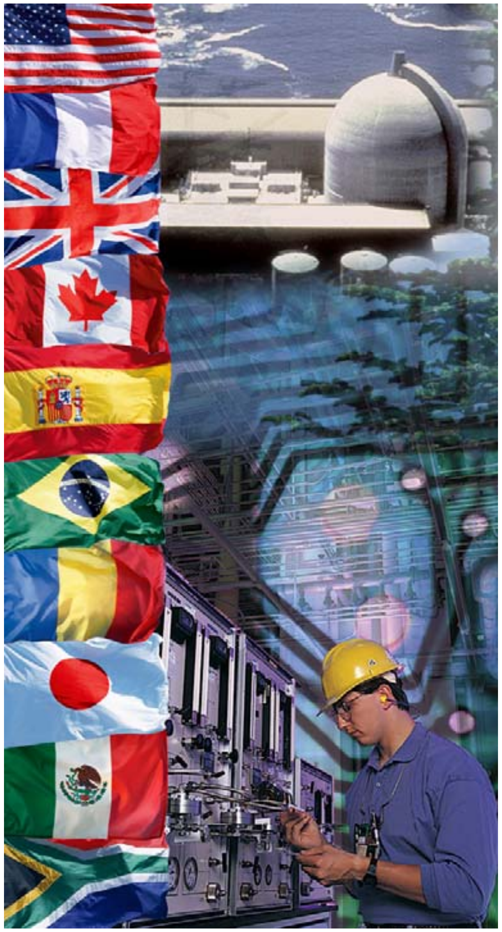


EPRI/NRC-RES FIRE PRA METHODOLOGY

Task 2 - Fire PRA Component Selection

Joint RES/EPRI Fire PRA Workshop
2007
Palo Alto, CA

A Collaboration of U.S. NRC Office of Nuclear Regulatory Research (RES) & Electric Power Research Institute (EPRI)

Component Selection
Scope

- Task 2: Fire PRA Component Selection
  - Deciding what equipment to model in the Fire PRA

Component Selection
General Comment/Observation

- Task 2 likely represents an expansion of what needs to be considered over previous fire analyses

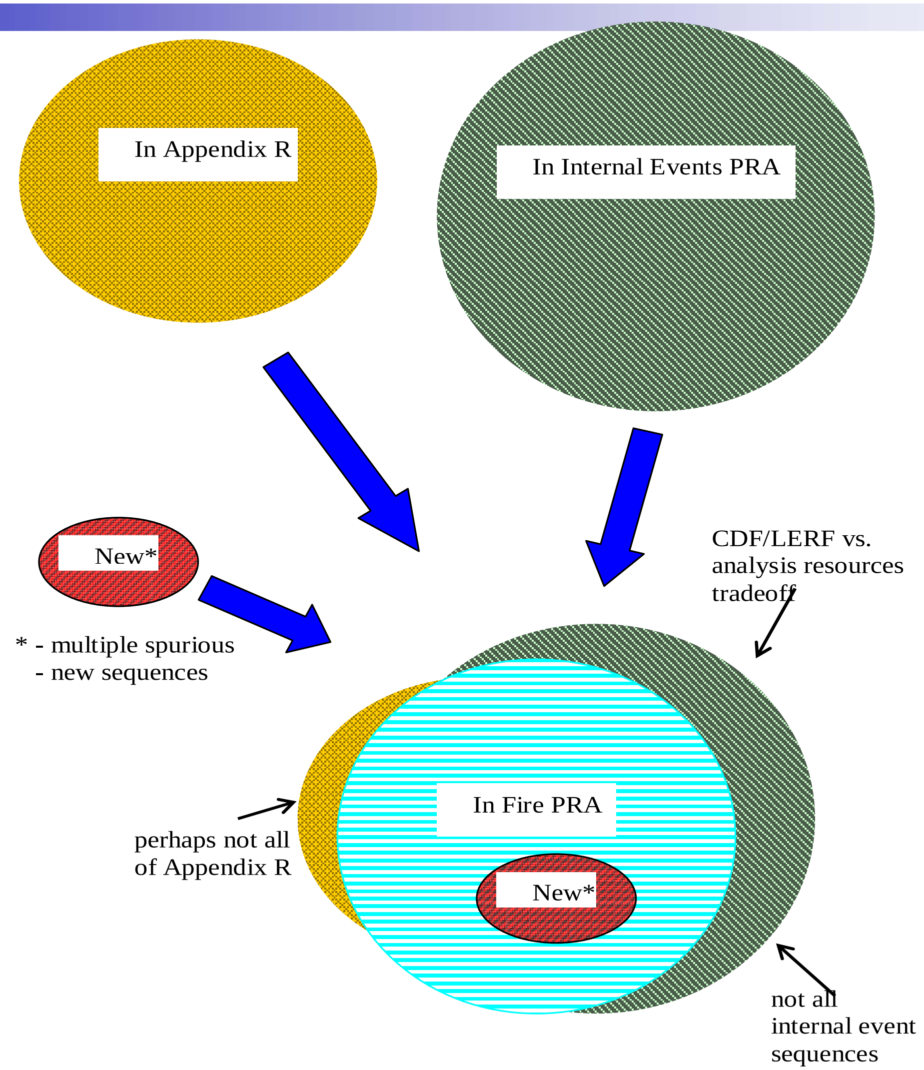
- Bottom line – just “tweaking” your Internal Events PRA is probably NOT sufficient

Task 2: Fire PRA Component Selection
General Objectives

Purpose: select plant components to be modeled to avoid core damage/large early release following fire in the plant

- See next slide for overview of scope
- WARNING: Just crediting Appendix R components may NOT be conservative
  - True that all other components in Internal Events PRA will be assumed to fail, but…
  - May be missing "new" components
  - May miss effects of non-modeled components on credited (modeled) systems/components and on operator performance
  - Still need to consider non-credited components as sources of fires

Task 2: Fire PRA Component Selection
Overview of Scope



Task 2: Fire PRA Component Selection
Scope of Component List

Should include following major categories of equipment:

- Equipment whose fire-induced failure causes an initiating event
  - Model initiating events, not the specific equipment
  - Need to identify worse-case initiator for each compartment
- Equipment needed to perform mitigating safety functions and to support operator actions
- Equipment whose fire-induced failure or spurious actuation may adversely impact credited mitigating safety functions
- Equipment whose fire-induced failure or spurious actuation may cause inappropriate or unsafe operator actions

Task 2: Fire PRA Component Selection
Inputs/Outputs

Task inputs and outputs:

- Inputs from other tasks: equipment considerations for operator actions from Task 12 (Post-Fire HRA)
- Could use inputs from other tasks to show equipment does not have to be modeled (e.g., Task 9 – Detailed Circuit Analysis or Task 11 - Fire Modeling to show an equipment item cannot spuriously fail or be affected by possible fires)
- Outputs to Task 3 (Cable Selection) and Task 5 (Risk Model)
- Choices made in this task set the overall analysis scope

Task 2: Fire PRA Component Selection
Steps In Procedure/Details

Step 1: Identify sequences to include and exclude from Fire PRA

- Some sequences can generally be excluded
  - Low frequency; e.g., fire with pipe-break LOCAs, SGTR, ATWS, vessel rupture
  - It may be decided to not model certain systems (i.e., assume failed for Fire PRA) thereby excluding some sequences (e.g., main feedwater as a mitigating system not important)
- Possible additional sequences (recommend use of expert panel to address plant specific considerations)
  - Sequences associated with spurious operation (e.g., vessel/SG overfills, PORV opening, letdown or other pressure/level control anomalies),
  - MCR abandonment scenarios and other sequences arising from Fire Emergency Procedures (FEPs) and/or use of local manual actions

Task 2: Fire PRA Component Selection
Steps In Procedure/Details

Step 2: Compare Internal Events PRA model to App. R SSD list

- Identify and reconcile differences in functions, success criteria, and sequences (e.g., App. R- no feed/bleed; PRA-feed/bleed)
- Identify and reconcile front-line and support system differences (e.g., App. R-need HVAC; PRA-do not need HVAC)
- Identify and reconcile system and equipment differences due to end state and mission considerations (e.g., App. R-cold shutdown; PRA-hot shutdown)
- Identify and reconcile other miscellaneous equipment differences. Include review of manual actions (e.g., actions needed for safe shutdown) in conjunction with Task 12

Task 2: Fire PRA Component Selection
Steps In Procedure/Details

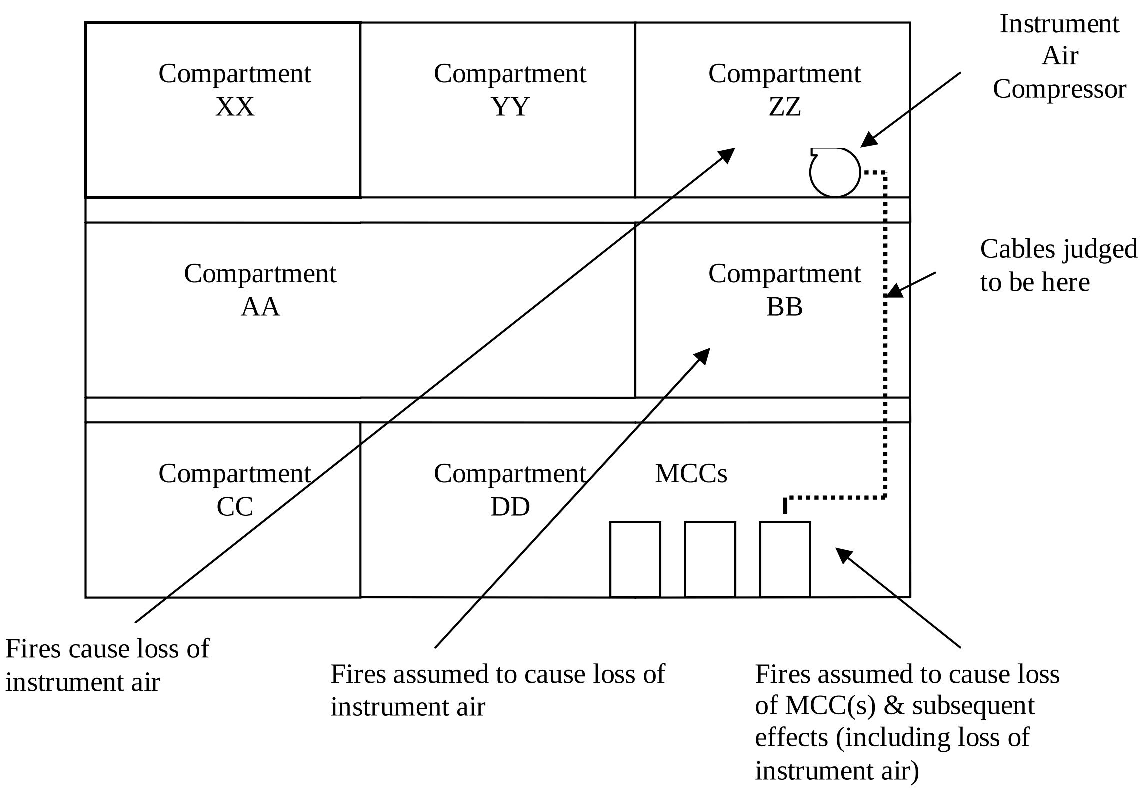
Step 3: Identify fire-induced initiating events. Consider:

- Equipment whose failure will cause automatic plant trip
- Equipment whose failure will likely result in manual plant trip, per procedures
- Equipment whose failure will invoke Tech. Spec. LCO necessitating a forced shutdown while fire may still be present (prior EPRI guidance recommended consideration of <8 hr LCO)
- Compartments with none of the above need not have initiator though can conservatively assume simple plant trip

Task 2: Fire PRA Component Selection
Steps In Procedure/Details (cont'd)

- Since not all equipment/cable locations in the plant (e.g., all BOP) may be identified, judgment involved in 'likely' cable paths
- Identify worse-case initiator based on possible initiators and other mitigating equipment likely to be affected
- Should consider spurious event(s) contributing to initiators

Task 2: Fire PRA Component Selection
Steps In Procedure/Details

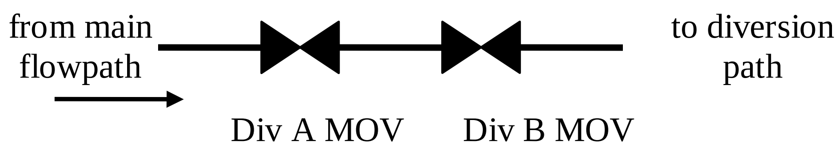


Task 2: Fire PRA Component Selection
Steps In Procedure/Details

Step 4: Identify equipment whose spurious actuation may challenge mitigating capability to avoid core damage/large early release

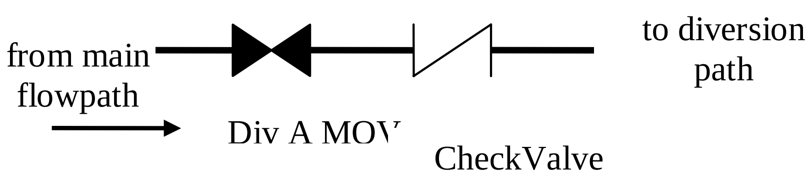
- Consider multiple spurious events within each system considering success criteria
- Involves review of system P&IDs and other drawings
- Focus on equipment or failure modes not already on the component list (e.g., flow diversion paths)
- Any new equipment/failure modes should be added to component list for subsequent cable-tracing and circuit analysis

Task 2: Fire PRA Component Selection
Steps In Procedure/Details



takes 2 spurious hot shorts to open diversion path

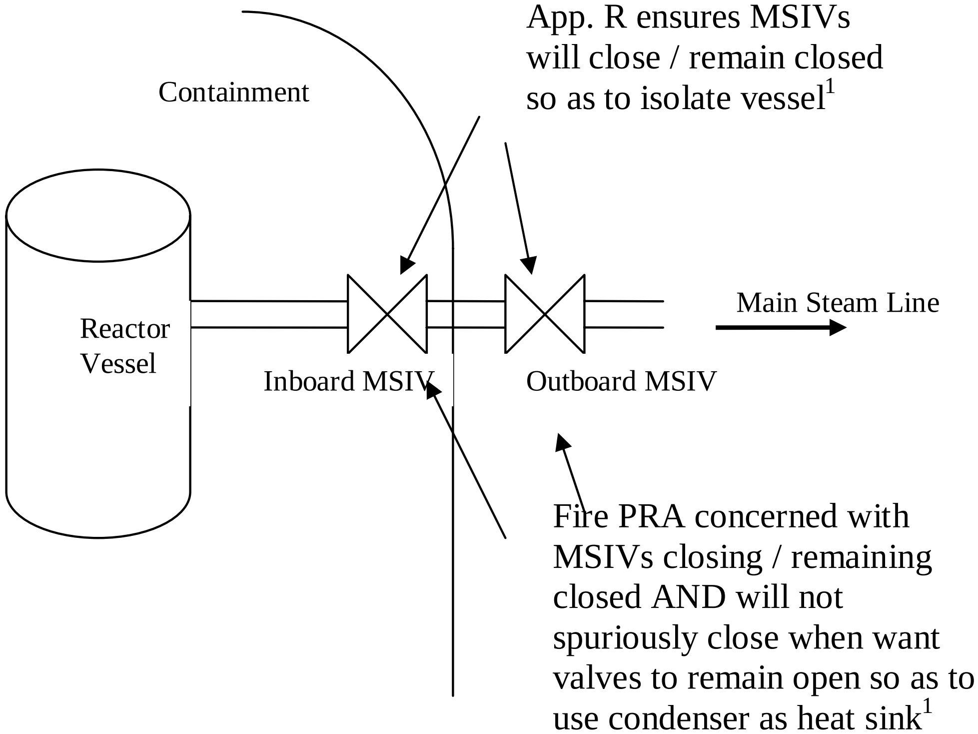
Included in model



takes 1 spurious hot short & failure of check valve to open diversion path

Screened from model if not potential high consequence event

Task 2: Fire PRA Component Selection
Steps In Procedure/Details



[1] different cables and corresponding circuits and analyses may need to be accounted for

Task 2: Fire PRA Component Selection
Steps In Procedure/Details

Step 5: Identify additional instrumentation/diagnostic equipment important to operator response (level of redundancy matters!)

- Identify human actions of interest in conjunction with Task 12
- Identify instrumentation and diagnostic equipment associated with credited and potentially harmful human actions considering spurious indications related to each action
  - Is there insufficient redundancy to credit desired actions in EOPs/FEPs/ARPs in spite of failed/spurious indications?
  - Can a spurious indication(s) cause an undesired action because action is dependent on an indication that could be 'false'?
  - If yes – put indication on component list for cable/circuit review

Task 2: Fire PRA Component Selection
Steps In Procedure/Details

Step 6: Include "potentially high consequence" related equipment

- High consequence events are one or more related failures at least partially caused by fire that, by themselves:
  - Cause core damage and large early release, or
  - Single component failures that cause loss of entire safety function and lead directly to core damage
- Example of first case: spurious opening of two valves in high-pressure/low pressure RCS interface, leading to ISLOCA
- Example of second case: spurious opening of single valve that drains safety injection water source

Task 2: Fire PRA Component Selection
Steps In Procedure/Details

Step 7: Assemble Fire PRA component list. Should include following information:

- Equipment ID and description (may be indicator or alarm)
- System designation
- Equipment type and location (at least compartment ID)
- PRA event ID and description
- Normal and desired position/status
- Failed electrical/air position
- References, comments, and notes

Task 2: Fire PRA Component Selection
Key Assumptions

The following key assumptions underlie this procedure:

- A good quality Internal Events PRA and App. R SSD analysis are available
- Analysts have considerable collective knowledge and understanding of plant systems and operator performance, and of the Internal Events PRA and App. R SSD analysis
- Steps 4 thru 6 are applied so as to determine an appropriate number of spurious actuations to consider
  - Configurations, timing, length of sustained spurious actuation, cable material, etc. among reasons to limit what will be modeled

Sample Problem Exercise for Task 2, Step 1

- Distribute blank handout for Task 2, Step 1

- Distribute completed handout for Task 2, Step 1

- Question and Answer Session

Sample Problem Exercise for Task 2, Steps 2 and 3

- Distribute blank handout for Task 2, Step 2

- Distribute completed handout for Task 2, Step 2 Question and Answer Session

- Discuss Step 3

Sample Problem Exercise for Task 2, Steps 4 through 6

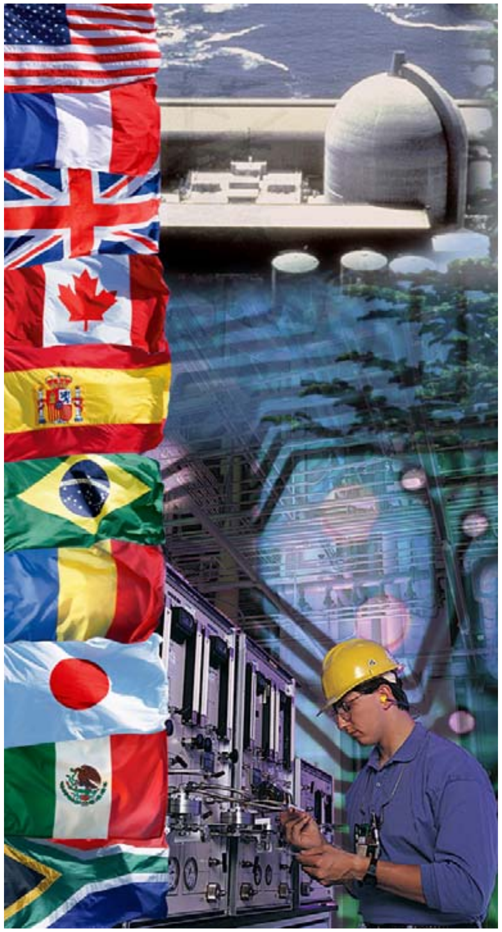
- Distribute blank handout for Task 2, Steps 4 through 6

- Distribute completed handout for Task 2, Steps 4 through 6

- Question and Answer Session

Sample Problem Exercise for Task 2, Step 7

- Distribute blank handout for Task 2, Step 7
- Distribute completed handout for Task 2, Step 7
- Question and Answer Session



EPRI/NRC-RES FIRE PRA METHODOLOGY

Task 12a - Screening Post-Fire HRA

Joint RES/EPRI Fire PRA Workshop
2007
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A Collaboration of U.S. NRC Office of Nuclear Regulatory Research (RES) & Electric Power Research Institute (EPRI)

HRA Screening
Scope

- Task 12a: Post-fire HRA (screening)
  - Identifying applicable post-fire human failure events and establishing screening values used during the running of the Fire PRA model

Task 12a: Post-Fire HRA (Screening)
General Objectives

Purpose: identify reasonable and feasible human actions and resulting HFEs to include in Fire PRA, and assign screening HEPs to simplify the model and focus analysis resources appropriately.

- Addresses screening values based on:
  - Whether a prior analyzed Internal Events HFE vs. a new fire-related HFE
  - Potential effects of fire scenario for which Internal Events HFE is applied
  - Timing considerations for new fire-related HFEs
- Accounts for fire-scenario-induced changes in assumptions, model structure, and performance shaping factors
- Addresses need to use procedures (e.g., FEPs) beyond those modeled in the Internal Events PRA
- Does not address pre-initiator HFEs that are handled within the data used in Tasks 6, 8, and 11

Task 12a: Post-Fire HRA (Screening)
Inputs/Outputs

- Inputs from other tasks:
  - Mitigating equipment and diagnostic indications from Task 2 (Fire PRA Component Selection),
  - Human actions already in PRA (because of internal events modeling) from Task 5 (Fire-Induced Risk Model),
  - Information may be used for identifying equipment failures, spurious operations and indications from Tasks 3 (Fire PRA Cable Selection), 9 (Detailed Circuit Failure Analysis), 10 (Circuit Failure Mode Likelihood Analysis), 8 (Scoping Fire Modeling), and 11 (Detailed Fire Modeling) as available, so as to determine proper screening criteria to be used

Task 12a: Post-Fire HRA (Screening)
Inputs/Outputs (continued)

- Outputs to other tasks:
  - May identify human actions implying other equipment and indications to be added in Task 2 (Fire PRA Component Selection) and thus modeling additions in Task 5 (Fire-Induced Risk Model)
  - Provides screening HEPs for Task 7 (Quantitative Screening)

Task 12a: Post-Fire HRA (Screening)
Steps In Procedure

Two major steps:

- Step 1: Modify and add HFEs to the model

- Step 2: Assign quantitative screening HEPs

Task 12a: Post-Fire HRA (Screening)
Steps In Procedure/Details

Step 1: Modify and add HFEs to the model.

- Step 1.1: Review existing Internal Events HFEs and modify as necessary
  - Many existing HFEs will remain as is except for screening value
  - Some existing HFEs may need to change such as due to the use of different procedures, possible fire environmental effects, or different scenario timing due to fire
- Step 1.2: Add new fire-unique HFEs
  - Primarily from fire-specific procedures
  - Actions taken in response to spurious (erroneous) indications

Task 12a: Post-Fire HRA (Screening)
Steps In Procedure/Details

The following are important elements of the identification process:

- Expected steps taken in response to fires in specific compartments
- Comparison of fire response actions to EOP actions
- Consider fire-specific training, if information is available and relevant
- Role of each crew member during fire scenario
- Fire-specific informal rules that are part of crew knowledge

Task 12a: Post-Fire HRA (Screening)
Steps In Procedure/Details

Step 2: Assign quantitative screening HEPs (on a fire scenario specific basis)

- Four sets of screening criteria :
  - Set 1: multiply internal events HEP by 10 to account for effects of potential fire brigade interaction and other minor increased workload/distraction issues. Examine dependencies across scenario.
  - Set 2 (spurious events could have impact but to only one critical safety-related train/division): increase internal events HEP to 0.1, or 10 times original value, whichever is greater. Examine dependencies across scenario.
  - Set 3: applies generally to new HFEs but also to existing HFEs not meeting Set 1 or 2. Use 1.0 if action has to be performed within one hour of fire initiation. Use 0.1 otherwise.
  - Set 4: applies to new HFEs associated with MCR abandonment. Use screening value of 1.0.

Task 12a: Post-Fire HRA (Screening)
Bases for Screening Values

Values have no direct empirical bases. Bases are:

- Experience with range of screening values used and accepted in HRA
- Experience in quantifying HEPs for events in nuclear power plant HRAs
- Experience applying range of HRA methods and values associated with those methods
- Experience performing HRA for Fire PRAs, including pilots
- Peer comments
- Not so low so as to miss potential dependencies among HFEs

Sample Problem Demonstration for Task 12a

- Task 12a Exercise
- Question and Answer Session

Step 1: Identify Internal Events PRA Sequences to be Included (and those to be excluded) in the Fire PRA Model

INITIATING EVENTS IN THE PRA MODEL					
Initiator	**Average Frequency (per yr)**	**Description**	**Accident Sequence or Event Tree Model**	**Address in Fire PRA Model? (Y or N)**	**Comments**
%T1	7.23E-01	Reactor Trip	Transient Event Tree		
%T2	9.33E-02	Loss of Condenser Vacuum	Transient Event Tree		
%T3	4.13E-01	Turbine trip	Transient Event Tree		
%T4	3.73E-02	Loss of Main Feedwater	Transient Event Tree		
%T5P	4.25E-02	Loss of Offsite Power (Plant-Centered)	Transient Event Tree		
%T5C	1.02E-02	Loss of Off-Site Power (Grid-Related)	Transient Event Tree		
%T5D	6.26E-03	Loss of Off-Site Power (Weather-Induced)	Transient Event Tree		
%T6	7.35E-03	Steamline/Feed line Break Upstream of Main Steam Isolation valves	Main Steamline Break Event		

INITIATING EVENTS IN THE PRA MODEL					
Initiator	**Average Frequency (per yr)**	**Description**	**Accident Sequence or Event Tree Model**	**Address in Fire PRA Model? (Y or N)**	**Comments**
		or Downstream of Feedwater Isolation Valves (Includes Stuck-Open Secondary relief valves)	Tree		
%T7	5.44E-03	Steamline Break Downstream of Main Steam isolation valves (Includes Stuck-Open Secondary relief valves)	Main Steamline Break Event		
%T8	2.94E-04	Loss of 4160 V Bus 1	Transient Event Tree		
%T9	2.94E-04	Loss of 4160 V Bus A	Transient Event Tree		
%T10	2.94E-04	Loss of 4160 V Bus B	Transient Event Tree		
%T11	2.94E-04	Loss of 4160 V Bus 2	Transient Event Tree		
%T12	3.00E-03	Loss of 125 VDC Bus A	Transient Event Tree		
%T13	3.00E-03	Loss of 125 VDC Bus B	Transient Event Tree		
%T15	Fault Tree	Loss of CCW System	Transient		

INITIATING EVENTS IN THE PRA MODEL					
Initiator	**Average Frequency (per yr)**	**Description**	**Accident Sequence or Event Tree Model**	**Address in Fire PRA Model? (Y or N)**	**Comments**
	Model %T15-INIT		Event Tree		
%T16	Fault Tree Model %T16-INIT	Loss of Service Water System	Transient Event Tree		
%T17	Fault Tree Model %T17-INIT	Loss of Instrument Air	Transient Event Tree		
%T21	3.41E-02	Closure of MSIV (1 SG Loop)	Transient Event Tree		
%T22	1.24E-02	Closure of both MSIVs	Transient Event Tree		
%T23	1.78E-01	Partial Load Rejection	Transient Event Tree		
%T24	5.79E-02	Spurious Steam Gen. Isolation Signal	Transient Event Tree		
%T25	7.23E-02	Reactor Trip With PORV Opening/Demand	Transient Event Tree		
%T26	Fault Tree Model %T26-INIT	Loss of Power from120 VAC Buses A & B	Transient Event Tree		
%S	6.8E-03	Small LOCA (pipe breaks and RCP seal	Small LOCA		

INITIATING EVENTS IN THE PRA MODEL					
Initiator	**Average Frequency (per yr)**	**Description**	**Accident Sequence or Event Tree Model**	**Address in Fire PRA Model? (Y or N)**	**Comments**
		LOCA)	Event Tree		
%M	9.60E-06	Medium LOCA (pipe breaks)	Medium LOCA Event Tree		
%A	7.77E-05	Large LOCA (pipe breaks)	Large LOCA Event Tree		
%R	7.93E-03	Steam Generator Tube Rupture	SGTR Event Tree		
%I2	2.000E-07	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)	ISLRHR Sequence (single event model)		
%I3	Fault Tree Model I3QINIT	Interfacing Systems LOCA at RCS/CCW interface (Reactor Coolant Pump Cooler rupture)	ISLCCW Sequence		
%VR	2.70E-07	Reactor Vessel Rupture	Single Event in Master Fault Tree		

ACCIDENT SEQUENCE OR EVENT TREE MODELS IN THE PRA				
Accident Sequence or Event Tree Model	**Description**	**Additional Details**	**Address in Fire PRA Model? (Y or N)**	**Comments**
TRA	Transient	Includes transient-induced LOCAs such as stuck-open PORV and RCP seal LOCA		
SLOCA	Small LOCA	Pipe breaks & RCP seal LOCA		
MLOCA	Medium LOCA	Pipe breaks		
LLOCA	Large LOCA	Pipe breaks		
ATWS	Anticipated Transients Without Scram	Reactor Protection System fails safe on loss of power. Trip circuits are highly redundant and confirmed to be physically separated.		
SGTR	Steam Generator Tube Rupture			
MSLB	Main Steamline Break	Includes spurious opening of secondary relief valves.		
ISLCCW	Interfacing Systems LOCA at RCS/CCW interface	Rupture of Reactor Coolant Pump Cooler		
ISLRHR	Interfacing Systems LOCA at RCS/RHR Interface	Fire-induced opening of RHR suction valves		
New?				
New?				

Step 1: Identify Internal Events PRA Sequences to be Included (and those to be excluded) in the Fire PRA Model

INITIATING EVENTS IN THE PRA MODEL					
Initiator	**Average Frequency (per yr)**	**Description**	**Accident Sequence or Event Tree Model**	**Address in Fire PRA Model? (Y or N)**	**Comments**
%T1	7.23E-01	Reactor Trip	Transient Event Tree	Y	
%T2	9.33E-02	Loss of Condenser Vacuum	Transient Event Tree	Y	
%T3	4.13E-01	Turbine trip	Transient Event Tree	Y	
%T4	3.73E-02	Loss of Main Feedwater	Transient Event Tree	Y	
%T5P	4.25E-02	Loss of Offsite Power (Plant-Centered)	Transient Event Tree	Y	
%T5C	1.02E-02	Loss of Off-Site Power (Grid-Related)	Transient Event Tree	N	Grid-related loss of offsite power due to internal fire is highly unlikely
%T5D	6.26E-03	Loss of Off-Site Power (Weather-Induced)	Transient Event Tree	N	Weather-induced loss of offsite power due to internal fire is highly unlikely
%T6	7.35E-03	Steamline/Feed line Break Upstream of Main Steam Isolation valves	Main Steamline Break Event	Y	Fire-induced pipe break is not likely. However, stuck-open SG PORV/atmospheric relief valve could result in uncontrolled cooldown.

INITIATING EVENTS IN THE PRA MODEL					
Initiator	**Average Frequency (per yr)**	**Description**	**Accident Sequence or Event Tree Model**	**Address in Fire PRA Model? (Y or N)**	**Comments**
		or Downstream of Feedwater Isolation Valves (Includes Stuck-Open Secondary relief valves)	Tree		
%T7	5.44E-03	Steamline Break Downstream of Main Steam isolation valves (Includes Stuck-Open Secondary relief valves)	Main Steamline Break Event	Y	Fire-induced pipe break is not likely. However, condenser steam dump valve(s) could result in uncontrolled cooldown.
%T8	2.94E-04	Loss of 4160 V Bus 1	Transient Event Tree	Y	
%T9	2.94E-04	Loss of 4160 V Bus A	Transient Event Tree	Y	
%T10	2.94E-04	Loss of 4160 V Bus B	Transient Event Tree	Y	
%T11	2.94E-04	Loss of 4160 V Bus 2	Transient Event Tree	Y	
%T12	3.00E-03	Loss of 125 VDC Bus A	Transient Event Tree	Y	
%T13	3.00E-03	Loss of 125 VDC Bus B	Transient Event Tree	Y	
%T15	Fault Tree	Loss of CCW System	Transient	Y	

INITIATING EVENTS IN THE PRA MODEL					
Initiator	**Average Frequency (per yr)**	**Description**	**Accident Sequence or Event Tree Model**	**Address in Fire PRA Model? (Y or N)**	**Comments**
	Model %T15-INIT		Event Tree		
%T16	Fault Tree Model %T16-INIT	Loss of Service Water System	Transient Event Tree	Y	
%T17	Fault Tree Model %T17-INIT	Loss of Instrument Air	Transient Event Tree	Y	
%T21	3.41E-02	Closure of MSIV (1 SG Loop)	Transient Event Tree	Y	
%T22	1.24E-02	Closure of both MSIVs	Transient Event Tree	Y	
%T23	1.78E-01	Partial Load Rejection	Transient Event Tree	Y	
%T24	5.79E-02	Spurious Steam Gen. Isolation Signal	Transient Event Tree	Y	
%T25	7.23E-02	Reactor Trip With PORV Opening/Demand	Transient Event Tree	Y	
%T26	Fault Tree Model %T26-INIT	Loss of Power from120 VAC Buses A & B	Transient Event Tree	Y	
%S	6.8E-03	Small LOCA (pipe breaks and RCP seal	Small LOCA	See comment	Fire-induced pipe break or passive RCP seal failure is unlikely. However, portion of small

INITIATING EVENTS IN THE PRA MODEL					
Initiator	**Average Frequency (per yr)**	**Description**	**Accident Sequence or Event Tree Model**	**Address in Fire PRA Model? (Y or N)**	**Comments**
		LOCA)	Event Tree		LOCA event tree likely needed to treat transient-induced small LOCA from Transient Event Tree such as the pressurizer PORV demanded and stuck-open or RCP seal LOCA via loss of RCP seal cooling.
%M	9.60E-06	Medium LOCA (pipe breaks)	Medium LOCA Event Tree	See comment	Fire-induced pipe break is unlikely. For our simplified plant, any transient-induced LOCA is considered small. If in another plant, a transient-induced medium LOCA could occur based on one or more events (e.g., a single but large size PORV or multiple PORVs spuriously opening), then a portion of the medium LOCA event tree may be needed.
%A	7.77E-05	Large LOCA (pipe breaks)	Large LOCA Event Tree	See comment	Fire-induced pipe break is unlikely. For our simplified plant, any transient-induced LOCA is considered small. If in another plant, a transient-induced large LOCA could occur based on one or more events (e.g., a single but large size PORV or multiple PORVs spuriously opening), then a portion of the large LOCA event tree may be needed.
%R	7.93E-03	Steam Generator Tube Rupture	SGTR Event Tree	N	Fire-induced rupture of SG tubes is highly unlikely.
%I2	2.000E-07	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)	ISLRHR Sequence (single event model)	Y	Spurious opening of both RHR suction valves could result in ISLOCA. Since power to the inboard valve is racked out, a 3-phase hot short would be required to open that valve. Consideration of 3-phase hot shorts is

INITIATING EVENTS IN THE PRA MODEL					
Initiator	**Average Frequency (per yr)**	**Description**	**Accident Sequence or Event Tree Model**	**Address in Fire PRA Model? (Y or N)**	**Comments**
					required for high-consequence lines.
%I3	Fault Tree Model I3QINIT	Interfacing Systems LOCA at RCS/CCW interface (Reactor Coolant Pump Cooler rupture)	ISLCCW Sequence	N	Fire-induced ISLOCA highly unlikely via a passive rupture of the RCP Cooler
%VR	2.70E-07	Reactor Vessel Rupture	Single Event in Master Fault Tree	N	Fire-induced rupture of the reactor vessel is highly unlikely

ACCIDENT SEQUENCE OR EVENT TREE MODELS IN THE PRA				
Accident Sequence or Event Tree Model	**Description**	**Additional Details**	**Address in Fire PRA Model? (Y or N)**	**Comments**
TRA	Transient	Includes transient-induced LOCAs such as stuck-open PORV and RCP seal LOCA	Y	
SLOCA	Small LOCA	Pipe breaks & RCP seal LOCA	See comment	Fire-induced pipe break or passive RCP seal failure is unlikely. However, portion of small LOCA event tree likely needed to treat transient-induced small LOCA from Transient Event Tree such as the pressurizer PORV demanded and stuck-open or RCP seal LOCA via loss of RCP seal cooling.
MLOCA	Medium LOCA	Pipe breaks	See comment	Fire-induced pipe break is unlikely. For our simplified plant, any transient-induced LOCA is considered small. If in another plant, a transient-induced medium LOCA could occur based on one or more events (e.g., a single but large size PORV or multiple PORVs spuriously opening), then a portion of the medium LOCA event tree may be needed.
LLOCA	Large LOCA	Pipe breaks	See comment	Fire-induced pipe break is unlikely. For our simplified plant, any transient-induced LOCA is considered small. If in another plant, a transient-induced large LOCA could occur based on one or more events (e.g., a single but large size PORV or multiple PORVs spuriously opening), then a portion of

				the large LOCA event tree may be needed.
ATWS	Anticipated Transients Without Scram	Reactor Protection System fails safe on loss of power. Trip circuits are highly redundant and confirmed to be physically separated.	N	Fire-induced failure of the reactor protection system is highly unlikely.
SGTR	Steam Generator Tube Rupture		N	Fire-induced rupture of SG tubes is highly unlikely.
MSLB	Main Steamline Break	Includes spurious opening of secondary relief valves.	Y	Fire-induced pipe break is not likely. However, stuck-open SG PORV/atmospheric relief valve or condenser steam dump valve(s) could result in uncontrolled cooldown.
ISLCCW	Interfacing Systems LOCA at RCS/CCW interface	Rupture of Reactor Coolant Pump Cooler	N	Requires passive failure of RCP cooler – not likely coincident with fire.
ISLRHR	Interfacing Systems LOCA at RCS/RHR Interface	Fire-induced opening of RHR suction valves	Y	Spurious opening of both RHR suction valves could result in ISLOCA
New	Spurious Safety Injection with HPI	Requires multiple spurious valve openings and possibly 2nd pump start	See comment	Need to check on potential to cause such an event and the number of spurious events required. Likely to cause reactor trip (manual or automatic on high pressure) if is not or cannot be terminated by operator. Could cause subsequent LOCA.
New	Feedwater ramp-up or AFW spurious start	May require multiple spurious events (need to check)	See comment	Need to check on potential to cause such an event and the number of spurious events required. Likely to cause reactor trip (manual or automatic such as on steam/feed mismatch) if is not or cannot be terminated by operator. Could cause damage to AFW-B pump.

New	RWST drain down event	Requires combination of either or both MOV-5,6 with either or both MOV-3,4 spuriously opening.	See comment	Need to check on potential to cause such an event and the number of spurious events required. Likely to cause procedure-driven manual reactor trip due to loss of initial safety injection water supply / LCO condition for HPI.

Step 2: Review of the Internal Events PRA Against the Fire Safe Shutdown Analysis

TABLE 1: SYSTEMS IN PRA MODEL				
System	**Description**	**Additional Details**	**Address in Fire PRA Model?** **(Y or N)**	**Comments**
RCS	Reactor Coolant System	PORV for pressure relief and feed & bleed. Stuck-open PORV causes small LOCA.		
CVCS	Chemical and Volume Control System	Normal charging and letdown functions are not modeled. However, components required to isolate charging and letdown are modeled for HPI mode.		
HPI	High Pressure Injection System	The charging pumps in the CVCS also function as safety injection pumps.		
RHR	Residual Heat Removal System	Shutdown cooling is not modeled		
AFW	Auxiliary Feedwater System	Only Trains A and B are modeled		
MFW	Main Feed Water	Would take considerable effort to get cables involved and their locations		

TABLE 1: SYSTEMS IN PRA MODEL				
System	**Description**	**Additional Details**	**Address in Fire PRA Model? (Y or N)**	**Comments**
MS	Main Steam System	Stuck-open secondary relief valves could cause equivalent of mainsteam line break.		
CS	Containment Spray	Required for recirculation during LOCA		
CF	Containment Fan Coolers	Required for recirculation during LOCA		
CI	Containment Isolation	Modeled in LERF		
ESFAS	Emergency Safeguards Actuation System			
CCW	Component Cooling Water System			
SW	Service Water System			
AC	AC Power (all voltage levels)	To extent power is needed to support equipment in the PRA.		

TABLE 1: SYSTEMS IN PRA MODEL				
System	**Description**	**Additional Details**	**Address in Fire PRA Model?** **(Y or N)**	**Comments**
DG	Emergency Diesel Generators			
DC	DC Power	To extent power is needed to support equipment in the PRA.		
IA	Instrument Air	Required for PORV and other valves. Backup nitrogen is provided for PORV and is what is credited.		
HVAC-HPI	HVAC in HPI Pump Room	HVAC is required during 24-hr PRA mission		

TABLE 2: SYSTEMS IN APPENDIX R				
System	**Description**	**Additional Details**	**Address in Fire PRA Model? (Y or N)**	**Comments**
RCS	Reactor Coolant System	PORV to prevent spurious opening and consequential small LOCA.		
CVCS	Chemical Volume and Control System	Normal charging and letdown functions are credited.		
RHR	Residual heat Removal System	Shutdown cooling is credited		
AFW	Auxiliary Feedwater System	Trains A&C are credited		
MS	Main Steam System	Secondary relief valves and MSIVs are included to prevent spurious opening causing uncontrolled secondary depressurization.		
CCW	Component Cooling Water System			
SW	Service Water System			

TABLE 2: SYSTEMS IN APPENDIX R				
System	**Description**	**Additional Details**	**Address in Fire PRA Model?** **(Y or N)**	**Comments**
AC	AC Power (all voltage levels)	But certain buses not credited (especially non-safety) if loads not otherwise required for safe shutdown		
DG	Emergency Diesel Generators			
DC	DC Power	But certain buses not credited (especially non-safety) if loads not otherwise required for safe shutdown		
RCS Instruments	RCS pressure, temperature, nuclear instrumentation, etc	Required for safe shutdown monitoring.		
IA	Instrument Air	Required for PORV and other valves. Backup nitrogen is provided for PORV.		

TABLE 2: SYSTEMS IN APPENDIX R				
System	**Description**	**Additional Details**	**Address in Fire PRA Model?** **(Y or N)**	**Comments**
Secondary Instruments	Steam Generator level, Streamline pressure, etc.	Required for safe shutdown monitoring.		
HVAC-HPI	HVAC in HPI Pump Room	HVAC is required during 72-hr Appendix R mission		
HVAC-AFW	HVAC in AFW Pump Room	HVAC is required during 72-hr Appendix R mission		

TABLE 3: LIST OF BASIC EVENTS IN MODEL	
Basic Event	**Description**
%I2	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)
%I3	Interfacing Systems LOCA at RCS/CCW interface (Reactor Coolant Pump Cooler rupture)
%T15	LOSS OF COMPONENT COOLING WATER (CCW)
%T23	PARTIAL LOAD REJECTION
%T25	REACTOR TRIP WITH PORV OPENING
%T3	TURBINE TRIP
%T4	LOSS OF MAIN FEEDWATER
%T1	REACTOR TRIP
AFWA-FTR	AFWA fails to run
AFWA-FTS	AFWA fails to start
AFWB-FTR	AFWB fails to run
AFWB-FTS	AFWB fails to start
AOV-1_FTC	PORV AOV-1 fails to CLOSE
AOV-1_FTO	PORV AOV-1 fails to open
AOV-3_FTC	AOV-3 FAILS TO CLOSE

TABLE 3: LIST OF BASIC EVENTS IN MODEL	
Basic Event	**Description**
EPS-120VBUSAF	120V BUS A FAULT
EPS-120VBUSAINVF	FAILURE OF 120V BUS A INVERTER
EPS-125VDCBUSAF	FAULT ON 125V DC BUS A
EPS-125VDCBUSBF	FAULT ON 125V DC BUS B
EPS-125VDCPNLAF	FAULT ON 125V DC PANEL A
EPS-125VDCPNLBF	FAULT ON 125V DC PANEL B
EPS-480VLCAF	480V LOAD CENTER A FAULT
EPS-480VLCAXTF	480V LOAD CENTER A TRANSFORMER FAILS
EPS-480VLCBF	480V LOAD CENTER B FAULT
EPS-480VLCBXTF	480V LOAD CENTER B TRANSFORMER FAILS
EPS-480VMCCA1F	480V MCC A1 FAULT
EPS-480VMCCB1F	480V MCC B1 FAULT
EPS-4VBUSAF	4KV BUS A FAULT
EPS-4VBUSBF	4KV BUS B FAULT
EPS-BATA	FAILURE OF BATTERY A

TABLE 3: LIST OF BASIC EVENTS IN MODEL	
Basic Event	**Description**
EPS-BATB	FAILURE OF BATTERY B
EPS-BCAF	FAILURE OF BATTERY CHARGER A
EPS-BCBF	FAILURE OF BATTERY CHARGER B
EPS-DGAF	FAILURE OF DIESEL GENERATOR A
EPS-DGBF	FAILURE OF DIESEL GENERATOR B
HPIA_FTR	HPIA fails to run
HPIA_FTS	HPIA fails to start
HPIB_FTR	HPIB fails to run
HPIB_FTS	HPIB fails to start
MFWFAIL	MAIN FEEDWATER SYSTEM FAILURE AFTER REACTOR TRIP
MOV-10_FTO	MOV-10 fails to open
MOV-11_FTO	MOV-11 fails to open
MOV-14_FTO	MOV-14 FAILS TO OPEN
MOV-15_FTO	MOV-15 FAILS TO OPEN
MOV-1_FTO	MOV-1 FAILS TO OPEN

TABLE 3: LIST OF BASIC EVENTS IN MODEL	
Basic Event	**Description**
MOV-2_FTC	MOV-2 fails to close
MOV-3_FTO	MOV-3 fails to open
MOV-4_FTO	MOV-4 fails to open
MOV-5_FTC	MOV-5 fails to close
MOV-5_FTO	MOV-5 fails to open
MOV-6_FTC	MOV-6 fails to close
MOV-6_FTO	MOV-6 fails to open
MOV-9_FTO	MOV-9 FAILS TO OPEN
OPER-1	Operator fails to switch over to recirculation
OPER-4	Operator fails to establish feed an bleed cooling
OPER-7	OPERATOR FAILS TO TRIP REACTOR COOLANT PUMP
RCPSEAL	RCP SEAL LOCA GIVEN LOSS OF CCW AND SUCCESSFUL RCP TRIP
SUTF	FAILURE OF START-UP TRANSFORMER (SUT)
UATF	FAILURE OF UNIT AUXILIARY TRANSFORMER (UAT)

Continuation of Step2 and Including Steps 4 thru 6:

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
HPI-A	High pressure safety injection pump A	4.16kV Bus A		Y		
HPI-B	High pressure safety injection pump B	4.16kV Bus B		Y		
RHR-B	RHR pump	4.16kV Bus B		Y		
COMP-1	Instrument air compressor	480 V LC 1		Y		
AFW-A	Motor driven AFW pump A	4.16kV Bus A		Y		
AFW-B	Steam driven AFW Pump B	N/A		N		
AFW-C	AFW Pump C	4.16 kV Bus 2		Y		
AOV-1 (SOV-1)	Pressure operated relief valve	120VAC Bus A		Y (only to ensure remains		

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
				closed)		
AOV-2 (SOV-2)	Letdown isolation valve	125 VDC Bus B		Y (for normal letdown)		
AOV-3 (SOV-3)	Charging pump injection valve	125 VDC Bus B		Y (for normal charging)		
MOV-1	HPI valve	480V MCC A1		N		
MOV-2	VCT isolation valve	480V MCC B1		Y (for normal suction to charging)		
MOV-3	Cont. sump recirc valve	480V MCC A1		N		
MOV-4	Cont. sump recirc valve	480V MCC B1		N		
MOV-5	RWST isolation valve	480V MCC A1		N		
MOV-6	RWST isolation valve	480V MCC B1		N		
MOV-7	RHR inboard suction valve	480V MCC A1		Y (for shutdown		

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
				cooling)		
MOV-8	RHR outboard suction valve	480V MCC B1		Y (for shutdown cooling)		
MOV-9	HPI valve	480V MCC B1		N		
MOV-10	AFW discharge valve	480V MCC A1		Y		
MOV-11	AFW discharge valve	125 VDC Bus B		N		
MOV-13	PORV block valve	480V MCC A1		Y		
MOV-14	AFW turbine steam line isolation valve	125 VDC Bus B		N		
MOV-15	AFW steam inlet throttle valve	125 VDC Bus B		N		
MOV-16	AFW test line isolation valve	480V MCC A1		N		
MOV-17	AFW test line isolation	480V MCC B1		N		

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
	valve					
MOV-18	AFW C Pump Discharge	480 V MCC-2		Y		
MOV-19	AFW test line isolation valve	480 V MCC-2		N		
V-12	CST isolation valve	N/A		Y (for admin purposes to ensure open)		
LI-1	RWST level	120VAC Bus A		Y		
LI-2	RWST level	120VAC Bus B		Y		
LI-3	Cont. sump level	120VAC Bus A		Y		
LI-4	Cont. sump level	120VAC Bus B		Y		
TI-1	Letdown heat exchanger	120VAC Bus		N		

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
	outlet temp	A				
PT-1	RCS pressure	120VAC Bus B		N		
A-1	AFW motor high temp	120VAC Bus A		N		
SWGR-A	Train A 4160 V Bus	SUT-1 EDG-A		Y		
SWGR-B	Train B 4160 V Bus	SUT-1 EDG-B		Y		
SWGR-1	Non-Safety 4160 V Bus	UAT-1 SUT-1		N		
SWGR-2	Non-Safety 4160 V Bus	UAT-1 SUT-1		Y		
SUT-1	Startup Transformer	OSP		Y		
EDG-A	Train A Emergency	PNL-A		Y		

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
	Diesel Generator					
EDG-B	Train B Emergency Diesel Generator	PNL-B		Y		
LC-1	Non-Safety 480 V Load Center	SST-1		N		
LC-2	Non-Safety 480 V Load Center	SST-2		Y		
LC-A	Train A 480 V Load Center	SST-A		Y		
LC-B	Train B 480 V Load Center	SST-B		N		
SST-1	Non-Safety Station Service Transformer	SWGR-1		N		
SST-2	Non-Safety Station Service Transformer	SWGR-2		Y		
SST-A	Train A Station Service	SWGR-A		Y		

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
	Transformer					
SST-B	Train B Station Service Transformer	SWGR-B		N		
MCC-1	Non-Safety 480 V Motor Control Center	LC-1		N		
MCC-2	Non-Safety 480 V Motor Control Center	LC-2		Y		
MCC-A1	Train A 480 V Motor Control Center	LC-A		Y		
MCC-B1	Train B 480 V Motor Control Center	LC-B		N		
BC-1	Non-Safety Swing Battery Charger	MCC-1 MCC-2		N		
BC-A	Train A Battery Charger	MCC-A1		N		
BC-B	Train B Battery Charger	MCC-B1		N		
BAT-1	Non-Safety Battery	N/A		N		

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
BAT-A	Train A Battery	N/A		Y		
BAT-B	Train B Battery	N/A		Y		
DC BUS-1	Non-Safety 125 VDC Bus	BC-1 BAT-1		N		
DC BUS-A	Train A 125 VDC Bus	BC-A BAT-A		Y		
DC BUS-B	Train B 125 VDC Bus	BC-B BAT-B		Y		
INV-A	Train A Inverter	DC BUS-A		Y		
INV-B	Train B Inverter	DC BUS-B		Y		
VITAL-A	Train A 120 VAC Vital Bus	INV-A		Y		
VITAL-B	Train B 120 VAC Vital Bus	INV-B		Y		
PNL-A	Train A 125 VDC Panel	DC BUS-A		Y		

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
PNL-B	Train B 125 VDC Panel	DC BUS-B		Y		

Step 3: Identify Fire-Induced Initiating Events Based on Equipment Affected

Will need to examine each fire compartment / analysis unit and determine based on the equipment and cables located there, which of the initiators (from Step 1 of Task 2) can be caused by a fire in that compartment / analysis unit. If any new initiators are identified, include in the Fire PRA. The Fire PRA will then include fires mapped to initiating events in the model. Each compartment / analysis unit should have a disposition with regard to the initiating event(s) that occur as a result of a fire in each location (even if “none”). Hold discussion with instructor.

