSTM fails for any number of possible reasons, but mainly because of OPECS failure. If OPECS fails (operators fail to follow IDHR ONEP), something is wrong and hard to give credit for OPSTM. This sends us to the P tree. Operators could steam on safety set point of 1SRV. OPSTH is steaming at high pressure (CRD or HPCS) and the operators have 4 hours for this task.

Locator Files

File Name: OPSTH.T5A

Initiator: T5A5H

Event Tree: P (from S, Seq. 35, from E, Seq. 51,
from T5A5H, Seq. 3, 4)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	1.0		HEP 41
OPSTH	0.025	5	HEP 42

A loss of SSW is the initiator. SDC(B) fails and RWCU (letdown) does not auto-isolate. The operators either recognize the loss of SDC or initially fail to do so (OPSDC succeeds or fails). Regardless, they fail to initiate ECCS water solid operation per the IDHR ONEP (OPECS fails). The operators fail to steam at low pressure (OPSTM fails) and the P tree is entered. OPIS is the operator action to isolate the SDC low pressure piping if the auto-isolation at 135 psi fails. OPIS must occur in the same time period as OPSTM. If OPECS fails in the current context, something is wrong and it is difficult to give credit for OPSTM or OPIS in the time available. If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get low level isolations (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the corrediagnosissis and perform the necessary actions.

File Name: OPSTH.T5D

Initiator: T5D5H

Event Tree: P (from S, Seq. 35, from EA, Seq. 81 (or E, Seq. 51)
from T5D5H, Seq. 5, 21, 22)

P (from S, Seq. 35, from E, Seq. 51,
from L, Seq. 32, 48, from T5D5H, Seq. 3)

P (from S, Seq. 35, from EA, Seq. 81,
from LA, Seq. 32, 48, from T5D5H, Seq. 18)

P (from S, Seq. 35, from E, Seq. 51,
from R, Seq. 28, from L, Seq. 31, 47,
from T5D5H, Seq. 3)

P (from S, Seq. 35, from EA, Seq. 81,
from RA, Seq. 28, from LA, Seq. 31, 47,
from T5D5H, Seq. 18)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	1.0		HEP 41
OPSTH	0.025	5	HEP 42

A loss of CCW is the initiator. A random failure of SDC occurs. If initially on ADHR and SDC(B) starts, the operators fail to control level (OPDHR fails). Regardless, they fail to initiate ECCS water solid operation per the IDHR ONEP (OPECS fails) and letdown needs to be isolated. The operators fail to steam at low pressure (OPSTM fails) and the P tree is entered. OPIS is the operator action to isolate the SDC low pressure piping if the auto-isolation at 135 psi fails. OPIS must occur in the same time period as OPSTM. If OPECS fails in the current context, something is wrong and it is difficult to give credit for OPSTM or OPIS in the time available. If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get low level isolations (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

Locator Files

File Name: OPSTH.TAB

Initiator: TAB

Event Tree: P (from S, Seq. 10, 35, from E, Seq. 23, 24,
from SDC, Seq. 3, from TAB5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	0.063	10	HEP 57
OPSTH	0.025	5	HEP 42

Loss of AC bus is the initiator. SDC(B) fails and the operators either detect the loss or initially fail to do so (OPSDC succeeds or fails). RWCU auto-isolates on the loss of power. The operators attempt to initiate ECCS water solid operation with HPCS (OPECS succeeds), but 2 SRVs fail to open. The operators either fail to open 1 SRV (OP1SV) and proceed with going water solid or 1 SRV (1SRVB) fails to open and they can't go water solid. In either case, they did successfully diagnose the need to go water solid and tried to open two SRVs. With no SRVs available, the operators should be aware of the fact that pressure will be increasing. The low pressure piping needs to be isolated at 135 psi (auto-isolation at 135 psi) and the operators should receive an alarm prior to 135 psi. In addition, if the auto-isolation fails, the operators should get an isolation failure signal. Thus, in this scenario where operators are attempting to follow procedure (OPECS succeeds), whether or not the operators consciously decide to steam (OPSTM succeeds or fails) they should have some probability of realizing the need to manually isolate the low pressure piping (OPIS) if the auto-isolation fails (RHRIP). OPIS must be done in the same time period as OPSTM (23 min.).