Step 2: Review of the Internal Events PRA Against the Fire Safe Shutdown Analysis

TABLE 1: SYSTEMS IN PRA MODEL				
System	**Description**	**Additional Details**	**Address in Fire PRA Model? (Y or N)**	**Comments**
RCS	Reactor Coolant System	PORV for pressure relief and feed & bleed. Stuck-open PORV causes small LOCA.	Y	
CVCS	Chemical and Volume Control System	Normal charging and letdown functions are not modeled. However, components required to isolate charging and letdown are modeled for HPI mode.	Y	Only includes isolation of letdown and charging for operation in HPI mode
HPI	High Pressure Injection System	The charging pumps in the CVCS also function as safety injection pumps.	Y	
RHR	Residual Heat Removal System	Shutdown cooling is not modeled	N	Will be the same as Internal events model
AFW	Auxiliary Feedwater System	Only Trains A and B are modeled	Y	
MFW	Main Feed Water	Would take considerable effort to get cables involved and their locations	N	Although credited in the PRA model, the cost of cable routing out weighs

TABLE 1: SYSTEMS IN PRA MODEL				
System	**Description**	**Additional Details**	**Address in Fire PRA Model? (Y or N)**	**Comments**
				the risk benefit.
MS	Main Steam System	Stuck-open secondary relief valves could cause equivalent of mainsteam line break.	Y	
CS	Containment Spray	Required for recirculation during LOCA	Y	
CF	Containment Fan Coolers	Required for recirculation during LOCA	Y	
CI	Containment Isolation	Modeled in LERF	Y	
ESFAS	Emergency Safeguards Actuation System		Y	
CCW	Component Cooling Water System		Y	
SW	Service Water System		Y	
AC	AC Power (all voltage	To extent power is needed to support	Y	To extent power is needed to support

TABLE 1: SYSTEMS IN PRA MODEL				
System	**Description**	**Additional Details**	**Address in Fire PRA Model? (Y or N)**	**Comments**
	levels)	equipment in the PRA.		equipment in the PRA.
DG	Emergency Diesel Generators		Y	
DC	DC Power	To extent power is needed to support equipment in the PRA.	Y	To extent power is needed to support equipment in the PRA.
IA	Instrument Air	Required for PORV and other valves. Backup nitrogen is provided for PORV and is what is credited.	Y	
HVAC-HPI	HVAC in HPI Pump Room	HVAC is required during 24-hr PRA mission	Y	

TABLE 2: SYSTEMS IN APPENDIX R				
System	**Description**	**Additional Details**	**Address in Fire PRA Model?** **(Y or N)**	**Comments**
RCS	Reactor Coolant System	PORV to prevent spurious opening and consequential small LOCA.	Y	But need in fire PRA for more than just ensuring closure for Appendix R.
CVCS	Chemical Volume and Control System	Normal charging and letdown functions are credited.	N	Normal charging and letdown functions are not credited in PRA. However isolation of letdown and normal charging is to be modeled for HPI mode.
RHR	Residual heat Removal System	Shutdown cooling is credited	N	Shutdown cooling not credited in PRA
AFW	Auxiliary Feedwater System	Trains A&C are credited	Y	Especially since will not credit MFW, crediting all trains of AFW in the Fire PRA may be important for ‘realistic’ risk estimates.
MS	Main Steam System	Secondary relief valves and MSIVs are included to prevent spurious opening causing uncontrolled secondary depressurization.	Y	Review from PRA perspective

TABLE 2: SYSTEMS IN APPENDIX R				
System	**Description**	**Additional Details**	**Address in Fire PRA Model?** **(Y or N)**	**Comments**
CCW	Component Cooling Water System		Y	
SW	Service Water System		Y	
AC	AC Power (all voltage levels)	But certain buses not credited (especially non-safety) if loads not otherwise required for safe shutdown	Y	Need to ensure all buses are included that are needed to support equipment to be modeled in the Fire PRA.
DG	Emergency Diesel Generators		Y	
DC	DC Power	But certain buses not credited (especially non-safety) if loads not otherwise required for safe shutdown	Y	Need to ensure all buses are included that are needed to support equipment to be modeled in the Fire PRA.
IA	Instrument Air	Required for PORV and other valves. Backup nitrogen is provided for PORV.	Y	

TABLE 2: SYSTEMS IN APPENDIX R				
System	**Description**	**Additional Details**	**Address in Fire PRA Model? (Y or N)**	**Comments**
RCS Instruments	RCS pressure, temperature, nuclear instrumentation, etc	Required for safe shutdown monitoring.	See comment	Include in model if instruments impact equipment or human failure events in the PRA. See Step 5.
Secondary Instruments	Steam Generator level, Streamline pressure, etc.	Required for safe shutdown monitoring.	See comment	Include in model if secondary instruments impact equipment or human failure events in the PRA. See Step 5.
HVAC-HPI	HVAC in HPI Pump Room	HVAC is required during 72-hr Appendix R mission	Y	Required for PRA during 24-hr mission. 72-hr mission is for cold shutdown and not part of PRA.
HVAC-AFW	HVAC in AFW Pump Room	HVAC is required during 72-hr Appendix R mission	N	72-hr mission is for cold shutdown and not part of PRA. Not required for PRA mission.

TABLE 3: LIST OF BASIC EVENTS IN MODEL	
Basic Event	**Description**
%I2	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)
%I3	Interfacing Systems LOCA at RCS/CCW interface (Reactor Coolant Pump Cooler rupture)
%T15	LOSS OF COMPONENT COOLING WATER (CCW)
%T23	PARTIAL LOAD REJECTION
%T25	REACTOR TRIP WITH PORV OPENING
%T3	TURBINE TRIP
%T4	LOSS OF MAIN FEEDWATER
%T1	REACTOR TRIP
AFWA-FTR	AFWA fails to run
AFWA-FTS	AFWA fails to start
AFWB-FTR	AFWB fails to run
AFWB-FTS	AFWB fails to start
AOV-1_FTC	PORV AOV-1 fails to CLOSE
AOV-1_FTO	PORV AOV-1 fails to open
AOV-3_FTC	AOV-3 FAILS TO CLOSE

TABLE 3: LIST OF BASIC EVENTS IN MODEL	
Basic Event	**Description**
EPS-120VBUSAF	120V BUS A FAULT
EPS-120VBUSAINVF	FAILURE OF 120V BUS A INVERTER
EPS-125VDCBUSAF	FAULT ON 125V DC BUS A
EPS-125VDCBUSBF	FAULT ON 125V DC BUS B
EPS-125VDCPNLAF	FAULT ON 125V DC PANEL A
EPS-125VDCPNLBF	FAULT ON 125V DC PANEL B
EPS-480VLCAF	480V LOAD CENTER A FAULT
EPS-480VLCAXTF	480V LOAD CENTER A TRANSFORMER FAILS
EPS-480VLCBF	480V LOAD CENTER B FAULT
EPS-480VLCBXTF	480V LOAD CENTER B TRANSFORMER FAILS
EPS-480VMCCA1F	480V MCC A1 FAULT
EPS-480VMCCB1F	480V MCC B1 FAULT
EPS-4VBUSAF	4KV BUS A FAULT
EPS-4VBUSBF	4KV BUS B FAULT
EPS-BATA	FAILURE OF BATTERY A

TABLE 3: LIST OF BASIC EVENTS IN MODEL	
Basic Event	**Description**
EPS-BATB	FAILURE OF BATTERY B
EPS-BCAF	FAILURE OF BATTERY CHARGER A
EPS-BCBF	FAILURE OF BATTERY CHARGER B
EPS-DGAF	FAILURE OF DIESEL GENERATOR A
EPS-DGBF	FAILURE OF DIESEL GENERATOR B
HPIA_FTR	HPIA fails to run
HPIA_FTS	HPIA fails to start
HPIB_FTR	HPIB fails to run
HPIB_FTS	HPIB fails to start
MFWFAIL	MAIN FEEDWATER SYSTEM FAILURE AFTER REACTOR TRIP
MOV-10_FTO	MOV-10 fails to open
MOV-11_FTO	MOV-11 fails to open
MOV-14_FTO	MOV-14 FAILS TO OPEN
MOV-15_FTO	MOV-15 FAILS TO OPEN
MOV-1_FTO	MOV-1 FAILS TO OPEN

TABLE 3: LIST OF BASIC EVENTS IN MODEL	
Basic Event	**Description**
MOV-2_FTC	MOV-2 fails to close
MOV-3_FTO	MOV-3 fails to open
MOV-4_FTO	MOV-4 fails to open
MOV-5_FTC	MOV-5 fails to close
MOV-5_FTO	MOV-5 fails to open
MOV-6_FTC	MOV-6 fails to close
MOV-6_FTO	MOV-6 fails to open
MOV-9_FTO	MOV-9 FAILS TO OPEN
OPER-1	Operator fails to switch over to recirculation
OPER-4	Operator fails to establish feed and bleed cooling
OPER-7	OPERATOR FAILS TO TRIP REACTOR COOLANT PUMP
RCPSEAL	RCP SEAL LOCA GIVEN LOSS OF CCW AND SUCCESSFUL RCP TRIP
SUTF	FAILURE OF START-UP TRANSFORMER (SUT)
UATF	FAILURE OF UNIT AUXILIARY TRANSFORMER (UAT)

Continuation of Step2 and Including Steps 4 thru 6:

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
HPI-A	High pressure safety injection pump A	4.16kV Bus A	Y	Y	Y	
HPI-B	High pressure safety injection pump B	4.16kV Bus B	Y	Y	Y	
RHR-B	RHR pump	4.16kV Bus B	N	Y	N	Not modeling shutdown cooling and spurious operation benign to credited functions (See Step 4)
COMP-1	Instrument air compressor	480 V LC 1	Y	Y	Y	To ensure long-term PORV operation
AFW-A	Motor driven AFW pump A	4.16kV Bus A	Y	Y	Y	
AFW-B	Steam driven AFW Pump B	N/A	Y	N	Y	
AFW-C	AFW Pump C	4.16 kV Bus 2	N	Y	Y	Credited in Appendix R. Will

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
						be credited for the fire PRA
AOV-1 (SOV-1)	Pressure operated relief valve	120VAC Bus A	Y	Y (only to ensure remains closed)	Y	Need for both ensuring closure (does not spuriously open) and to open when needed for feed and bleed.
AOV-2 (SOV-2)	Letdown isolation valve	125 VDC Bus B	N	Y (for normal letdown)	Y	Especially for isolation when needed. See Step 4.
AOV-3 (SOV-3)	Charging pump injection valve	125 VDC Bus B	Y	Y (for normal charging)	Y	Especially for isolation when needed.
MOV-1	HPI valve	480V MCC A1	Y	N	Y	
MOV-2	VCT isolation valve	480V MCC B1	Y	Y (for normal suction to charging)	Y	Especially for isolation when needed.
MOV-3	Cont. sump recirc valve	480V MCC A1	Y	N	Y	Also see Step 4 for spurious operation concerns
MOV-4	Cont. sump recirc valve	480V MCC B1	Y	N	Y	Also see Step 4 for spurious

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
						operation concerns
MOV-5	RWST isolation valve	480V MCC A1	Y	N	Y	Need to ensure both open and close when desirable
MOV-6	RWST isolation valve	480V MCC B1	Y	N	Y	Need to ensure both open and close when desirable
MOV-7	RHR inboard suction valve	480V MCC A1	Y (for ISLOCA)	Y (for shutdown cooling)	Y	PRA will not address shutdown cooling but need to address for fire-induced ISLOCA and possible high consequence event (see Step 6)
MOV-8	RHR outboard suction valve	480V MCC B1	Y (for ISLOCA)	Y (for shutdown cooling)	Y	PRA will not address shutdown cooling but need to address for fire-induced ISLOCA and possible high consequence event (see Step 6)
MOV-9	HPI valve	480V MCC B1	Y	N	Y	

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
MOV-10	AFW discharge valve	480V MCC A1	Y	Y	Y	
MOV-11	AFW discharge valve	125 VDC Bus B	Y	N	Y	
MOV-13	PORV block valve	480V MCC A1	N	Y	Y	
MOV-14	AFW turbine steam line isolation valve	125 VDC Bus B	Y	N	Y	
MOV-15	AFW steam inlet throttle valve	125 VDC Bus B	Y	N	Y	
MOV-16	AFW test line isolation valve	480V MCC A1	N	N	N	Potential for significant flow diversion is small. See Step 4
MOV-17	AFW test line isolation valve	480V MCC B1	N	N	N	Potential for significant flow diversion is small. See Step 4
MOV-18	AFW C Pump Discharge	480 V MCC-2	N	Y	Y	
MOV-19	AFW test line isolation	480 V MCC-2	N	N	N	Potential for significant flow

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
	valve					diversion is small. See Step 4.
V-12	CST isolation valve	N/A	N	Y (for admin purposes to ensure open)	N	Unlikely to be closed/plugged coincident with fire.
LI-1	RWST level	120VAC Bus A	N	Y	Y	See Step 5.
LI-2	RWST level	120VAC Bus B	N	Y	Y	See Step 5.
LI-3	Cont. sump level	120VAC Bus A	N	Y	Y	See Step 5.
LI-4	Cont. sump level	120VAC Bus B	N	Y	Y	See Step 5.
TI-1	Letdown heat exchanger outlet temp	120VAC Bus A	N	N	Y	See Step 5.
PT-1	RCS pressure	120VAC Bus B	N	N	Y	See Step 5.

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
A-1	AFW motor high temp	120VAC Bus A	N	N	Y	See Step 5.
SWGR-A	Train A 4160 V Bus	SUT-1 EDG-A	Y	Y	Y	
SWGR-B	Train B 4160 V Bus	SUT-1 EDG-B	Y	Y	Y	
SWGR-1	Non-Safety 4160 V Bus	UAT-1 SUT-1	N	N	Y	
SWGR-2	Non-Safety 4160 V Bus	UAT-1 SUT-1	N	Y	Y	
SUT-1	Startup Transformer	OSP	Y	Y	Y	
EDG-A	Train A Emergency Diesel Generator	PNL-A	Y	Y	Y	
EDG-B	Train B Emergency Diesel Generator	PNL-B	Y	Y	Y	

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
LC-1	Non-Safety 480 V Load Center	SST-1	N	N	Y	
LC-2	Non-Safety 480 V Load Center	SST-2	N	Y	Y	
LC-A	Train A 480 V Load Center	SST-A	Y	Y	Y	
LC-B	Train B 480 V Load Center	SST-B	Y	N	Y	
SST-1	Non-Safety Station Service Transformer	SWGR-1	N	N	Y	
SST-2	Non-Safety Station Service Transformer	SWGR-2	N	Y	Y	
SST-A	Train A Station Service Transformer	SWGR-A	Y	Y	Y	
SST-B	Train B Station Service Transformer	SWGR-B	Y	N	Y	

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
MCC-1	Non-Safety 480 V Motor Control Center	LC-1	N	N	Y	
MCC-2	Non-Safety 480 V Motor Control Center	LC-2	N	Y	Y	
MCC-A1	Train A 480 V Motor Control Center	LC-A	Y	Y	Y	
MCC-B1	Train B 480 V Motor Control Center	LC-B	Y	N	Y	
BC-1	Non-Safety Swing Battery Charger	MCC-1 MCC-2	N	N	Y	
BC-A	Train A Battery Charger	MCC-A1	Y	N	Y	
BC-B	Train B Battery Charger	MCC-B1	Y	N	Y	
BAT-1	Non-Safety Battery	N/A	N	N	Y	
BAT-A	Train A Battery	N/A	Y	Y	Y	
BAT-B	Train B Battery	N/A	Y	Y	Y	

TABLE 4: DISPOSTION OF COMPONENTS IN PRA AND APPENDIX R (USE TABLES 1-3 AND FIGURES 1-3)						
Equipment ID	**Equipment Description**	**Power Supply**	**In PRA Model? (Y or N)**	**In Appendix R? (Y or N)**	**Add to Fire PRA Equipment List? (Y or N)**	**Comments**
DC BUS-1	Non-Safety 125 VDC Bus	BC-1 BAT-1	N	N	Y	
DC BUS-A	Train A 125 VDC Bus	BC-A BAT-A	Y	Y	Y	
DC BUS-B	Train B 125 VDC Bus	BC-B BAT-B	Y	Y	Y	
INV-A	Train A Inverter	DC BUS-A	Y	Y	Y	
INV-B	Train B Inverter	DC BUS-B	N	Y	Y	
VITAL-A	Train A 120 VAC Vital Bus	INV-A	Y	Y	Y	
VITAL-B	Train B 120 VAC Vital Bus	INV-B	N	Y	Y	
PNL-A	Train A 125 VDC Panel	DC BUS-A	Y	Y	Y	
PNL-B	Train B 125 VDC Panel	DC BUS-B	Y	Y	Y	

Step 3: Identify Fire-Induced Initiating Events Based on Equipment Affected

Will need to examine each fire compartment / analysis unit and determine based on the equipment and cables located there, which of the initiators (from Step 1 of Task 2) can be caused by a fire in that compartment / analysis unit. If any new initiators are identified, include in the Fire PRA. The Fire PRA will then include fires mapped to initiating events in the model. Each compartment / analysis unit should have a disposition with regard to the initiating event(s) that occur as a result of a fire in each location (even if “none”). Hold discussion with instructor.

Step 4: Identify Equipment with Potential Spurious Actuations that May Challenge the Mitigating Capability to be Credited

Considered spurious equipment operations	Description	PRA System or Function Possibly Affected	Comments/Disposition
MOV-16	AFW test line isolation valve		
MOV-17	AFW test line isolation valve		
MOV-19	AFW test line isolation valve		
MOV-3	Cont. sump recirc. valve		
MOV-4	Cont. sump recirc. valve		
AOV-2	Letdown isolation valve		
RHR	RHR pump		

Step 5: Identify Additional Mitigating, Instrumentation, and Diagnostic Equipment Important to Human Response

Instrumentation required to perform human actions	Description	Potentially Affected Human Failure Event in PRA model	Comments/Disposition
LI-1	RWST level		
LI-2	RWST level		
LI-3	Cont. sump level		
LI-4	Cont. sump level		
TI-1	Letdown heat exchanger outlet temp		
PT-1	RCS pressure		
A-1	AFW motor high temp		

Step 6: Include Potentially High Consequence Related Equipment

Equipment or combinations of equipment that can cause high consequence event	Description of high consequence event	Comments/Disposition

Step 4: Identify Equipment with Potential Spurious Actuations that May Challenge the Mitigating Capability to be Credited

Considered spurious equipment operations	Description	PRA System or Function Possibly Affected	Comments/Disposition
MOV-16	AFW test line isolation valve	Failure of AFW-A due to flow diversion	Fire-induced spurious opening of MOV-16 could occur but flow diversion is not significant. Will not be modeled.
MOV-17	AFW test line isolation valve	Failure of AFW-B due to flow diversion	Fire-induced spurious opening of MOV-17 could occur but flow diversion is not significant. Will not be modeled.
MOV-19	AFW test line isolation valve	Failure of AFW-C due to flow diversion	Fire-induced spurious opening of MOV-19 could occur but flow diversion is not significant. Will not be modeled.
MOV-3	Cont. sump recirc. valve	Failure of high pressure injection	Fire-induced spurious opening of MOV-3 during HPI injection mode will fail HPI – need to model this failure.
MOV-4	Cont. sump recirc. valve	Failure of high pressure injection	Fire-induced spurious opening of MOV-4 during HPI injection mode will fail HPI – need to model this failure.
AOV-2	Letdown isolation valve	Failure of high pressure injection	Loss of CCW with failure to isolate letdown (such as spurious open signal) will result in HPSI pump cavitation
RHR	RHR pump	Spurious operation of pump – investigate effect on HPI & RHR	Could fail RHR pump (assuming no pump suction protection) but RHR shutdown cooling not modeled anyway. No adverse effect on high pressure injection. No need to model.

Step 5: Identify Additional Mitigating, Instrumentation, and Diagnostic Equipment Important to Human Response

Instrumentation required to perform human actions	Description	Potentially Affected Human Failure Event in PRA model	Comments/Disposition
LI-1	RWST level	OPER-1 Failure to align recirculation	Instrumentation required to identify need to switch over to recirculation. While lots of redundancy with other LI's, all are in close proximity on MCR board and so one fire could affect multiple instruments. Hence will model.
LI-2	RWST level	OPER-1 Failure to align recirculation	Instrumentation required to identify need to switch over to recirculation. While lots of redundancy with other LI's, all are in close proximity on MCR board and so one fire could affect multiple instruments. Hence will model.
LI-3	Cont. sump level	OPER-1 Failure to align recirculation	Instrumentation required to identify need to switch over to recirculation. While lots of redundancy with other LI's, all are in close proximity on MCR board and so one fire could affect multiple instruments. Hence will model.
LI-4	Cont. sump level	OPER-1 Failure to align recirculation	Instrumentation required to identify need to switch over to recirculation. While lots of redundancy with other LI's, all are in close proximity on MCR board and so one fire could affect multiple instruments. Hence will model.
TI-1	Letdown heat exchanger outlet temp	OPER-2 Failure to isolate letdown on high temperature due to CCW loss	Instrumentation required to identify need to isolate letdown when CCW is lost
PT-1	RCS pressure	OPER-4 Failure to align feed and bleed	Instrumentation (indicator) required to identify need for feed and bleed
A-1	AFW motor high temp	N/A	Spurious high temperature alarm causes operator to shut down AFW pump erroneously

Step 6: Include Potentially High Consequence Related Equipment

Equipment or combinations of equipment that can cause high consequence event	**Description of high consequence event**	**Comments/Disposition**
MOV-7 and MOV-8	Spurious opening of MOV-7 and MOV-8 results in interfacing system LOCA – meets high consequence event definition.	Need to model this combination failure.

Step 7: Assemble Fire PRA Equipment List

Table 1: Fire PRA Equipment List Information (For Instructors)

Equipment ID	Equipment Description	Equipment Type	Location	Power Supply	PRA Event Identifier	PRA Event Description	Normal Position/ Status	Desired Position/ Status	Failed Electrical Position	Failed Air Position
HPI-A[1]	High pressure safety injection pump A	Pump	Aux Bldg. El. 0 Ft	SWGR-A	HPIA_FTS	HPIA fails to start				
					HPIA_FTR	HPIA fails to run				
HPI-B	High pressure safety injection pump B	Pump	Aux Bldg. El. 0 Ft	SWGR-B	HPIB_FTS	HPIB fails to start				
					HPIB_FTR	HPIB fails to run				
AFW-A	Motor driven AFW pump A	Pump	Turbine Bldg. El. 0 Ft	SWGR-A	AFWA-FTS	AFWA fails to start				
AFW-A	Motor driven AFW pump A	Pump	Turbine Bldg. El. 0 Ft	Turbine Bldg. El. 0 Ft	AFWA-FTR	AFWA fails to run				
AFW-B	Steam driven AFW pump B	Pump	Turbine Bldg. El. 0 Ft	N/A	AFWB-FTS	AFWB fails to start				
AFW-B	Steam driven AFW pump B	Pump	Turbine Bldg. El. 0 Ft	N/A	AFWB-FTR	AFWB fails to run				
AFW-C	Motor driven AFW pump C	Pump	Turbine Bldg. El. 0 Ft	SWGR-2	AFWC-FTS	AFWC fails to start				
AFW-C	Motor driven AFW pump C	Pump	Turbine Bldg. El. 0 Ft	SWGR-2	AFWC-FTR	AFWC fails to run				
RCP	Reactor coolant pump	Pump	Containment	SWGR-1	RCP1-FTT	RCP 1 fails to trip				
COMP-1	Instrument air compressor	Compressor	Turbine Bldg. El. 0 Ft	LC-1	IA-COMP1_FTS	Instrument air compressor fails to start				

Equipment ID	Equipment Description	Equipment Type	Location	Power Supply	PRA Event Identifier	PRA Event Description	Normal Position/ Status	Desired Position/ Status	Failed Electrical Position	Failed Air Position
COMP-1	Instrument air compressor	Compressor	Turbine Bldg. El. 0 Ft	LC-1	IA-COMP1_FTR	Instrument air compressor fails to run				
AOV-1[2] (SOV-1)	Power operated relief valve	AOV	Containment	VITAL-A	AOV-1_TO	PORV AOV-1 transfers open				
					AOV-1_FTO	PORV AOV-1 fails to open				
AOV-2[3] (SOV-2)	Letdown isolation valve	AOV	Aux Bldg. El. 0 Ft	DC BUS-B	AOV-2_FTC	AOV-2 fails to close				
AOV-3[4] (SOV-3)	Charging pump injection valve	AOV	Aux Bldg. El. 0 Ft	DC BUS-B	AOV-3_FTC	AOV-3 FAILS TO CLOSE				
MOV-1	HPI discharge valve	MOV	Aux Bldg. El. 0 Ft	MCC-A1	MOV-1_FTO	MOV-1 FAILS TO OPEN				
MOV-2[5]	VCT isolation valve	MOV	Aux Bldg. El. 0 Ft	MCC-B1	MOV-2_FTC	MOV-2 fails to close				
MOV-3[6]	Cont. sump recirc valve	MOV	Aux Bldg. El. -20 Ft	MCC-A1	MOV-3_FTO	MOV-3 fails to open				
					MOV-3_TO	MOV-3 TRANSFERS OPEN				
MOV-4	Cont. sump recirc valve	MOV	Aux Bldg. El. -20 Ft	MCC-B1	MOV-4_FTO	MOV-4 fails to open				
					MOV-4_TO	MOV-4 TRANSFERS OPEN				
MOV-5	RWST isolation valve	MOV	Aux Bldg. El. 0 Ft	MCC-A1	MOV-5_FTO	MOV-5 fails to open				
MOV-6	RWST isolation valve	MOV	Aux Bldg. El. 0 Ft	MCC-B1	MOV-6_FTO	MOV-6 fails to open				
MOV-7[7]	RHR inboard suction valve	MOV	Containment	MCC-A1	MOV-7_TO	MOV-7 TRANSFERS OPEN				
MOV-8	RHR outboard suction valve	MOV	Aux Bldg. El. -20 Ft	MCC-B1	MOV-8_TO	MOV-8 TRANSFERS OPEN				

Equipment ID	Equipment Description	Equipment Type	Location	Power Supply	PRA Event Identifier	PRA Event Description	Normal Position/ Status	Desired Position/ Status	Failed Electrical Position	Failed Air Position
MOV-9	HPI discharge valve	MOV	Aux Bldg. El. 0 Ft	MCC-B1	MOV-9_FTO	MOV-9 FAILS TO OPEN				
MOV-10	AFW pump A discharge valve	MOV	Turbine Bldg. El. 0 Ft	MCC-A1	MOV-10_FTO	MOV-10 fails to open				
MOV-11	AFW pump B discharge valve	MOV	Turbine Bldg. El. 0 F	DC BUS-B	MOV-11_FTO	MOV-11 fails to open				
MOV-13	PORV block valve	MOV	Containment	MCC-A1	MOV-13_FTC	MOV-13 fails to close				
MOV-14	AFW pump B turbine steam line isolation valve	MOV	Turbine Bldg. El. 0 Ft	DC BUS-B	MOV-14_FTO	MOV-14 FAILS TO OPEN				
MOV-15	AFW pump B steam inlet throttle valve	MOV	Turbine Bldg. El. 0 Ft	DC BUS-B	MOV-15_FTO	MOV-15 FAILS TO OPEN				
MOV-18	AFW pump C discharge valve	MOV	Turbine Bldg. El. 0 Ft	MCC-2	MOV-18_FTO	MOV-18 fails to open				
LI-1[8]	RWST level	Instrument	Yard	VITAL-A	LI-1_FL	RWST Level indication fails low				
					LI-1_FH	RWST Level indication fails high				
LI-2	RWST level	Instrument	Yard	VITAL-B	LI-2_FL	RWST Level indication fails low				
					LI-2_FH	RWST Level indication fails high				
LI-3	Cont. sump level	Instrument	Containment	VITAL-A	LI-3_FH	Cont sump Level indication fails high				
LI-4	Cont. sump level	Instrument	Containment	VITAL-B	LI-4_FH	Cont sump Level indication fails high				
TI-1[9]	Letdown heat exchanger outlet temp	Instrument	Aux Bldg. El. 0 Ft	VITAL-A	TI-1_FL	Letdown temperature indication fails low				
PT-1[10]	RCS pressure	Instrument	Containment	VITAL-B	PI-1_FH	RCS pressure indication fails high				

Equipment ID	Equipment Description	Equipment Type	Location	Power Supply	PRA Event Identifier	PRA Event Description	Normal Position/ Status	Desired Position/ Status	Failed Electrical Position	Failed Air Position
A-1	AFW motor high temperature	Annunciator	SWG Access Room	VITAL-A	ANN-1_FH	AFW motor high temperature annunciator spuriously indicates high				
SWGR-A[11]	Train A 4160 V switchgear	Switchgear	Switchgear Room A	SUT-1 DC BUS-A	PNL-A EPS-4VBUSAF-1	4KV BUS A FAULT				
				EDG-A DC BUS-A	PNL-A EPS-4VBUSAF-2	4KV BUS A FAULT				
SWGR-B	Train B 4160 V switchgear	Switchgear	Switchgear Room B	SUT-1 DC BUS-B	PNL-B EPS-4VBUSBF-1	4KV BUS A FAULT				
				EDG-B DC BUS-B	PNL-B EPS-4VBUSBF-2	4KV BUS A FAULT				
SWGR-1	Non-safety 4160 V switchgear	Switchgear	Turbine Bldg. El. 0ft	UAT-1 SUT-1	EPS-4VBUS1F	4KV BUS 1 FAULT				
SWGR-2	Non-safety 4160 V switchgear	Switchgear	Turbine Bldg. El. 0ft	UAT-1 SUT-1	EPS-4VBUS2F	4KV BUS 2 FAULT				
SUT-1	Startup transformer	Transformer	Yard	OSP	SUTF	FAILURE OF START-UP TRANSFORMER (SUT)				
EDG-A	Train A emergency diesel generator	Diesel Generator	DG Bldg.	DC BUS-A	EPS-DGAF	FAILURE OF DIESEL GENERATOR A				
EDG-B	Train B emergency diesel generator	Diesel Generator	DG Bldg.	DC BUS-B	EPS-DGBF	FAILURE OF DIESEL GENERATOR B				
LC-1	Non-safety 480 V load center	Load Center	Turbine Bldg. El. 0 ft	SST-1	EPS-480VLC1F	480V LOAD CENTER 1 FAULT				
LC-2	Non-safety 480 V load center	Load Center	Turbine Bldg. El. 0 ft	SST-2	EPS-480VLC2F	480V LOAD CENTER 2 FAULT				

Equipment ID	Equipment Description	Equipment Type	Location	Power Supply	PRA Event Identifier	PRA Event Description	Normal Position/ Status	Desired Position/ Status	Failed Electrical Position	Failed Air Position
LC-A	Train A 480 V load center	Load Center	Switchgear Room A	SST-A PNL-A	EPS-480VLCAF	480V LOAD CENTER A FAULT				
LC-B	Train B 480 V load center	Load Center	Switchgear Room B	SST-B PNL-B	EPS-480VLCBF	480V LOAD CENTER B FAULT				
SST-1	Non-safety station service transformer	Transformer	Turbine Bldg. El. 0 F	SWGR-1	EPS-480VLC1XTF	480V LOAD CENTER 1 TRANSFORMER FAILS				
SST-2	Non-safety station service transformer	Transformer	Turbine Bldg. El. 0 F	SWGR-2	EPS-480VLC2XTF	480V LOAD CENTER 2 TRANSFORMER FAILS				
SST-A	Train A station service transformer	Transformer	Switchgear Room A	SWGR-A	EPS-480VLCAXTF	480V LOAD CENTER A TRANSFORMER FAILS				
SST-B	Train B station service transformer	Transformer	Switchgear Room B	SWGR-B	EPS-480VLCBXTF	480V LOAD CENTER B TRANSFORMER FAILS				
MCC-1	Non-safety 480 V motor control center	Motor Control Center	Turbine Bldg. El. 0 Ft	LC-1	EPS-480VMCC1F	480V MCC 1 FAULT				
MCC-2	Non-safety 480 V motor control center	Motor Control Center	Turbine Bldg. El. 0 Ft	LC-2	EPS-480VMCC2F	480V MCC 2 FAULT				
MCC-A1	Train A 480 V motor control center	Motor Control Center	SWG Access Room	LC-A	EPS-480VMCCA1F	480V MCC A1 FAULT				
MCC-B1	Train B 480 V motor control center	Motor Control Center	SWG Access Room	LC-B	EPS-480VMCCB1F	480V MCC B1 FAULT				
ATS-1	Automatic transfer switch	ATS	SWG Access Room	MCC-1 MCC-2	EPS-ATS1F	AUTOMATIC TRANSFER SWITCH ATS-1 FAILS				
BC-1	Non-safety swing battery charger	Battery Charger	Turbine Bldg. El. 0 Ft	ATS-1	EPS-BC1F	FAILURE OF BATTERY CHARGER 1				
BC-A	Train A battery charger	Battery Charger	Switchgear Room A	MCC-A1	EPS-BCAF	FAILURE OF BATTERY CHARGER A				

Equipment ID	Equipment Description	Equipment Type	Location	Power Supply	PRA Event Identifier	PRA Event Description	Normal Position/ Status	Desired Position/ Status	Failed Electrical Position	Failed Air Position
BC-B	Train B battery charger	Battery Charger	Switchgear Room B	MCC-B1	EPS-BCBF	FAILURE OF BATTERY CHARGER B				
BAT-1	Non-safety battery	Battery	Turbine Bldg. El. 0 Ft	N/A	EPS-SB	FAILURE OF STATION BATTERY				
BAT-A	Train A battery	Battery	Battery Room A	N/A	EPS-BATA	FAILURE OF BATTERY A				
BAT-B	Train B battery	Battery	Battery Room B	N/A	EPS-BATB	FAILURE OF BATTERY B				
DC BUS-1	Non-safety 125 VDC bus	DC Bus	Turbine Bldg. El. 0 Ft	BC-1 BAT-1	EPS-125VNSDCBUSF	FAULT ON 125V NON-SAFETY DC BUS				
DC BUS-A	Train A 125 VDC bus	DC Bus	Switchgear Room A	BC-A BAT-A	EPS-125VDCBUSAF	FAULT ON 125V DC BUS A				
DC BUS-B	Train B 125 VDC bus	DC Bus	Switchgear Room B	BC-B BAT-B	EPS-125VDCBUSBF	FAULT ON 125V DC BUS B				
PNL-A	Train A 125 VDC panel	Panel board	Switchgear Room A	DC BUS-A	EPS-125VDCPNLAF	FAULT ON 125V DC PANEL A				
PNL-B	Train B 125 VDC panel	Panel board	Switchgear Room B	DC BUS-B	EPS-125VDCPNLBF	FAULT ON 125V DC PANEL A				
INV-A	Train A inverter	Inverter	Switchgear Room A	DC BUS-A	EPS-120VBUSAINVF	FAILURE OF 120V BUS A INVERTER				
INV-B	Train B inverter	Inverter	Switchgear Room B	DC BUS-B	EPS-120VBUSAINVF	FAILURE OF 120V BUS B INVERTER				
VITAL-A	Train A 120 VAC vital bus	120VAC Bus	SWG Access Room	INV-A	EPS-120VBUSAF	120V BUS A FAULT				
VITAL-B	Train B 120 VAC vital bus	120VAC Bus	SWG Access Room	INV-B	EPS-120VBUSBF	120V BUS A FAULT				

Notes:

Legend

Appendix R	
Components/failures added to PRA for Fire PRA Model	

[1] HPI pumps A & B are in Appendix R for normal charging function; not for HPI.

[2] Closed to prevent LOCA /Open for feed and bleed. Appendix R has valve only to ensure remains closed.

[3] AOV-2 in Appendix R only for normal letdown function.

[4] AOV-3 in Appendix R only for normal charging function.

[5] MOV-2 in Appendix R only for normal suction to charging.

[6] MOV-3 and MOV-4 need to be closed for when using RWST water supply for HPI / Open for recirculation mode of injection. MOVs 5 & 6 are correspondingly open for RWST use and closed for recirc.

[7] Valve electrically blocked closed. Control power fuses are supposed to be removed. MOV-7 & 8 in Appendix R for both normal isolation and shutdown cooling functions.

[8] If RWST level indication fails high the operator will fail to establish recirculation. If the RWST level fails low and containment sump level fails high, the operator will establish suction to dry sump and fail the HPI the pumps due to insufficient suction. Need to resolve failure mode.

[9] If letdown temperature indication fails low, the operator will fail to isolate the letdown line on loss of CCW. This will cause HPI pumps to cavitate due to high temperature in the suction line.

[10] If RCS pressure instrument fails high, the low pressure signal to initiate emergency safeguards actuation during a lire-induced LOCA will not be initiated

[11] For SWGR-A or SWGR-B, only one basic event is used in the model. However, the circuit analysis impact to the switchgear is a function of the power supply

Step 7: Assemble Fire PRA Equipment List

Table 1: Fire PRA Equipment List Information (For Instructors)

Equipment ID	Equipment Description	Equipment Type	Location	Power Supply	PRA Event Identifier	PRA Event Description	Normal Position/ Status	Desired Position/ Status	Failed Electrical Position	Failed Air Position
HPI-A[1]	High pressure safety injection pump A	Pump	Aux Bldg. El. 0 Ft	SWGR-A	HPIA_FTS	HPIA fails to start	Standby	On	Off	N/A
					HPIA_FTR	HPIA fails to run	On	On	Off	N/A
HPI-B	High pressure safety injection pump B	Pump	Aux Bldg. El. 0 Ft	SWGR-B	HPIB_FTS	HPIB fails to start	Standby	On	Off	N/A
					HPIB_FTR	HPIB fails to run	On	On	Off	N/A
AFW-A	Motor driven AFW pump A	Pump	Turbine Bldg. El. 0 Ft	SWGR-A	AFWA-FTS	AFWA fails to start	Standby	On	Off	N/A
AFW-A	Motor driven AFW pump A	Pump	Turbine Bldg. El. 0 Ft	Turbine Bldg. El. 0 Ft	AFWA-FTR	AFWA fails to run	On	On	Off	N/A
AFW-B	Steam driven AFW pump B	Pump	Turbine Bldg. El. 0 Ft	N/A	AFWB-FTS	AFWB fails to start	Standby	On	N/A	N/A
AFW-B	Steam driven AFW pump B	Pump	Turbine Bldg. El. 0 Ft	N/A	AFWB-FTR	AFWB fails to run	On	On	N/A	N/A
AFW-C	Motor driven AFW pump C	Pump	Turbine Bldg. El. 0 Ft	SWGR-2	AFWC-FTS	AFWC fails to start	Standby	On	Off	N/A
AFW-C	Motor driven AFW pump C	Pump	Turbine Bldg. El. 0 Ft	SWGR-2	AFWC-FTR	AFWC fails to run	Standby	On	Off	N/A
RCP	Reactor coolant pump	Pump	Containment	SWGR-1	RCP1-FTT	RCP 1 fails to trip	On	Off	Off	N/A
COMP-1	Instrument air compressor	Compressor	Turbine Bldg. El. 0 Ft	LC-1	IA-COMP1_FTS	Instrument air compressor fails to start	Cycle	Cycle	Off	N/A

Equipment ID	Equipment Description	Equipment Type	Location	Power Supply	PRA Event Identifier	PRA Event Description	Normal Position/ Status	Desired Position/ Status	Failed Electrical Position	Failed Air Position
COMP-1	Instrument air compressor	Compressor	Turbine Bldg. El. 0 Ft	LC-1	IA-COMP1_FTR	Instrument air compressor fails to run	Cycle	Cycle	Off	N/A
AOV-1[2] (SOV-1)	Power operated relief valve	AOV	Containment	VITAL-A	AOV-1_TO	PORV AOV-1 transfers open	Closed	Closed	Closed	Closed
					AOV-1_FTO	PORV AOV-1 fails to open	Closed	Open	Closed	Closed
AOV-2[3] (SOV-2)	Letdown isolation valve	AOV	Aux Bldg. El. 0 Ft	DC BUS-B	AOV-2_FTC	AOV-2 fails to close	Open	Closed	Closed	Closed
AOV-3[4] (SOV-3)	Charging pump injection valve	AOV	Aux Bldg. El. 0 Ft	DC BUS-B	AOV-3_FTC	AOV-3 FAILS TO CLOSE	Open	Closed	Closed	Closed
MOV-1	HPI discharge valve	MOV	Aux Bldg. El. 0 Ft	MCC-A1	MOV-1_FTO	MOV-1 FAILS TO OPEN	Closed	Open	As Is	N/A
MOV-2[5]	VCT isolation valve	MOV	Aux Bldg. El. 0 Ft	MCC-B1	MOV-2_FTC	MOV-2 fails to close	Open	Closed	As Is	N/A
MOV-3[6]	Cont. sump recirc valve	MOV	Aux Bldg. El. -20 Ft	MCC-A1	MOV-3_FTO	MOV-3 fails to open	Closed	Open	As Is	N/A
					MOV-3_TO	MOV-3 TRANSFERS OPEN	Closed	Closed	As Is	N/A
MOV-4	Cont. sump recirc valve	MOV	Aux Bldg. El. -20 Ft	MCC-B1	MOV-4_FTO	MOV-4 fails to open	Closed	Open	As Is	N/A
					MOV-4 _TO	MOV-4 TRANSFERS OPEN	Closed	Closed	As Is	N/A
MOV-5	RWST isolation valve	MOV	Aux Bldg. El. 0 Ft	MCC-A1	MOV-5_FTO	MOV-5 fails to open	Closed	Open/Close d	As Is	N/A
MOV-6	RWST isolation valve	MOV	Aux Bldg. El. 0 Ft	MCC-B1	MOV-6_FTO	MOV-6 fails to open	Closed	Open/Close d	As Is	N/A
MOV-7[7]	RHR inboard suction valve	MOV	Containment	MCC-A1	MOV-7_TO	MOV-7 TRANSFERS OPEN	Closed	Closed	As Is	N/A
MOV-8	RHR outboard suction valve	MOV	Aux Bldg. El. -20 Ft	MCC-B1	MOV-8_TO	MOV-8 TRANSFERS OPEN	Closed	Closed	As Is	N/A

Equipment ID	Equipment Description	Equipment Type	Location	Power Supply	PRA Event Identifier	PRA Event Description	Normal Position/ Status	Desired Position/ Status	Failed Electrical Position	Failed Air Position
MOV-9	HPI discharge valve	MOV	Aux Bldg. El. 0 Ft	MCC-B1	MOV-9_FTO	MOV-9 FAILS TO OPEN	Closed	Open	As Is	N/A
MOV-10	AFW pump A discharge valve	MOV	Turbine Bldg. El. 0 Ft	MCC-A1	MOV-10_FTO	MOV-10 fails to open	Closed	Open	As Is	N/A
MOV-11	AFW pump B discharge valve	MOV	Turbine Bldg. El. 0 F	DC BUS-B	MOV-11_FTO	MOV-11 fails to open	Closed	Open	As is	N/A
MOV-13	PORV block valve	MOV	Containment	MCC-A1	MOV-13_FTC	MOV-13 fails to close	Open	Open/ Closed	As is	N/A
MOV-14	AFW pump B turbine steam line isolation valve	MOV	Turbine Bldg. El. 0 Ft	DC BUS-B	MOV-14_FTO	MOV-14 FAILS TO OPEN	Closed	Open	As-Is	N/A
MOV-15	AFW pump B steam inlet throttle valve	MOV	Turbine Bldg. El. 0 Ft	DC BUS-B	MOV-15_FTO	MOV-15 FAILS TO OPEN	Closed	Throttled	As-Is	N/A
MOV-18	AFW pump C discharge valve	MOV	Turbine Bldg. El. 0 Ft	MCC-2	MOV-18_FTO	MOV-18 fails to open	Closed	Open	As-Is	N/A
LI-1[8]	RWST level	Instrument	Yard	VITAL-A	LI-1_FL	RWST Level indication fails low	Available	Available	Low	N/A
					LI-1_FH	RWST Level indication fails high	Available	Available	High	N/A
LI-2	RWST level	Instrument	Yard	VITAL-B	LI-2_FL	RWST Level indication fails low	Available	Available	Low	N/A
					LI-2_FH	RWST Level indication fails high	Available	Available	High	N/A
LI-3	Cont. sump level	Instrument	Containment	VITAL-A	LI-3_FH	Cont sump Level indication fails high	Available	Available	High	N/A
LI-4	Cont. sump level	Instrument	Containment	VITAL-B	LI-4_FH	Cont sump Level indication fails high	Available	Available	High	N/A
TI-1[9]	Letdown heat exchanger outlet temp	Instrument	Aux Bldg. El. 0 Ft	VITAL-A	TI-1_FL	Letdown temperature indication fails low	Available	Available	Low	N/A
PT-1[10]	RCS pressure	Instrument	Containment	VITAL-B	PI-1_FH	RCS pressure indication fails high	Available	Available	High	N/A

Equipment ID	Equipment Description	Equipment Type	Location	Power Supply	PRA Event Identifier	PRA Event Description	Normal Position/ Status	Desired Position/ Status	Failed Electrical Position	Failed Air Position
A-1	AFW motor high temperature	Annunciator	SWG Access Room	VITAL-A	ANN-1_FH	AFW motor high temperature annunciator spuriously indicates high	Available	Non spurious	Unavailable	N/A
SWGR-A[11]	Train A 4160 V switchgear	Switchgear	Switchgear Room A	SUT-1 DC BUS-A	PNL-A EPS-4VBUSAF-1	4KV BUS A FAULT	Energized from SUT-1	Energized from SUT-1	De-Energized	N/A
				EDG-A DC BUS-A	PNL-A EPS-4VBUSAF-2	4KV BUS A FAULT	Energized from SUT-1	Energized from EDG-A	De-Energized	N/A
SWGR-B	Train B 4160 V switchgear	Switchgear	Switchgear Room B	SUT-1 DC BUS-B	PNL-B EPS-4VBUSBF-1	4KV BUS A FAULT	Energized from SUT-1	Energized from SUT-1	De-Energized	N/A
				EDG-B DC BUS-B	PNL-B EPS-4VBUSBF-2	4KV BUS A FAULT	Energized from SUT-1	Energized from EDG-B	De-Energized	N/A
SWGR-1	Non-safety 4160 V switchgear	Switchgear	Turbine Bldg. El. 0ft	UAT-1 SUT-1	EPS-4VBUS1F	4KV BUS 1 FAULT	Energized	Energized	De-Energized	N/A
SWGR-2	Non-safety 4160 V switchgear	Switchgear	Turbine Bldg. El. 0ft	UAT-1 SUT-1	EPS-4VBUS2F	4KV BUS 2 FAULT	Energized	Energized	De-Energized	N/A
SUT-1	Startup transformer	Transformer	Yard	OSP	SUTF	FAILURE OF START-UP TRANSFORMER (SUT)	Energized	Energized	De-Energized	N/A
EDG-A	Train A emergency diesel generator	Diesel Generator	DG Bldg.	DC BUS-A	EPS-DGAF	FAILURE OF DIESEL GENERATOR A	Standby	On	Off	N/A
EDG-B	Train B emergency diesel generator	Diesel Generator	DG Bldg.	DC BUS-B	EPS-DGBF	FAILURE OF DIESEL GENERATOR B	Standby	On	Off	N/A
LC-1	Non-safety 480 V load center	Load Center	Turbine Bldg. El. 0 ft	SST-1	EPS-480VLC1F	480V LOAD CENTER 1 FAULT	Energized	Energized	De-Energized	N/A

Equipment ID	Equipment Description	Equipment Type	Location	Power Supply	PRA Event Identifier	PRA Event Description	Normal Position/ Status	Desired Position/ Status	Failed Electrical Position	Failed Air Position
LC-2	Non-safety 480 V load center	Load Center	Turbine Bldg. El. 0 ft	SST-2	EPS-480VLC2F	480V LOAD CENTER 2 FAULT	Energized	Energized	De-Energized	N/A
LC-A	Train A 480 V load center	Load Center	Switchgear Room A	SST-A PNL-A	EPS-480VLCAF	480V LOAD CENTER A FAULT	Energized	Energized	De-Energized	N/A
LC-B	Train B 480 V load center	Load Center	Switchgear Room B	SST-B PNL-B	EPS-480VLCBF	480V LOAD CENTER B FAULT	Energized	Energized	De-Energized	N/A
SST-1	Non-safety station service transformer	Transformer	Turbine Bldg. El. 0 F	SWGR-1	EPS-480VLC1XTF	480V LOAD CENTER 1 TRANSFORMER FAILS	Energized	Energized	De-Energized	N/A
SST-2	Non-safety station service transformer	Transformer	Turbine Bldg. El. 0 F	SWGR-2	EPS-480VLC2XTF	480V LOAD CENTER 2 TRANSFORMER FAILS	Energized	Energized	De-Energized	N/A
SST-A	Train A station service transformer	Transformer	Switchgear Room A	SWGR-A	EPS-480VLCAXTF	480V LOAD CENTER A TRANSFORMER FAILS	Energized	Energized	De-Energized	N/A
SST-B	Train B station service transformer	Transformer	Switchgear Room B	SWGR-B	EPS-480VLCBXTF	480V LOAD CENTER B TRANSFORMER FAILS	Energized	Energized	De-Energized	N/A
MCC-1	Non-safety 480 V motor control center	Motor Control Center	Turbine Bldg. El. 0 Ft	LC-1	EPS-480VMCC1F	480V MCC 1 FAULT	Energized	Energized	De-Energized	N/A
MCC-2	Non-safety 480 V motor control center	Motor Control Center	Turbine Bldg. El. 0 Ft	LC-2	EPS-480VMCC2F	480V MCC 2 FAULT	Energized	Energized	De-Energized	N/A
MCC-A1	Train A 480 V motor control center	Motor Control Center	SWG Access Room	LC-A	EPS-480VMCCA1F	480V MCC A1 FAULT	Energized	Energized	De-Energized	N/A
MCC-B1	Train B 480 V motor control center	Motor Control Center	SWG Access Room	LC-B	EPS-480VMCCB1F	480V MCC B1 FAULT	Energized	Energized	De-Energized	N/A
ATS-1	Automatic transfer switch	ATS	SWG Access Room	MCC-1 MCC-2	EPS-ATS1F	AUTOMATIC TRANSFER SWITCH ATS-1 FAILS	Energized from MCC-1	Energized from MCC-1	De-Energized	N/A
BC-1	Non-safety swing battery charger	Battery Charger	Turbine Bldg. El. 0 Ft	ATS-1	EPS-BC1F	FAILURE OF BATTERY CHARGER 1	Energized	Energized	De-Energized	N/A

Equipment ID	Equipment Description	Equipment Type	Location	Power Supply	PRA Event Identifier	PRA Event Description	Normal Position/ Status	Desired Position/ Status	Failed Electrical Position	Failed Air Position
BC-A	Train A battery charger	Battery Charger	Switchgear Room A	MCC-A1	EPS-BCAF	FAILURE OF BATTERY CHARGER A	Energized	Energized	De-Energized	N/A
BC-B	Train B battery charger	Battery Charger	Switchgear Room B	MCC-B1	EPS-BCBF	FAILURE OF BATTERY CHARGER B	Energized	Energized	De-Energized	N/A
BAT-1	Non-safety battery	Battery	Turbine Bldg. El. 0 Ft	N/A	EPS-SB	FAILURE OF STATION BATTERY	Available	Available	Unavailable	N/A
BAT-A	Train A battery	Battery	Battery Room A	N/A	EPS-BATA	FAILURE OF BATTERY A	Available	Available	Unavailable	N/A
BAT-B	Train B battery	Battery	Battery Room B	N/A	EPS-BATB	FAILURE OF BATTERY B	Available	Available	Unavailable	N/A
DC BUS-1	Non-safety 125 VDC bus	DC Bus	Turbine Bldg. El. 0 Ft	BC-1 BAT-1	EPS-125VNSDCBUSF	FAULT ON 125V NON-SAFETY DC BUS	Energized	Energized	De-Energized	N/A
DC BUS-A	Train A 125 VDC bus	DC Bus	Switchgear Room A	BC-A BAT-A	EPS-125VDCBUSAF	FAULT ON 125V DC BUS A	Energized	Energized	De-Energized	N/A
DC BUS-B	Train B 125 VDC bus	DC Bus	Switchgear Room B	BC-B BAT-B	EPS-125VDCBUSBF	FAULT ON 125V DC BUS B	Energized	Energized	De-Energized	N/A
PNL-A	Train A 125 VDC panel	Panel board	Switchgear Room A	DC BUS-A	EPS-125VDCPNLAF	FAULT ON 125V DC PANEL A	Energized	Energized	De-Energized	N/A
PNL-B	Train B 125 VDC panel	Panel board	Switchgear Room B	DC BUS-B	EPS-125VDCPNLBF	FAULT ON 125V DC PANEL A	Energized	Energized	De-Energized	N/A
INV-A	Train A inverter	Inverter	Switchgear Room A	DC BUS-A	EPS-120VBUSAINVF	FAILURE OF 120V BUS A INVERTER	Energized	Energized	De-Energized	N/A
INV-B	Train B inverter	Inverter	Switchgear Room B	DC BUS-B	EPS-120VBUSAINVF	FAILURE OF 120V BUS B INVERTER	Energized	Energized	De-Energized	N/A
VITAL-A	Train A 120 VAC vital bus	120VAC Bus	SWG Access Room	INV-A	EPS-120VBUSAF	120V BUS A FAULT	Energized	Energized	De-Energized	N/A
VITAL-B	Train B 120 VAC vital bus	120VAC Bus	SWG Access Room	INV-B	EPS-120VBUSBF	120V BUS A FAULT	Energized	Energized	De-Energized	N/A

Notes:

Legend

Appendix R	
Components/failures added to PRA for Fire PRA Model	

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[1] HPI pumps A & B are in Appendix R for normal charging function; not for HPI.

[2] Closed to prevent LOCA /Open for feed and bleed. Appendix R has valve only to ensure remains closed.

[3] AOV-2 in Appendix R only for normal letdown function.

[4] AOV-3 in Appendix R only for normal charging function.

[5] MOV-2 in Appendix R only for normal suction to charging.

[6] MOV-3 and MOV-4 need to be closed for when using RWST water supply for HPI / Open for recirculation mode of injection. MOVs 5 & 6 are correspondingly open for RWST use and closed for recirc.

[7] Valve electrically blocked closed. Control power fuses are supposed to be removed. MOV-7 & 8 in Appendix R for both normal isolation and shutdown cooling functions.

[8] If RWST level indication fails high the operator will fail to establish recirculation. If the RWST level fails low and containment sump level fails high, the operator will establish suction to dry sump and fail the HPI the pumps due to insufficient suction. Need to resolve failure mode.

[9] If letdown temperature indication fails low, the operator will fail to isolate the letdown line on loss of CCW. This will cause HPI pumps to cavitate due to high temperature in the suction line.

[10] If RCS pressure instrument fails high, the low pressure signal to initiate emergency safeguards actuation during a lire-induced LOCA will not be initiated

[11] For SWGR-A or SWGR-B, only one basic event is used in the model. However, the circuit analysis impact to the switchgear is a function of the power supply

Basic Event	Description	Time (min)	Location	Base Value	CR-1 No Abandonment		
					Set	Reason for set selection	Screening Value
OPER-1	Operator fails to switch over to re-circulation	>120	CR	0.001		**Potential damage to multiple trains of both safety and non-safety equipment as well as affect operators.**	
OPER-2	Operator fails to isolate letdown and establish RWST flow	15	CR	new			
OPER-4	Operator fails to establish feed and bleed	30	CR	0.008			
OPER-5	Operator fails to close PORV block valve	10	CR	new			
OPER-6	Operator fails to depower stuck open PORV	<10	Local	new			
OPER-7	Operator fails to trip reactor coolant pumps (loss of CCW)	<10	CR	0.010			

Basic Event	Description	Time (min)	Location	Base Value	CR-2 Abandonment		
					Set	Reason for set selection	Screening Value
OPER-1	Operator fails to switch over to re-circulation	>120	CR	0.001		**Fire requires CR abandonment.**	
OPER-2	Operator fails to isolate letdown and establish RWST flow	15	CR	new			
OPER-4	Operator fails to establish feed and bleed	30	CR	0.008			
OPER-5	Operator fails to close PORV block valve	10	CR	new			
OPER-6	Operator fails to depower stuck open PORV	<10	Local	new			
OPER-7	Operator fails to trip reactor coolant pumps (loss of CCW)	<10	CR	0.010			

Basic Event	Description	Time (min)	Location	Base Value	Area 4B (AFW)		
					Set	Reason for set selection	Screening Value
OPER-1	Operator fails to switch over to re-circulation	>120	CR	0.001		**Potentially damages both trains of safety-related AFW.**	
OPER-2	Operator fails to isolate letdown and establish RWST flow	15	CR	new			
OPER-4	Operator fails to establish feed and bleed	30	CR	0.008			
OPER-5	Operator fails to close PORV block valve	10	CR	new			
OPER-6	Operator fails to depower stuck open PORV	<10	Local	new			
OPER-7	Operator fails to trip reactor coolant pumps (loss of CCW)	<10	CR	0.010			

Basic Event	Description	Time (min)	Location	Base Value	Area 5 (Battery Room A)		
					Set	Reason for set selection	Screening Value
OPER-1	Operator fails to switch over to re-circulation	>120	CR	0.001		**Potentially damages A train only equipment (Battery -A)**.	
OPER-2	Operator fails to isolate letdown and establish RWST flow	15	CR	new			
OPER-4	Operator fails to establish feed and bleed	30	CR	0.008			
OPER-5	Operator fails to close PORV block valve	10	CR	new			
OPER-6	Operator fails to depower stuck open PORV	<10	Local	new			
OPER-7	Operator fails to trip reactor coolant pumps (loss of CCW)	<10	CR	0.010			

Basic Event	Description	Time (min)	Location	Base Value	Area 10 (Switchgear A)		
					Set	Reason for set selection	Screening Value
OPER-1	Operator fails to switch over to re-circulation	>120	CR	0.001		**Potentially damages A train equipment as well as B train diesel generator.**	
OPER-2	Operator fails to isolate letdown and establish RWST flow	15	CR	new			
OPER-4	Operator fails to establish feed and bleed	30	CR	0.008			
OPER-5	Operator fails to close PORV block valve	10	CR	new			
OPER-6	Operator fails to depower stuck open PORV	<10	Local	new			
OPER-7	Operator fails to trip reactor coolant pumps (loss of CCW)	<10	CR	0.010			

Basic Event	Description	Time (min)	Location	Base Value	Area 11 (Switchgear B)		
					Set	Reason for set selection	Screening Value
OPER-1	Operator fails to switch over to re-circulation	>120	CR	0.001		**Potentially damages B train only equipment.**	
OPER-2	Operator fails to isolate letdown and establish RWST flow	15	CR	new			
OPER-4	Operator fails to establish feed and bleed	30	CR	0.008			
OPER-5	Operator fails to close PORV block valve	10	CR	new			
OPER-6	Operator fails to depower stuck open PORV	<10	Local	new			
OPER-7	Operator fails to trip reactor coolant pumps (loss of CCW)	<10	CR	0.010			

Basic Event	Description	Time (min)	Location	Base Value	CR-1 No Abandonment		
					Set	Reason for set selection	Screening Value
OPER-1	Operator fails to switch over to re-circulation	>120	CR	0.001	3	**Potential damage to multiple trains of both safety and non-safety equipment as well as affect operators.** Set 1: Does not meet environmental impact condition. Depending on fire location/size, may not meet spurious behavior conditions. Set 2: Same concerns as for Set 1. Set 4: Applies only for CR abandonment. Hence should use Set 3 criteria for both existing and new HFEs.	0.100
OPER-2	Operator fails to isolate letdown and establish RWST flow	15	CR	new	3		1.000
OPER-4	Operator fails to establish feed and bleed	30	CR	0.008	3		1.000
OPER-5	Operator fails to close PORV block valve	10	CR	new	3		1.000
OPER-6	Operator fails to depower stuck open PORV	<10	Local	new	3		1.000
OPER-7	Operator fails to trip reactor coolant pumps (loss of CCW)	<10	CR	0.010	3		1.000

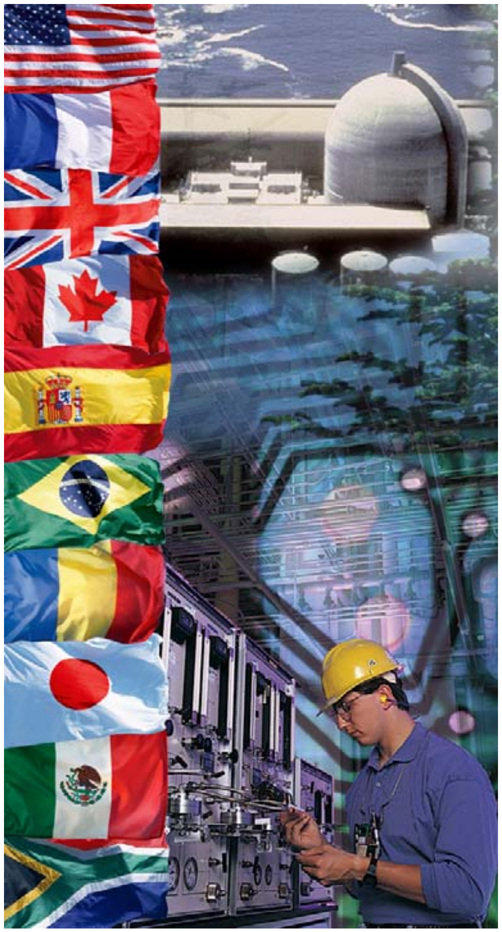
Basic Event	Description	Time (min)	Location	Base Value	CR-2 Abandonment		
					Set	Reason for set selection	Screening Value
OPER-1	Operator fails to switch over to re-circulation	>120	CR	0.001	4	**Fire requires CR abandonment.** Set 4 criteria is directly applicable. Requires more detailed analysis and modeling.	1.000
OPER-2	Operator fails to isolate letdown and establish RWST flow	15	CR	new	4		
OPER-4	Operator fails to establish feed and bleed	30	CR	0.008	4		
OPER-5	Operator fails to close PORV block valve	10	CR	new	4		
OPER-6	Operator fails to depower stuck open PORV	<10	Local	new	4		
OPER-7	Operator fails to trip reactor coolant pumps (loss of CCW)	<10	CR	0.010	4		

Basic Event	Description	Time (min)	Location	Base Value	Area 4B (AFW)		
					Set	Reason for set selection	Screening Value
OPER-1	Operator fails to switch over to re-circulation	>120	CR	0.001	3	**Potentially damages both trains of safety-related AFW.** Therefore does not meet Set 1 or Set 2 criteria. Set 4 criteria is for CR abandonment. Need to use Set 3 criteria for both existing and new HFEs.	0.100
OPER-2	Operator fails to isolate letdown and establish RWST flow	15	CR	new	3		1.000
OPER-4	Operator fails to establish feed and bleed	30	CR	0.008	3		1.000
OPER-5	Operator fails to close PORV block valve	10	CR	new	3		1.000
OPER-6	Operator fails to depower stuck open PORV	<10	Local	new	3		1.000
OPER-7	Operator fails to trip reactor coolant pumps (loss of CCW)	<10	CR	0.010	3		1.000

Basic Event	Description	Time (min)	Location	Base Value	Area 5 (Battery Room A)		
					Set	Reason for set selection	Screening Value
OPER-1	Operator fails to switch over to re-circulation	>120	CR	0.001	1	**Potentially damages A train only equipment (Battery -A)**. Would not expect safety-related spurious actuations. Meets Set 1 criteria for existing HFEs. For new HFEs, use Set 3 critieria.	0.010
OPER-2	Operator fails to isolate letdown and establish RWST flow	15	CR	new	3		1.000
OPER-4	Operator fails to establish feed and bleed	30	CR	0.008	1		0.080
OPER-5	Operator fails to close PORV block valve	10	CR	new	3		1.000
OPER-6	Operator fails to depower stuck open PORV	<10	Local	new	3		1.000
OPER-7	Operator fails to trip reactor coolant pumps (loss of CCW)	<10	CR	0.010	1		0.100

Basic Event	Description	Time (min)	Location	Base Value	Area 10 (Switchgear A)		
					Set	Reason for set selection	Screening Value
OPER-1	Operator fails to switch over to re-circulation	>120	CR	0.001	3	**Potentially damages A train equipment as well as B train diesel generator.** A fire in this area could affect multiple safety-related trains particularly if we can lose offsite power and need EDG-B. It is therefore most conservative to conclude that this does not meet Set 1 or Set 2 criteria. Set 4 applies only to CR abandonment. Best to use Set 3 criteria for both existing and new HFEs.	0.100
OPER-2	Operator fails to isolate letdown and establish RWST flow	15	CR	new	3		1.000
OPER-4	Operator fails to establish feed and bleed	30	CR	0.008	3		1.000
OPER-5	Operator fails to close PORV block valve	10	CR	new	3		1.000
OPER-6	Operator fails to depower stuck open PORV	<10	Local	new	3		1.000
OPER-7	Operator fails to trip reactor coolant pumps (loss of CCW)	<10	CR	0.010	3		1.000

Basic Event	Description	Time (min)	Location	Base Value	Area 11 (Switchgear B)		
					Set	Reason for set selection	Screening Value
OPER-1	Operator fails to switch over to re-circulation	>120	CR	0.001	2	**Potentially damages B train only equipment.** Could expect mutliple safety-related spurious actuations but only for B train equipment. Hence does not meet Set 1 but does meet Set 2 criteria for existing HFEs. For new HFEs, need to use Set 3 criteria.	0.100
OPER-2	Operator fails to isolate letdown and establish RWST flow	15	CR	new	3		1.000
OPER-4	Operator fails to establish feed and bleed	30	CR	0.008	2		0.100
OPER-5	Operator fails to close PORV block valve	10	CR	new	3		1.000
OPER-6	Operator fails to depower stuck open PORV	<10	Local	new	3		1.000
OPER-7	Operator fails to trip reactor coolant pumps (loss of CCW)	<10	CR	0.010	2		0.100



EPRI/NRC-RES FIRE PRA METHODOLOGY

Task 5 - Fire-Induced Risk Model Development

Joint RES/EPRI Fire PRA Workshop
2007
Palo Alto, CA

A Collaboration of U.S. NRC Office of Nuclear Regulatory Research (RES) & Electric Power Research Institute (EPRI)

Fire PRA Risk Model
Scope

- Task 5: Fire-Induced Risk Model Development
  - Constructing the PRA model

Fire PRA Risk Model
General Comment/Observation

- Task 5 does not represent any changes from past practice, but what is modeled is largely based on Task 2 with HRA input from Task 12

- Bottom line – just “tweaking” your Internal Events PRA is probably NOT sufficient

Task 5: Fire Risk Model Development
General Objectives

Purpose: Configure the Internal Events PRA to provide fire risk metrics of interest (primarily CDF and LERF).

- Based on standard state-of-the-art PRA practices
- Intended to be applicable for any PRA methodology or software
- Allows user to quantify CDF and LERF, or conditional metrics CCDP and CLERP
- *Conceptually, nothing "new" here – need to "build the PRA model" reflecting fire induced initiators, equipment and failure modes, and human actions of interest*

Task 5: Fire Risk Model Development
Inputs/Outputs

Task inputs and outputs:

- Inputs from other tasks: [Note: inclusion of spatial information requires cable locations from Task 3]
  – Sequence considerations, initiating event considerations, and components from Task 2 (Fire PRA Component Selection),
  – Unscreened fire compartments from Task 4 (Qualitative Screening),
  – HRA events from Task 12 (Post-Fire HRA)
- Output to Task 7 (Quantitative Screening) which will further modify the model development
- Can always iterate back to refine aspects of the model

Task 5: Fire Risk Model Development
Steps in Procedure

Two major steps:

- Step 1: Develop CDF/CCDP model

- Step 2: Develop LERF/CLERP model

Task 5: Fire Risk Model Development
Steps in Procedure/Details

Step 1 (2): Develop CDF/CCDP (LERF/CLERP) models

Step 1.1 (2.1): Select fire-induced initiators and sequences and incorporate into the model

- Each fire-induced initiator is mapped to an internal initiator that mimics the effect on the plant of the fire initiator
- Internal events sequences form bulk of sequences for Fire PRA, but a search for new sequences should be made (see Task 2). Some new sequences may require new logic to be added to the PRA model

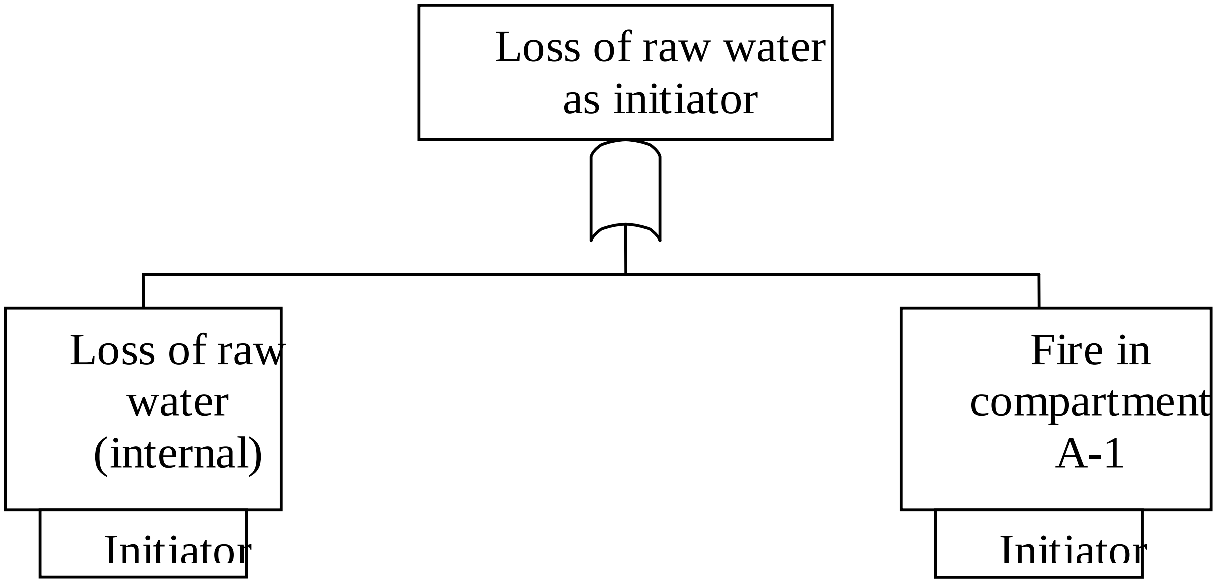
Task 5: Fire Risk Model Development
Steps in Procedure/Details

Step 1.1 (2.1) - continued

- Plants that use fire emergency procedures (FEPs) may need special models to address unique fire-related actions (e.g., pre-defined fire response actions and MCR abandonment).

- Some human actions may induce new sequences not covered in Internal Events PRA and can “fail” components
  - Example: SISBO, or partial SISBO

Task 5: Fire Risk Model Development
Steps in Procedure/Details



Example of new logic with a fire-induced loss of raw water initiating event

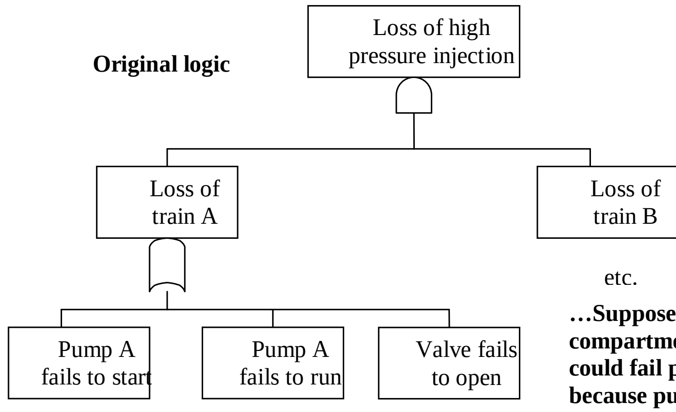
Task 5: Fire Risk Model Development
Steps in Procedure/Details

Step 1.2 (2.2): Incorporate fire-induced equipment failures

- Fire PRA database documents list of potentially failed equipment for each fire compartment
- Basic events for fire-induced spurious operations are defined and added to the PRA model
- Inclusion of spatial information requires equipment and cable locations
  - May be an integral part of model logic, or handled with manipulation of a cable location database, etc.

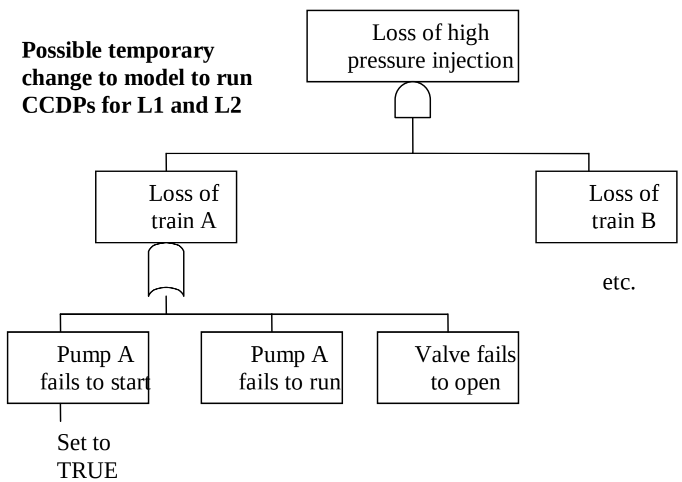
Task 5: Fire Risk Model Development
Steps in Procedure/Details

Original logic

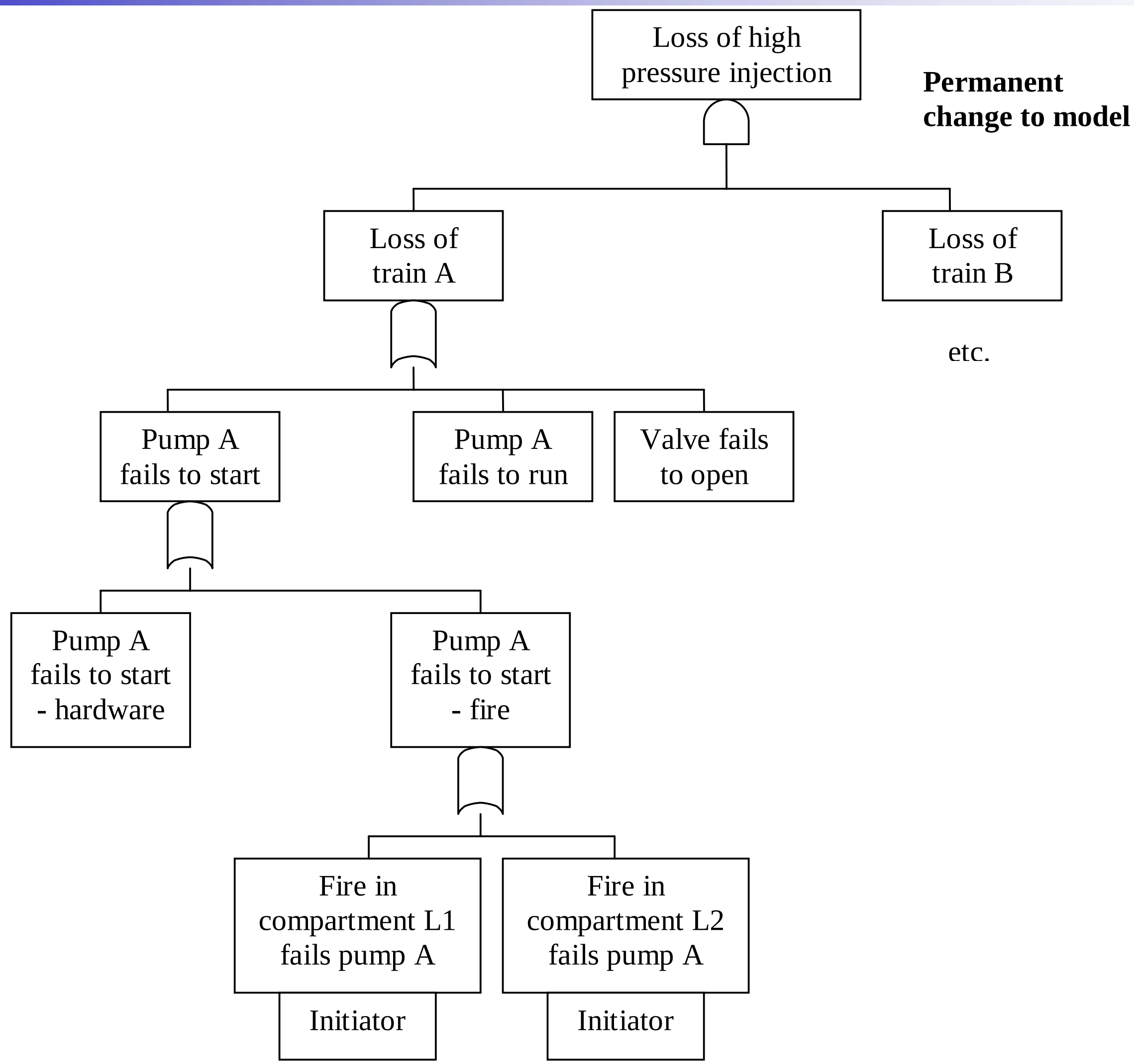


…Suppose fire in compartment L1 or L2 could fail pump A because pump A is in L1 and cable for pump A is in L2 …

Possible temporary change to model to run CCDPs for L1 and L2



Task 5: Fire Risk Model Development
Steps in Procedure/Details



Task 5: Fire Risk Model Development
Steps in Procedure/Details

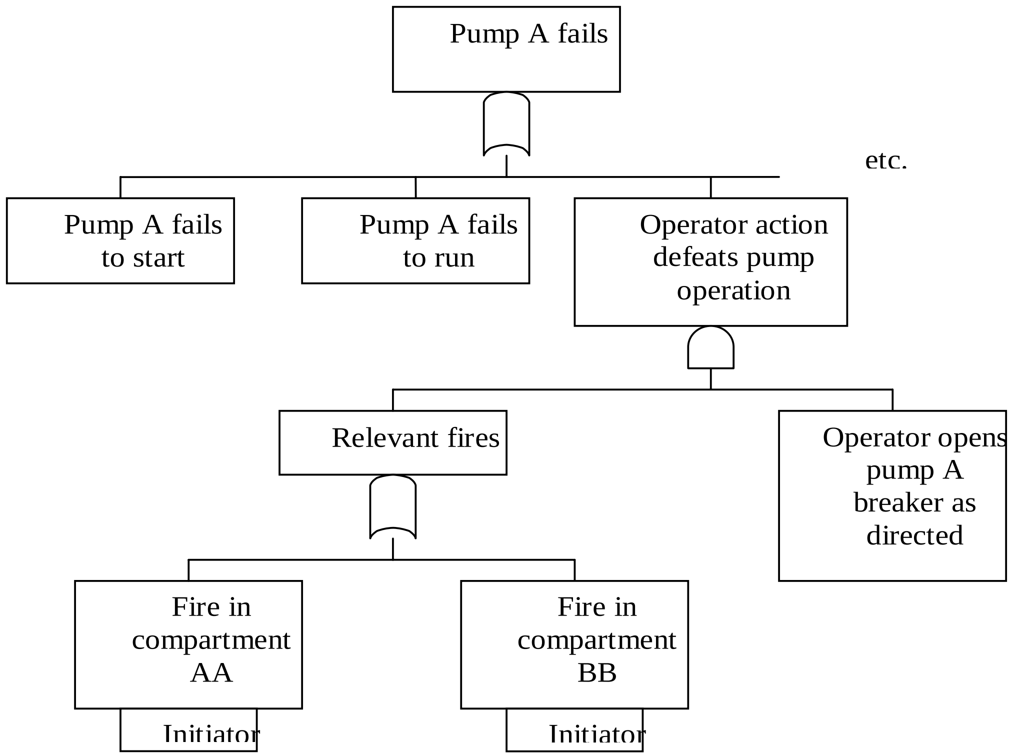
Step 1.3 (2.3): Incorporate fire-induced human failures

- New fire-specific HFEs may have to be added to the model to address actions specified in FEPs [Note: all HFEs will be set at screening values at first, using Task 12 guidance]

- Successful operator actions may temporarily disable ("fail") components

Task 5: Fire Risk Model Development
Steps in Procedure/Details

Suppose a proceduralized manual action carried out for fires in compartments AA & BB defeats Pump A operation by de-energizing the pump (opening its breaker drawer)…

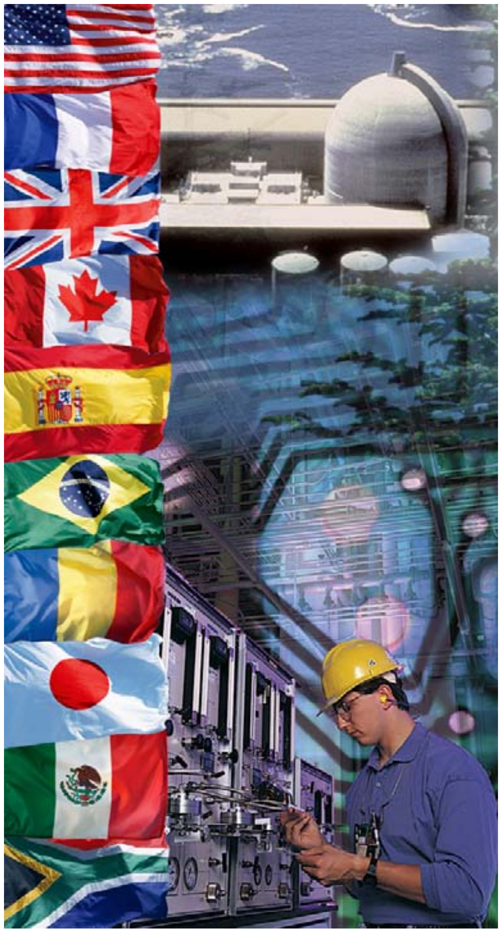


Sample Problem Exercise for Task 5

- Distribute blank handout for Task 5, Steps 1 and 2

- Distribute completed handout for Task 5, Steps 1 and 2

- Question and Answer Session



EPRI/NRC-RES FIRE PRA METHODOLOGY

Task 4 - Qualitative Screening
Task 7 - Quantitative Screening

Joint RES/EPRI Fire PRA Workshop
2007
Palo Alto, CA

A Collaboration of U.S. NRC Office of Nuclear Regulatory Research (RES) & Electric Power Research Institute (EPRI)

Qualitative / Quantitative Screening
Scope

- Task 4: Qualitative Screening
  - First chance to identify very low risk compartments
- Task 7: Quantitative Screening
  - Running the Fire PRA model to iteratively screen / maintain modeled sequences at different levels of detail

Task 4: Qualitative Screening
Objectives and Scope

- The objective of Task 4 is to identify those Fire Compartments that can be shown to have a negligible risk contribution <u>without</u> quantitative analysis
  - This is where you drop the office building inside the protected area
- Task 4 *only* considers fire compartments as individual contributors
  - Multi-compartment scenarios are covered in Task 11(b)
  - Compartments that screen out qualitatively need to be re-considered as potential Exposing Compartments in the multi-compartment analysis (but not as the Exposed Compartment)

Task 4: Qualitative Screening
Required Input and Task Output

- To complete Task 4 you need the following input:
  - List of fire compartments from Task 1
  - List of Fire PRA equipment from Task 2 including location mapping results
  - List of Fire PRA cables from Task 3 including location mapping results

- Task Output: A list of Fire Compartments that will be screened out (no further analysis) based on qualitative criteria

Task 4: Qualitative Screening
A Note….

- Qualitative Screening is OPTIONAL!
  - You may choose to retain any number of fire compartments (from one to all) without formally conducting the Qualitative Screening Assessment for the compartment
  - However, to eliminate a compartment, you must exercise the screening process for the compartment
  - *Example 1*: Many areas will never pass qualitative screening, so simply keep them
  - *Example 2*: If you are dealing with an application with limited scope (e.g. NFPA 805 Change Evaluation) a formalized Qualitative Screening may be pointless

Task 4: Qualitative Screening
Screening Criteria

- A Fire Compartment may be screened out if:
  - No Fire PRA equipment or cables are located in the compartment, and
  - No fire that remains confined to the compartment could lead to:
    - An automatic plant trip, or
    - A manual trip *as specified by plant procedures*, or
    - A *near-term* manual shutdown due to violation of plant Technical Specifications*

*In the case of tech spec shutdown, consideration of the time window <u>is</u> appropriate

- No firm time window is specified in the procedure – rule of thumb: consistent with the time window of the fire itself
- Analyst must choose and justify the maximum time window considered

Task 7: Quantitative Screening
General Objectives

Purpose: allow (i.e., optional) screening of fire compartments and scenarios based on contribution to fire risk. Screening is primarily compartment-based (Tasks 7A/B). Scenario-based screening (Tasks 7C/D) is a further refinement (optional).

- Screening criteria not the same as acceptance criteria for regulatory applications (e.g., R.G. 1.174)
- Screening does not mean "throw away" – screened compartments/scenarios will be quantified (recognized to be conservative) and carried through to Task 14 as a measure of the residual fire risk

Task 7: Quantitative Screening
Inputs/Outputs

- Inputs from other tasks for compartment-based screening (7A/B):
  - Fire ignition frequencies from Task 6,
  - Task 5 (Fire-Induced Risk Model),
  - Task 12 (Post-Fire HRA Screening), and
  - Task 8 (Scoping Fire Modeling) (7B only)

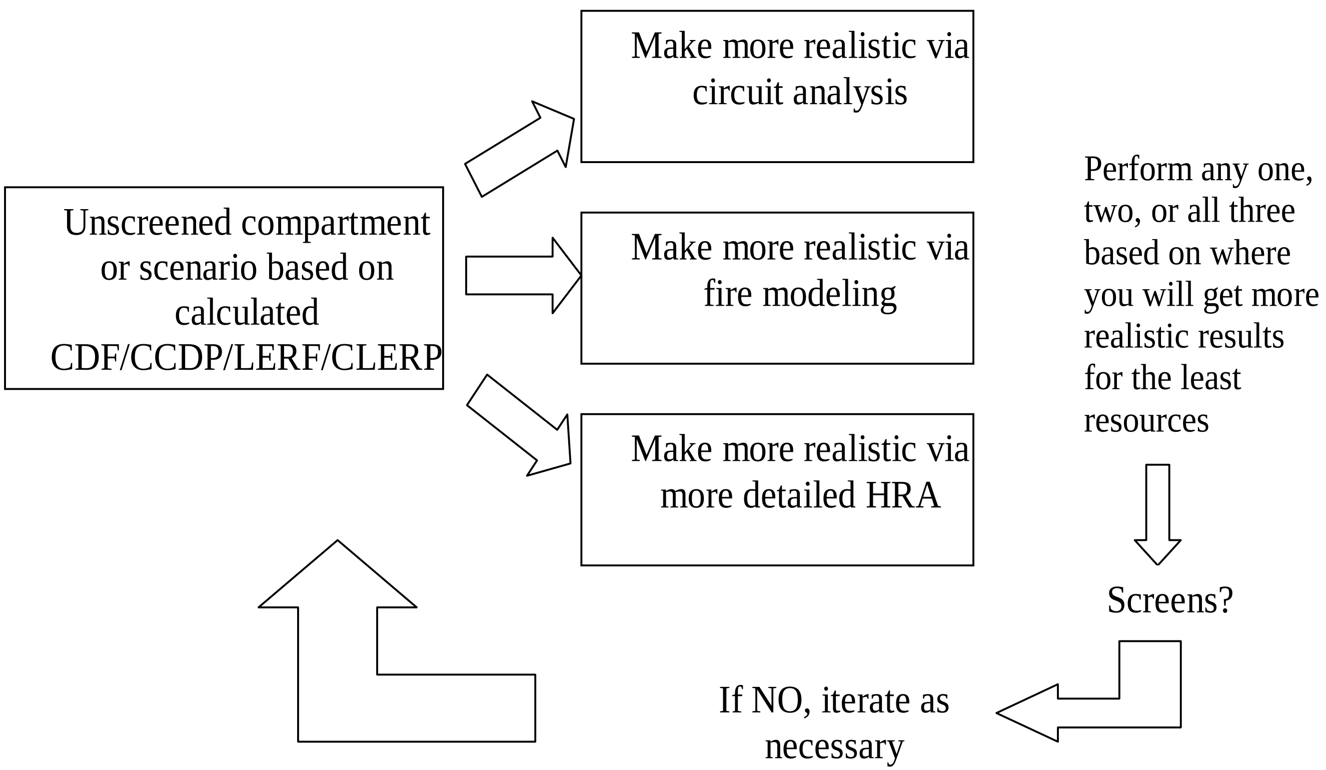
Task 7: Quantitative Screening
Inputs/Outputs (cont'd)

- Inputs from other tasks for scenario-based screening (7C/D) include inputs listed above plus:
  - Task 9 (Detailed Circuit Failure Analysis) and/or
  - Task 11 (Detailed Fire Modeling) and/or
  - Task 12 (Post-Fire HRA Detailed), and
  - Task 10 (Circuit Failure Mode Likelihood Analysis) (7D only)

Task 7: Quantitative Screening
Inputs/Outputs (cont'd)

- Outputs to other tasks:
  - Unscreened fire compartments from Task 7A go to Task 8 (Scoping Fire Modeling),
  - Unscreened fire compartments from Task 7B go to Task 9 (Detailed Circuit Failure Analysis) and/or Task 11 (Detailed Fire Modeling) and/or Task 12 (detailed Post-Fire HRA),
  - Unscreened fire scenarios from Task 7C/D go to Task 14 (Fire Risk Quantification) for best-estimate risk calculation

Task 7: Quantitative Screening
Overview of the Process



Task 7: Quantitative Screening
Steps in Procedure

Three major steps in the procedure:

- Step 1: Quantify CDF/CCDP model
- Step 2: Quantify LERF/CLERP model
- Step 3: Quantitative screening

Task 7: Quantitative Screening
Steps in Procedure/Details

Step 1: Quantify CDF/CCDP models.

- Step 1.1: Quantify CCDP model
  - Fire initiators are set to TRUE (1.0) for each fire compartment, CCDP calculated for each compartment
  - This step can be bypassed, if desired, by using fire frequencies in the model directly and calculating CDF

Task 7: Quantitative Screening
Steps in Procedure/Details

Step 1: Quantify CDF/CCDP models.

- Step 1.2: Quantify CDF
  - Compartment fire initiator frequencies combined with compartment CCDPs from Step 1.1 to obtain compartment CDFs
- Step 1.3: Quantify ICDP (optional)
  - ICDP includes unavailability of equipment removed from service routinely
  - Recommend this be done if will use PRA for configuration management

Task 7: Quantitative Screening
Steps in Procedure/Details

Step 2: Develop LERF/CLERP models.