If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get a low level isolation (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

File Name: OPSTH.TDB

Initiator: TDB5H

Event Tree: P (from S, Seq. 35, from EA, Seq. 81,
from ADHR, Seq. 5, from TDB5H, Seq. 5)

P (from S, Seq. 35, from E, Seq. 51,
from L, Seq. 32, 48, from SDC, Seq. 1,
from TDB5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	1.0		IEP 41
OPSTH	0.025	5	HEP 42

A loss of DC bus is initiator. Either SDC(B) continues to run and the operators fail to control level (OPDHR fails) or SDC fails. The operators either recognize the loss of SDC or initially fail to do so (OPSDC succeeds or fails). Regardless, they fail to initiate ECCS water solid operation per the IDHR ONEP (OPECS fails). Letdown (RWCU) needs to be isolated. The operators fail to steam at low pressure (OPSTM fails) and the P tree is entered. OPIS is the operator action to isolate the SDC low pressure piping if the auto-isolation at 135 psi fails. OPIS must occur in the same time period as OPSTM. If OPECS fails in the current context, something is wrong and it is difficult to give credit for OPSTM or OPIS in the time available. If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get low level isolations (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

Locator Files

File Name: OPSTH.TIA

Initiator: TIA5H

Event Tree: P (from S, Seq. 35, from E, Seq. 51,
from TIA5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	1.0		HEP 41
OPSTH	0.025	5	HEP 42

A loss of IA is the initiator. SDC(B) fails. The operators recognize the loss of SDC (OPSDC succeeds). However, they fail to initiate ECCS water solid operation per the IDHR ONEP (OPECS fails). The operators fail to steam at low pressure (OPSTM fails) and the P tree is entered. OPIS is the operator action to isolate the SDC low pressure piping if the auto-isolation at 135 psi fails. OPIS must occur in the same time period as OPSTM. If OPECS fails in the current context, something is wrong and it is difficult to give credit for OPSTM or OPIS in the time available. If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get low level isolations (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

File Name: OPSTH2.TIA

Initiator: TIA5H

Event Tree: P (from S, Seq. 35, from E, Seq. 51,
from L, Seq. 32, 48, from TIA5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	1.0		HEP 41
OPSTH	0.025	5	HEP 55

Loss of IA is the initiator. SDC(B) continues to run but the operators fail to control level (OPDHR fails). They also fail to initiate ECCS water solid operation with the functional loss of SDC that occurs from no level control (OPECS fails). Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam. Thus, OPSTM fails for this scenario. This sends us to the P tree. OPIS must occur concurrently with OPSTM. If OPECS (and OPSTM) fails, something is wrong and hard to give credit for OPIS which is operator action to isolate low pressure piping if auto isolation at 135 psi fails. If the operators and logic fail to isolate low pressure piping, when something breaks, drain down will occur and should get a low level isolation (RHRIL and SDCIL). If these succeed (or RHRIP), the operators could steam on safety set point of 1SRV. OPSTH is steaming at high pressure (CRD or HPCS). The operators have 4 hours to accomplish the relevant tasks.

Locator Files

File Name: OPSTH3.TIA

Initiator: TIA5H

Event Tree: P (from S, Seq. 35, from E, Seq. 81,
from L, Seq. 32, 43, from TIA5H, Seq. 18)

PP (from SP, Seq. 29, from EP, Seq. 51,
from LP, Seq. 8, 15, from TIA5H, Seq. 7)

Human Error Events:

	<u>Mean HETs</u>	<u>EF</u>	<u>Code#</u>
OPIS	1.0		HEP 41
OPSTH	0.025	5	HEP 55

Loss of IA is the initiator. If a LOSP occurs, the diesels start and load (DV1-2). SDC(B) continues to run but the operators fail to control level (OPDHR fails). They also fail to initiate ECCS water solid operation with the functional loss of SDC that occurs from no level control (OPECS fails). Failure of OPECS in this instance implies a failure to provide makeup with ECCS and go water solid. These activities are clearly called out by procedure. Thus, if OPECS fails, there is no reason to expect the control room to consciously decide to steam. Thus, OPSTM fails for this scenario. This sends us to the P tree. OPIS must occur concurrently with OPSTM. If OPECS (and OPSTM) fails, something is wrong and hard to give credit for OPIS which is operator action to isolate low pressure piping if auto isolation at 135 psi fails. If the operators and logic fail to isolate low pressure piping, when something breaks, drain down will occur and should get a low level isolation (RHRIL and SDCIL). If these succeed (or RHRIP), the operators could steam on safety set point of 1SRV. OPSTH is steaming at high pressure (HPCS). The operators have 4 hours to accomplish the relevant tasks.