- Exactly analogous to Step 1 but now for LERF and CLERP

Task 7: Quantitative Screening
Screening Criteria for Single Fire Compartment

Step 3: Quantitative screening, Table 7.2 from NUREG/CR-6850

Quantification Type	CDF and LERF Compartment Screening Criteria	ICDP and ILERP Compartment Screening Criteria (Optional)
Fire Compartment CDF	CDF < 1.0E-7/yr	
Fire Compartment CDF With Intact Trains/Systems Unavailable		ICDP < 1.0E-7
Fire Compartment LERF	LERF < 1.0E-8/yr	
Fire Compartment LERF With Intact Trains/Systems Unavailable		ILERP < 1.0E-8

Task 7: Quantitative Screening
Screening Criteria For All Screened Compartments

Step 3: Quantitative screening, Table 7.3 from NUREG/CR-6850

Quantification Type	Screening Criteria
Sum of CDF for all screened-out fire compartments	< 0.1 ∗ (internal event average CDF)
Sum of LERF for all screened-out fire compartments	< 0.1 ∗ (internal event average LERF)
Sum of ICDP for all screened-out fire compartments	< 1.0E-6
Sum of ILERP for all screened-out fire compartments	< 1.0E-7

Task 7: Quantitative Screening
Bases for Values

Bases for quantitative screening criteria provided in App. D to NUREG/CR-6850

- Premise is that most CDFs are ~1.0E-5/yr
- Increase in CDF less than 1.0E-6/yr is defined as very small increase in R.G. 1.174
- Sum of CDF from screened-out compartments therefore limited to 10% of total CDF
- Individual compartment limit set at 1.0E-7/yr, or 1% of total CDF

Task 7: Quantitative Screening
Bases for Values (cont'd)

- Basis for LERF values same as for CDF, but factor of 10 lower
- ICDP screening criterion of 1.0E-6 based on temporary change risk criterion in EPRI PSA Applications Guide, EPRI-TR-105396
- Similar basis for ICLERP criterion of 1.0E-7

Sample Problem Demonstration for Task 7

- On-line demonstration of Task 7

- Question and Answer Session

Step 1: Develop CDF or CCDP Model

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-1					
%FA-1					
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CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-1					
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CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-1					
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CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-1					
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CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-1					
%FA-1					
%FA-1					
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%FA-2					
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%FA-2					

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
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CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
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CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	Equipment ID	PRA Event Identifier	PRA Initiating Event	Additional model changes are required to facilitate mapping? (Y or N)	Describe modeling strategy to facilitate mapping.
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CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
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CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
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%FA-4A					
%FA-4A					
%FA-5					
%FA-6					
%FA-7					
%FA-7					

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
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%FA-8A					

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
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CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
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CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
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%FA-12					

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
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CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
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CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
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CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
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CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-13					
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%FA-13					
%FA-13					
%FA-15					

Step 2: Develop LERF or CLERP Model

LERF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%I2TAG					
%I2TAG					

Task 5 Inputs

Table 1: Target Equipment Loss Report

Equipment ID	Equipment Description	Equipment Type	Location	Desired Position/ Status	Target Loss Locations
HPI-A	High pressure safety injection pump A	Pump	Aux Bldg. El. 0 Ft	On	1, 2, 3, 10
				On	1, 2, 3, 10
HPI-B	High pressure safety injection pump B	Pump	Aux Bldg. El. 0 Ft	On	1, 2, 3, 11
				On	1, 2, 3, 11
RHR	Residual heat removal pump	Pump	Aux Bldg. El. -20 Ft	Off	1, 2, 3, 4A, 9, 11
AFW-A	Motor driven AFW pump A	Pump	Aux Bldg. EL. 0 Ft	On	1, 3, 4B, 9, 10
AFW-B	Steam driven AFW pump B	Pump	Aux Bldg. EL. 0 Ft	On	1, 3, 4B, 9, 11
AFW-C	Motor driven AFW pump C	Pump	Turbine Bldg. El. 0 Ft	On	1, 3, 12
RCP	Reactor coolant pump	Pump	Containment	Off	1, 2, 3, 7, 12
COMP-1	Instrument air compressor	Compressor	Turbine Bldg. El. 0 Ft	Cycle	12
AOV-1 (SOV-1)	Power operated relief valve	AOV	Containment	Closed	1, 3, 7, 9
				Open	1, 3, 7, 9, 10
AOV-2 (SOV-2)	Letdown isolation valve	AOV	Aux Bldg. El. 0 Ft	Closed	1, 2, 3, 9

Equipment ID	Equipment Description	Equipment Type	Location	Desired Position/ Status	Target Loss Locations
AOV-3 (SOV-3)	Charging pump injection valve	AOV	Aux Bldg. El. 0 Ft	Closed	1, 2, 3, 9
MOV-1	HPI discharge valve	MOV	Aux Bldg. El. 0 Ft	Open	1, 2, 3, 9, 10
MOV-2	VCT isolation valve	MOV	Aux Bldg. El. 0 Ft	Closed	1, 2, 3, 9, 11
MOV-3	Cont. sump recirc. valve	MOV	Aux Bldg. El. -20 Ft	Open/ Closed[2]	1, 2, 3, 4A, 9, 10
MOV-4	Cont. sump recirc. valve	MOV	Aux Bldg. El. -20 Ft	Open/ Closed	1, 2, 3, 4A, 9, 11
MOV-5	RWST isolation valve	MOV	Aux Bldg. El. 0 Ft	Open	1, 2, 3, 12
MOV-6	RWST isolation valve	MOV	Aux Bldg. El. 0 Ft	Open	1, 2, 3, 12
MOV-7	RHR inboard suction valve	MOV	Containment	Closed	4A,7,9,12
MOV-8	RHR outboard suction valve	MOV	Aux Bldg. El. -20 Ft	Closed	4A,9,12
MOV-9	HPI discharge valve	MOV	Aux Bldg. El. 0 Ft	Open	1,2,3,,9
MOV-10	AFW pump A discharge valve	MOV	Aux Bldg. EL. 0 Ft	Open	1,3,4B,9,12
MOV-11	AFW pump B discharge valve	MOV	Aux Bldg. EL. 0 Ft	Open	1,3,4B,9,11,12
MOV-13	PORV block valve	MOV	Containment	Open/ Closed[1]	1, 3, 7, 9
MOV-14	AFW pump B turbine steam line isolation valve	MOV	Turbine Bldg. El. 0 Ft	Open	1, 3, 4B, 12
MOV-15	AFW pump B steam inlet throttle valve	MOV	Turbine Bldg. El. 0 Ft	Throttled	1, 3, 4B, 12
MOV-18	AFW pump C discharge valve	MOV	Turbine Bldg. El. 0 Ft	Open	1, 3, 12

Equipment ID	Equipment Description	Equipment Type	Location	Desired Position/ Status	Target Loss Locations
V-12	CST isolation valve	MOV	Turbine Bldg. El. 0 Ft	Open	12
LI-1	RWST level	Instrument	Yard	Available	1, 3, 12, 13
LI-2	RWST level	Instrument	Yard	Available	1, 3, 12, 13
LI-3	Cont. sump level	Instrument	Containment	Available	1, 3, 7, 12
LI-4	Cont. sump level	Instrument	Containment	Available	1, 3, 7, 12
TI-1	Letdown heat exchanger outlet temperature	Instrument	Aux Bldg El. 0 Ft	Available	1, 2, 3, 9
PT-1	RCS pressure	Instrument	Containment	Available	1, 3, 7
A-1	AFW motor high temperature	Annunciator	SWG Access Room	Non spurious	1, 2, 3, 9, 4B
SWGR-A	Train A 4160 V switchgear	Switchgear	Switchgear Room A	Energized from SUT-1	1, 3, 10, 12, 13
				Energized from EDG-A	1, 3, 8A, 10, 12
SWGR-B	Train B 4160 V switchgear	Switchgear	Switchgear Room B	Energized from SUT-1	1, 3, 9, 11, 12, 13
				Energized from EDG-A	1, 3, 8B, 9, 11, 12
SWGR-1	Non-safety 4160 V switchgear	Switchgear	Turbine Bldg. El. 0ft	Energized	1, 3, 12, 13
SWGR-2	Non-safety 4160 V switchgear	Switchgear	Turbine Bldg. El. 0ft	Energized	1, 3, 12, 13

Equipment ID	Equipment Description	Equipment Type	Location	Desired Position/ Status	Target Loss Locations
SUT-1	Startup transformer	Transformer	Yard	Energized	1, 3, 12, 13
EDG-A	Train A emergency diesel generator	Diesel Generator	DG Bldg.	On	1, 3, 8A, 10, 12
EDG-B	Train B emergency diesel generator	Diesel Generator	DG Bldg.	On	1, 3, 8B, 10, 12
LC-1	Non-safety 480 V load center	Load Center	Turbine Bldg. El. 0 ft	Energized	1, 3, 12
LC-2	Non-safety 480 V load center	Load Center	Turbine Bldg. El. 0 ft	Energized	1, 3, 12
LC-A	Train A 480 V load center	Load Center	Switchgear Room A	Energized	1, 3,10
LC-B	Train B 480 V load center	Load Center	Switchgear Room B	Energized	1, 3, 11
SST-1	Non-safety station service transformer	Transformer	Turbine Bldg. El. 0 F	Energized	12
SST-2	Non-safety station service transformer	Transformer	Turbine Bldg. El. 0 F	Energized	12
SST-A	Train A station service transformer	Transformer	Switchgear Room A	Energized	10
SST-B	Train B station service transformer	Transformer	Switchgear Room B	Energized	11
MCC-1	Non-safety 480 V motor control center	Motor Control Center	Turbine Bldg El. 0 Ft	Energized	12
MCC-2	Non-safety 480 V motor control center	Motor Control Center	Turbine Bldg El. 0 Ft	Energized	12
MCC-A1	Train A 480 V motor control center	Motor Control Center	SWG Access Room	Energized	9, 10
MCC-B1	Train B 480 V motor control center	Motor Control Center	SWG Access Room	Energized	9, 11
ATS-1	Automatic transfer switch	ATS	SWG Access Room	Energized from MCC-1	12

Equipment ID	Equipment Description	Equipment Type	Location	Desired Position/ Status	Target Loss Locations
BC-1	Non-safety swing battery charger	Battery Charger	Turbine Bldg El. 0 Ft	Energized	12
BC-A	Train A battery charger	Battery Charger	Switchgear Room A	Energized	9, 10
BC-B	Train B battery charger	Battery Charger	Switchgear Room B	Energized	9, 11
BAT-1	Non-safety battery	Battery	Turbine Bldg El. 0 Ft	Available	12, 15
BAT-A	Train A battery	Battery	Battery Room A	Available	5, 10
BAT-B	Train B battery	Battery	Battery Room B	Available	6, 11
DC BUS-1	Non-safety 250 VDC bus	DC Bus	Turbine Bldg El. 0 Ft	Energized	12
DC BUS-A	Train A 125 VDC bus	DC Bus	Switchgear Room A	Energized	10
DC BUS-B	Train B 125 VDC bus	DC Bus	Switchgear Room B	Energized	11
PNL-A	Train A 125 VDC panel	Panel board	Switchgear Room A	Energized	10
PNL-B	Train B 125 VDC panel	Panel board	Switchgear Room B	Energized	11
INV-A	Train A inverter	Inverter	Switchgear Room A	Energized	3, 9, 10
INV-B	Train B inverter	Inverter	Switchgear Room B	Energized	3, 9, 11
VITAL-A	Train A 120 VAC vital bus	120VAC Bus	SWG Access Room	Energized	9, 10
VITAL-B	Train B 120 VAC vital bus	120VAC Bus	SWG Access Room	Energized	9, 11