File Name: OPSTH4.TIA

Initiator: TIA5H

Event Tree: P (from S, Seq. 29, from EP, Seq. 51,
from TIA5H, Seq. 9)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	1.0		HEP 41
OPSTH	0.025	5	HEP 42

A loss of IA is the initiator. SDC(B) fails and the operators initially fail to recognize the loss of SDC (OPSDC succeeds). They also fail to initiate ECCS water solid operation per the IDHR ONEP (OPECS fails). The operators fail to steam at low pressure (OPSTM fails) and the P tree is entered. OPIS is the operator action to isolate the SDC low pressure piping if the auto-isolation at 135 psi fails. OPIS must occur in the same time period as OPSTM. If OPECS fails in the current context, something is wrong and it is difficult to give credit for OPSTM or OPIS in the time available. If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get low level isolations (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

Locator Files

File Name: OPSTH5.TIA

Initiator: TIA5H

Event Tree: P (from S, Seq. 35, from EA, Seq. 81,
from TIA5H, Seq. 20, 21)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	1.0		HEP 41
OPSTH	0.025	5	HEP 42

A loss of IA is the initiator. ADHR and SDC(B) fails. The operators recognize or initially fail to recognize the loss of SDC (OPSDC succeeds). However, they fail to initiate ECCS water solid operation per the IDHR ONEP (OPECS fails). The operators fail to steam at low pressure (OPSTM fails) and the P tree is entered. OPIS is the operator action to isolate the SDC low pressure piping if the auto-isolation at 135 psi fails. OPIS must occur in the same time period as OPSTM. If OPECS fails in the current context, something is wrong and it is difficult to give credit for OPSTM or OPIS in the time available. If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get low level isolations (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

File Name: OPSTHCFF.T5A

Initiator: T5A5H

Event Tree: P (from S, Seq. 35, from F, Seq. 21,
from E, Seq. 4, 9, 11, 20, 22,
from T5A5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	0.063	10	HEP 57
OPSTH	0.025	5	HEP 42

A loss of SSW is the initiator. No LO SP. OPSDC succeeds or not, but SDC fails. The operators attempt to initiate ECCS water solid operation (OPECS succeeds), but either HPCS fails or no water in the SP). Operators either fail to decide to flood or fail because of inadequate time available to align FW. They then fail to decide to steam (OPSTM fails). The operators should be aware of the fact that pressure will be increasing. The low pressure piping needs to be isolated at 135 psi (auto-isolation at 135 psi) and the operators should receive an alarm prior to 135 psi. In addition, if the auto-isolation fails, the operators should get an isolation failure signal. Thus, in this scenario where operators are attempting to follow procedure (OPECS succeeds), whether or not the operators consciously decide to steam (OPSTM succeeds or fails) they should have some probability of realizing the need to manually isolate the low pressure piping (OPIS) if the auto-isolation fails (RHRIP). OPIS must be done in the same time period as OPSTM (23 minutes).

If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get a low level isolation (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

Locator Files

File Name: OPSTHCFF.T5D

Initiator: T5D5H

Event Tree: P (from S, Seq. 35, from F, Seq. 21,
from E, Seq. 5, 10, 11,
from L, Seq. 32, 48
from T5D5H, Seq. 3)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	0.063	10	HEP 57
OPSTH	0.025	5	HEP 42

A loss of CCW is the initiator. SDC continues to run, but the operators fail to control level (OPDHR fails). The operators attempt to initiate ECCS water solid operation (OPECS succeeds), but either the ECCS system fails or no water in the SP). Operators either fail to decide to flood or fail because of inadequate time available to align FW. They then fail to decide to steam (OPSTM fails). The operators should be aware of the fact that pressure will be increasing. The low pressure piping needs to be isolated at 135 psi (auto-isolation at 135 psi) and the operators should receive an alarm prior to 135 psi. In addition, if the auto-isolation fails, the operators should get an isolation failure signal. Thus, in this scenario where operators are attempting to follow procedure (OPECS succeeds), whether or not the operators consciously decide to steam (OPSTM succeeds or fails) they should have some probability of realizing the need to manually isolate the low pressure piping (OPIS) if the auto-isolation fails (RHRIP). OPIS must be done in the same time period as OPSTM (23 minutes).

If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get a low level isolation (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

File Name: OPSTHCFF.TAB

Initiator: TAB5H

Event Tree: P (from S, Seq. 35, from F, Seq. 3, 6, 21,
from E, Seq. 4, 9, 11, 15, 20, 22,
from SDC, Seq. 3
from TAB5H, Seq. 3)

P (from S, Seq. 35, from F, Seq. 3, 6, 21,
from EA, Seq. 4, 9, 11, 15, 20, 22,
from ADH, Seq. 4
from TAB5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	0.063	10	HEP 57
OPSTH	0.025	5	HEP 42

A loss of AC bus is the initiator. No LOSEP. OPSDC succeeds or not, but SDC fails. The operators attempt to initiate ECCS water solid operation (OPECS succeeds), but either HPCS fails or no water in the SP). Operators either fail to decide to flood or fail because of inadequate time available to align FW. They then fail to decide to steam (OPSTM fails). The operators should be aware of the fact that pressure will be increasing. The low pressure piping needs to be isolated at 135 psi (auto-isolation at 135 psi) and the operators should receive an alarm prior to 135 psi. In addition, if the auto-isolation fails, the operators should get an isolation failure signal. Thus, in this scenario where operators are attempting to follow procedure (OPECS succeeds), whether or not the operators consciously decide to steam (OPSTM succeeds or fails) they should have some probability of realizing the need to manually isolate the low pressure piping (OPIS) if the auto-isolation fails (RHRIP). OPIS must be done in the same time period as OPSTM (23 minutes).

If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get a low level isolation (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

Locator Files

File Name: OPSTHCFF.TDB

Initiator: TDB5H

Event Tree: P (from S, Seq. 35, from F, Seq. 3, 6, 21,
from E, Seq. 4, 9, 11, 15, 20, 22,
from SDC, Seq. 3
from TDB5H, Seq. 3)

P (from S, Seq. 35, from F, Seq. 3, 6, 21,
from EA, Seq. 4, 9, 11, 15, 20, 22,
from ADH, Seq. 4
from TDB5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	0.063	10	HEP 57
OPSTH	0.025	5	HEP 42

A loss of DC bus is the No LOSP. OPSDC succeeds or not, but SDC fails. The operators attempt to initiate ECCS water solid operation (OPECS succeeds), but either HPCS fails or no water in the SP). Operators either fail to decide to flood or fail because of inadequate time available to align FW. They then fail to decide to steam (OPSTM fails). The operators should be aware of the fact that pressure will be increasing. The low pressure piping needs to be isolated at 135 psi (auto-isolation at 135 psi) and the operators should receive an alarm prior to 135 psi. In addition, if the auto-isolation fails, the operators should get an isolation failure signal. Thus, in this scenario where operators are attempting to follow procedure (OPECS succeeds), whether or not the operators consciously decide to steam (OPSTM succeeds or fails) they should have some probability of realizing the need to manually isolate the low pressure piping (OPIS) if the auto-isolation fails (RHRIP). OPIS must be done in the same time period as OPSTM (23 minutes).