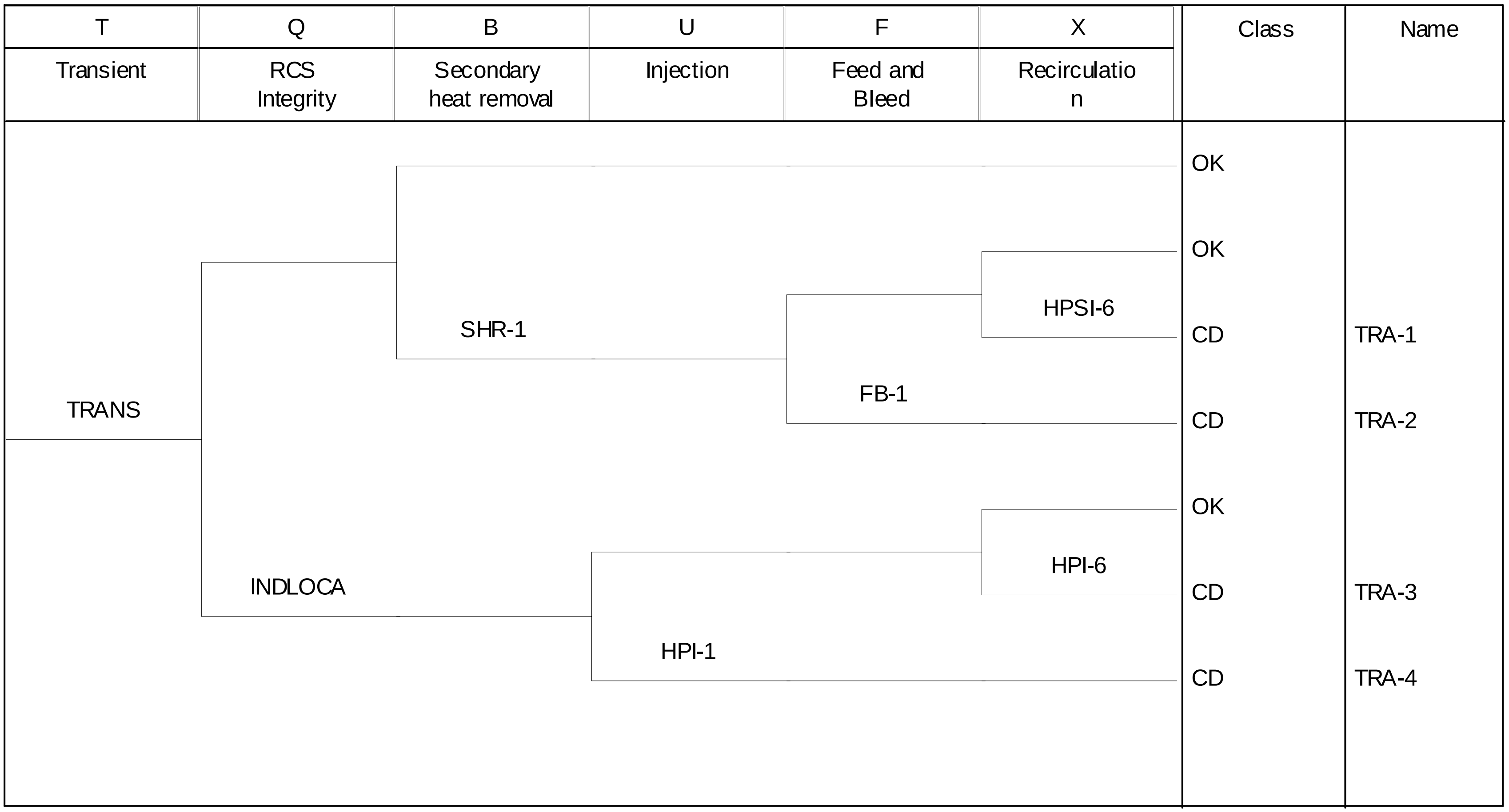


Figure 1: Transient Event Tree

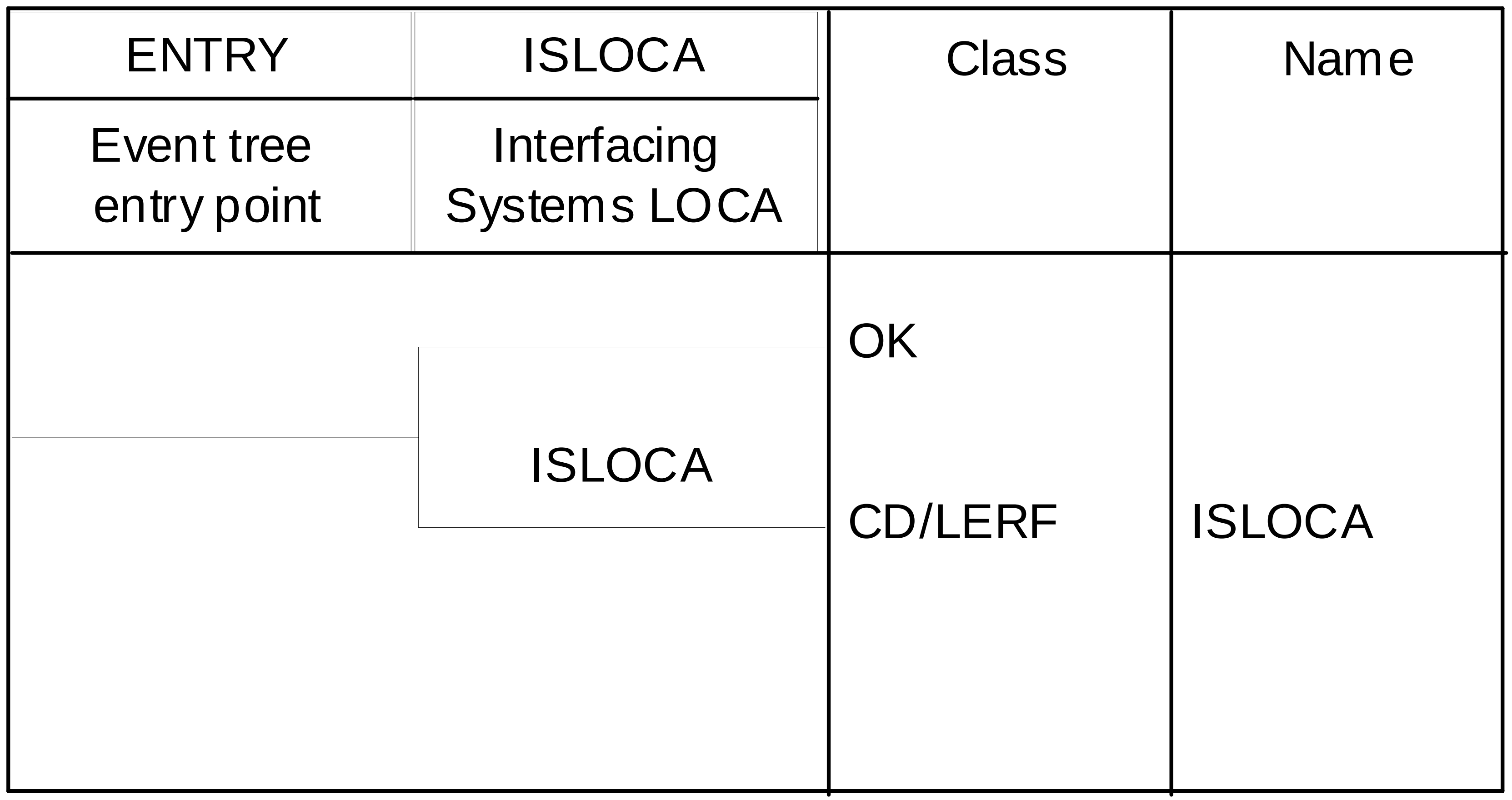


Figure 2: ISLOCA Event Tree

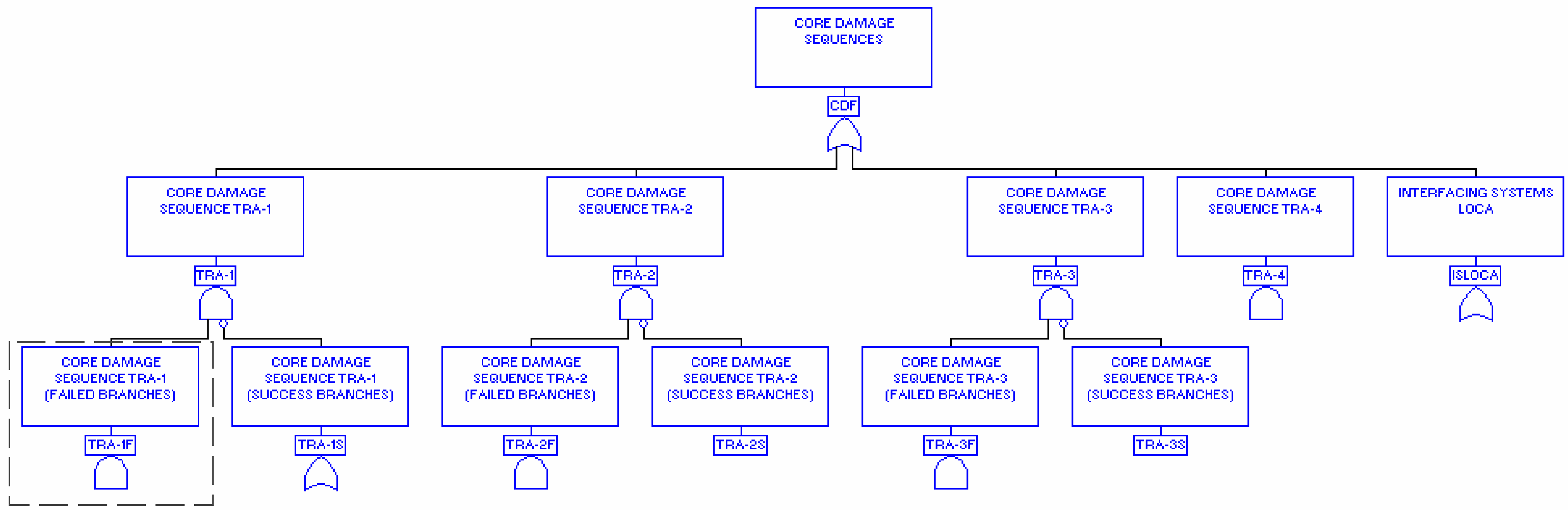


Figure 3: Gate CDF

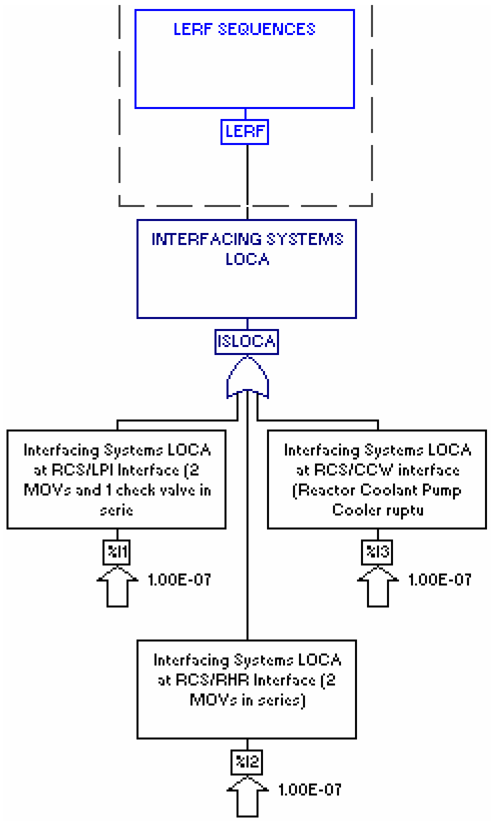


Figure 4: Gate LERF

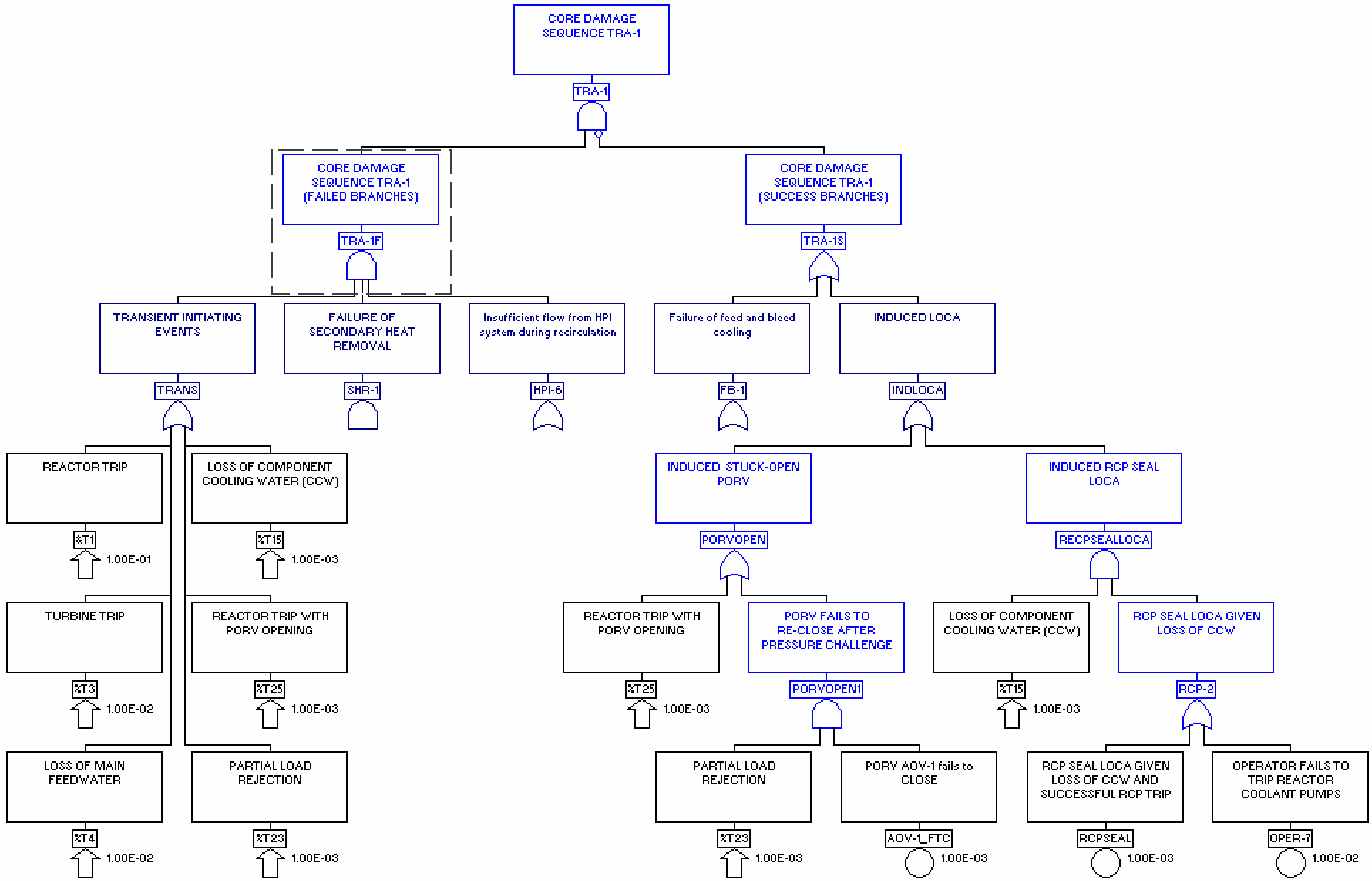


Figure 5: Gate TRA-1

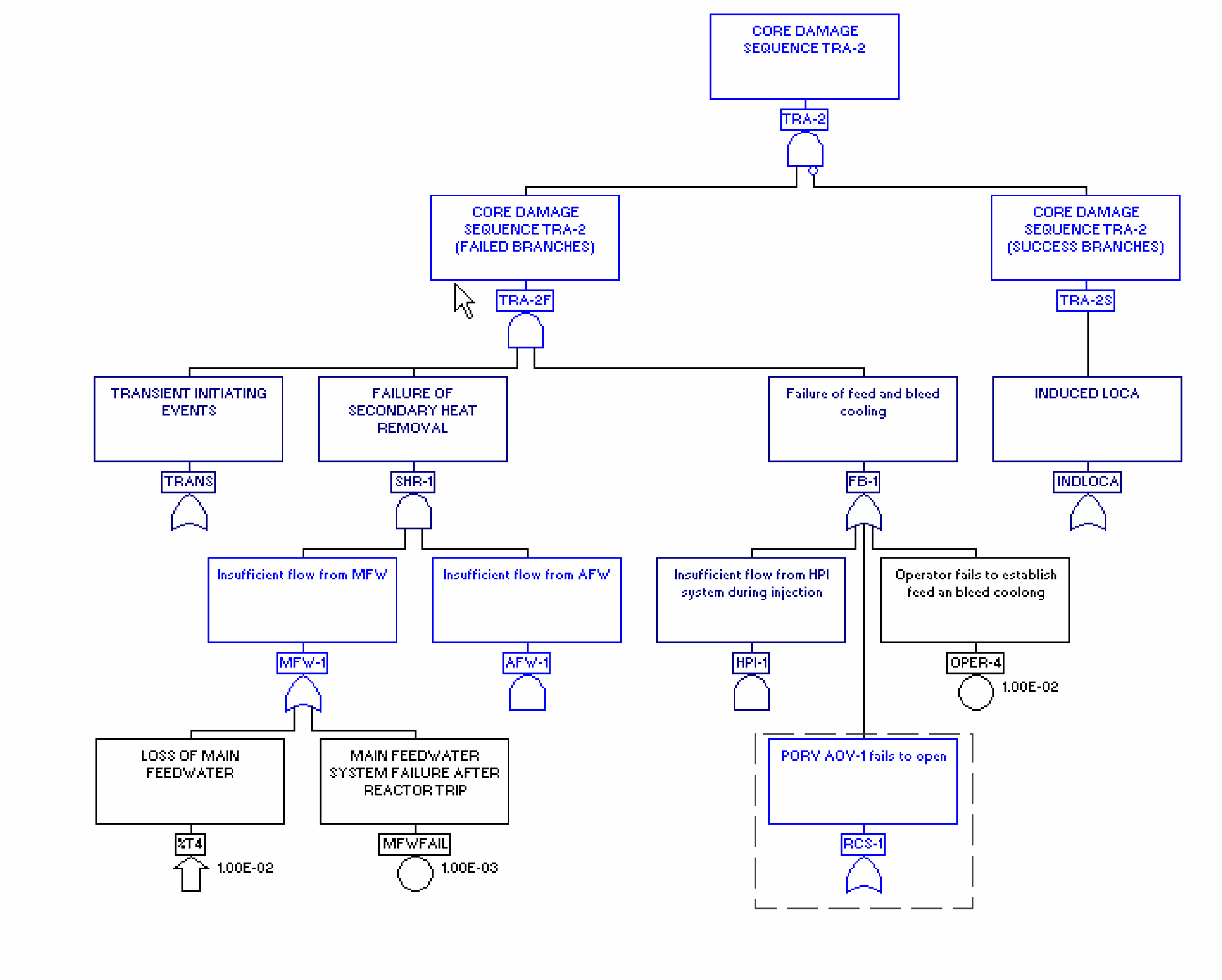


Figure 6: Gate TRA-2

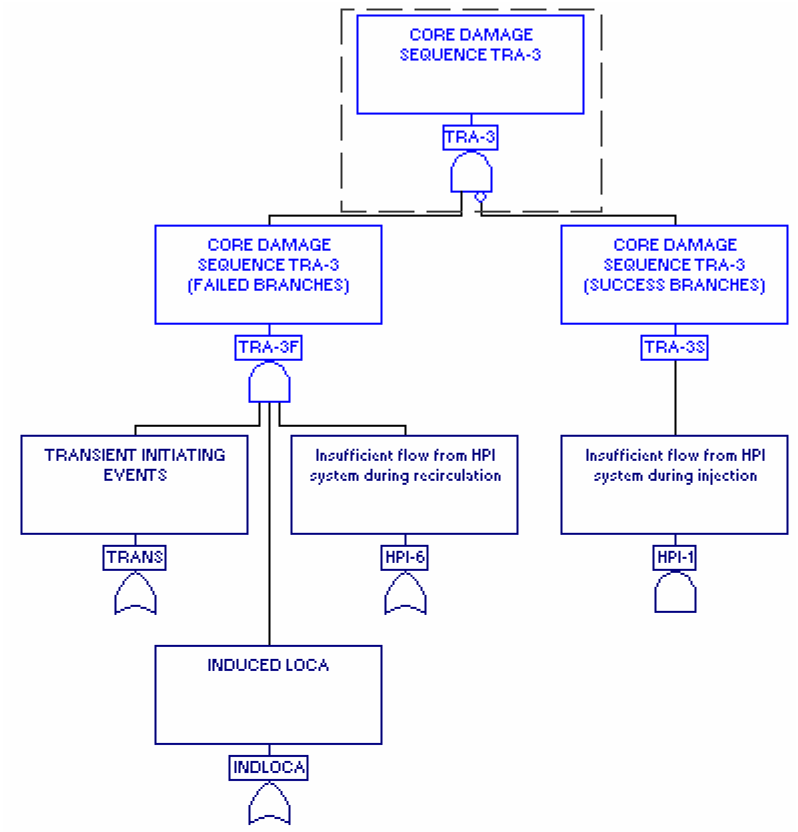


Figure 7: Gate TRA-3

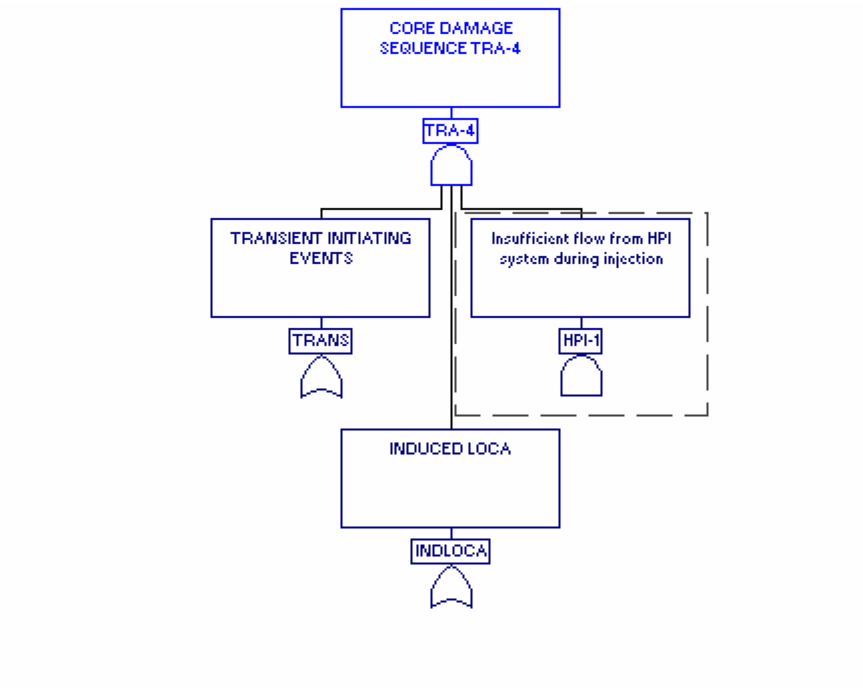


Figure 8: Gate TRA-4

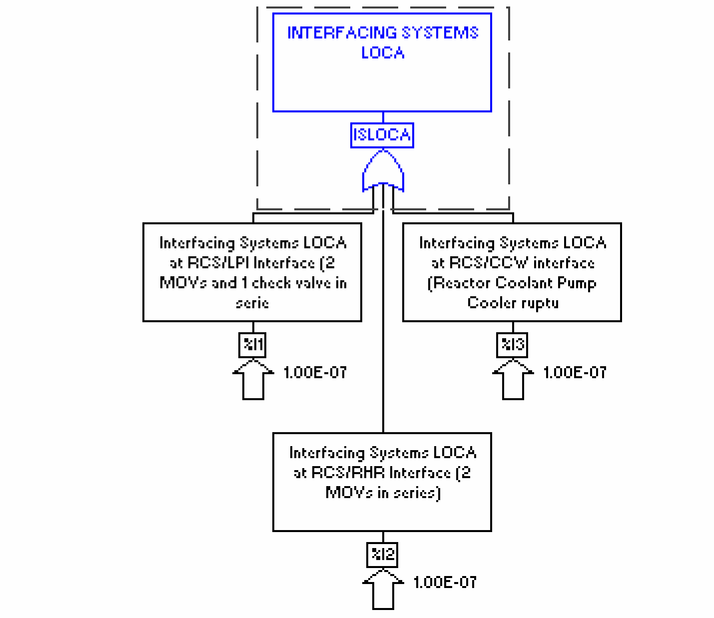


Figure 9: Gate ISLOCA

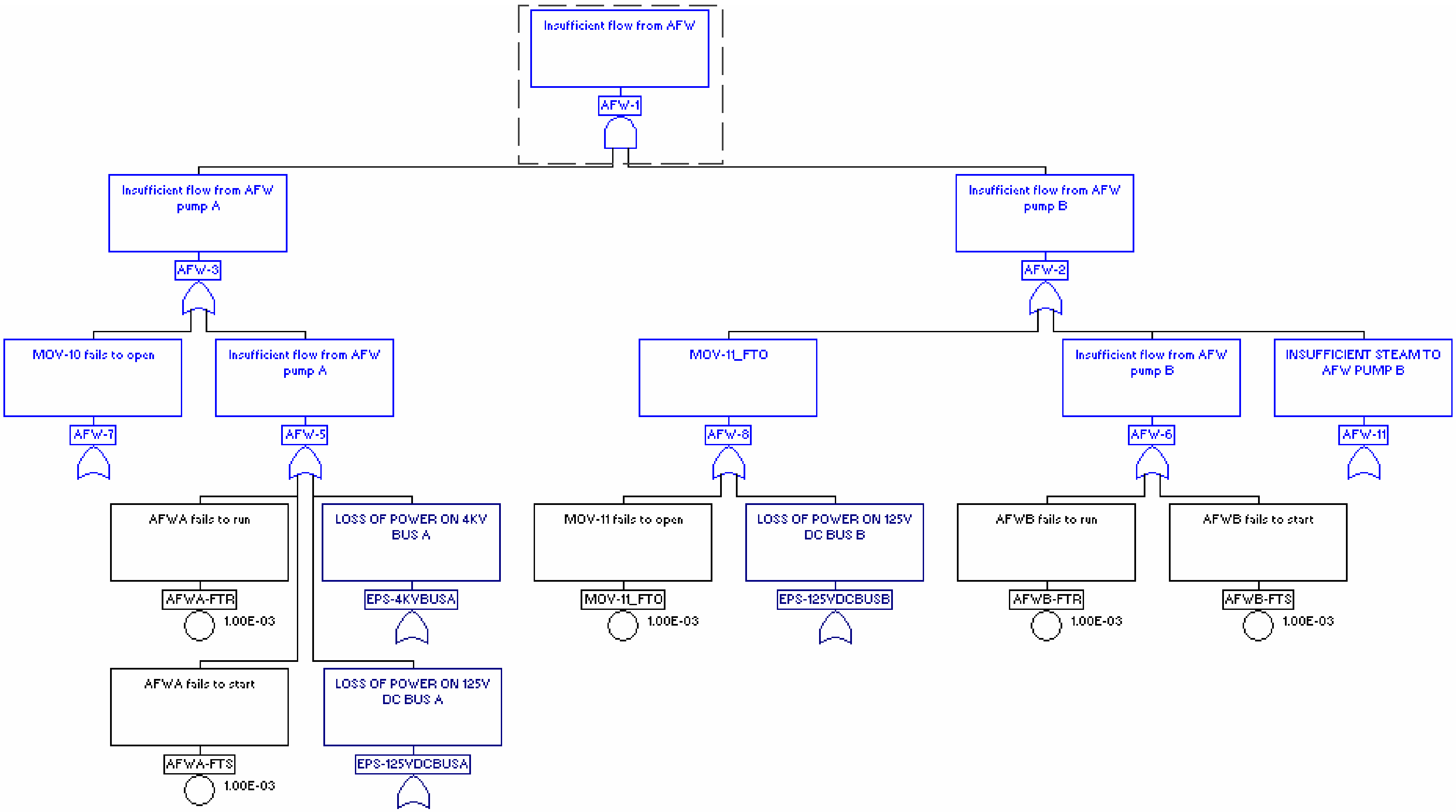


Figure 10: Gate AFW-1

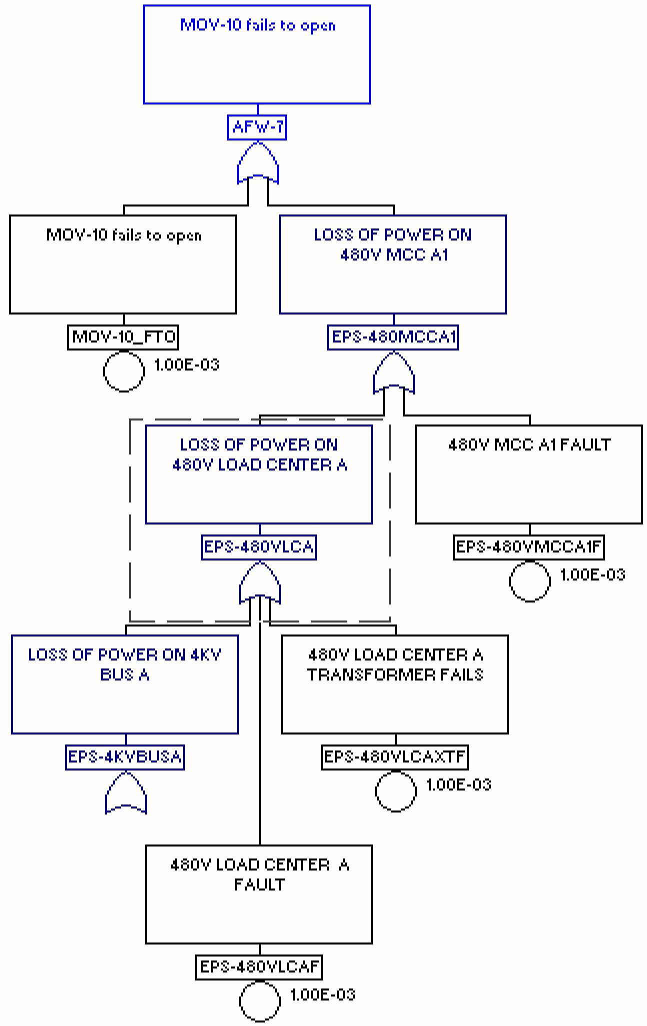


Figure 11: Gate AFW-7

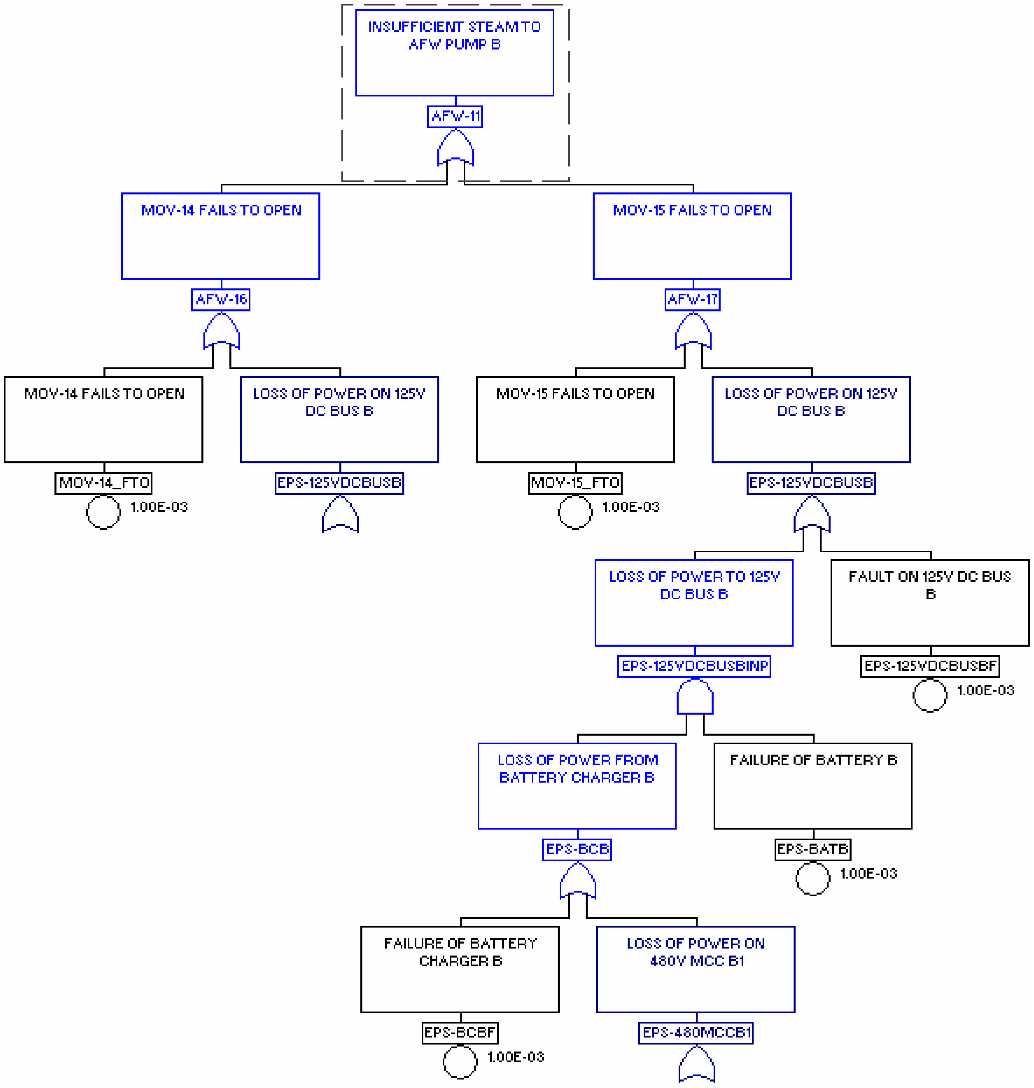


Figure 12: Gate AFW-11

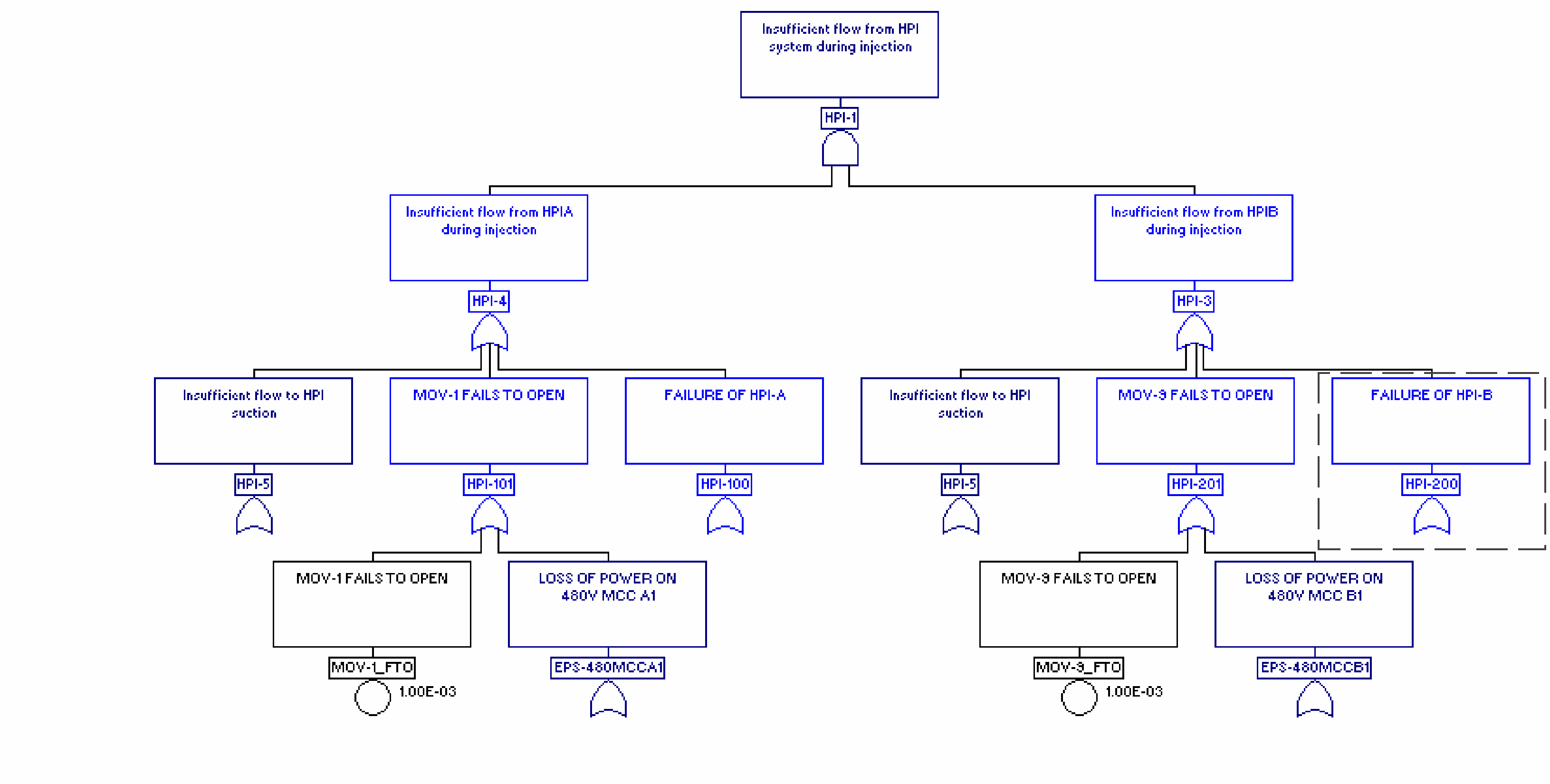


Figure 13: Gate HPI-1

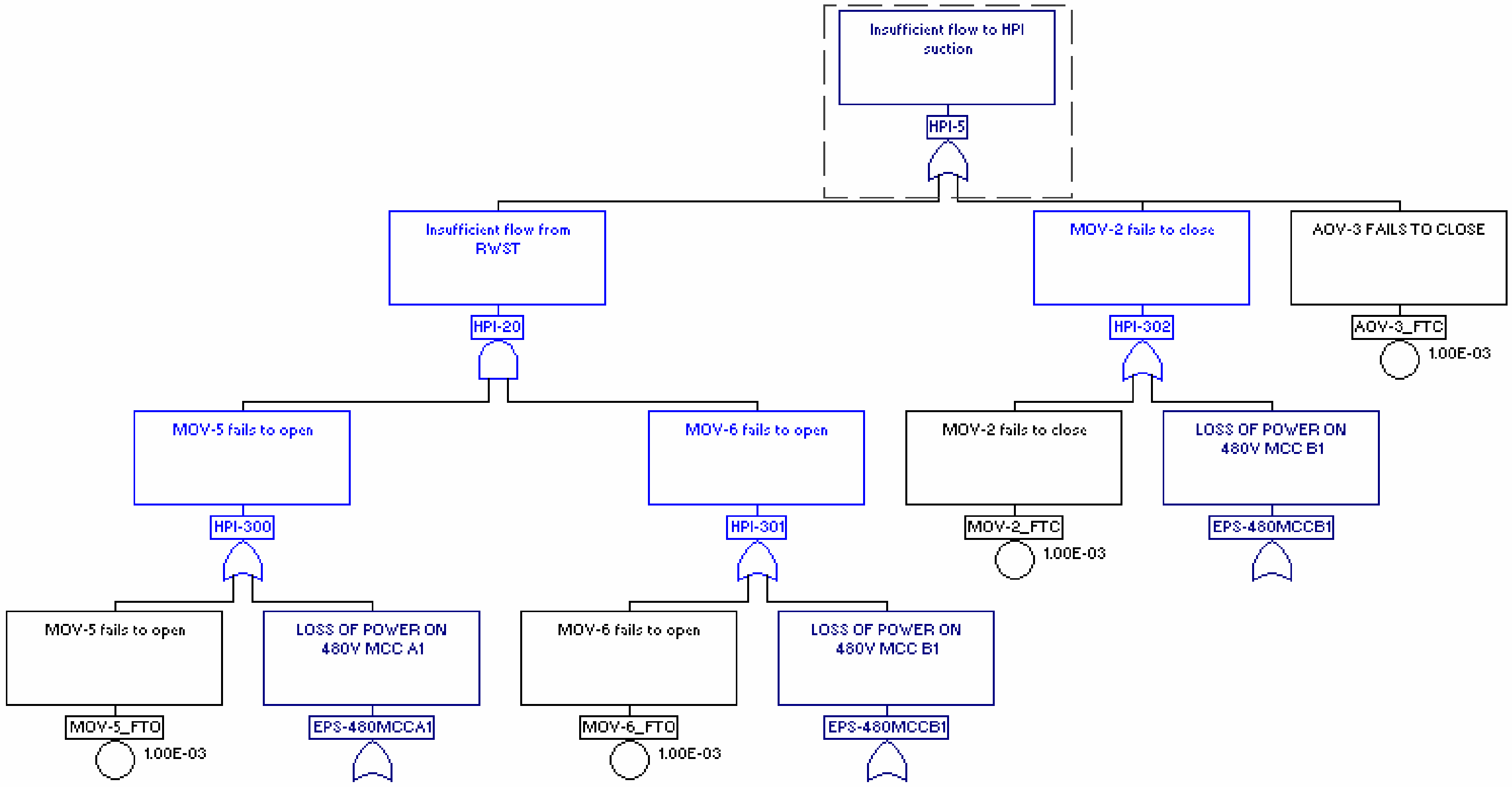


Figure 14: Gate HPI-5

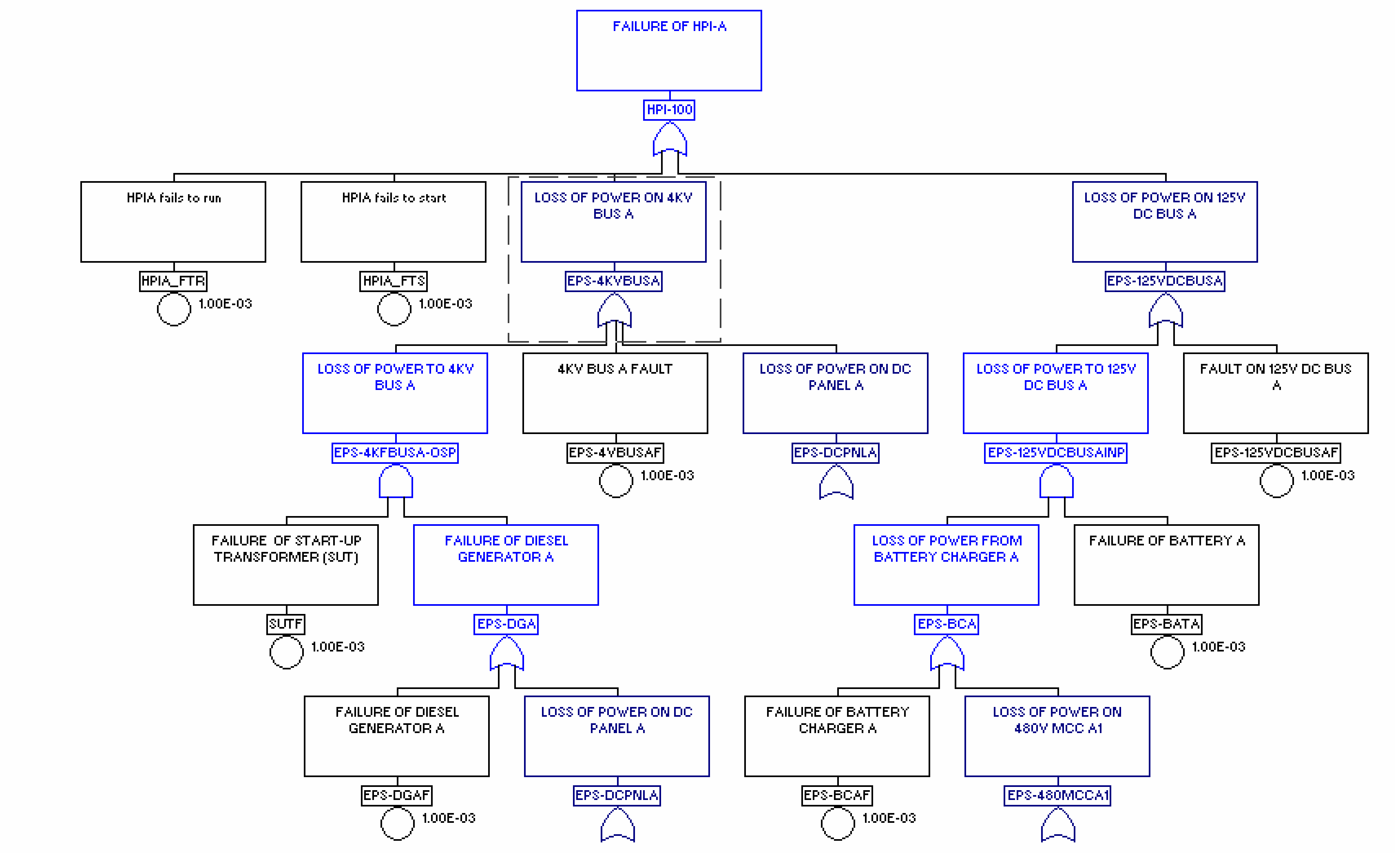


Figure 15: Gate HPI-100

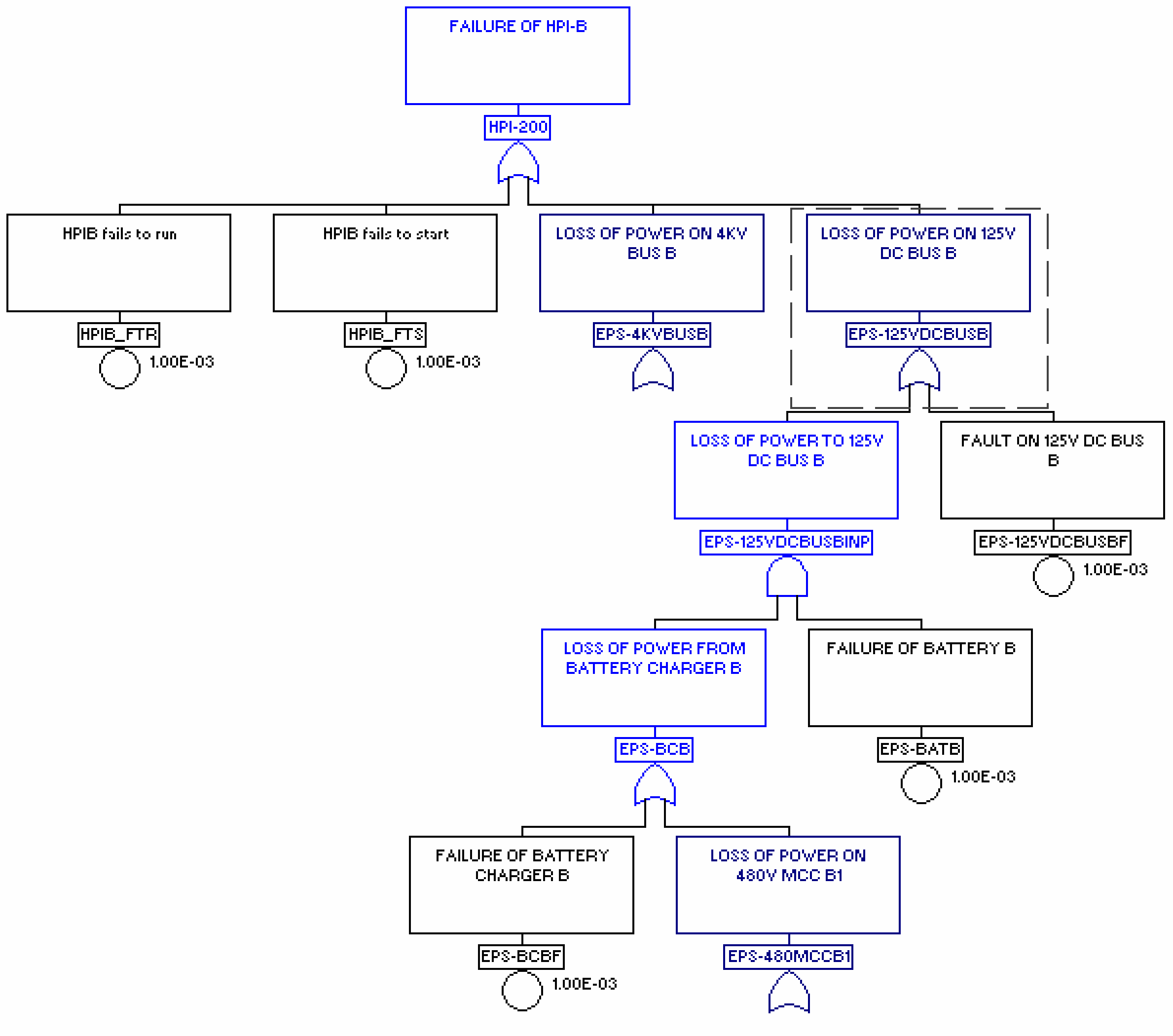


Figure 16: Gate HPI-200

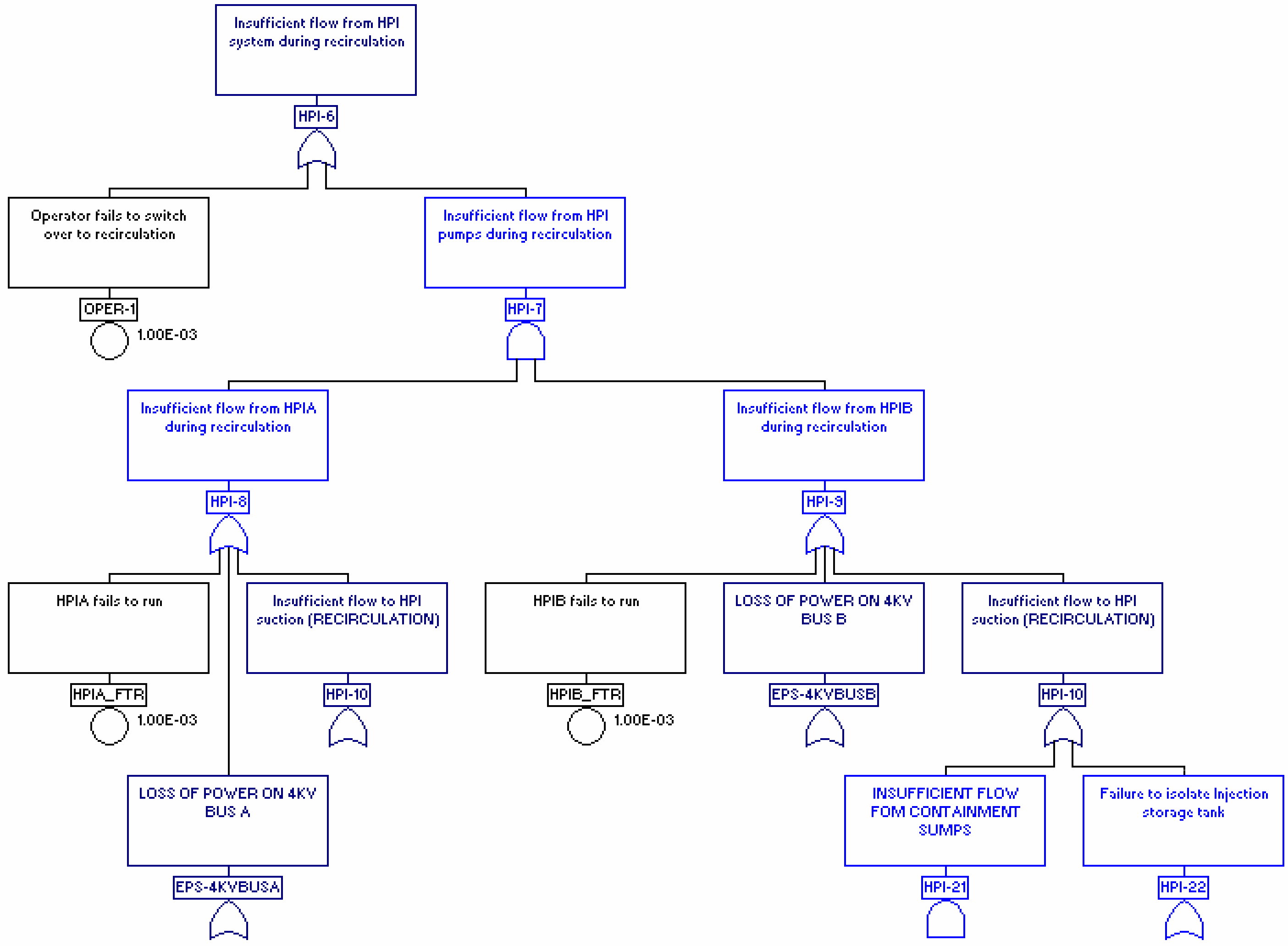


Figure 17: Gate HPI-6

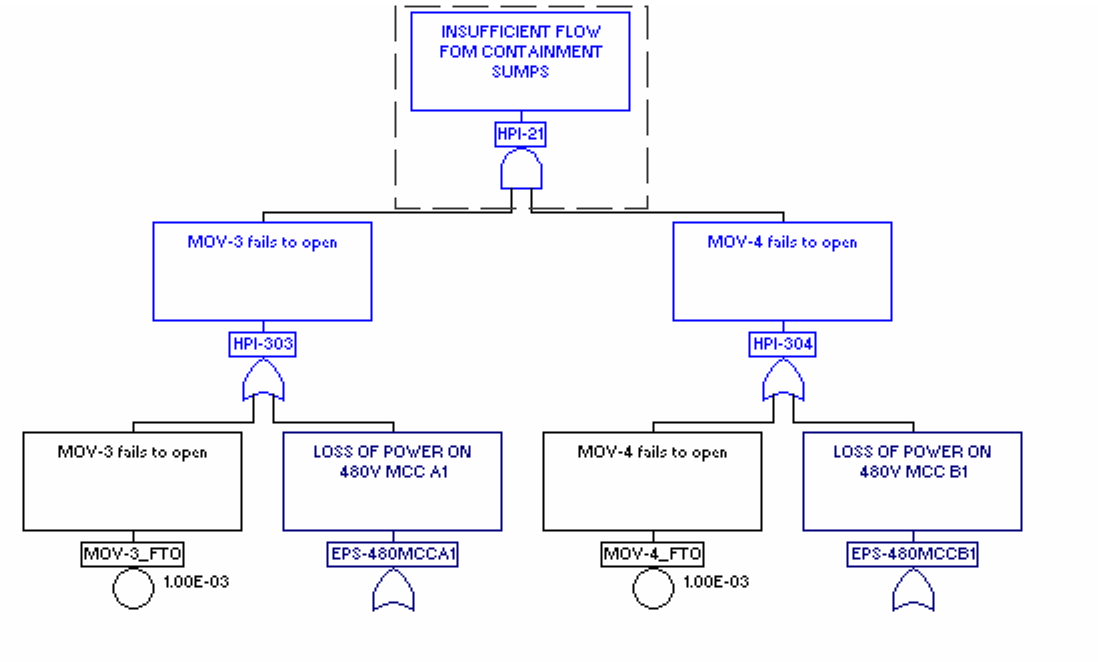


Figure 18: Gate HPI-21

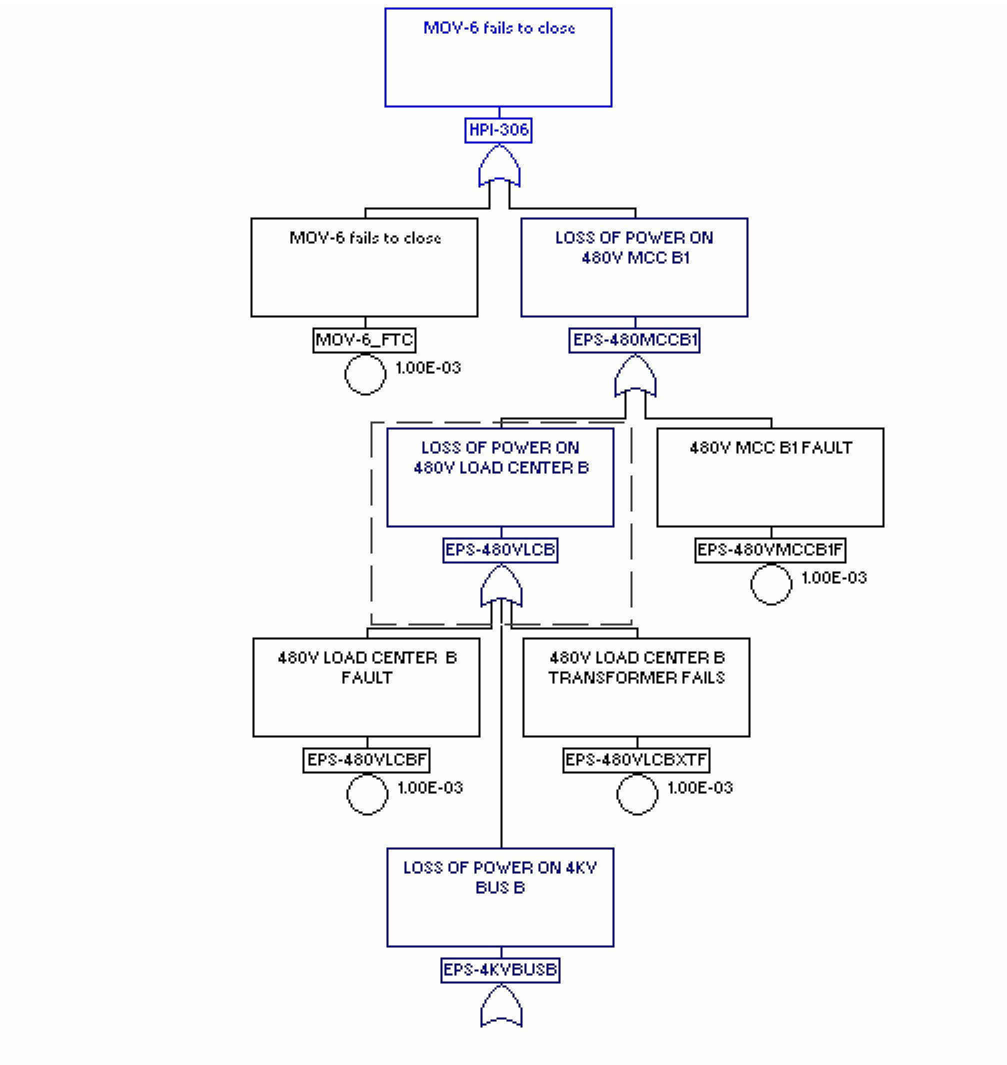


Figure 19: Gate HPI-306

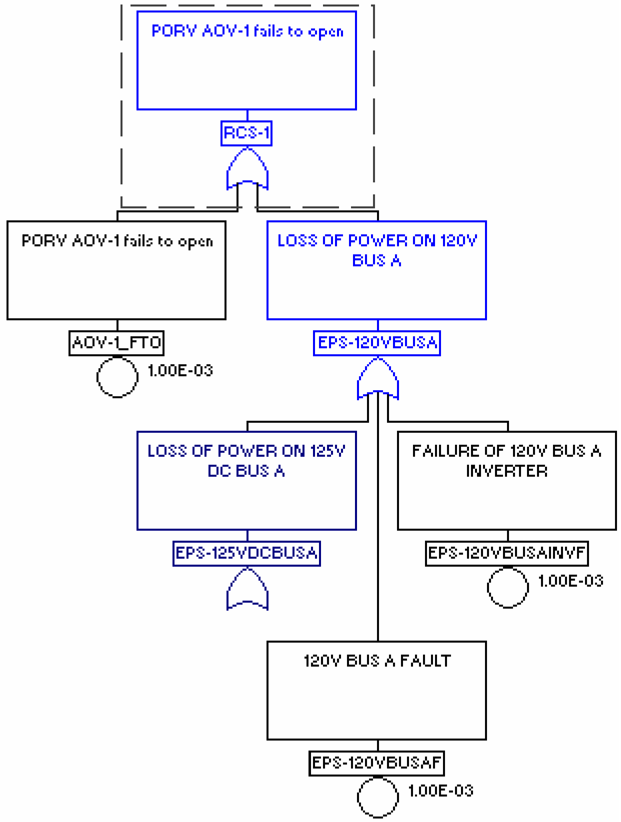


Figure 20: Gate RCS-1

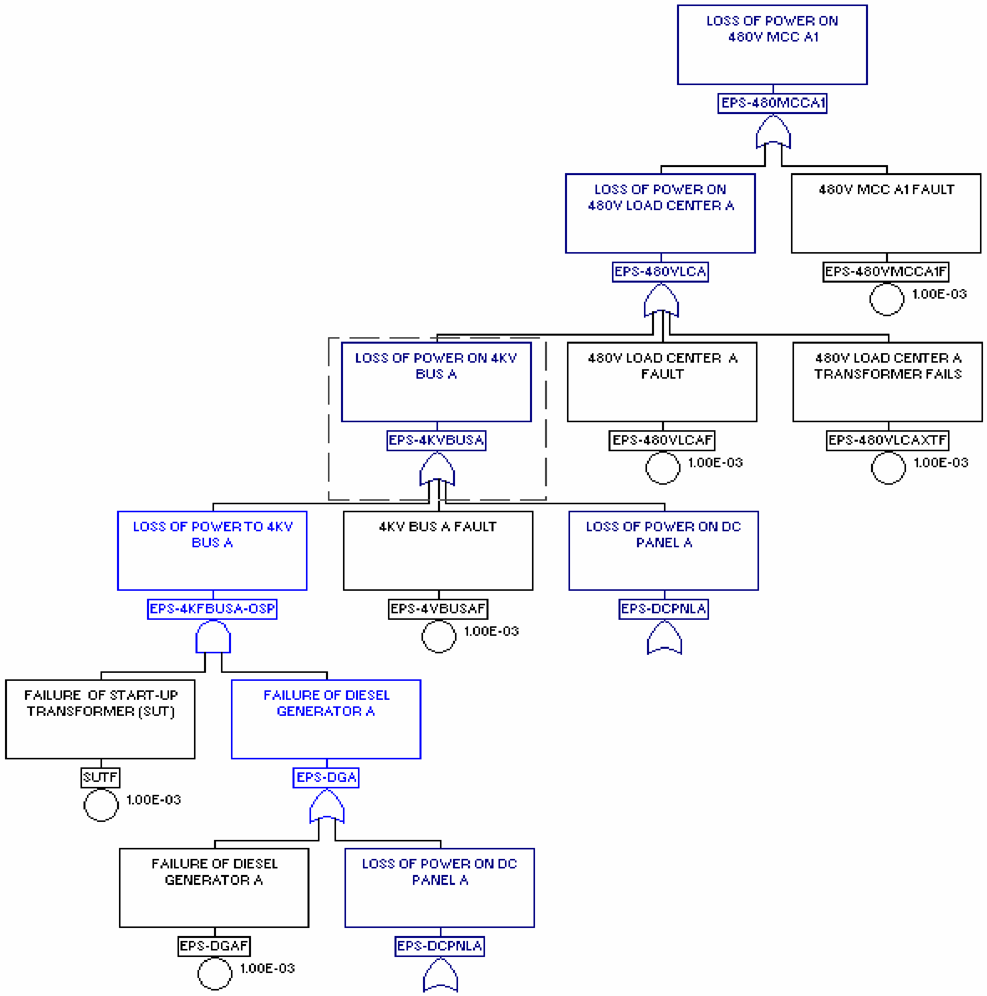


Figure 21: Gate EPS-480MCCA1

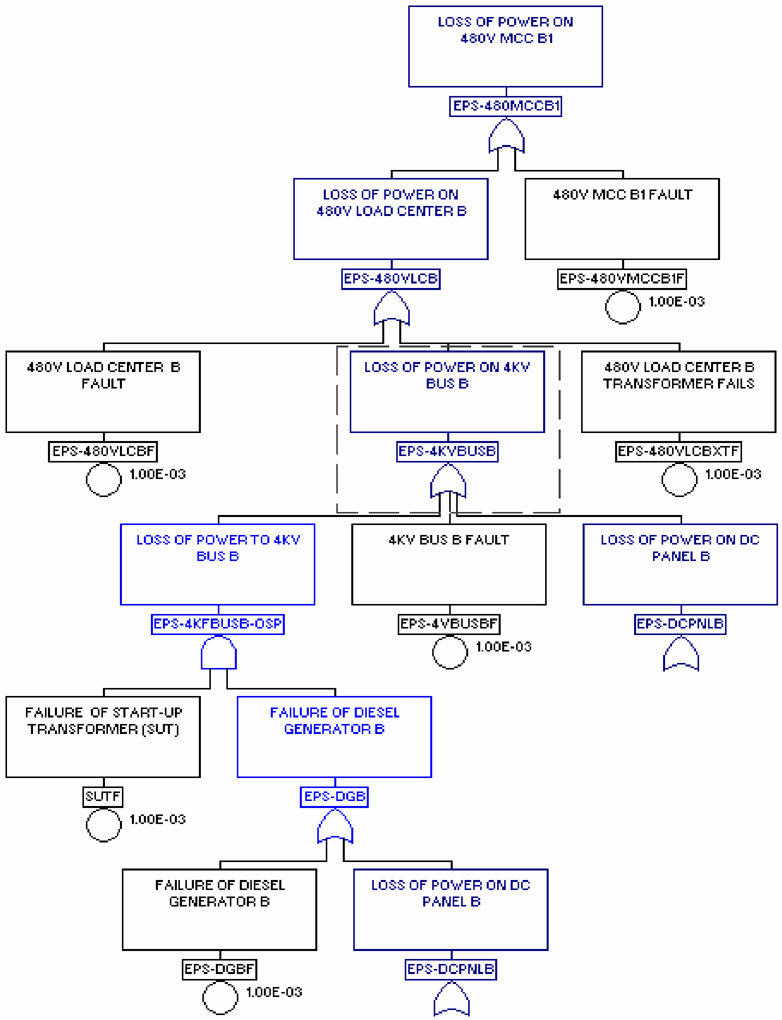


Figure 22: Gate EPS-480MCCB1

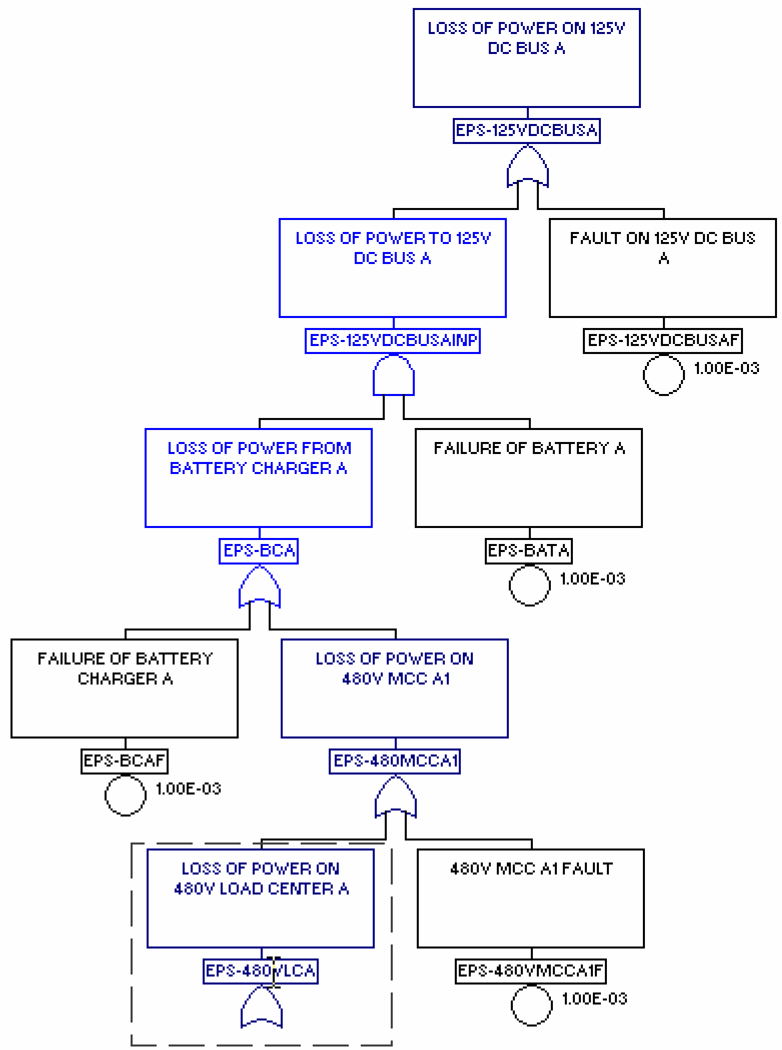


Figure 23: Gate EPS-125VDBUSA

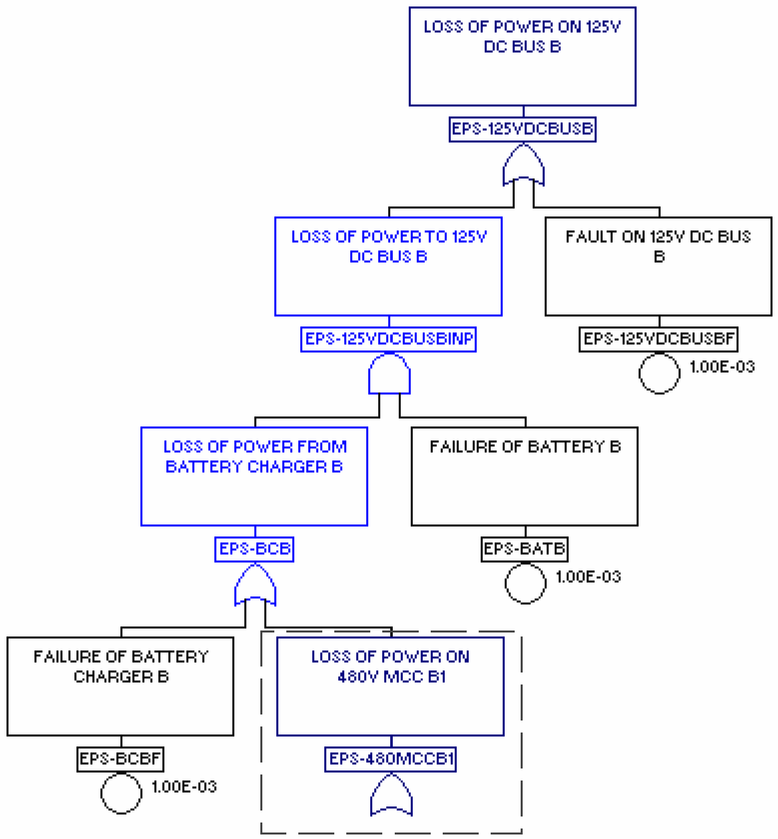


Figure 24: Gate EPS-125VDBUSB

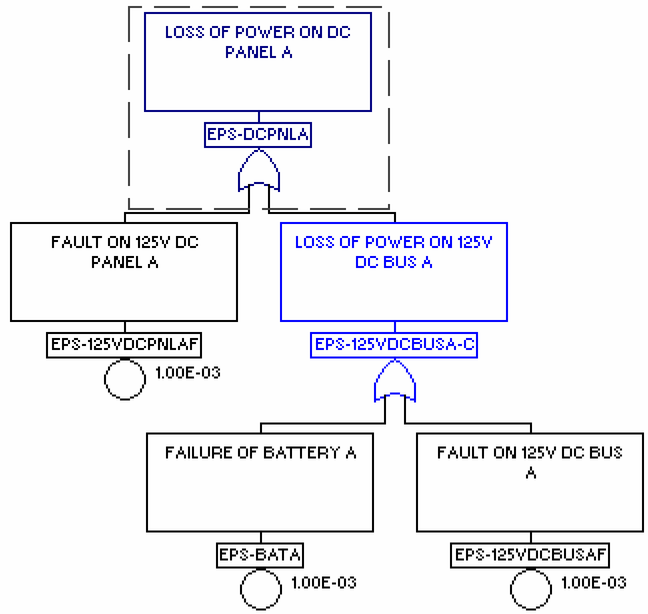


Figure 25: Gate EPS-DCPNLA

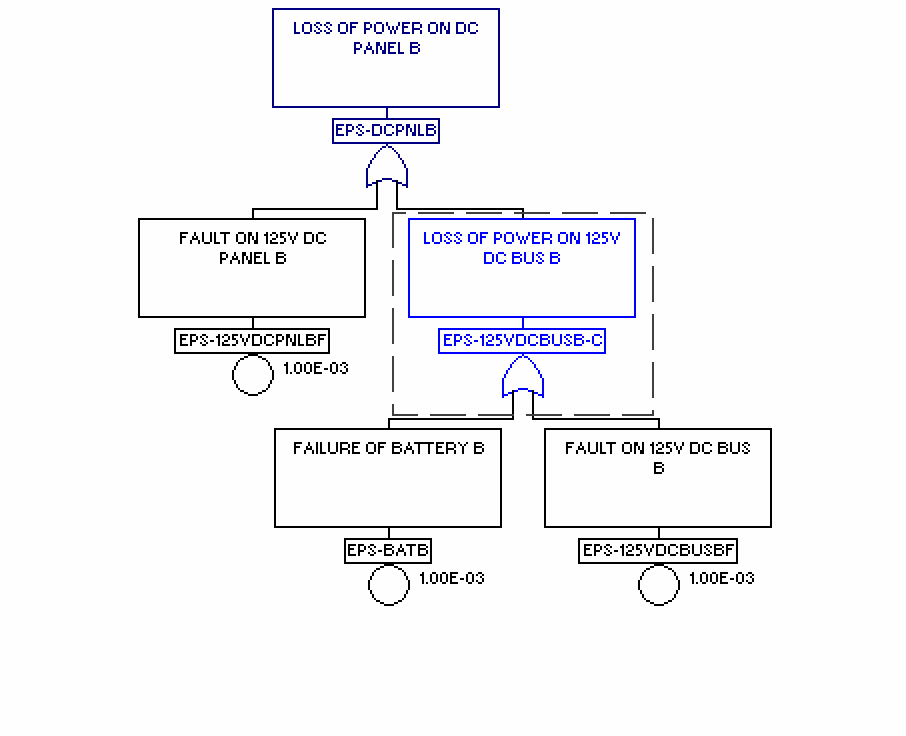


Figure 26: Gate EPS-DCPNLB

Step 1: Develop CDF or CCDP Model

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-1	HPI-A	HPIA_FTS	%T1	N	
%FA-1	HPI-A	HPIA_FTR	%T1	N	
%FA-1	HPI-B	HPIB_FTS	%T1	N	
%FA-1	HPI-B	HPIB_FTR	%T1	N	
%FA-1	AFW-A	AFWA-FTS	%T1	N	
%FA-1	AFW-B	AFWB-FTS	%T1	N	
%FA-1	AFW-C	AFWC-FTS	%T1	Y	Insufficient flow from AFW pump C
%FA-1	AFW-C	AFWC-FTR	%T1	Y	Insufficient flow from AFW pump C
%FA-1	RCP	RCP1-FTT	%T15	Y	RCP fails to trip given loss of CCW

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-1	AOV-1 (SOV-1)	AOV-1_TO	%T1	Y	Spurious opening of PORV and failure to open PORV path
%FA-1	AOV-1 (SOV-1)	AOV-1_FTO	%T1	N	
%FA-1	AOV-2 (SOV-2)	AOV-2_FTC	%T1	Y	Failure to isolate letdown and establish flow from injection tank
%FA-1	AOV-3 (SOV-3)	AOV-3_FTC	%T1	N	
%FA-1	MOV-1	MOV-1_FTO	%T1	N	
%FA-1	MOV-2	MOV-2_FTC	%T1	N	
%FA-1	MOV-3	MOV-3_TO	%T1	Y	Containment sump flow path open
%FA-1	MOV-4	MOV-4_TO	%T1	Y	Containment sump flow path open

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-1	MOV-5	MOV-5_FTO	%T1	N	
%FA-1	MOV-6	MOV-6_FTO	%T1	N	
%FA-1	MOV-9	MOV-9_FTO	%T1	N	
%FA-1	MOV-10	MOV-10_FTO	%T1	N	
%FA-1	MOV-11	MOV-11_FTO	%T1	N	
%FA-1	MOV-13	MOV-13_FTC	%T1	Y	Spurious opening of PORV and failure to close PORV path
%FA-1	MOV-14	MOV-14_FTO	%T1	N	
%FA-1	MOV-15	MOV-15_FTO	%T1	N	
%FA-1	MOV-18	MOV-18_FTO	%T1	Y	Insufficient flow from AFW pump C
%FA-1	LI-1	LI-1_FL	%T1	Y	Spurious instrumentation failure causes operator to prematurely switchover to recirculation

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-1	LI-1	LI-1_FH	%T1	Y	Operator fails to switchover to recirculation due to instrumentation failure
%FA-1	LI-2	LI-2_FL	%T1	Y	Spurious instrumentation failure causes operator to prematurely switchover to recirculation
%FA-1	LI-2	LI-2_FH	%T1	Y	Operator fails to switchover to recirculation due to instrumentation failure
%FA-1	LI-3	LI-3_FH	%T1	Y	Spurious instrumentation failure causes operator to prematurely switchover to recirculation
%FA-1	LI-4	LI-4_FH	%T1	Y	Spurious instrumentation failure causes operator to prematurely switchover to recirculation
%FA-1	TI-1	TI-1_FL	%T1	Y	Failure to isolate letdown and establish flow from injection tank due to instrumentation failure
%FA-1	PT-1	PI-1_FH	%T1	N	

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-1	PT-1	PI-1_FL	%T1	Y	Operator fails to establish feed and bleed cooling due instrumentation failure.
%FA-1	A-1	ANN-1_FH	%T1	Y	Operator shuts down AFW pump A due to high motor temperature alarm.
%FA-1	SWGR-A	PNL-A / EPS-4VBUSAF-1st	%T1	N	
%FA-1	SWGR-A	PNL-A / EPS-4VBUSAF-2nd	%T1	N	
%FA-1	SWGR-B	PNL-A / EPS-4VBUSBF-1st	%T1	N	
%FA-1	SWGR-B	PNL-A / EPS-4VBUSBF-2nd	%T1	N	
%FA-1	SWGR-1	EPS-4VBUS1F	%T1	N	

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-1	SWGR-2	EPS-4VBUS2F	%T1	N	
%FA-1	SUT-1	SUTF	%T1	N	
%FA-1	EDG-A	EPS-DGAF	%T1	N	
%FA-1	EDG-B	EPS-DGBF	%T1	N	
%FA-1	LC-1	EPS-480VLC1F	%T1	N	
%FA-1	LC-2	EPS-480VLC2F	%T1	N	
%FA-1	LC-A	EPS-480VLCAF	%T1	N	
%FA-1	LC-B	EPS-480VLCBF	%T1	N	
%FA-2	HPI-A	HPIA_FTS	%T1	N	
%FA-2	HPI-A	HPIA_FTR	%T1	N	
%FA-2	HPI-B	HPIB_FTS	%T1	N	

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-2	HPI-B	HPIB_FTR	%T1	N	
%FA-2	RCP-1	RCP1-FTT	%T15	Y	RCP fails to trip given loss of CCW
%FA-2	RCP-2	RCP2-FTT	%T15	Y	RCP fails to trip given loss of CCW
%FA-2	AOV-2 (SOV-2)	AOV-2_FTC	%T1	Y	Failure to isolate letdown and establish flow from injection tank
%FA-2	AOV-3 (SOV-3)	AOV-3_FTC	%T1	N	
%FA-2	MOV-1	MOV-1_FTO	%T1	N	
%FA-2	MOV-2	MOV-2_FTC	%T1	N	
%FA-2	MOV-3	MOV-3_TO	%T1	Y	Containment sump flow path open
%FA-2	MOV-4	MOV-4_TO	%T1	Y	Containment sump flow path open
%FA-2	MOV-5	MOV-5_FTO	%T1	N	

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-2	MOV-6	MOV-6_FTO	%T1	N	
%FA-2	MOV-9	MOV-9_FTO	%T1	N	
%FA-2	TI-1	TI-1_FL	%T1	Y	Failure to isolate letdown and establish flow from injection tank due to instrumentation failure
%FA-2	A-1	ANN-1_FH	%T1	Y	Operator shuts down AFW pump A due to high motor temperature alarm.
%FA-3	AFW-A	AFWA-FTS	%T1	N	
%FA-3	AFW-B	AFWB-FTS	%T1	N	
%FA-3	AFW-C	AFWC-FTS	%T1	Y	Insufficient flow from AFW pump C
%FA-3	AFW-C	AFWC-FTR	%T1	Y	Insufficient flow from AFW pump C
%FA-3	AOV-1 (SOV-1)	AOV-1_TO	%T1	Y	Spurious opening of PORV and failure to open PORV path

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-3	AOV-1 (SOV-1)	AOV-1_FTO	%T1	N	
%FA-3	MOV-10	MOV-10_FTO	%T1	N	
%FA-3	MOV-11	MOV-11_FTO	%T1	N	
%FA-3	MOV-13	MOV-13_FTC	%T1	Y	Spurious opening of PORV and failure to open PORV path
%FA-3	MOV-14	MOV-14_FTO	%T1	N	
%FA-3	MOV-15	MOV-15_FTO	%T1	N	
%FA-3	MOV-18	MOV-18_FTO	%T1	Y	Insufficient flow from AFW pump C
%FA-3	LI-1	LI-1_FL	%T1	Y	Spurious instrumentation failure causes operator to prematurely switchover to recirculation
%FA-3	LI-1	LI-1_FH	%T1	Y	Operator fails to switchover to recirculation due

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
					to instrumentation failure
%FA-3	LI-2	LI-2_FL	%T1	Y	Spurious instrumentation failure causes operator to prematurely switchover to recirculation
%FA-3	LI-2	LI-2_FH	%T1	Y	Operator fails to switchover to recirculation due to instrumentation failure
%FA-3	LI-3	LI-3_FH	%T1	Y	Spurious instrumentation failure causes operator to prematurely switchover to recirculation
%FA-3	LI-4	LI-4_FH	%T1	Y	Spurious instrumentation failure causes operator to prematurely switchover to recirculation
%FA-3	PT-1	PI-1_FH	%T1	N	
%FA-3	PT-1	PI-1_FL	%T1	Y	Operator fails to establish feed and bleed cooling
%FA-3	SWGR-A	PNL-A	%T1	N	

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-3	SWGR-A	PNL-A	%T1	N	
%FA-3	SWGR-B	PNL-B	%T1	N	
%FA-3	SWGR-B	PNL-B	%T1	N	
%FA-3	SWGR-1	EPS-4VBUS1F	%T1	N	
%FA-3	SWGR-2	EPS-4VBUS2F	%T1	N	
%FA-4B	AFW-A	AFWA-FTS	%T1	N	
%FA-4B	AFW-B	AFWB-FTS	%T1	N	
%FA-4B	MOV-10	MOV-10_FTO	%T1	N	
%FA-4B	MOV-11	MOV-11_FTO	%T1	N	
%FA-4B	MOV-14	MOV-14_FTO	%T1	N	
%FA-4B	MOV-15	MOV-15_FTO	%T1	N	

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-4B	A-1	ANN-1_FH	%T1	Y	Operator shuts down AFW pump A due to high motor temperature alarm.
%FA-4A	MOV-7	MOV-7_TO	%T1	Y	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)
%FA-4A	MOV-8	MOV-8_TO	%T1	Y	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)
%FA-4A	MOV-3	MOV-3_TO	%T1	Y	Containment sump flow path open
%FA-4A	MOV-4	MOV-4_TO	%T1	Y	Containment sump flow path open
%FA-5	BAT-A	EPS-BATA	%T1	N	
%FA-6	BAT-B	EPS-BATB	%T1	N	
%FA-7	MOV-7	MOV-7_TO	%T1	Y	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-7	AOV-1 (SOV-1)	AOV-1_TO	%T1	Y	Spurious opening of PORV and failure to open PORV path
%FA-7	AOV-1 (SOV-1)	AOV-1_FTO	%T1	N	
%FA-7	RCP-1	RCP1-FTT	%T15	Y	RCP fails to trip given loss of CCW
%FA-7	RCP-2	RCP2-FTT	%T15	Y	RCP fails to trip given loss of CCW
%FA-7	MOV-13	MOV-13_FTC	%T1	Y	Spurious opening of PORV and failure to open PORV path
%FA-7	LI-3	LI-3_FH	%T1	N	
%FA-7	LI-4	LI-4_FH	%T1	N	
%FA-7	PT-1	PI-1_FH	%T1	N	
%FA-7	PT-1	PI-1_FL	%T1	Y	Operator fails to establish feed and bleed cooling

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-8A	SWGR-A	PNL-A / EPS-4VBUSAF-1st	%T1	N	
%FA-8A	SWGR-A	PNL-A / EPS-4VBUSAF-2nd	%T1	N	
%FA-8A	EDG-A	EPS-DGAF	%T1	N	
%FA-8B	SWGR-B	PNL-A / EPS-4VBUSBF-1st	%T1	N	
%FA-8B	SWGR-B	PNL-A / EPS-4VBUSBF-2nd	%T1	N	
%FA-8B	EDG-B	EPS-DGBF	%T1	N	
%FA-9	AFW-A	AFWA-FTS	%T1	N	
%FA-9	AFW-B	AFWB-FTS	%T1	N	

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-9	AOV-1 (SOV-1)	AOV-1_TO	%T1	Y	Spurious opening of PORV and failure to open PORV path
%FA-9	AOV-1 (SOV-1)	AOV-1_FTO	%T1	N	
%FA-9	AOV-2 (SOV-2)	AOV-2_FTC	%T1	Y	Failure to isolate letdown and establish flow from injection tank
%FA-9	AOV-3 (SOV-3)	AOV-3-FTC	%T1	N	
%FA-9	MOV-1	MOV-1_FTO	%T1	N	
%FA-9	MOV-2	MOV-2_FTC	%T1	N	
%FA-9	MOV-3	MOV-3_TO	%T1	Y	Containment sump flow path open
%FA-9	MOV-4	MOV-4_TO	%T1	Y	Containment sump flow path open

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-9	MOV-7	MOV-7_TO	%T1	Y	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)
%FA-9	MOV-8	MOV-8_TO	%T1	Y	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)
%FA-9	MOV-9	MOV-9_FTO	%T1	N	
%FA-9	MOV-10	MOV-10_FTO	%T1	N	
%FA-9	MOV-11	MOV-11_FTO	%T1	N	
%FA-9	MOV-13	MOV-13_FTC	%T1	Y	Spurious opening of PORV and failure to open PORV path
%FA-9	TI-1	TI-1_FL	%T1	Y	Failure to isolate letdown and establish flow from injection tank due to instrumentation failure
%FA-9	A-1	ANN-1_FH	%T1	Y	Operator shuts down AFW pump A due to high

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
					motor temperature alarm.
%FA-9	MCC-A1	EPS-480VMCCA1F	%T1	N	
%FA-9	MCC-B1	EPS-480VMCCB1F	%T1	N	
%FA-9	BC-A	EPS-BCAF	%T1	N	
%FA-9	BC-B	EPS-BCBF	%T1	N	
%FA-9	INV-A	EPS-120VBUSAINVF	%T1	N	
%FA-9	INV-B	EPS-120VBUSBINVF	%T1	N	
%FA-9	VITAL-A	EPS-120VBUSAF	%T1	N	

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-9	VITAL-B	EPS-120VBUSBF	%T1	N	
%FA-9	SWGR-B	PNL-A / EPS-4VBUSBF-1st	%T1	N	
%FA-9	SWGR-B	PNL-A / EPS-4VBUSBF-2nd	%T1	N	
%FA-12	AFW-C	AFWC-FTS	%T1	Y	Insufficient flow from AFW pump C
%FA-12	AFW-C	AFWC-FTR	%T1	Y	Insufficient flow from AFW pump C
%FA-12	RCP	RCP1-FTT	%T15	Y	RCP fails to trip given loss of CCW
%FA-12	COMP-1	IA-COMP1_FTS	%T1	Y	Failure of instrument air
%FA-12	COMP-1	IA-COMP1_FTR	%T1	Y	Failure of instrument air
%FA-12	MOV-5	MOV-5_FTO	%T1	N	

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-12	MOV-6	MOV-6_FTO	%T1	N	
%FA-12	MOV-7	MOV-7_TO	%T1	Y	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)
%FA-12	MOV-8	MOV-8_TO	%T1	Y	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)
%FA-12	MOV-10	MOV-10_FTO	%T1	N	
%FA-12	MOV-11	MOV-11_FTO	%T1	N	
%FA-12	MOV-14	MOV-14_FTO	%T1	N	
%FA-12	MOV-15	MOV-15_FTO	%T1	N	
%FA-12	MOV-18	MOV-18_FTO	%T1	Y	Insufficient flow from AFW pump C
%FA-12	LI-1	LI-1_FL	%T1	Y	Spurious instrumentation failure causes operator to prematurely switchover to recirculation

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-12	LI-2	LI-1_FH	%T1	Y	Operator fails to switchover to recirculation due to instrumentation failure
%FA-12	LI-2	LI-2_FL	%T1	Y	Spurious instrumentation failure causes operator to prematurely switchover to recirculation
%FA-12	LI-2	LI-2_FH	%T1	Y	Operator fails to switchover to recirculation due to instrumentation failure
%FA-12	LI-3	LI-3_FH	%T1	Y	Spurious instrumentation failure causes operator to prematurely switchover to recirculation
%FA-12	LI-4	LI-4_FH	%T1	Y	Spurious instrumentation failure causes operator to prematurely switchover to recirculation
%FA-12	SWGR-A	PNL-A / EPS-4VBUSAF-1st	%T1	N	
%FA-12	SWGR-A	PNL-A / EPS-	%T1	N	

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
		4VBUSAF-2nd			
%FA-12	SWGR-B	PNL-A / EPS-4VBUSBF-1st	%T1	N	
%FA-12	SWGR-B	PNL-A / EPS-4VBUSBF-2nd	%T1	N	
%FA-12	SWGR-1	EPS-4VBUS1F	%T1	N	
%FA-12	SWGR-2	EPS-4VBUS2F	%T1	N	
%FA-12	SUT-1	SUTF	%T1	N	
%FA-12	EDG-A	EPS-DGAF	%T1	N	
%FA-12	EDG-B	EPS-DGBF	%T1	N	
%FA-12	LC-1	EPS-480VLC1F	%T1	N	
%FA-12	LC-2	EPS-480VLC2F	%T1	N	

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-12	SST-1	EPS-480VLC1XTF	%T1	N	
%FA-12	SST-2	EPS-480VLC2XTF	%T1	N	
%FA-12	MCC-1	EPS-480VMCC1F	%T1	N	
%FA-12	MCC-2	EPS-480VMCC2F	%T1	N	
%FA-12	ATS-1	EPS-ATS1F	%T1	N	
%FA-12	BC-1	EPS-BC1F	%T1	N	
%FA-12	BAT-1	EPS-SB	%T1	N	
%FA-12	DC BUS-1	EPS-	%T1	N	

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
		125VNSDCBUSF			
%FA-13	LI-1	LI-1_FL	%T1	Y	Spurious instrumentation failure causes operator to prematurely switchover to recirculation
%FA-13	LI-1	LI-1_FH	%T1	Y	Operator fails to switchover to recirculation due to instrumentation failure
%FA-13	LI-2	LI-2_FL	%T1	Y	Spurious instrumentation failure causes operator to prematurely switchover to recirculation
%FA-13	LI-2	LI-2_FH	%T1	Y	Operator fails to switchover to recirculation due to instrumentation failure
%FA-13	SWGR-A	PNL-A / EPS-4VBUSAF-1st	%T1	N	
%FA-13	SWGR-A	PNL-A / EPS-4VBUSAF-2nd	%T1	N	

CDF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-13	SWGR-B	PNL-A / EPS-4VBUSBF-1st	%T1	N	
%FA-13	SWGR-B	PNL-A / EPS-4VBUSBF-2nd	%T1	N	
%FA-13	SWGR-1	EPS-4VBUS1F	%T1	N	
%FA-13	SWGR-2	EPS-4VBUS2F	%T1	N	
%FA-13	SUT-1	SUTF	%T1	N	
%FA-15	BAT-1	EPS-SB	%T1	N	

Step 2: Develop LERF or CLERP Model

LERF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
%FA-4A	MOV-7	MOV-7_TO	%I2TAG	Y	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)
%FA-7	MOV-7	MOV-7_TO	%I2TAG	Y	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)
%FA-9	MOV-7	MOV-7_TO	%I2TAG	Y	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)
%FA-12	MOV-7	MOV-7_TO	%I2TAG	Y	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)
%FA-4A	MOV-8	MOV-8_TO	%I2TAG	Y	Interfacing Systems LOCA at RCS/RHR Interface

LERF FIRE PRA MODEL MAPPING TABLE (USE THE EVENT TREES AND FAULT TREES BELOW)					
Fire Initiating Event	**Equipment ID**	**PRA Event Identifier**	**PRA Initiating Event**	**Additional model changes are required to facilitate mapping? (Y or N)**	**Describe modeling strategy to facilitate mapping.**
					(2 MOVs in series)
%FA-9	MOV-8	MOV-8_TO	%I2TAG	Y	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)
%FA-12	MOV-8	MOV-8_TO	%I2TAG	Y	Interfacing Systems LOCA at RCS/RHR Interface (2 MOVs in series)

Task 5 model changes

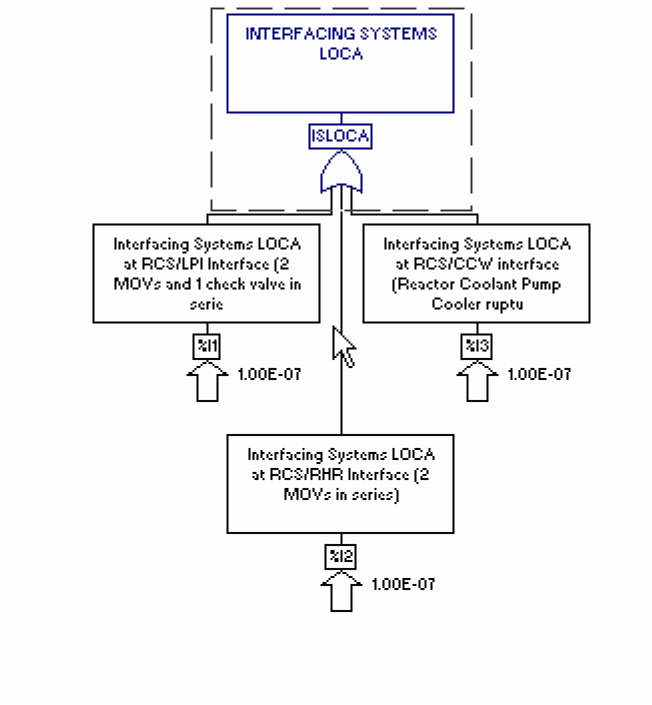


Figure 1: Gate ISLOCA – Before

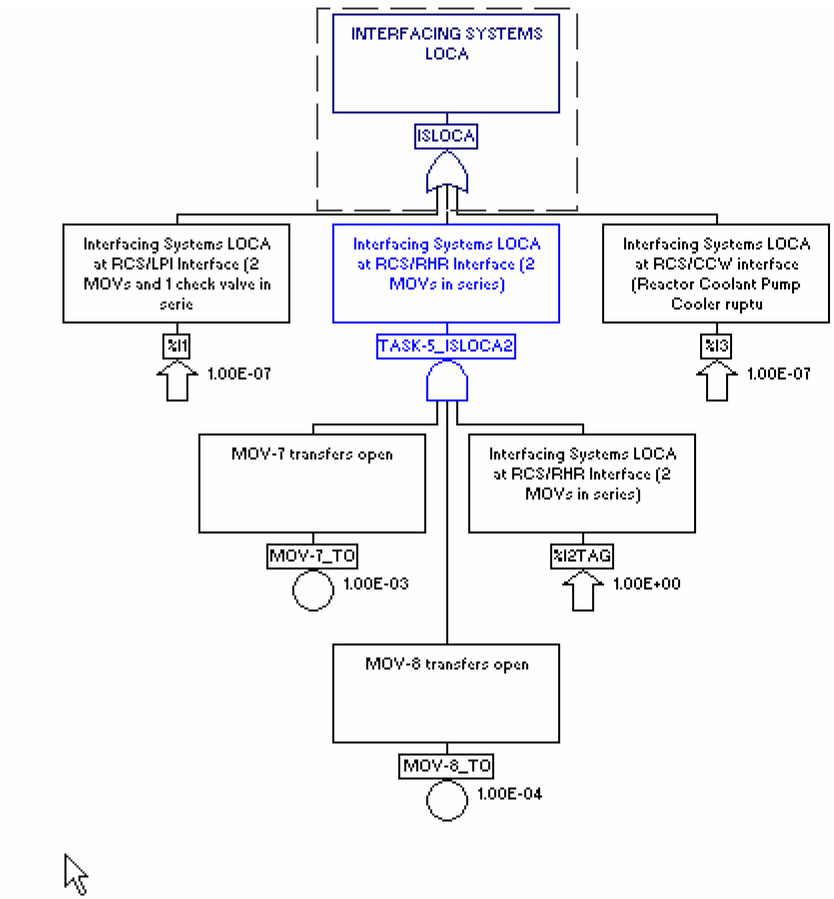


Figure 2: Gate ISLOCA – After

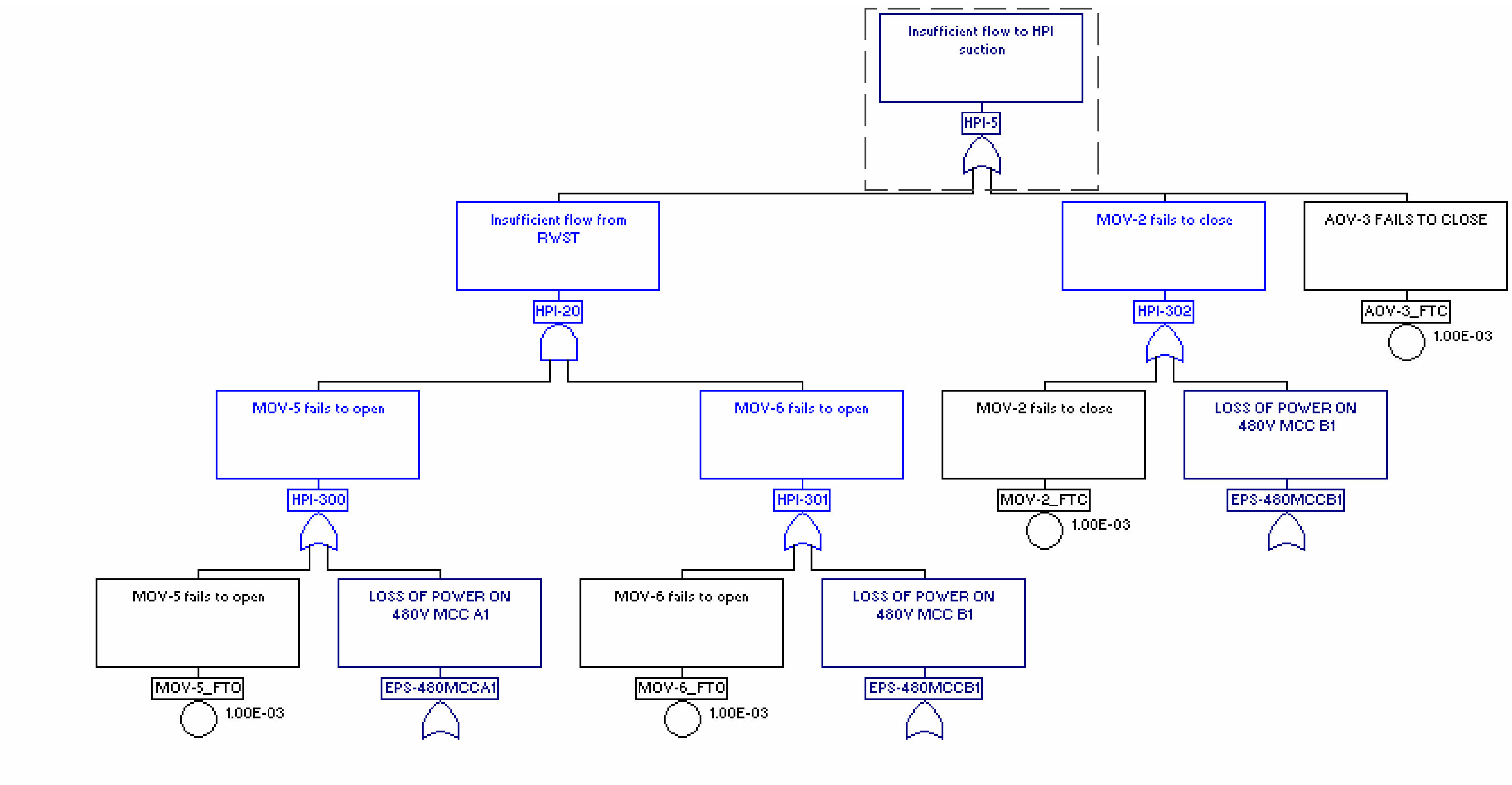


Figure 3: Gate HPI-5 Before

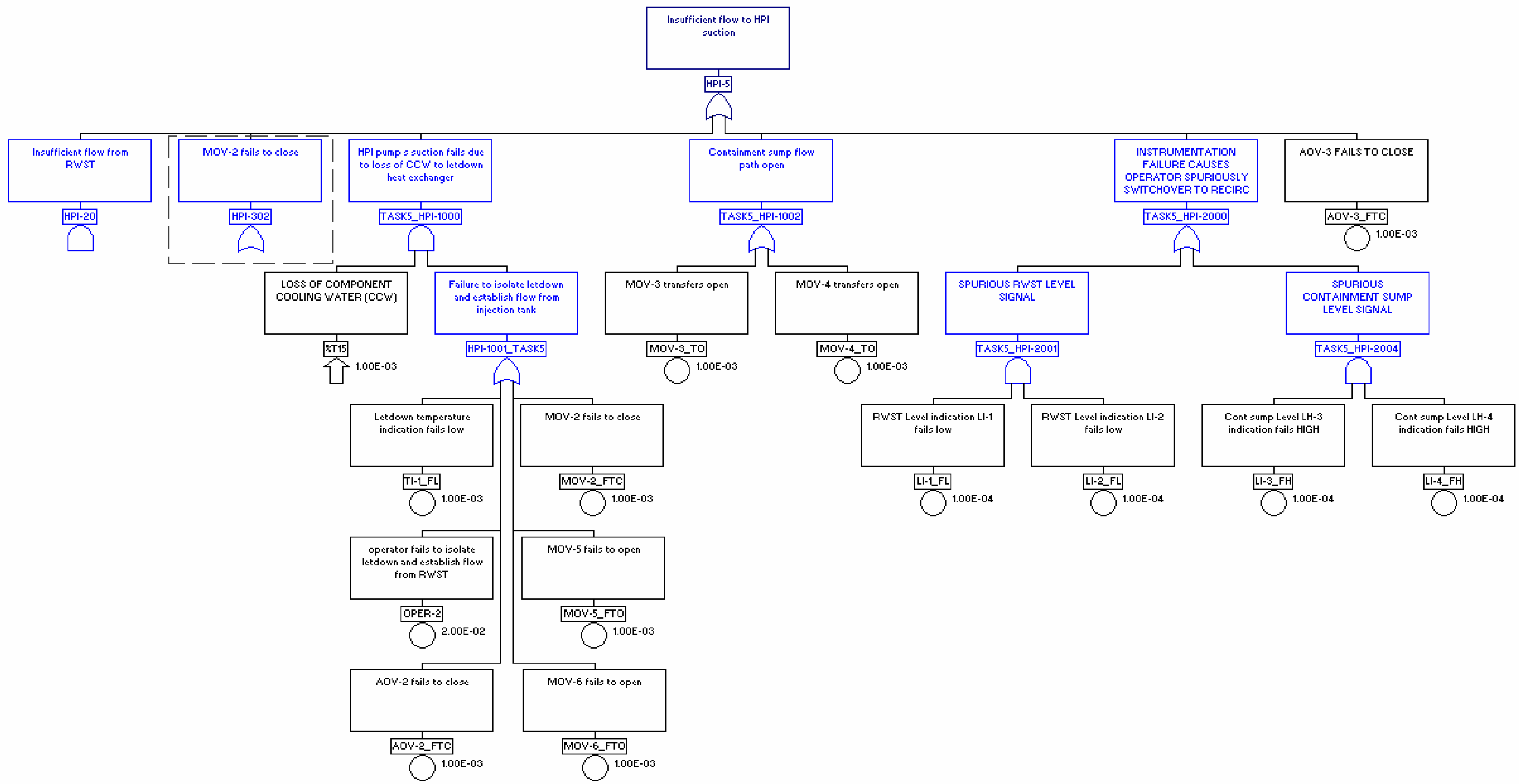


Figure 4: Gate HPI-5 After

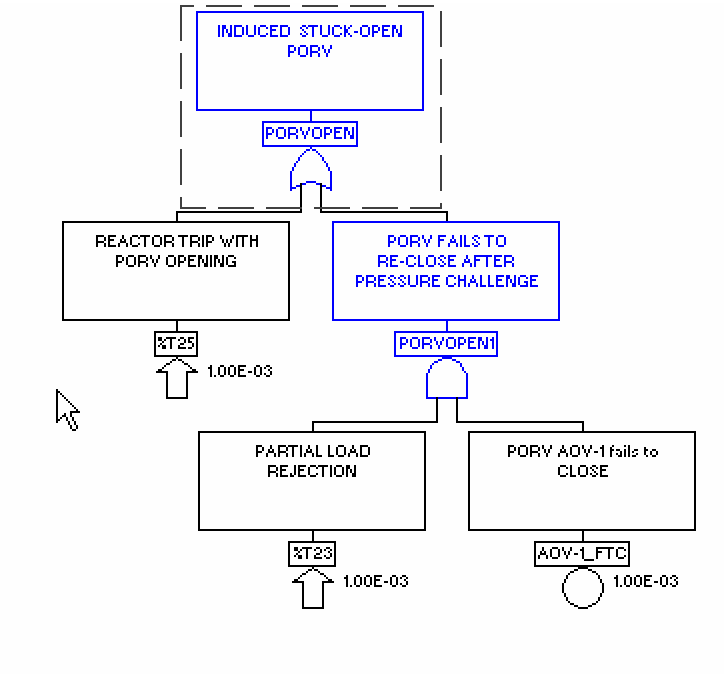


Figure 5: Gate PORVOPEN Before

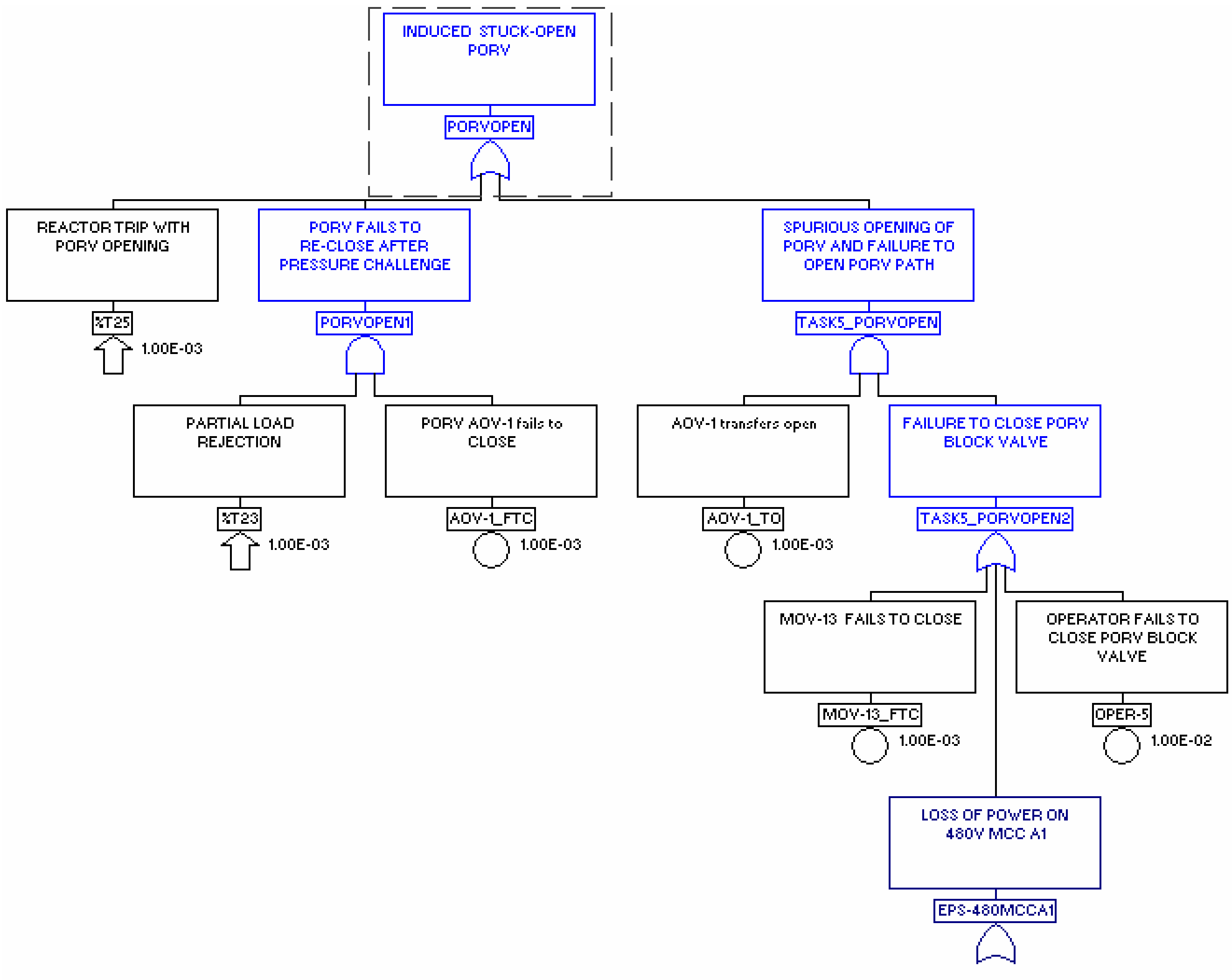


Figure 6: Gate PORVOPEN After

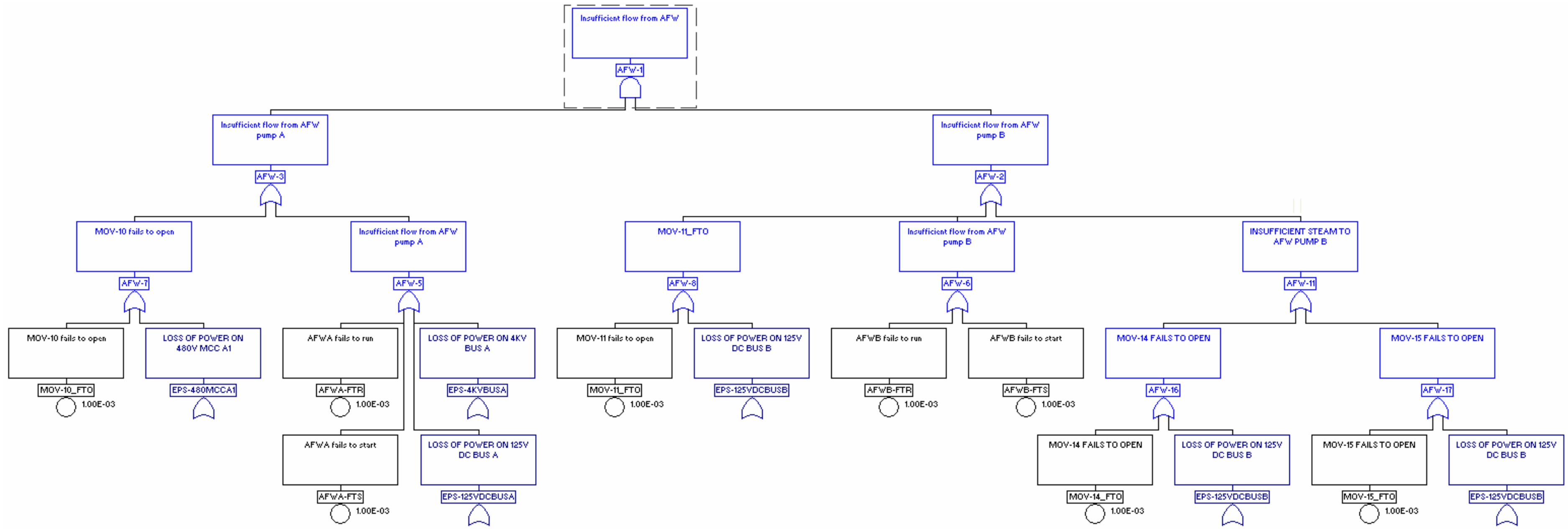


Figure 7: Gate AFW-1 Before

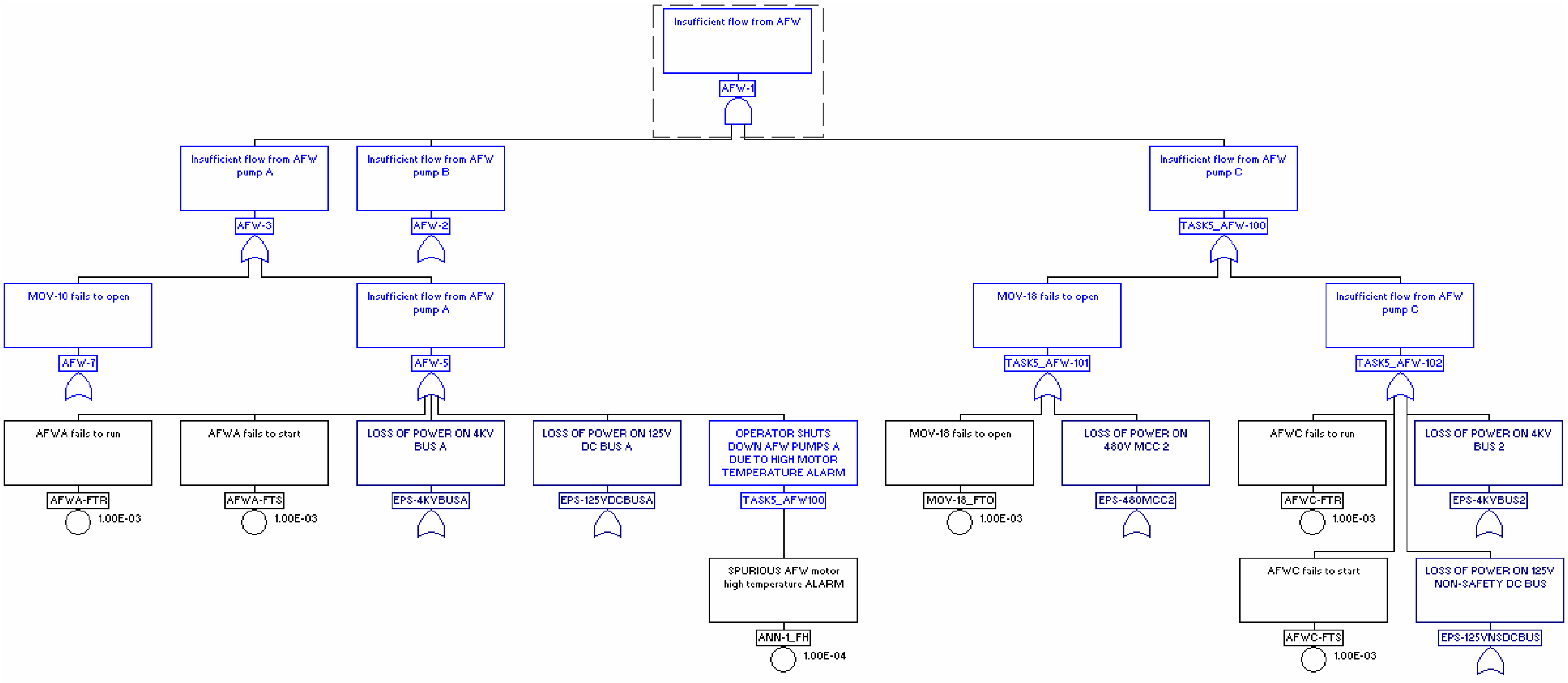


Figure 8:Gate AFW-1 After

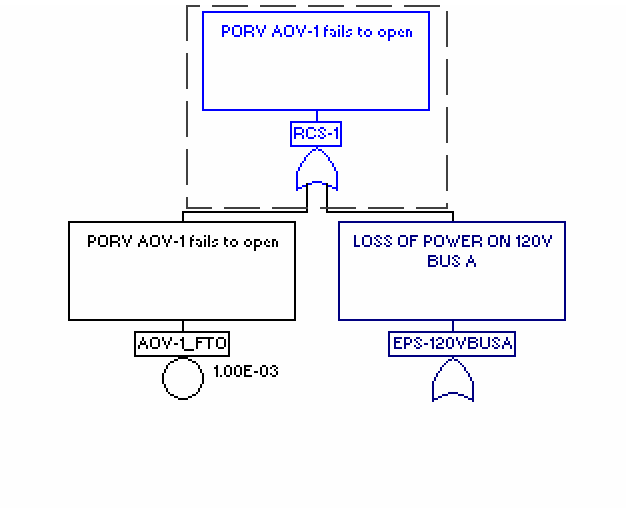


Figure 9: Gate RCS-1 Before

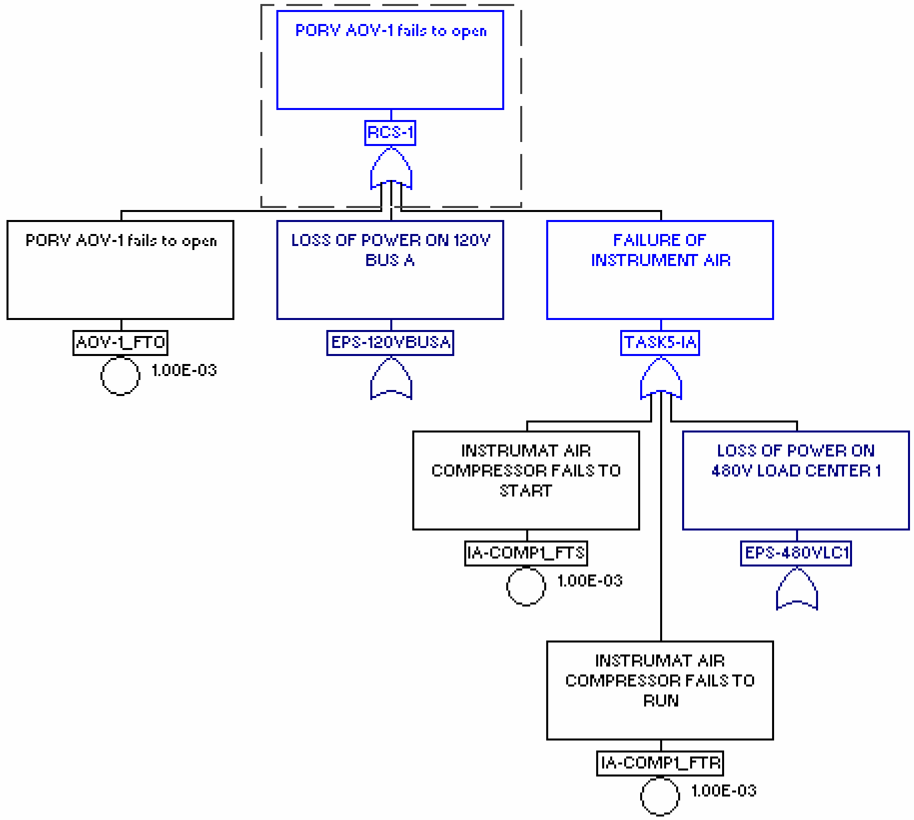


Figure 10: Gate RCS-1 After

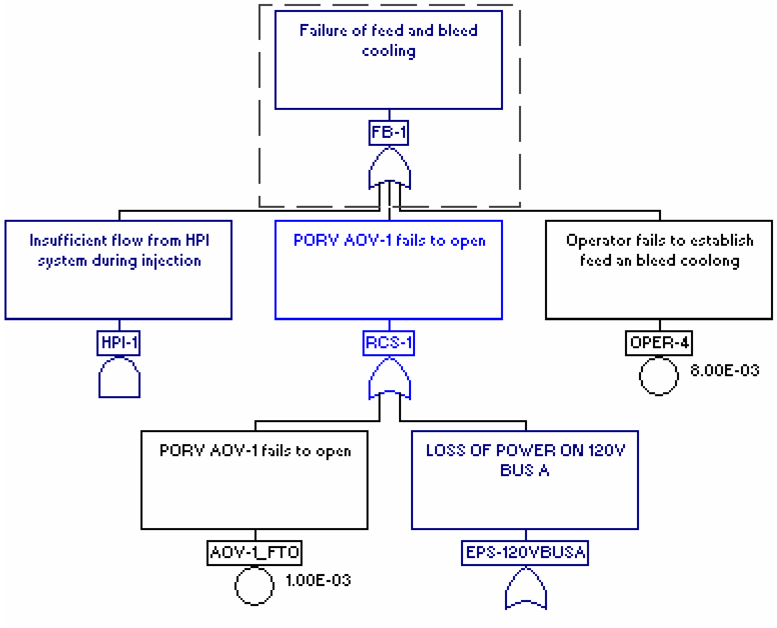


Figure 11: Gate FB-1 Before

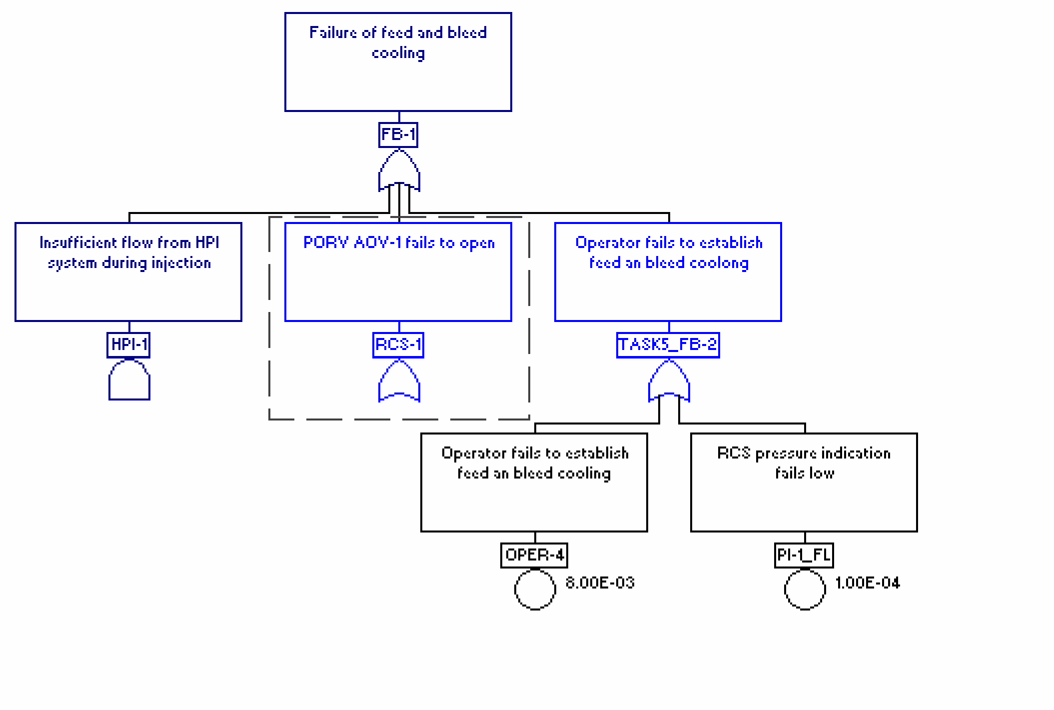


Figure 12: Gate FB-1 After

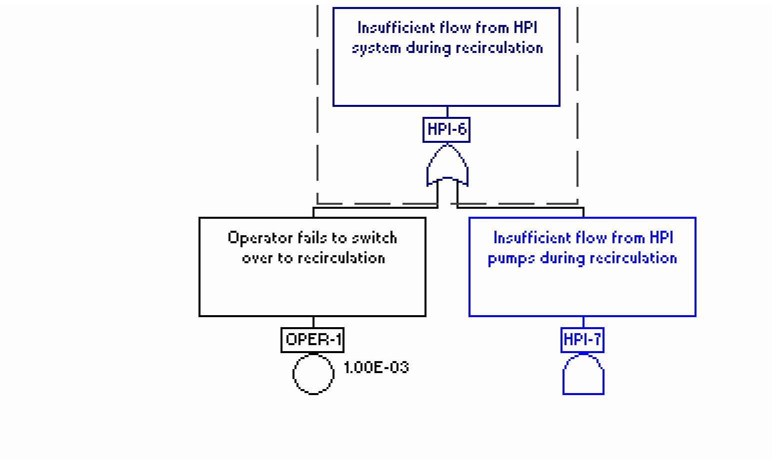


Figure 13: Gate HPI-6 Before

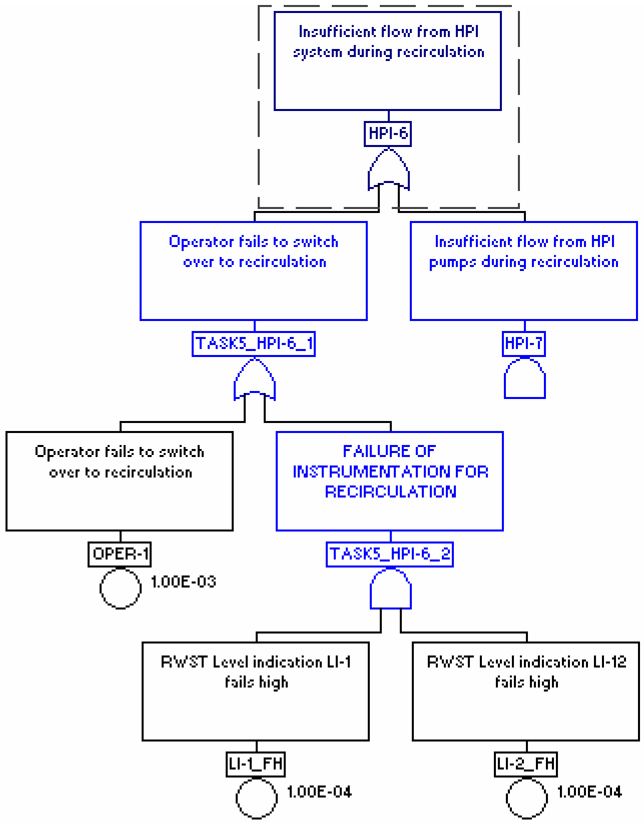


Figure 14: Gate HPI-6 After

Task 5 Inputs

Table 1: Target Equipment Loss Report

Equipment ID	Equipment Description	Equipment Type	Location	Desired Position/ Status	Target Loss Locations
HPI-A	High pressure safety injection pump A	Pump	Aux Bldg. El. 0 Ft	On	1, 2, 3, 10
				On	1, 2, 3, 10
HPI-B	High pressure safety injection pump B	Pump	Aux Bldg. El. 0 Ft	On	1, 2, 3, 11
				On	1, 2, 3, 11
RHR	Residual heat removal pump	Pump	Aux Bldg. El. -20 Ft	Off	1, 2, 3, 4A, 9, 11
AFW-A	Motor driven AFW pump A	Pump	Aux Bldg. EL. 0 Ft	On	1, 3, 4B, 9, 10
AFW-B	Steam driven AFW pump B	Pump	Aux Bldg. EL. 0 Ft	On	1, 3, 4B, 9, 11
AFW-C	Motor driven AFW pump C	Pump	Turbine Bldg. El. 0 Ft	On	1, 3, 12
RCP	Reactor coolant pump	Pump	Containment	Off	1, 2, 3, 7, 12
COMP-1	Instrument air compressor	Compressor	Turbine Bldg. El. 0 Ft	Cycle	12
AOV-1 (SOV-1)	Power operated relief valve	AOV	Containment	Closed	1, 3, 7, 9
				Open	1, 3, 7, 9, 10
AOV-2 (SOV-2)	Letdown isolation valve	AOV	Aux Bldg. El. 0 Ft	Closed	1, 2, 3, 9
AOV-3 (SOV-3)	Charging pump injection valve	AOV	Aux Bldg. El. 0 Ft	Closed	1, 2, 3, 9

Equipment ID	Equipment Description	Equipment Type	Location	Desired Position/ Status	Target Loss Locations
MOV-1	HPI discharge valve	MOV	Aux Bldg. El. 0 Ft	Open	1, 2, 3, 9, 10
MOV-2	VCT isolation valve	MOV	Aux Bldg. El. 0 Ft	Closed	1, 2, 3, 9, 11
MOV-3	Cont. sump recirc. valve	MOV	Aux Bldg. El. -20 Ft	Open/ Closed[2]	1, 2, 3, 4A, 9, 10
MOV-4	Cont. sump recirc. valve	MOV	Aux Bldg. El. -20 Ft	Open/ Closed	1, 2, 3, 4A, 9, 11
MOV-5	RWST isolation valve	MOV	Aux Bldg. El. 0 Ft	Open	1, 2, 3, 12
MOV-6	RWST isolation valve	MOV	Aux Bldg. El. 0 Ft	Open	1, 2, 3, 12
MOV-7	RHR inboard suction valve	MOV	Containment	Closed	4A,7,9,12
MOV-8	RHR outboard suction valve	MOV	Aux Bldg. El. -20 Ft	Closed	4A,9,12
MOV-9	HPI discharge valve	MOV	Aux Bldg. El. 0 Ft	Open	1,2,3,,9
MOV-10	AFW pump A discharge valve	MOV	Aux Bldg. EL. 0 Ft	Open	1,3,4B,9,12
MOV-11	AFW pump B discharge valve	MOV	Aux Bldg. EL. 0 Ft	Open	1,3,4B,9,11,12
MOV-13	PORV block valve	MOV	Containment	Open/ Closed[1]	1, 3, 7, 9
MOV-14	AFW pump B turbine steam line isolation valve	MOV	Turbine Bldg. El. 0 Ft	Open	1, 3, 4B, 12
MOV-15	AFW pump B steam inlet throttle valve	MOV	Turbine Bldg. El. 0 Ft	Throttled	1, 3, 4B, 12
MOV-18	AFW pump C discharge valve	MOV	Turbine Bldg. El. 0 Ft	Open	1, 3, 12
V-12	CST isolation valve	MOV	Turbine Bldg. El. 0 Ft	Open	12

Equipment ID	Equipment Description	Equipment Type	Location	Desired Position/ Status	Target Loss Locations
LI-1	RWST level	Instrument	Yard	Available	1, 3, 12, 13
LI-2	RWST level	Instrument	Yard	Available	1, 3, 12, 13
LI-3	Cont. sump level	Instrument	Containment	Available	1, 3, 7, 12
LI-4	Cont. sump level	Instrument	Containment	Available	1, 3, 7, 12
TI-1	Letdown heat exchanger outlet temperature	Instrument	Aux Bldg El. 0 Ft	Available	1, 2, 3, 9
PT-1	RCS pressure	Instrument	Containment	Available	1, 3, 7
A-1	AFW motor high temperature	Annunciator	SWG Access Room	Non spurious	1, 2, 3, 9, 4B
SWGR-A	Train A 4160 V switchgear	Switchgear	Switchgear Room A	Energized from SUT-1	1, 3, 10, 12, 13
SWGR-A	Train A 4160 V switchgear	Switchgear	Switchgear Room A	Energized from EDG-A	1, 3, 8A, 10, 12
SWGR-B	Train B 4160 V switchgear	Switchgear	Switchgear Room B	Energized from SUT-1	1, 3, 9, 11, 12, 13
SWGR-B	Train B 4160 V switchgear	Switchgear	Switchgear Room B	Energized from EDG-A	1, 3, 8B, 9, 11, 12
SWGR-1	Non-safety 4160 V switchgear	Switchgear	Turbine Bldg. El. 0ft	Energized	1, 3, 12, 13
SWGR-2	Non-safety 4160 V switchgear	Switchgear	Turbine Bldg. El. 0ft	Energized	1, 3, 12, 13
SUT-1	Startup transformer	Transformer	Yard	Energized	1, 3, 12, 13

Equipment ID	Equipment Description	Equipment Type	Location	Desired Position/ Status	Target Loss Locations
EDG-A	Train A emergency diesel generator	Diesel Generator	DG Bldg.	On	1, 3, 8A, 10, 12
EDG-B	Train B emergency diesel generator	Diesel Generator	DG Bldg.	On	1, 3, 8B, 10, 12
LC-1	Non-safety 480 V load center	Load Center	Turbine Bldg. El. 0 ft	Energized	1, 3, 12
LC-2	Non-safety 480 V load center	Load Center	Turbine Bldg. El. 0 ft	Energized	1, 3, 12
LC-A	Train A 480 V load center	Load Center	Switchgear Room A	Energized	1, 3,10
LC-B	Train B 480 V load center	Load Center	Switchgear Room B	Energized	1, 3, 11
SST-1	Non-safety station service transformer	Transformer	Turbine Bldg. El. 0 F	Energized	12
SST-2	Non-safety station service transformer	Transformer	Turbine Bldg. El. 0 F	Energized	12
SST-A	Train A station service transformer	Transformer	Switchgear Room A	Energized	10
SST-B	Train B station service transformer	Transformer	Switchgear Room B	Energized	11
MCC-1	Non-safety 480 V motor control center	Motor Control Center	Turbine Bldg El. 0 Ft	Energized	12
MCC-2	Non-safety 480 V motor control center	Motor Control Center	Turbine Bldg El. 0 Ft	Energized	12
MCC-A1	Train A 480 V motor control center	Motor Control Center	SWG Access Room	Energized	9, 10
MCC-B1	Train B 480 V motor control center	Motor Control Center	SWG Access Room	Energized	9, 11
ATS-1	Automatic transfer switch	ATS	SWG Access Room	Energized from MCC-1	12
BC-1	Non-safety swing battery charger	Battery Charger	Turbine Bldg El. 0 Ft	Energized	12

Equipment ID	Equipment Description	Equipment Type	Location	Desired Position/ Status	Target Loss Locations
BC-A	Train A battery charger	Battery Charger	Switchgear Room A	Energized	9, 10
BC-B	Train B battery charger	Battery Charger	Switchgear Room B	Energized	9, 11
BAT-1	Non-safety battery	Battery	Turbine Bldg El. 0 Ft	Available	12, 15
BAT-A	Train A battery	Battery	Battery Room A	Available	5, 10
BAT-B	Train B battery	Battery	Battery Room B	Available	6, 11
DC BUS-1	Non-safety 250 VDC bus	DC Bus	Turbine Bldg El. 0 Ft	Energized	12
DC BUS-A	Train A 125 VDC bus	DC Bus	Switchgear Room A	Energized	10
DC BUS-B	Train B 125 VDC bus	DC Bus	Switchgear Room B	Energized	11
PNL-A	Train A 125 VDC panel	Panel board	Switchgear Room A	Energized	10
PNL-B	Train B 125 VDC panel	Panel board	Switchgear Room B	Energized	11
INV-A	Train A inverter	Inverter	Switchgear Room A	Energized	3, 9, 10
INV-B	Train B inverter	Inverter	Switchgear Room B	Energized	3, 9, 11
VITAL-A	Train A 120 VAC vital bus	120VAC Bus	SWG Access Room	Energized	9, 10
VITAL-B	Train B 120 VAC vital bus	120VAC Bus	SWG Access Room	Energized	9, 11