If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get a low level isolation (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

File Name: OPSTHCFF.TIA

Initiator: TIA5H

Event Tree: P (from S, Seq. 35, from F, Seq. 3, 21,
from E, Seq. 5, 10, 11, from TIA5H, Seq. 5)

P (from S, Seq. 35, from F, Seq. 3, 21,
from EA, Seq. 5, 10, 11, from TIA5H, Seq. 20)

P (from S, Seq. 35, from F, Seq. 3, 21,
from EA, Seq. 5, 10, 11, from L, Seq. 32, 48,
from TIA5H, Seq. 18)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	0.063	10	HEP 57
OPSTH	0.025	5	HEP 42

Loss of IA is the initiator. SDC(B) continues to run but the operators fail to control level (OPDHR fails) or SDC fails. The operators attempt to initiate ECCS water solid operation (OPECS succeeds), but either the ECCS system fails or no water in the SP). Operators either fail to decide to flood or fail because SSWXT fails or there is inadequate time available to align FW. They then fail to decide to steam (OPSTM fails). The operators should be aware of the fact that pressure will be increasing. The low pressure piping needs to be isolated at 135 psi (auto-isolation at 135 psi) and the operators should receive an alarm prior to 135 psi. In addition, if the auto-isolation fails, the operators should get an isolation failure signal. Thus, in this scenario where operators are attempting to follow procedure (OPECS succeeds), whether or not the operators consciously decide to steam (OPSTM succeeds or fails) they should have some probability of realizing the need to manually isolate the low pressure piping (OPIS) if the auto-isolation fails (RHRIP). OPIS must be done in the same time period as OPSTM (23 minutes).

If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get a low level isolation (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

Locator Files

File Name: OPSTHF.E1B

Initiator: E1B5H

Event Tree: P (from S, Seq. 35, from F, Seq. 3, 21,
from E, Seq. 5, 10,
from E1B5H, Seq. 5, 8)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	0.063	10	HEP 57
OPSTH	0.025	5	HEP 42

A isolation of SDC(B) is the initiator. No LOSEP. SDC is lost in some way. The operators attempt to initiate ECCS water solid operation (OPECS succeeds), but either ECCS fails or there is no water in the SP. Operators diagnose the need to flood, but SSWXT fails to operate on demand or they fail to decide to flood. They then fail to decide to steam (OPSTM fails). The operators should be aware of the fact that pressure will be increasing. The low pressure piping needs to be isolated at 135 psi (auto-isolation at 135 psi) and the operators should receive an alarm prior to 135 psi. In addition, if the auto-isolation fails, the operators should get an isolation failure signal. Thus, in this scenario where operators are attempting to follow procedure (OPECS succeeds and they attempt to flood), whether or not the operators consciously decide to steam (OPSTM succeeds or fails) they should have some probability of realizing the need to manually isolate the low pressure piping (OPIS) if the auto-isolation fails (RHRIP). OPIS must be done in the same time period as OPSTM (23 minutes).

If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get a low level isolation (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.

File Name: OPSTHF.E2B

Initiator: E2B5H

Event Tree: P (from S, Seq. 35, from F, Seq. 21,
from E, Seq. 5, 10, 11, 22,
from E2B5H, Seq. 5)

Human Error Events:

	<u>Mean HEPs</u>	<u>EF</u>	<u>Code#</u>
OPIS	0.063	10	HEP 57
OPSTH	0.025	5	HEP 42

A complete loss of SDC(B) is the initiator. No LOSEP. The operators attempt to initiate ECCS water solid operation (OPECS succeeds), but either ECCS fails or there is no water in the SP. The operators do not decide to flood. They also fail to decide to steam at low pressure (OPSTM fails). The operators should be aware of the fact that pressure will be increasing. The low pressure piping needs to be isolated at 135 psi (auto-isolation at 135 psi) and the operators should receive an alarm prior to 135 psi. In addition, if the auto-isolation fails, the operators should get an isolation failure signal. Thus, in this scenario where operators are attempting to follow procedure (OPECS succeeds and they attempt to flood), whether or not the operators consciously decide to steam (OPSTM succeeds or fails) they should have some probability of realizing the need to manually isolate the low pressure piping (OPIS) if the auto-isolation fails (RHRIP). OPIS must be done in the same time period as OPSTM (23 minutes).

If the auto-isolation logic (RHRIP) and the operators fail to isolate the low pressure piping, then when something breaks, drain down will occur and they should get a low level isolation (RHRIL and SDCIL). As long as SDC is isolated in some way, the operators could steam the vessel at high pressure on the safety set point of 1SRV. OPSTH is the operator action to steam the vessel at high pressure (CRD or HPCS) to prevent uncovering the core. They have 4 hours to make the correct diagnosis and perform the necessary actions.