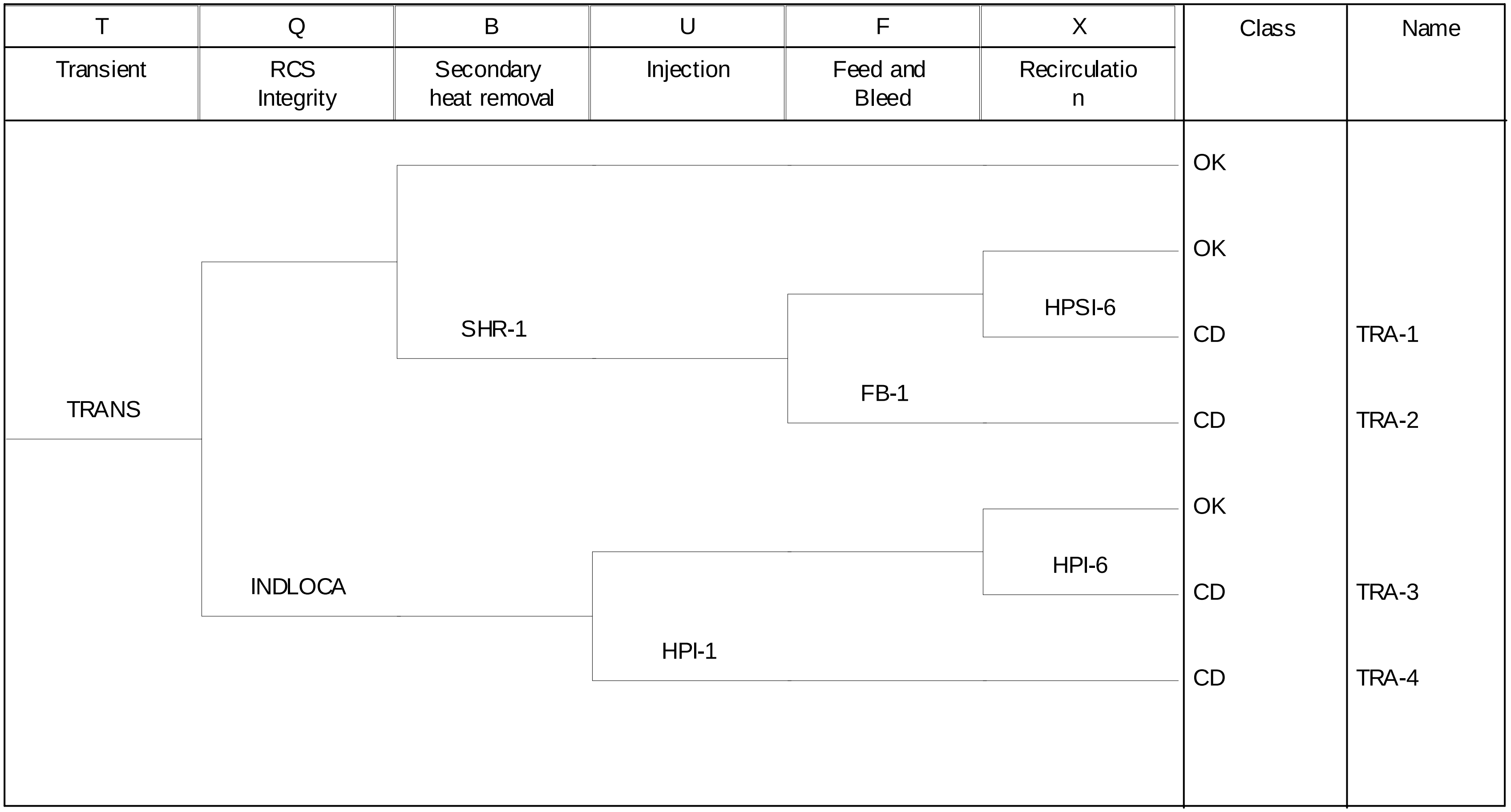


Figure 15: Transient Event Tree

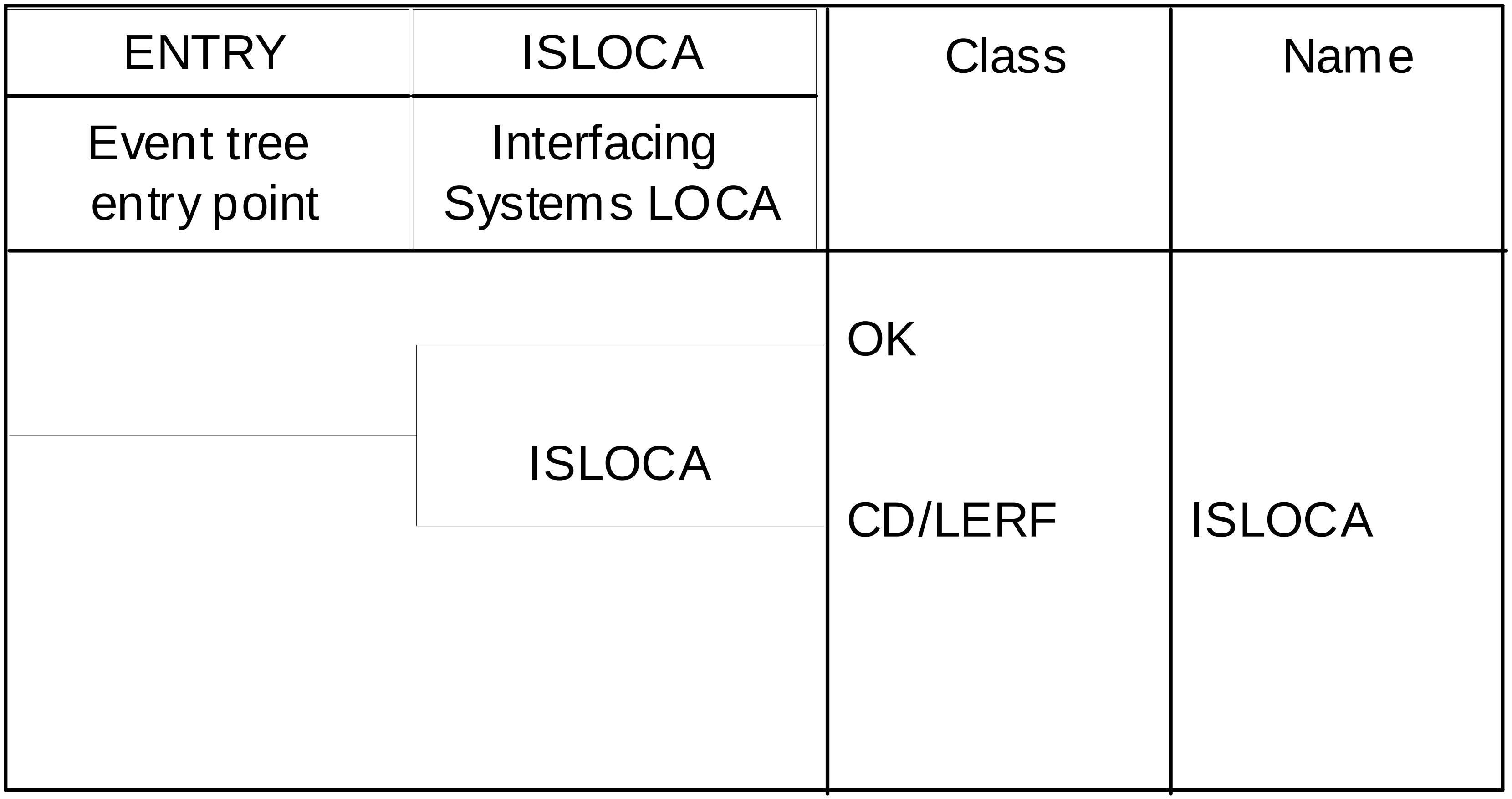


Figure 16: ISLOCA Event Tree

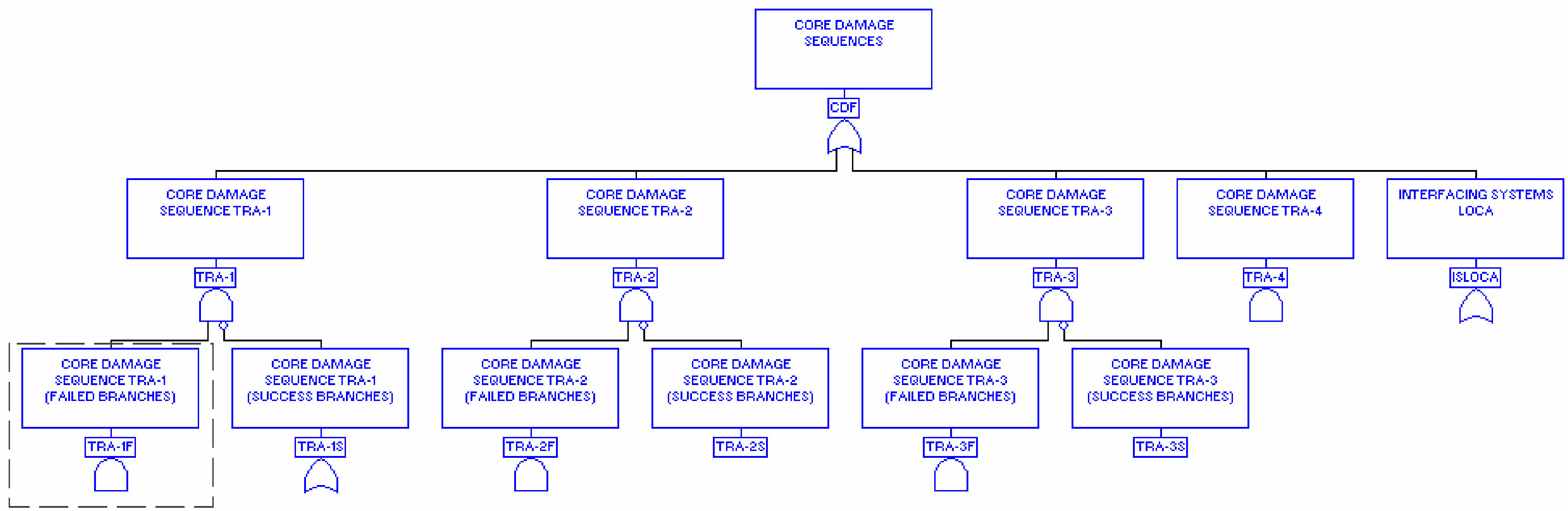


Figure 17: Gate CDF

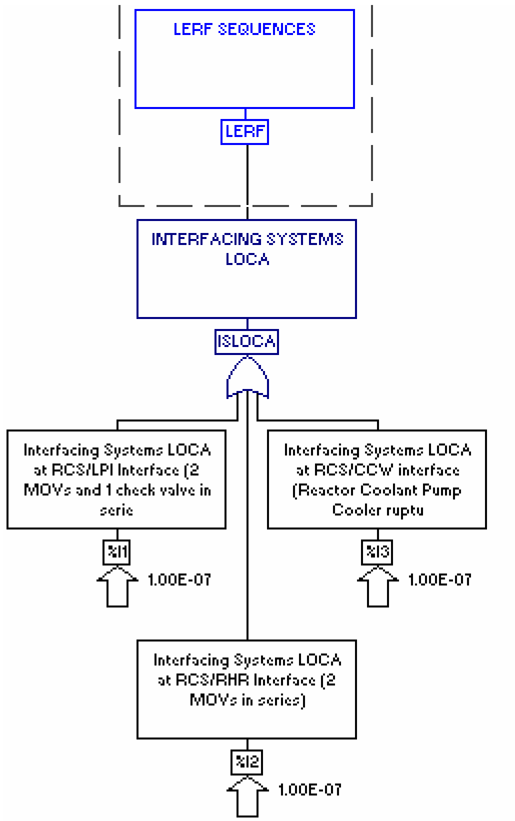


Figure 18: Gate LERF

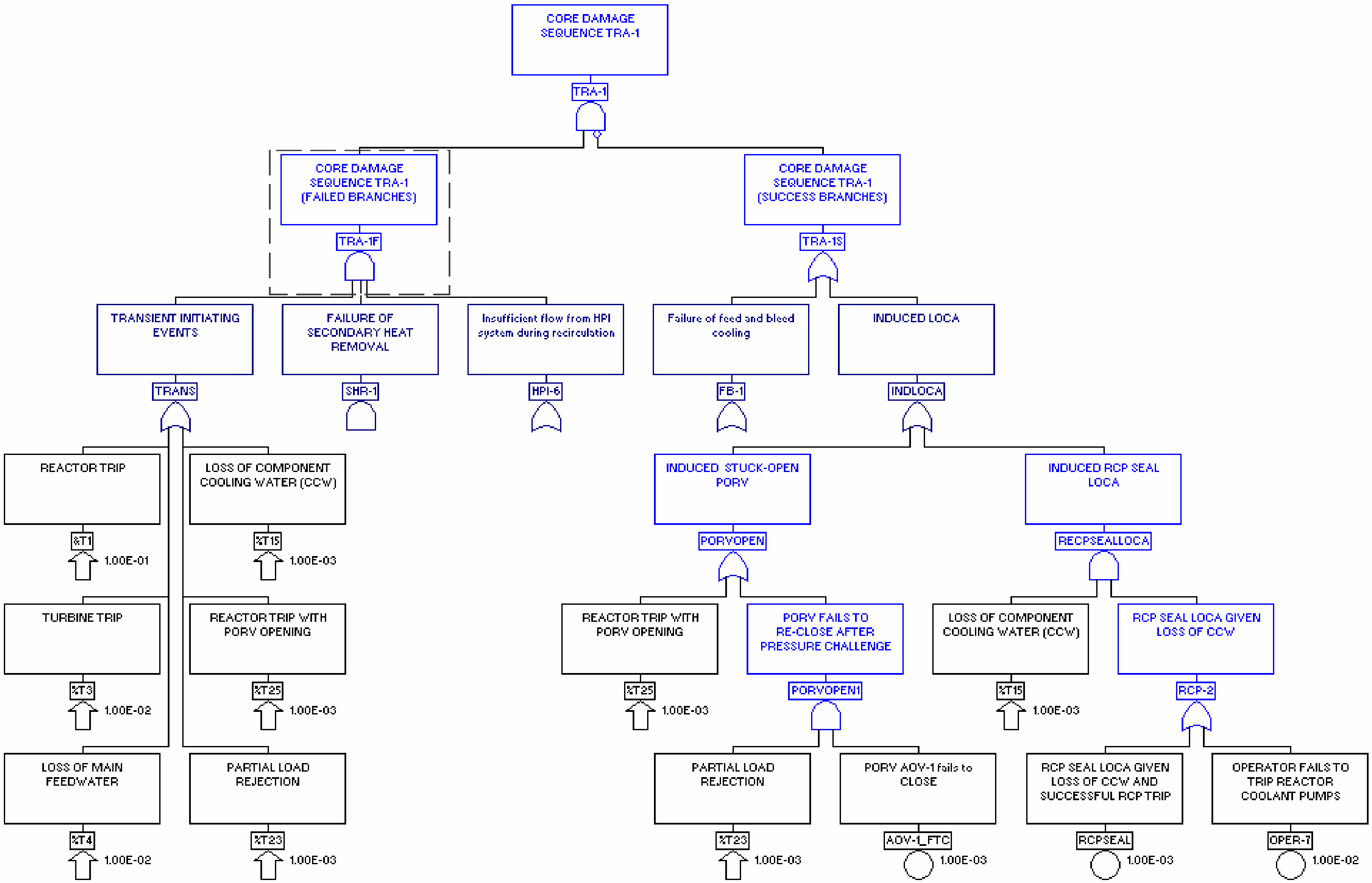


Figure 19: Gate TRA-1

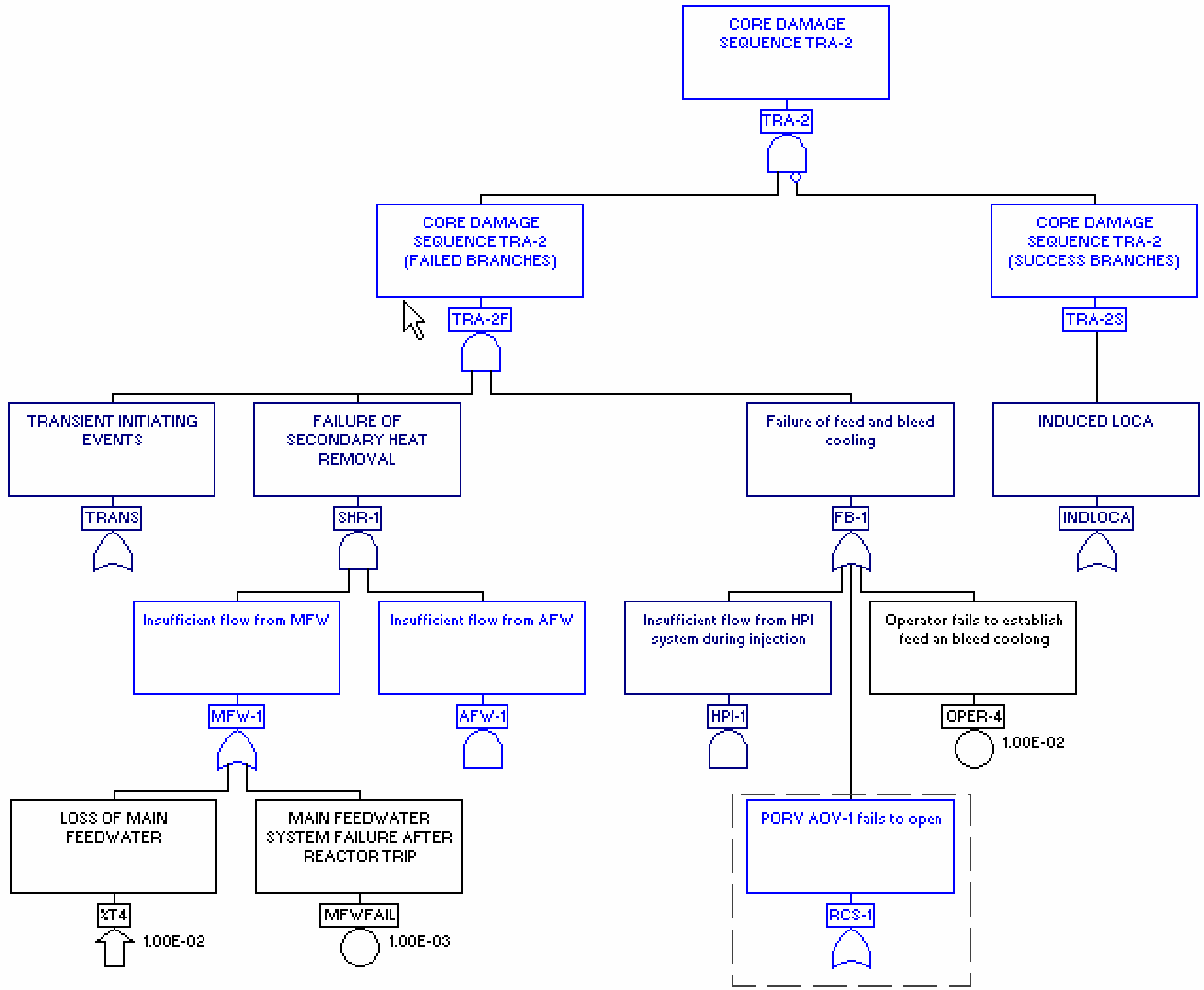


Figure 20: Gate TRA-2

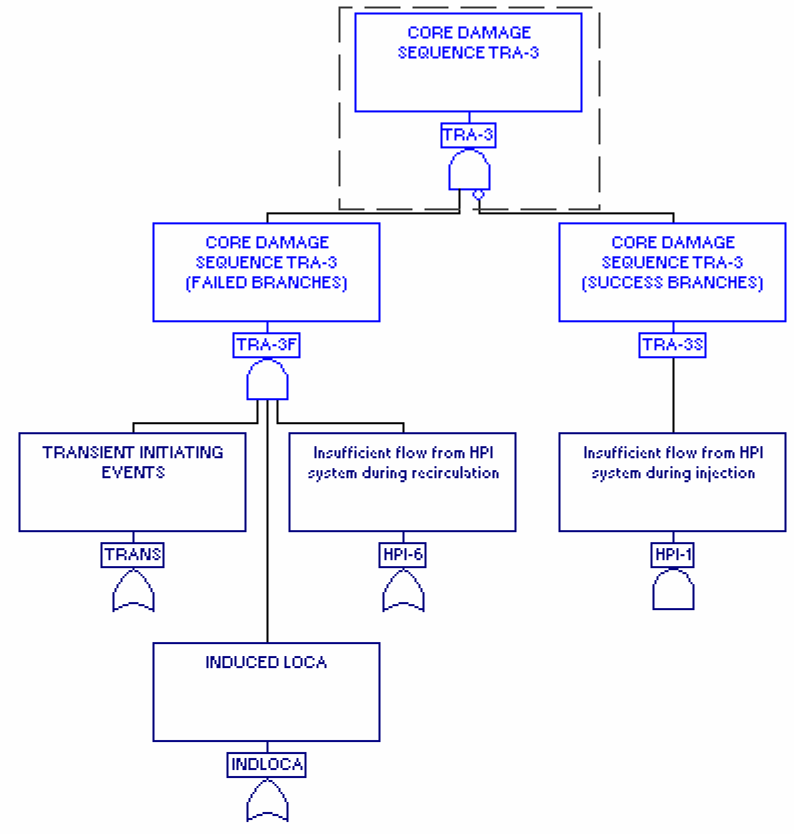


Figure 21: Gate TRA-3

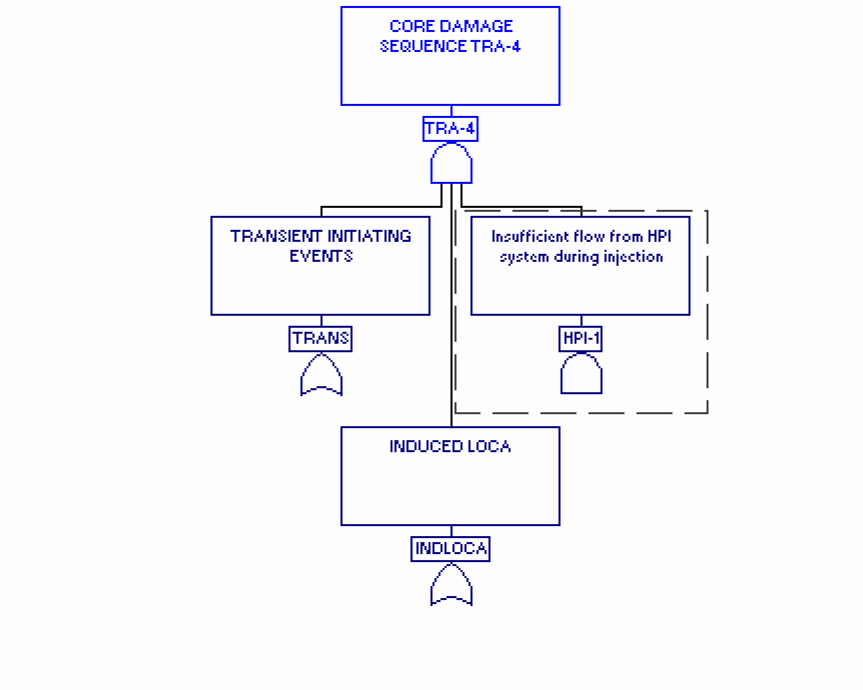


Figure 22: Gate TRA-4

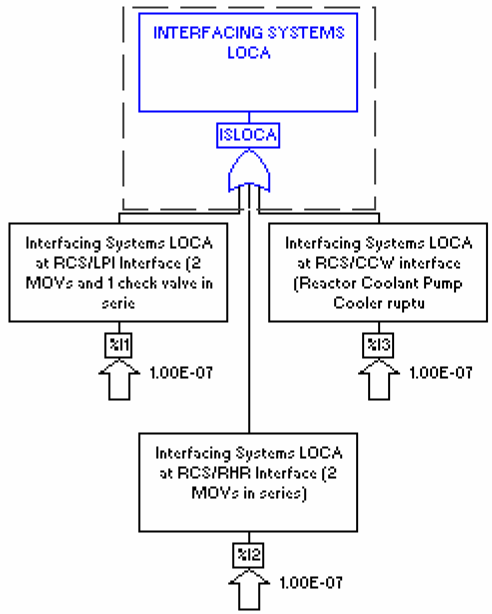


Figure 23: Gate ISLOCA

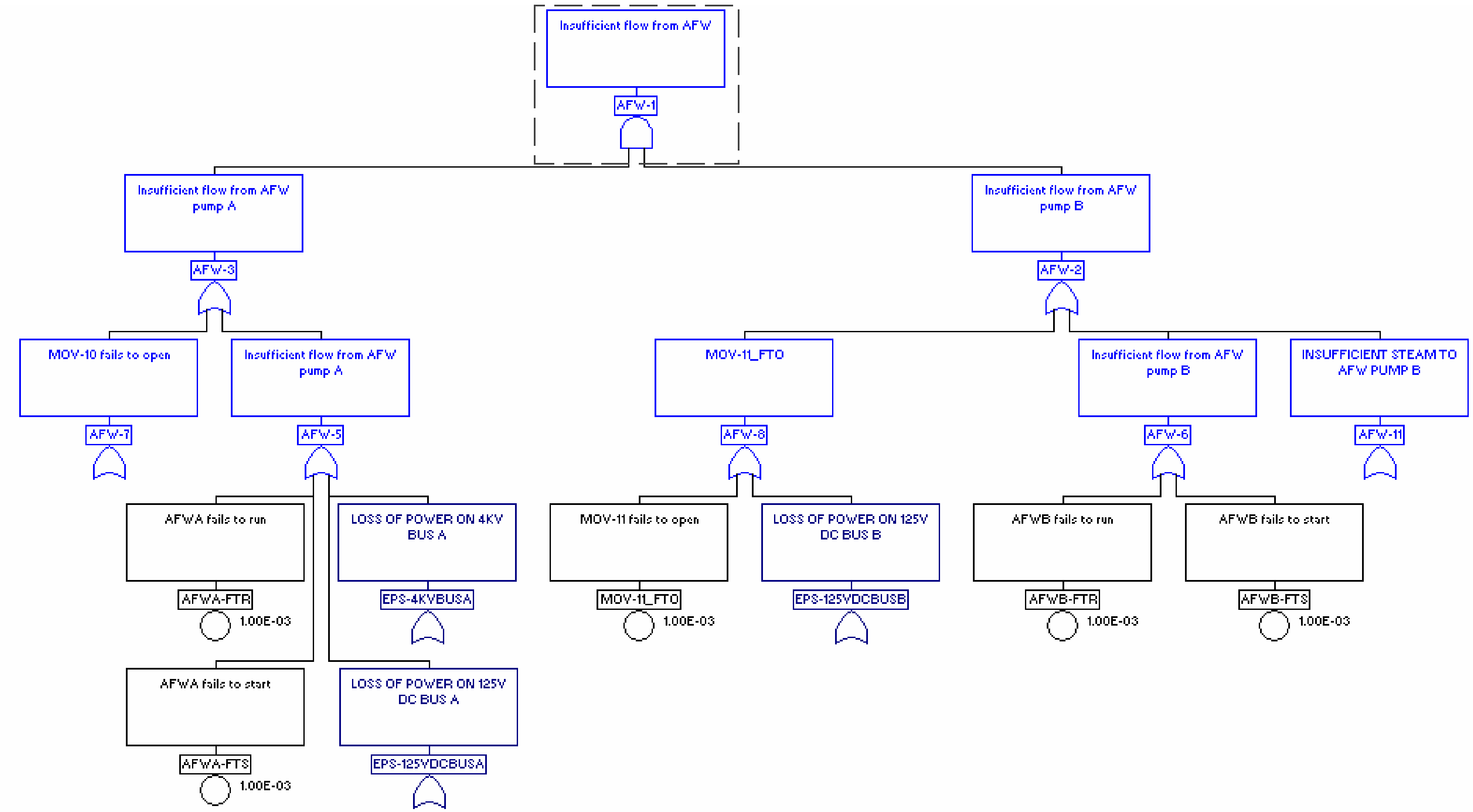


Figure 24: Gate AFW-1

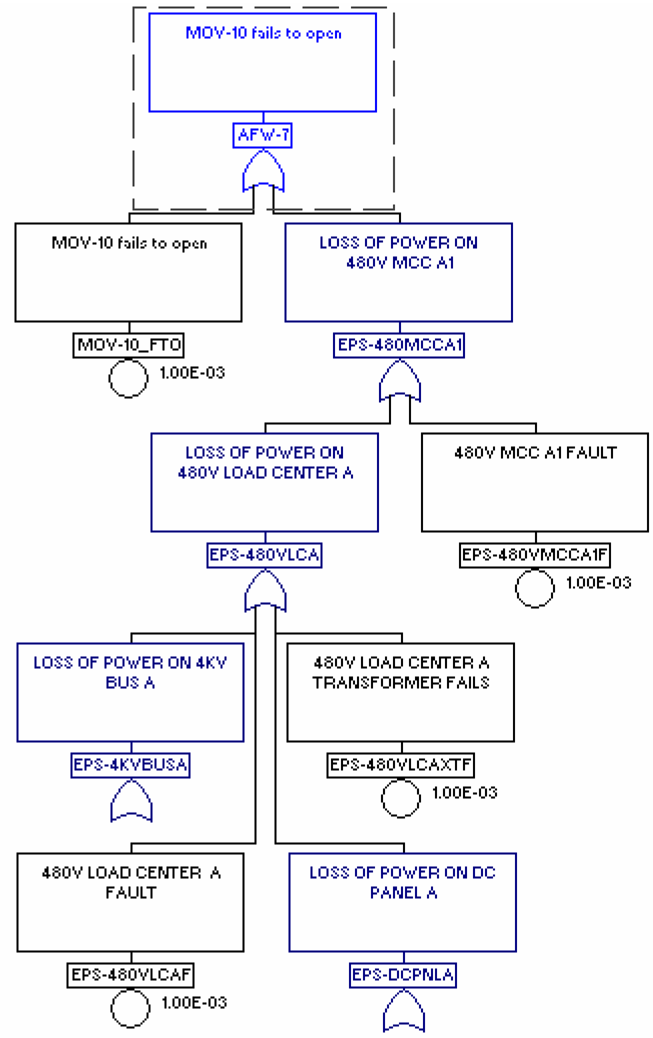


Figure 25: Gate AFW-7

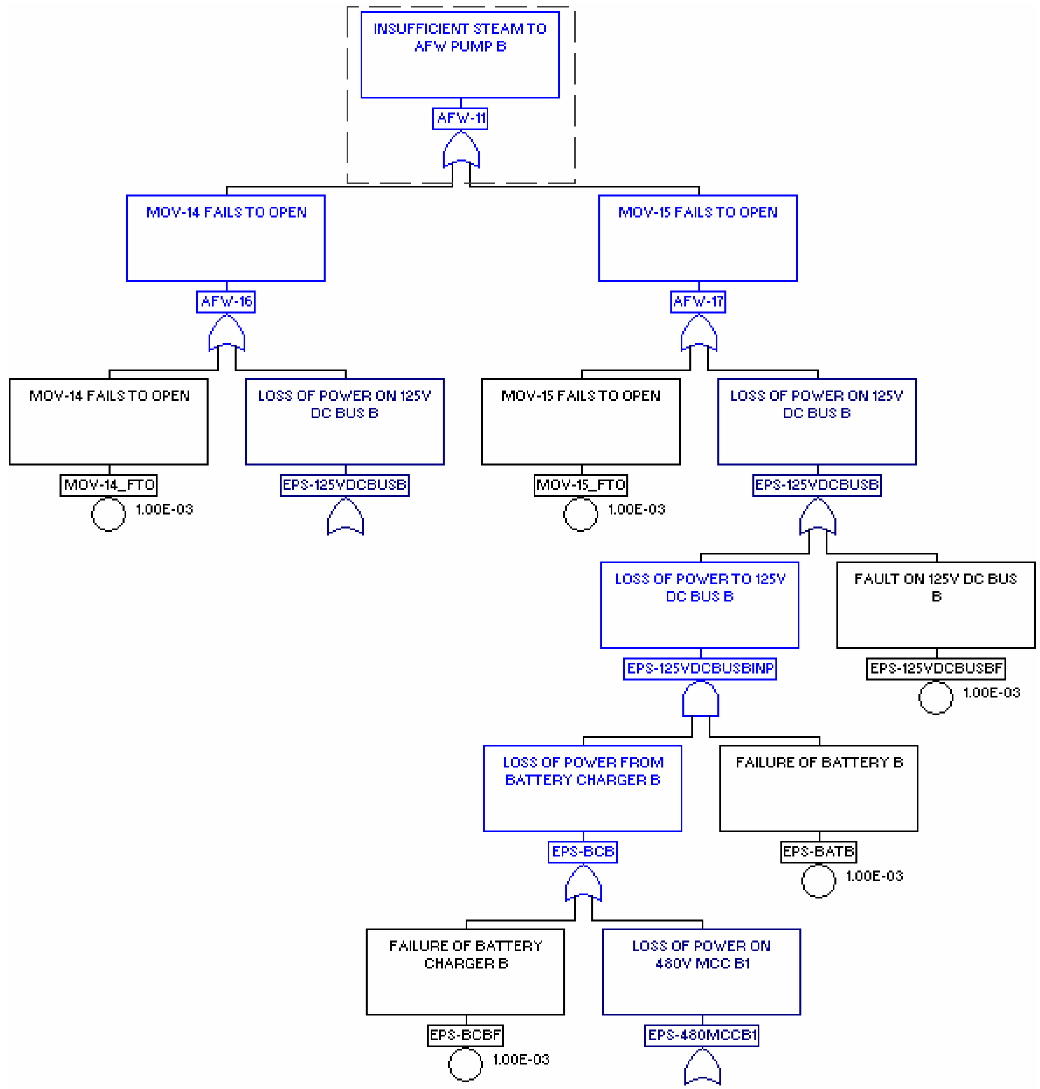


Figure 26: Gate AFW-11

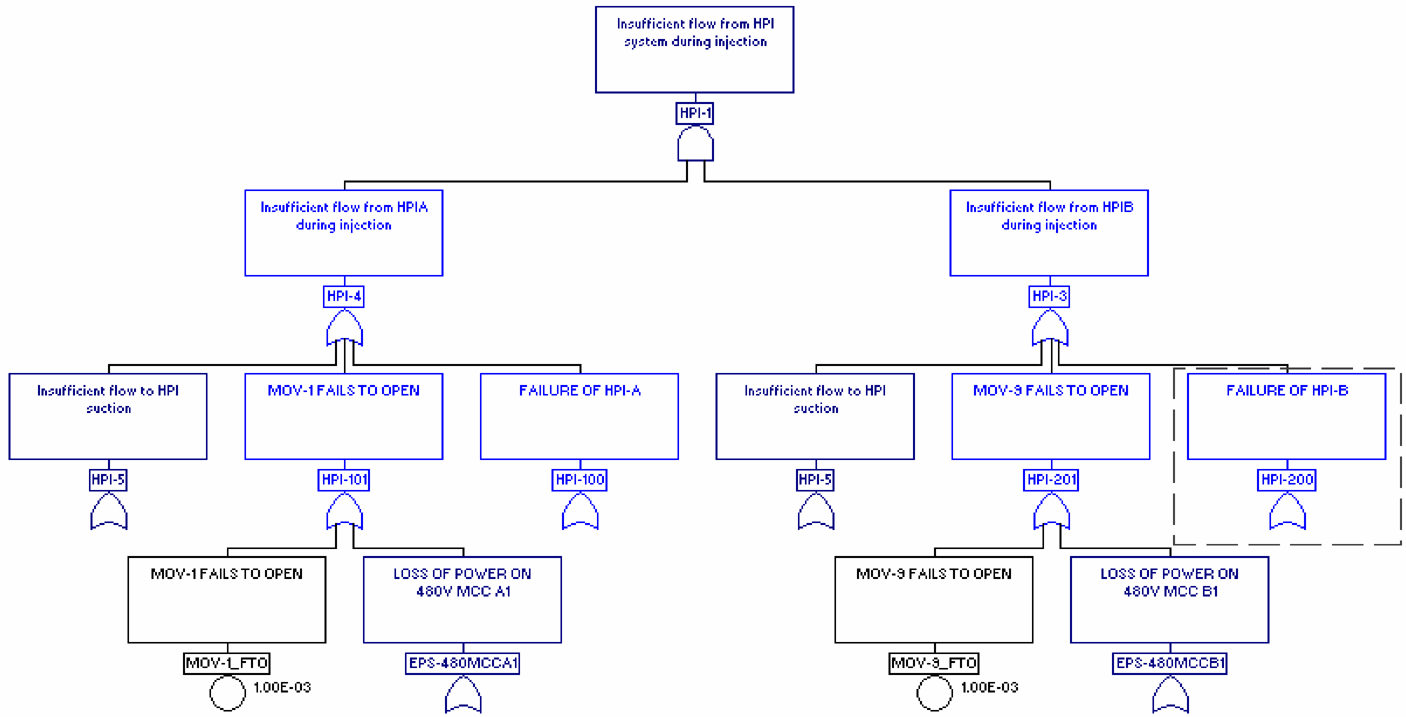


Figure 27: Gate HPI-1

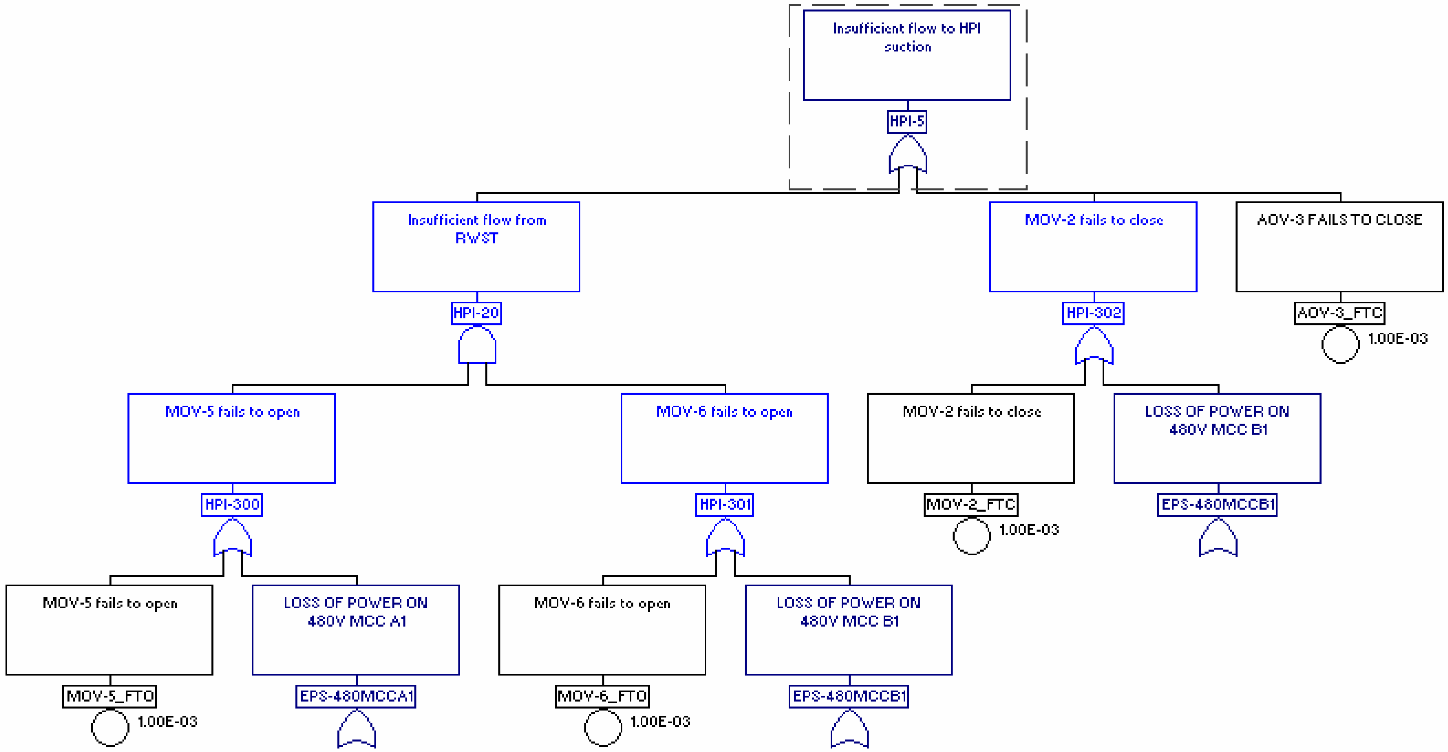


Figure 28: Gate HPI-5

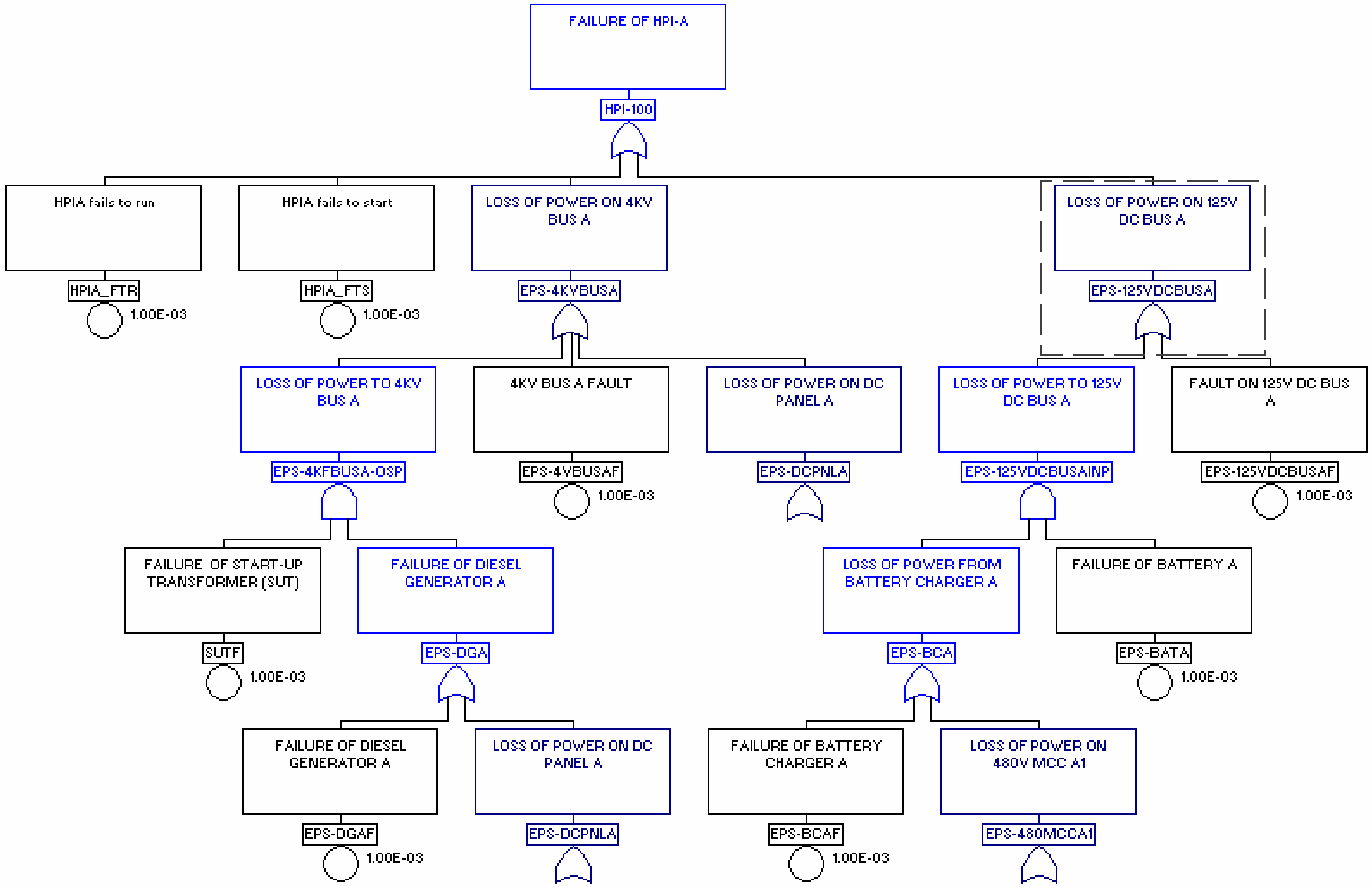


Figure 29: Gate HPI-100

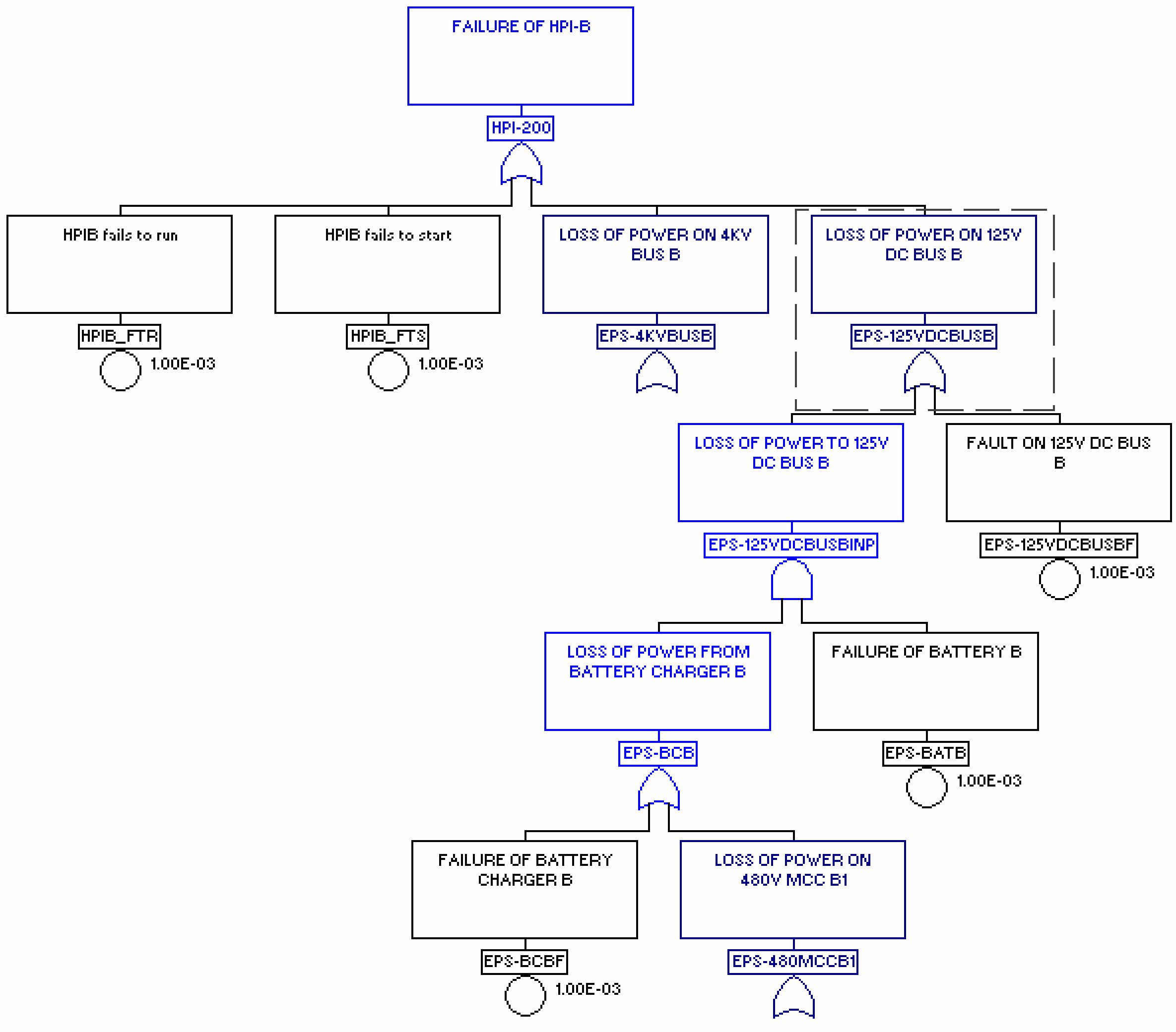


Figure 30: Gate HPI-200

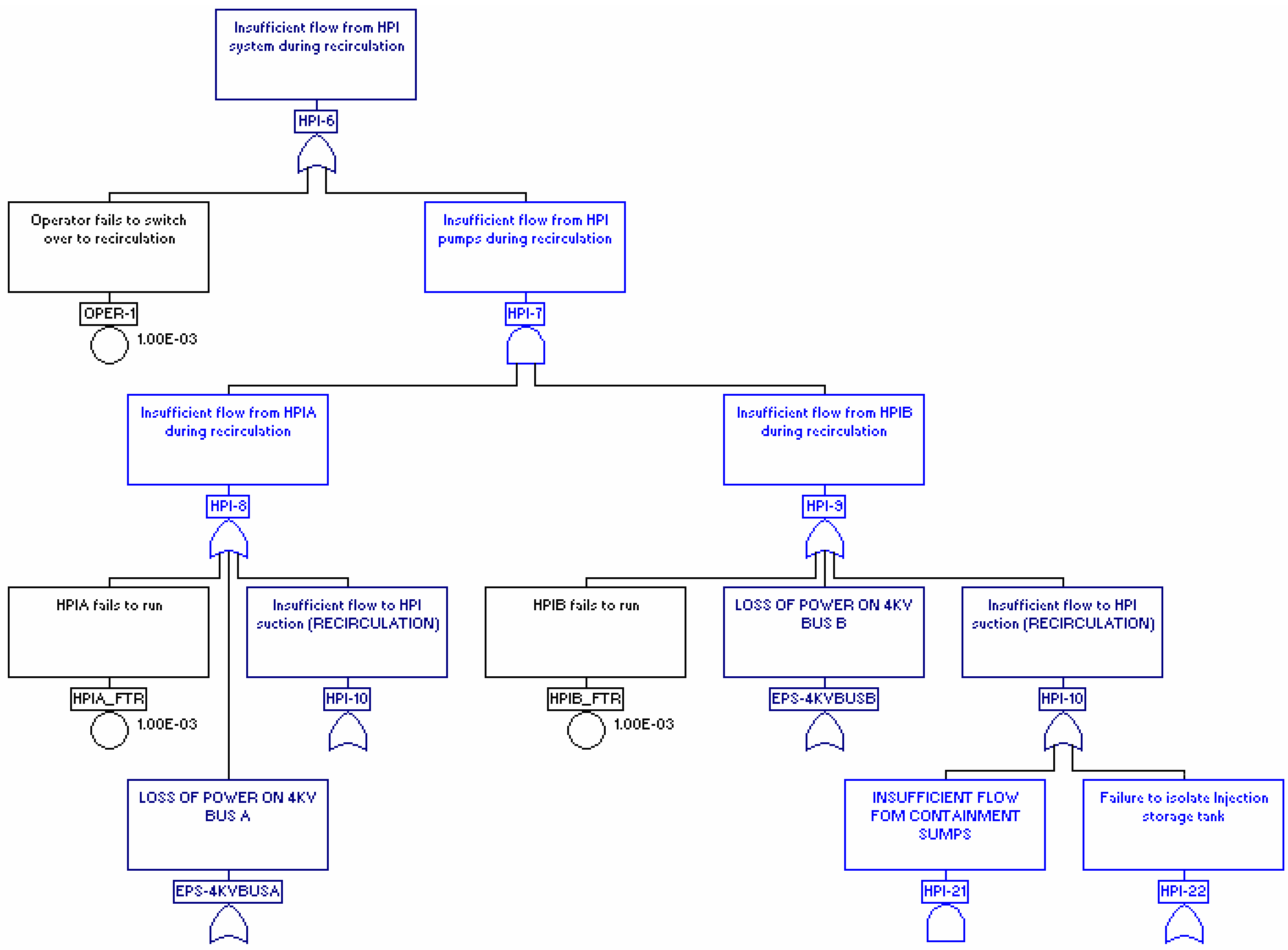


Figure 31: Gate HPI-6

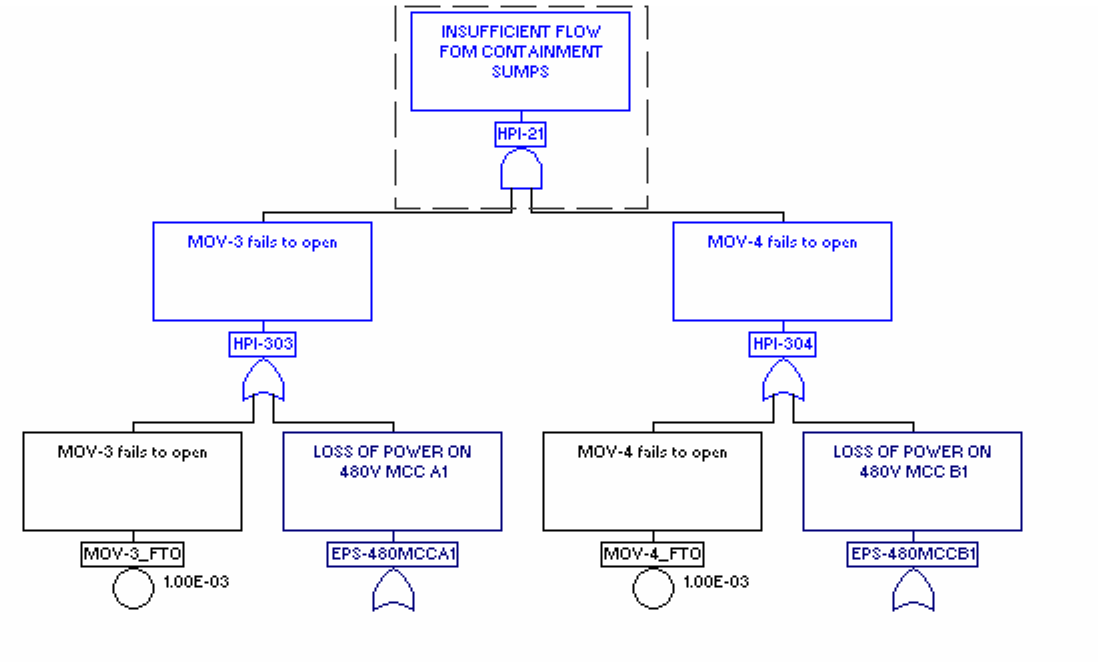


Figure 32: Gate HPI-21

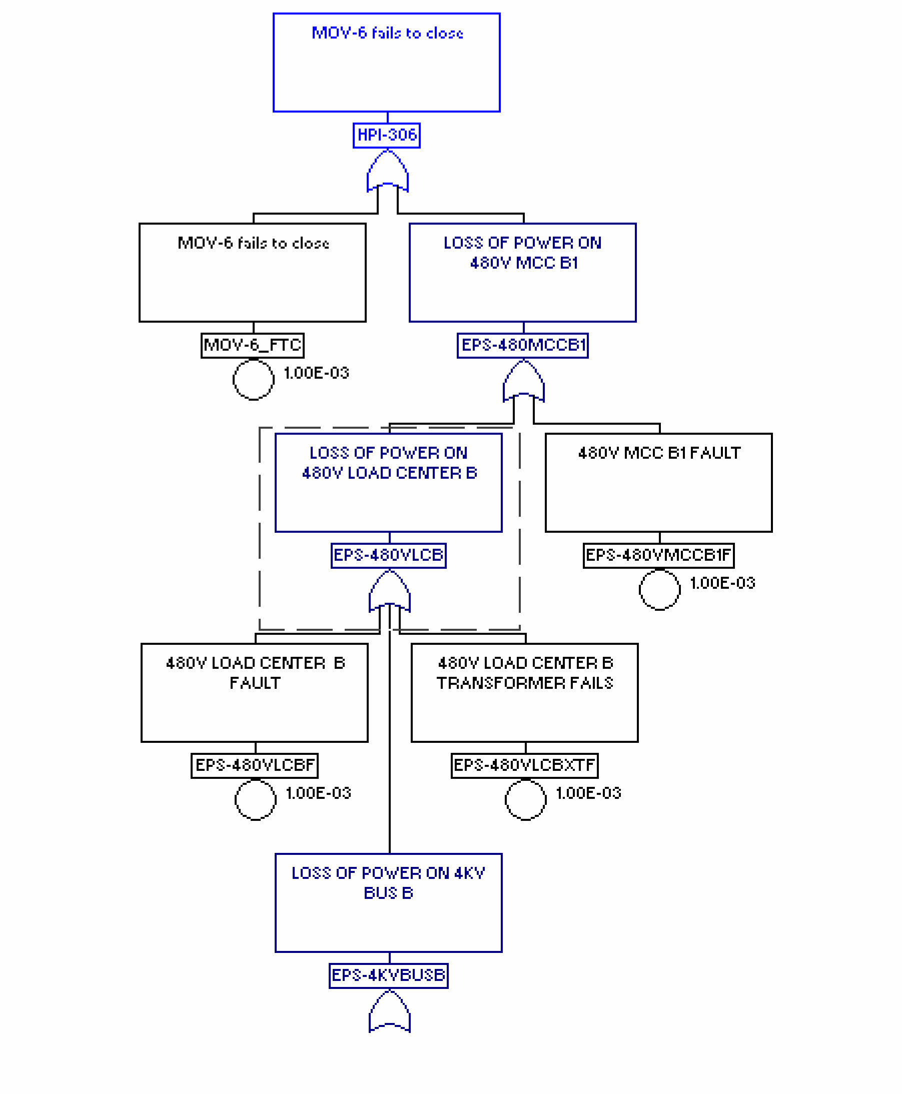


Figure 33: Gate HPI-306

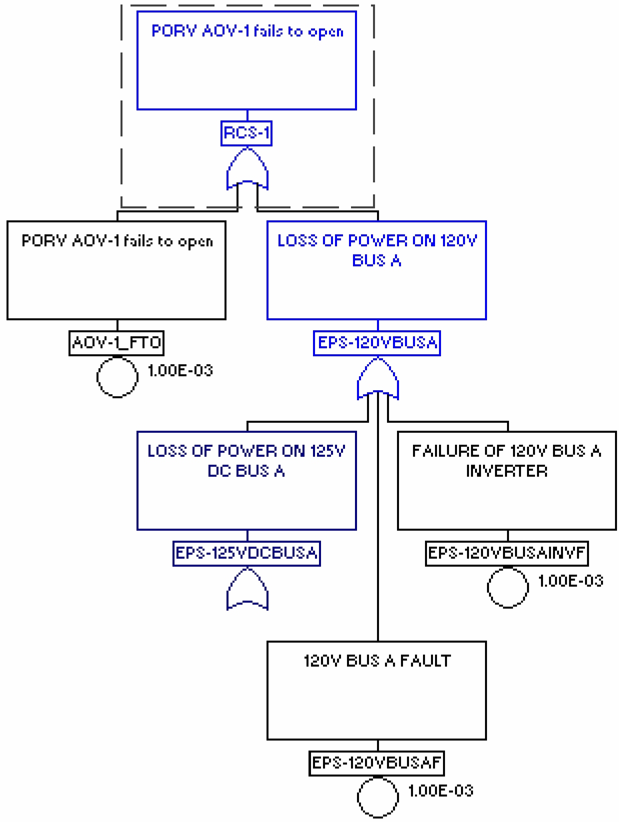


Figure 34: Gate RCS-1

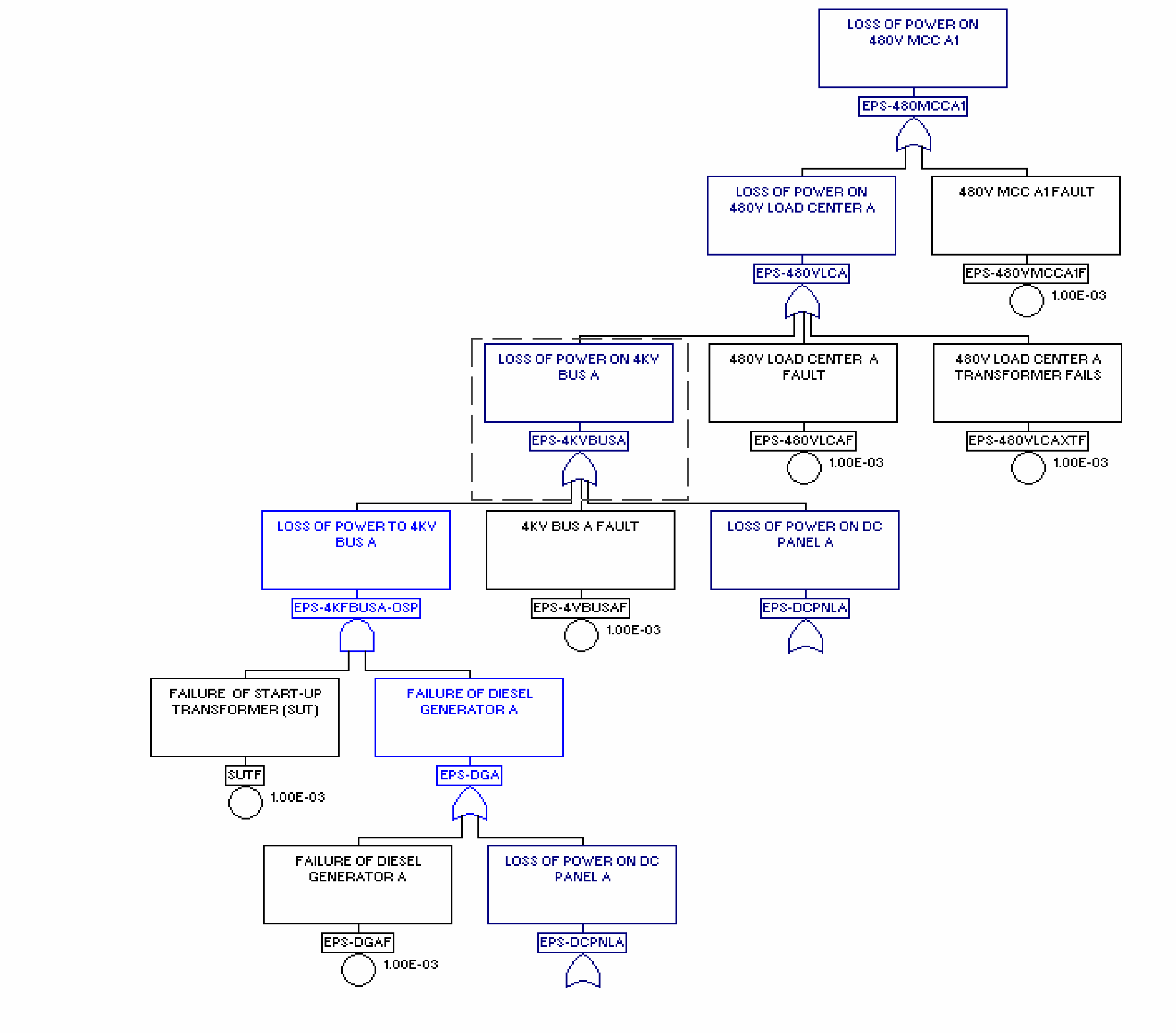


Figure 35: Gate EPS-480MCCA1

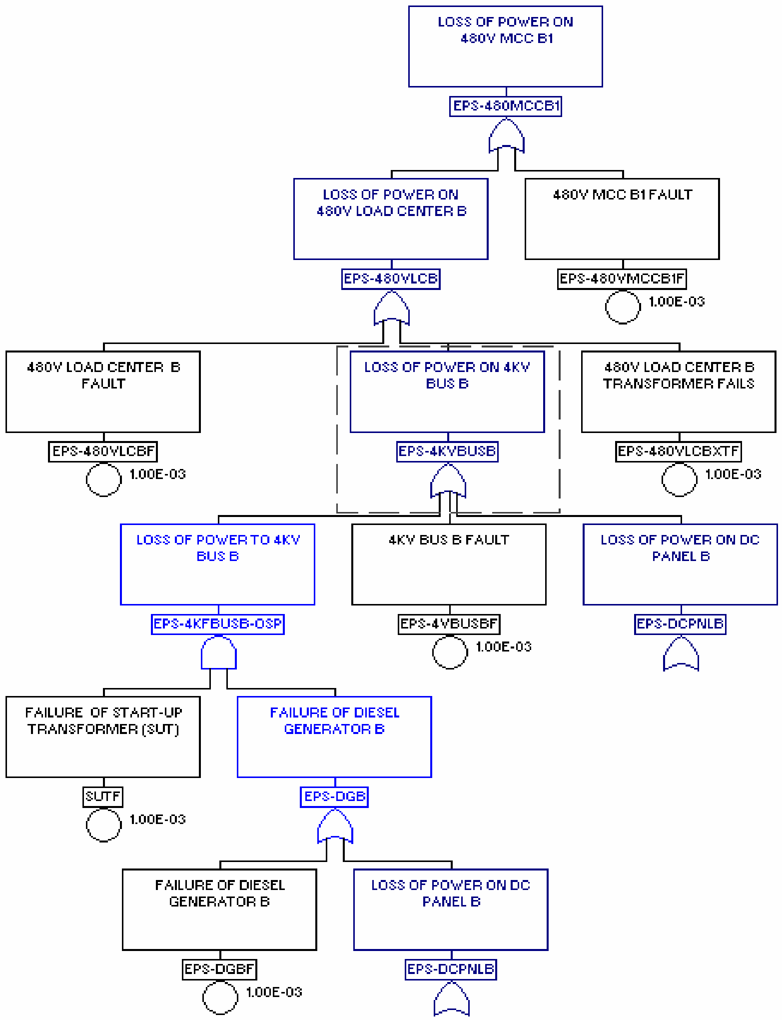


Figure 36: Gate EPS-480MCCB1

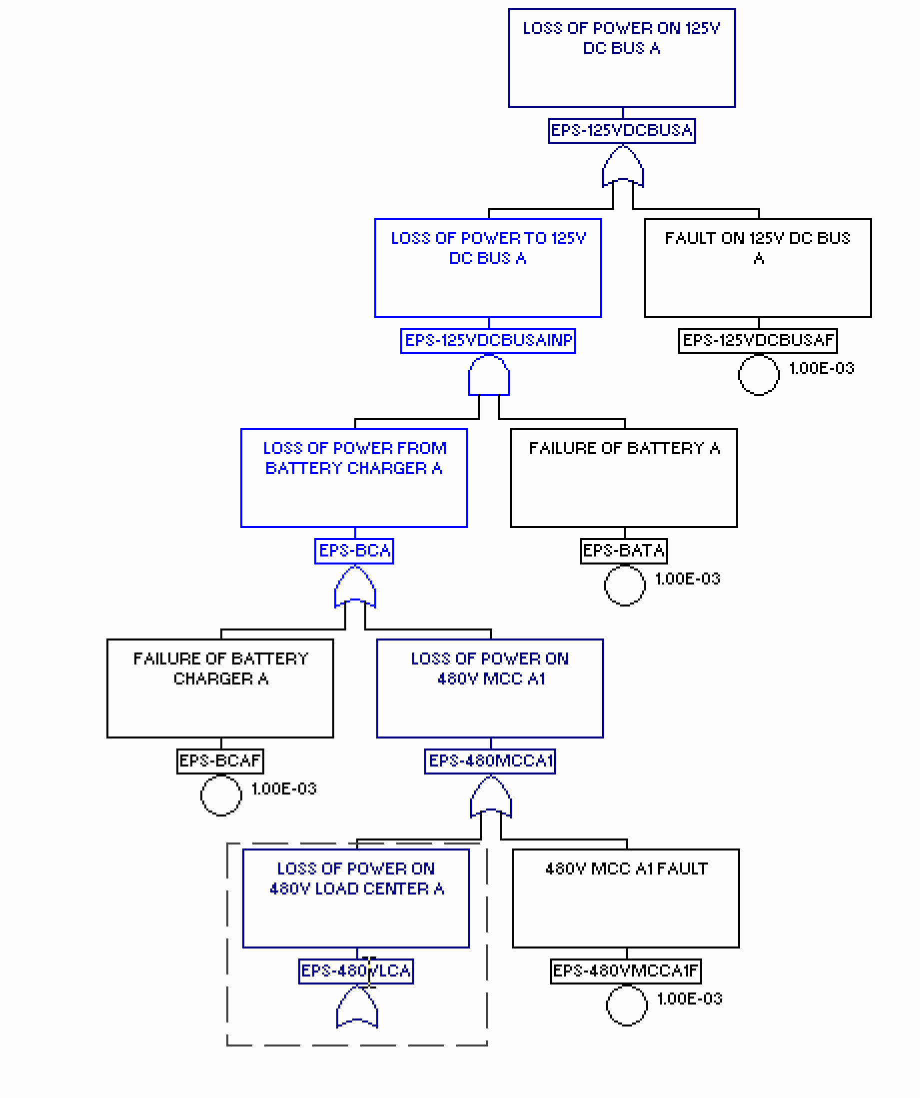


Figure 37: Gate EPS-125VDBUSA

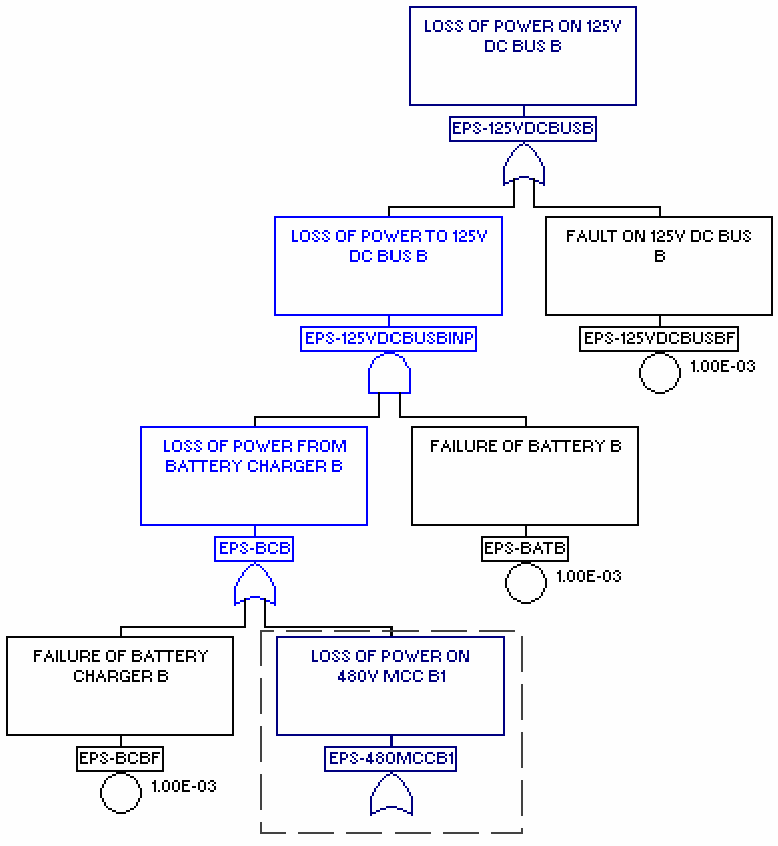


Figure 38: Gate EPS-125VDBUSB

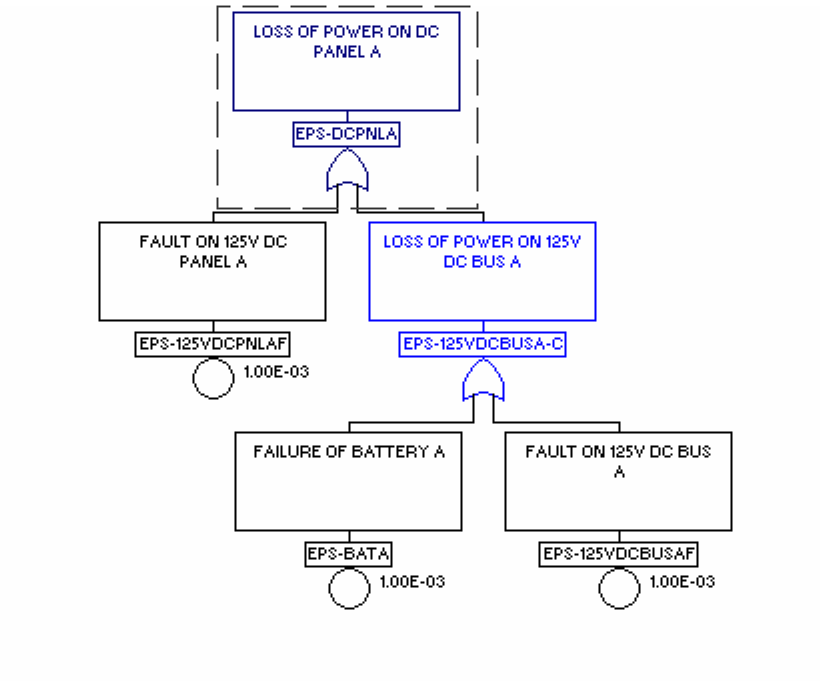


Figure 39: Gate EPS-DCPNLA

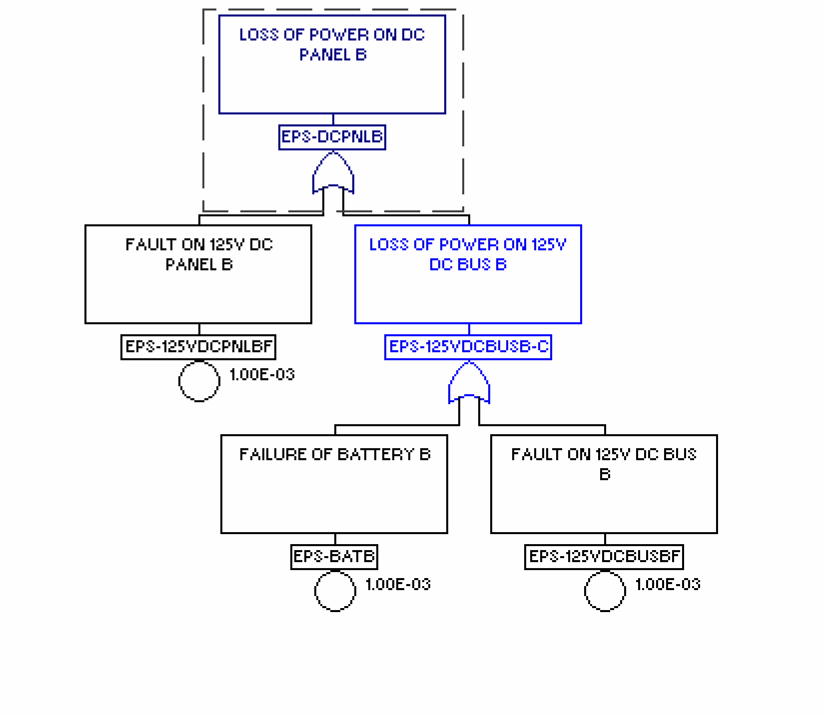
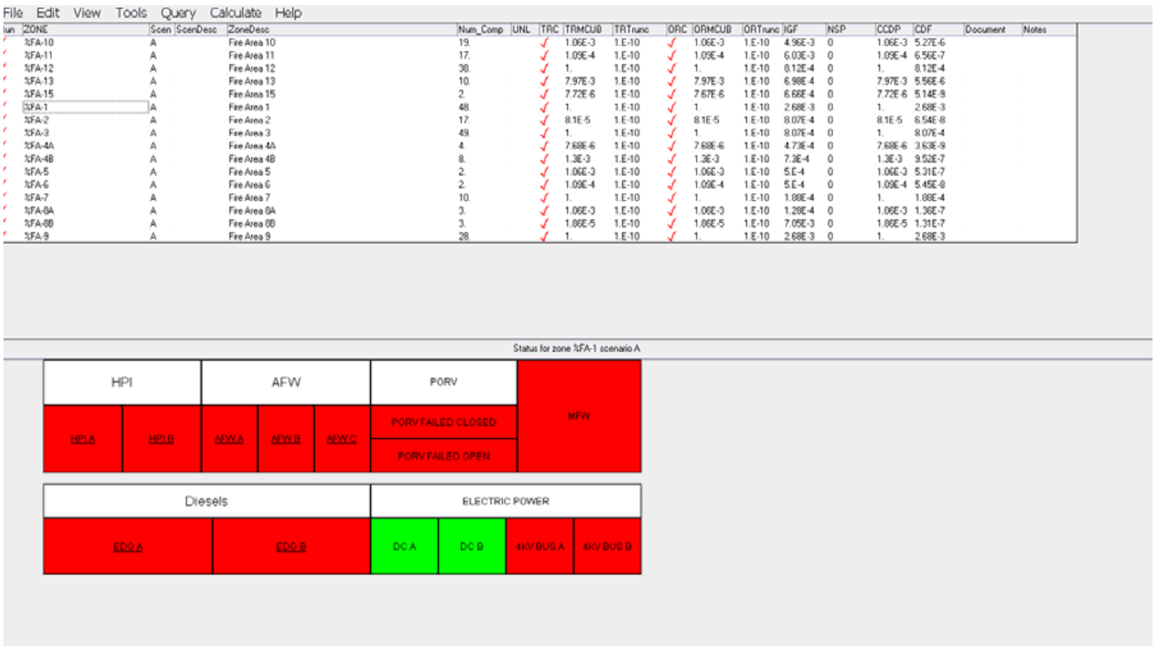


Figure 40: Gate EPS-DCPNLB

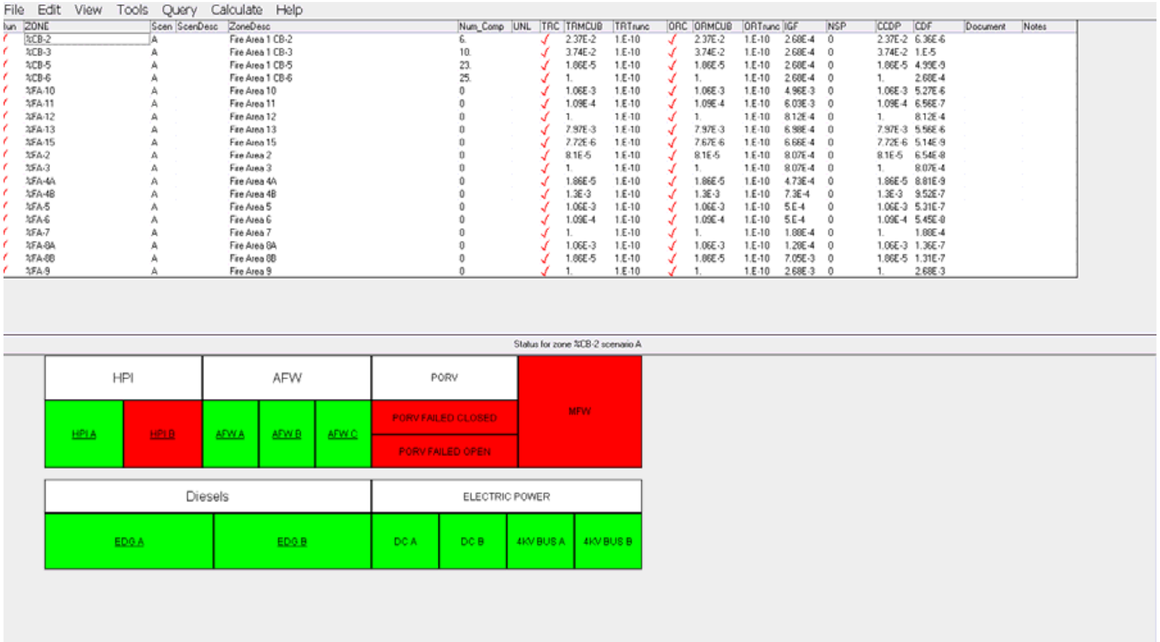
TASK 7 – DEMONSTRATION

METHOD 1 – BASIC EVENTS SET TO "TRUE" OR "ONE"



lun	ZONE	Scen	ScenDesc	ZoneDesc	Num_Comp	UNL	TRC	TRMCUB	TRTrunc	ORC	ORMCUB	ORTrunc	IGF	NSP	CCDP	CDF	Document	Notes
✓	%FA-10	A		Fire Area 10	19.		✓	1.06E-3	1.E-10	✓	1.06E-3	1.E-10	4.96E-3	0	1.06E-3	5.27E-6		
✓	%FA-11	A		Fire Area 11	17.		✓	1.09E-4	1.E-10	✓	1.09E-4	1.E-10	6.03E-3	0	1.09E-4	6.56E-7		
✓	%FA-12	A		Fire Area 12	30.		✓	1.	1.E-10	✓	1.	1.E-10	8.12E-4	0	1.	8.12E-4		
✓	%FA-13	A		Fire Area 13	10.		✓	7.97E-3	1.E-10	✓	7.97E-3	1.E-10	6.98E-4	0	7.97E-3	5.56E-6		
✓	%FA-15	A		Fire Area 15	2.		✓	7.72E-6	1.E-10	✓	7.67E-6	1.E-10	6.66E-4	0	7.72E-6	5.14E-9		
✓	%FA-1	A		Fire Area 1	48.		✓	1.	1.E-10	✓	1.	1.E-10	2.68E-3	0	1.	2.68E-3		
✓	%FA-2	A		Fire Area 2	17.		✓	8.1E-5	1.E-10	✓	8.1E-5	1.E-10	8.07E-4	0	8.1E-5	6.54E-8		
✓	%FA-3	A		Fire Area 3	49.		✓	1.	1.E-10	✓	1.	1.E-10	8.07E-4	0	1.	8.07E-4		
✓	%FA-4A	A		Fire Area 4A	4.		✓	7.68E-6	1.E-10	✓	7.68E-6	1.E-10	4.73E-4	0	7.68E-6	3.63E-9		
✓	%FA-4B	A		Fire Area 4B	8.		✓	1.3E-3	1.E-10	✓	1.3E-3	1.E-10	7.3E-4	0	1.3E-3	9.52E-7		
✓	%FA-5	A		Fire Area 5	2.		✓	1.06E-3	1.E-10	✓	1.06E-3	1.E-10	5.E-4	0	1.06E-3	5.31E-7		
✓	%FA-6	A		Fire Area 6	2.		✓	1.09E-4	1.E-10	✓	1.09E-4	1.E-10	5.E-4	0	1.09E-4	5.45E-8		
✓	%FA-7	A		Fire Area 7	10.		✓	1.	1.E-10	✓	1.	1.E-10	1.88E-4	0	1.	1.88E-4		
✓	%FA-8A	A		Fire Area 8A	3.		✓	1.06E-3	1.E-10	✓	1.06E-3	1.E-10	1.28E-4	0	1.06E-3	1.36E-7		
✓	%FA-8B	A		Fire Area 8B	3.		✓	1.86E-5	1.E-10	✓	1.86E-5	1.E-10	7.05E-3	0	1.86E-5	1.31E-7		
✓	%FA-9	A		Fire Area 9	28.		✓	1.	1.E-10	✓	1.	1.E-10	2.68E-3	0	1.	2.68E-3		

Figure 1: BEFORE CONTROL ROOM MODELING (METHOD 1)



Run	ZONE	Scen	ScenDesc	ZoneDesc	Num_Comp	UNL	TRC	TRMCUB	TRTrunc	ORC	ORMCUB	ORTrunc	IGF	NSP	CCDP	CDF	Document	Notes
✓	%CB-2	A		Fire Area 1 CB-2	6.		✓	2.37E-2	1.E-10	✓	2.37E-2	1.E-10	2.68E-4	0	2.37E-2	6.36E-6		
✓	%CB-3	A		Fire Area 1 CB-3	10.		✓	3.74E-2	1.E-10	✓	3.74E-2	1.E-10	2.68E-4	0	3.74E-2	1.E-5		
✓	%CB-5	A		Fire Area 1 CB-5	23.		✓	1.86E-5	1.E-10	✓	1.86E-5	1.E-10	2.68E-4	0	1.86E-5	4.99E-9		
✓	%CB-6	A		Fire Area 1 CB-6	25.		✓	1.	1.E-10	✓	1.	1.E-10	2.68E-4	0	1.	2.68E-4		
✓	%FA-10	A		Fire Area 10	0		✓	1.06E-3	1.E-10	✓	1.06E-3	1.E-10	4.96E-3	0	1.06E-3	5.27E-6		
✓	%FA-11	A		Fire Area 11	0		✓	1.09E-4	1.E-10	✓	1.09E-4	1.E-10	6.03E-3	0	1.09E-4	6.56E-7		
✓	%FA-12	A		Fire Area 12	0		✓	1.	1.E-10	✓	1.	1.E-10	8.12E-4	0	1.	8.12E-4		
✓	%FA-13	A		Fire Area 13	0		✓	7.97E-3	1.E-10	✓	7.97E-3	1.E-10	6.98E-4	0	7.97E-3	5.56E-6		
✓	%FA-15	A		Fire Area 15	0		✓	7.72E-6	1.E-10	✓	7.67E-6	1.E-10	6.66E-4	0	7.72E-6	5.14E-9		
✓	%FA-2	A		Fire Area 2	0		✓	8.1E-5	1.E-10	✓	8.1E-5	1.E-10	8.07E-4	0	8.1E-5	6.54E-8		
✓	%FA-3	A		Fire Area 3	0		✓	1.	1.E-10	✓	1.	1.E-10	8.07E-4	0	1.	8.07E-4		
✓	%FA-4A	A		Fire Area 4A	0		✓	1.86E-5	1.E-10	✓	1.86E-5	1.E-10	4.73E-4	0	1.86E-5	8.81E-9		
✓	%FA-4B	A		Fire Area 4B	0		✓	1.3E-3	1.E-10	✓	1.3E-3	1.E-10	7.3E-4	0	1.3E-3	9.52E-7		
✓	%FA-5	A		Fire Area 5	0		✓	1.06E-3	1.E-10	✓	1.06E-3	1.E-10	5.E-4	0	1.06E-3	5.31E-7		
✓	%FA-6	A		Fire Area 6	0		✓	1.09E-4	1.E-10	✓	1.09E-4	1.E-10	5.E-4	0	1.09E-4	5.45E-8		
✓	%FA-7	A		Fire Area 7	0		✓	1.	1.E-10	✓	1.	1.E-10	1.88E-4	0	1.	1.88E-4		
✓	%FA-8A	A		Fire Area 8A	0		✓	1.06E-3	1.E-10	✓	1.06E-3	1.E-10	1.28E-4	0	1.06E-3	1.36E-7		
✓	%FA-8B	A		Fire Area 8B	0		✓	1.86E-5	1.E-10	✓	1.86E-5	1.E-10	7.05E-3	0	1.86E-5	1.31E-7		
✓	%FA-9	A		Fire Area 9	0		✓	1.	1.E-10	✓	1.	1.E-10	2.68E-3	0	1.	2.68E-3		

Figure 2: AFTER CONTROL ROOM MODELING (METHOD 1)

METHOD 2 – FIRE INITIATING EVENTS INSERTED IN FAUL TREE LOGIC

Table 1: BEORE CONTROL ROOM MODELING (METHOD 2)				
CDF = 9.15E-03				
#	**Cutset Prob**	**Event Prob**	**Event**	**Description**
1	4.19E-03	4.19E-03	%FA-9	Fire Area 9
2	2.68E-03	2.68E-03	%FA-1	Fire Area 1
3	8.12E-04	8.12E-04	%FA-12	Fire Area 12
4	8.07E-04	8.07E-04	%FA-3	Fire Area 3
5	4.73E-04	4.73E-04	%FA-4A	Fire Area 4A
6	1.88E-04	1.88E-04	%FA-7	Fire Area 7
7	4.96E-06	4.96E-03	%FA-10	Fire Area 10
		1.00E-03	AOV-1_TO	AOV-1 transfers open
8	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	AOV-3_FTC	AOV-3 FAILS TO CLOSE
9	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-125VDCBUSAF	FAULT ON 125V DC BUS A
10	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-125VDCBUSBF	FAULT ON 125V DC BUS B
11	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-125VDCPNLAF	FAULT ON 125V DC PANEL A
12	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-125VDCPNLBF	FAULT ON 125V DC PANEL B
13	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-480VLCAF	480V LOAD CENTER A FAULT
14	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-480VLCAXTF	480V LOAD CENTER A TRANSFORMER FAILS
15	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-480VLCBF	480V LOAD CENTER B FAULT
16	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-480VLCBXTF	480V LOAD CENTER B TRANSFORMER FAILS
17	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-480VMCCA1F	480V MCC A1 FAULT
18	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-480VMCCB1F	480V MCC B1 FAULT
19	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING

Table 1: BEORE CONTROL ROOM MODELING (METHOD 2)				
CDF = 9.15E-03				
#	**Cutset Prob**	**Event Prob**	**Event**	**Description**
		1.00E-03	EPS-4VBUSAF	4KV BUS A FAULT
20	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-4VBUSBF	4KV BUS B FAULT

Table 2: AFTER CONTROL ROOM MODELING (METHOD 2)				
CDF = 6.78E-03				
#	**Cutset Prob**	**Event Prob**	**Event**	**Description**
1	4.19E-03	4.19E-03	%FA-9	Fire Area 9
2	8.12E-04	8.12E-04	%FA-12	Fire Area 12
3	8.07E-04	8.07E-04	%FA-3	Fire Area 3
4	4.73E-04	4.73E-04	%FA-4A	Fire Area 4A
5	2.68E-04	2.68E-04	%CB-6	Fire Area 1 - CB-6
6	1.88E-04	1.88E-04	%FA-7	Fire Area 7
7	4.96E-06	4.96E-03	%FA-10	Fire Area 10
		1.00E-03	AOV-1_TO	AOV-1 transfers open
8	2.14E-06	2.68E-04	%CB-3	Fire Area 1 - CB-3
		8.00E-03	OPER-4	Operator fails to establish feed an bleed cooling
9	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	AOV-3_FTC	AOV-3 FAILS TO CLOSE
10	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-125VDCBUSAF	FAULT ON 125V DC BUS A
11	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-125VDCBUSBF	FAULT ON 125V DC BUS B
12	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-125VDCPNLAF	FAULT ON 125V DC PANEL A
13	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-125VDCPNLBF	FAULT ON 125V DC PANEL B
14	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-480VLCAF	480V LOAD CENTER A FAULT
15	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-480VLCAXTF	480V LOAD CENTER A TRANSFORMER FAILS
16	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-480VLCBF	480V LOAD CENTER B FAULT
17	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-480VLCBXTF	480V LOAD CENTER B TRANSFORMER FAILS
18	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-480VMCCA1F	480V MCC A1 FAULT
19	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-480VMCCB1F	480V MCC B1 FAULT
20	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV

Table 2: AFTER CONTROL ROOM MODELING (METHOD 2)				
CDF = 6.78E-03				
#	**Cutset Prob**	**Event Prob**	**Event**	**Description**
				OPENING
		1.00E-03	EPS-4VBUSAF	4KV BUS A FAULT
21	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-4VBUSBF	4KV BUS B FAULT
22	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-BATA	FAILURE OF BATTERY A
23	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	EPS-BATB	FAILURE OF BATTERY B
24	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	MOV-2_FTC	MOV-2 fails to close
25	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	MOV-3_TO	MOV-3 transfers open
26	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	MOV-4_TO	MOV-4 transfers open
27	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	MOV-5_FTC	MOV-5 fails to close
28	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	MOV-6_FTC	MOV-6 fails to close
29	1.00E-06	1.00E-03	%T25	REACTOR TRIP WITH PORV OPENING
		1.00E-03	OPER-1	Operator fails to switch over to recirculation
30	7.30E-07	7.30E-04	%FA-4B	Fire Area 4B
		1.00E-03	UATF	FAILURE OF UNIT AUXILIARY TRANSFORMER (UAT)
31	6.98E-07	6.98E-04	%FA-13	Fire Area 13
		1.00E-03	AFWB-FTR	AFWB fails to run
32	6.98E-07	6.98E-04	%FA-13	Fire Area 13
		1.00E-03	AFWB-FTS	AFWB fails to start
33	6.98E-07	6.98E-04	%FA-13	Fire Area 13
		1.00E-03	AOV-1_TO	AOV-1 transfers open
34	6.98E-07	6.98E-04	%FA-13	Fire Area 13
		1.00E-03	EPS-125VDCBUSBF	FAULT ON 125V DC BUS B
35	6.98E-07	6.98E-04	%FA-13	Fire Area 13
		1.00E-03	EPS-BATB	FAILURE OF BATTERY B
36	6.98E-07	6.98E-04	%FA-13	Fire Area 13
		1.00E-03	MOV-11_FTO	MOV-11 fails to open
37	6.98E-07	6.98E-04	%FA-13	Fire Area 13
		1.00E-03	MOV-14_FTO	MOV-14 FAILS TO OPEN

Table 2: AFTER CONTROL ROOM MODELING (METHOD 2)				
CDF = 6.78E-03				
#	**Cutset Prob**	**Event Prob**	**Event**	**Description**
38	6.98E-07	6.98E-04	%FA-13	Fire Area 13
		1.00E-03	MOV-15_FTO	MOV-15 FAILS TO OPEN
39	5.00E-07	5.00E-04	%FA-5	Fire Area 5
		1.00E-03	AOV-1_TO	AOV-1 transfers open
40	2.68E-07	2.68E-04	%CB-2	Fire Area 1 - CB-2
		1.00E-03	AOV-3_FTC	AOV-3 FAILS TO CLOSE
41	2.68E-07	2.68E-04	%CB-2	Fire Area 1 - CB-2
		1.00E-03	EPS-125VDCBUSAF	FAULT ON 125V DC BUS A
42	2.68E-07	2.68E-04	%CB-2	Fire Area 1 - CB-2
		1.00E-03	EPS-125VDCBUSBF	FAULT ON 125V DC BUS B
43	2.68E-07	2.68E-04	%CB-2	Fire Area 1 - CB-2
		1.00E-03	EPS-125VDCPNLAF	FAULT ON 125V DC PANEL A
44	2.68E-07	2.68E-04	%CB-2	Fire Area 1 - CB-2
		1.00E-03	EPS-125VDCPNLBF	FAULT ON 125V DC PANEL B
45	2.68E-07	2.68E-04	%CB-2	Fire Area 1 - CB-2
		1.00E-03	EPS-480VLCAF	480V LOAD CENTER A FAULT
46	2.68E-07	2.68E-04	%CB-2	Fire Area 1 - CB-2
		1.00E-03	EPS-480VLCAXTF	480V LOAD CENTER A TRANSFORMER FAILS
47	2.68E-07	2.68E-04	%CB-2	Fire Area 1 - CB-2
		1.00E-03	EPS-480VLCBF	480V LOAD CENTER B FAULT
48	2.68E-07	2.68E-04	%CB-2	Fire Area 1 - CB-2
		1.00E-03	EPS-480VLCBXTF	480V LOAD CENTER B TRANSFORMER FAILS
49	2.68E-07	2.68E-04	%CB-2	Fire Area 1 - CB-2
		1.00E-03	EPS-480VMCCA1F	480V MCC A1 FAULT
50	2.68E-07	2.68E-04	%CB-2	Fire Area 1 - CB-2
		1.00E-03	EPS-480VMCCB1F	480V MCC B1 FAULT
1	4.19E-03	4.19E-03	%FA-9	Fire Area 9
2	8.12E-04	8.12E-04	%FA-12	Fire Area 12
3	8.07E-04	8.07E-04	%FA-3	Fire Area 3
4	4.73E-04	4.73E-04	%FA-4A	Fire Area 4A

SAPPHIRE DEMO FOR SIMPLIFIED FIRE PRA MODEL

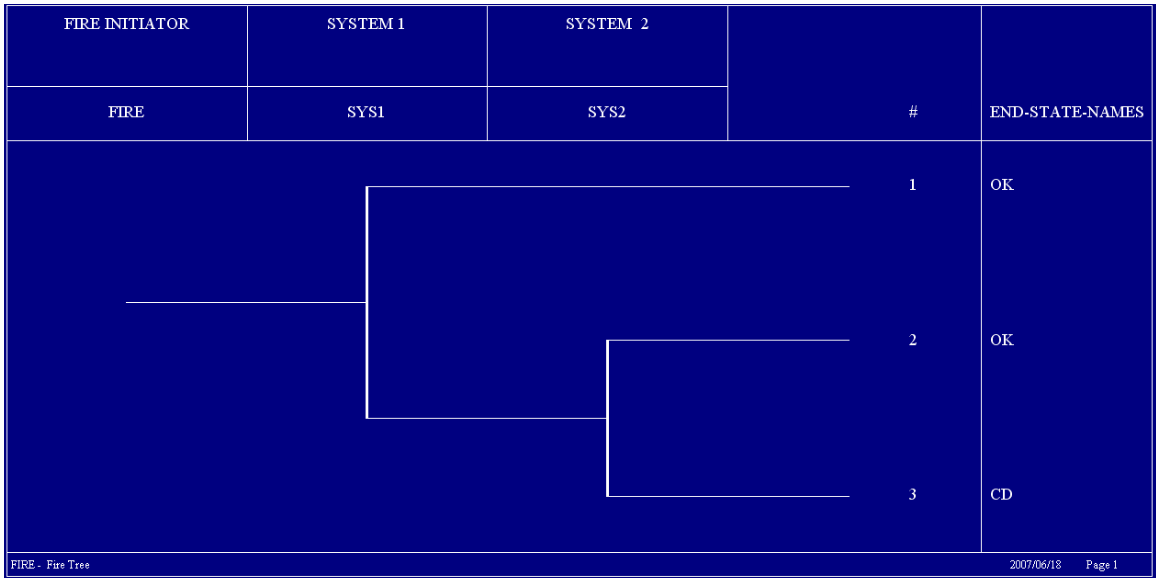


Figure 1: Simplified Fire PRA Event Tree

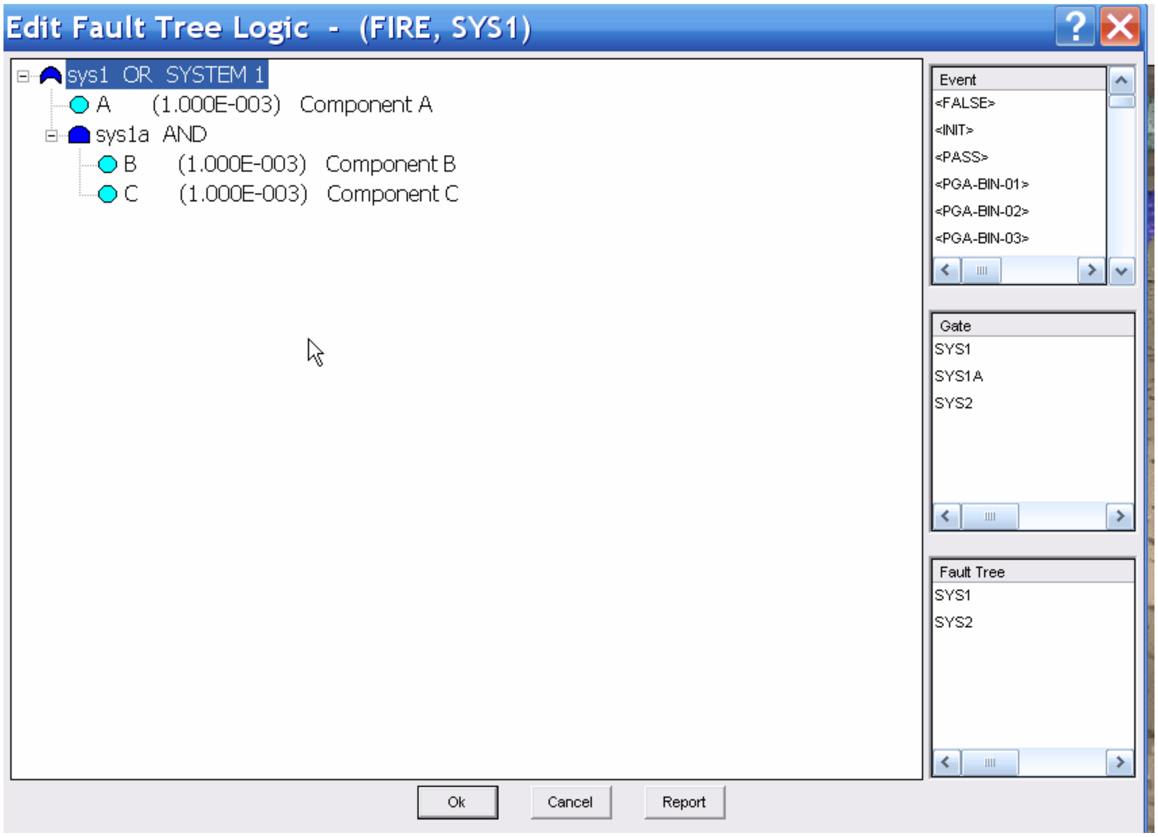


Figure 2: System 1 Fault Tree

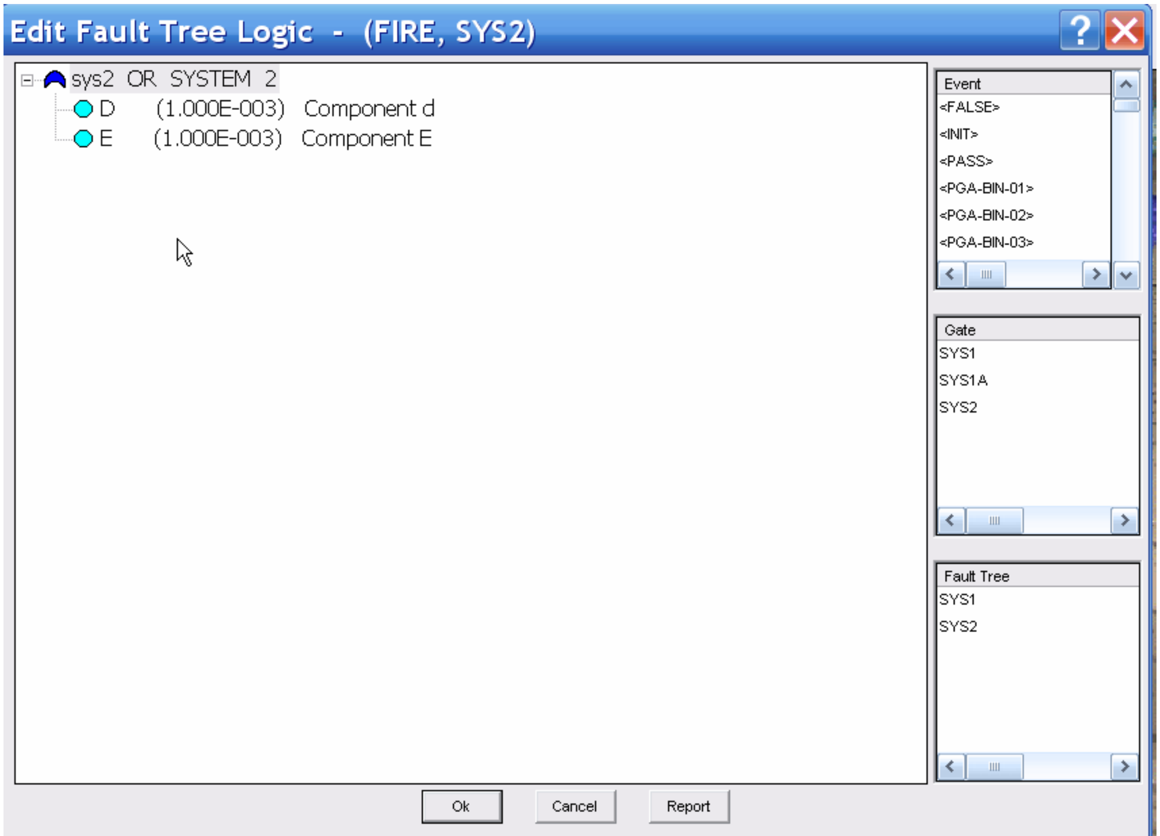


Figure 3: System 2 Fault Tree

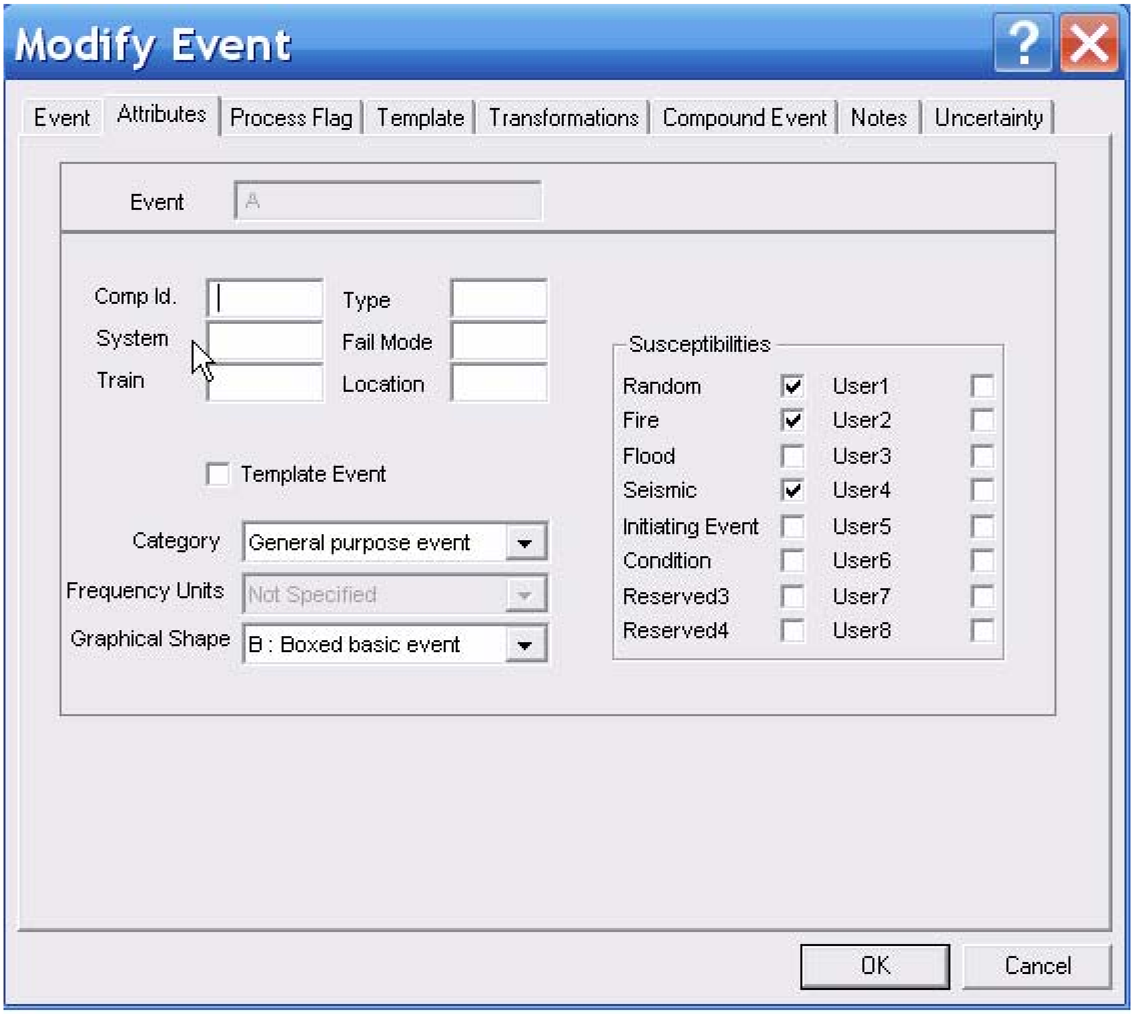


Figure 4: Basic Event A Attributes

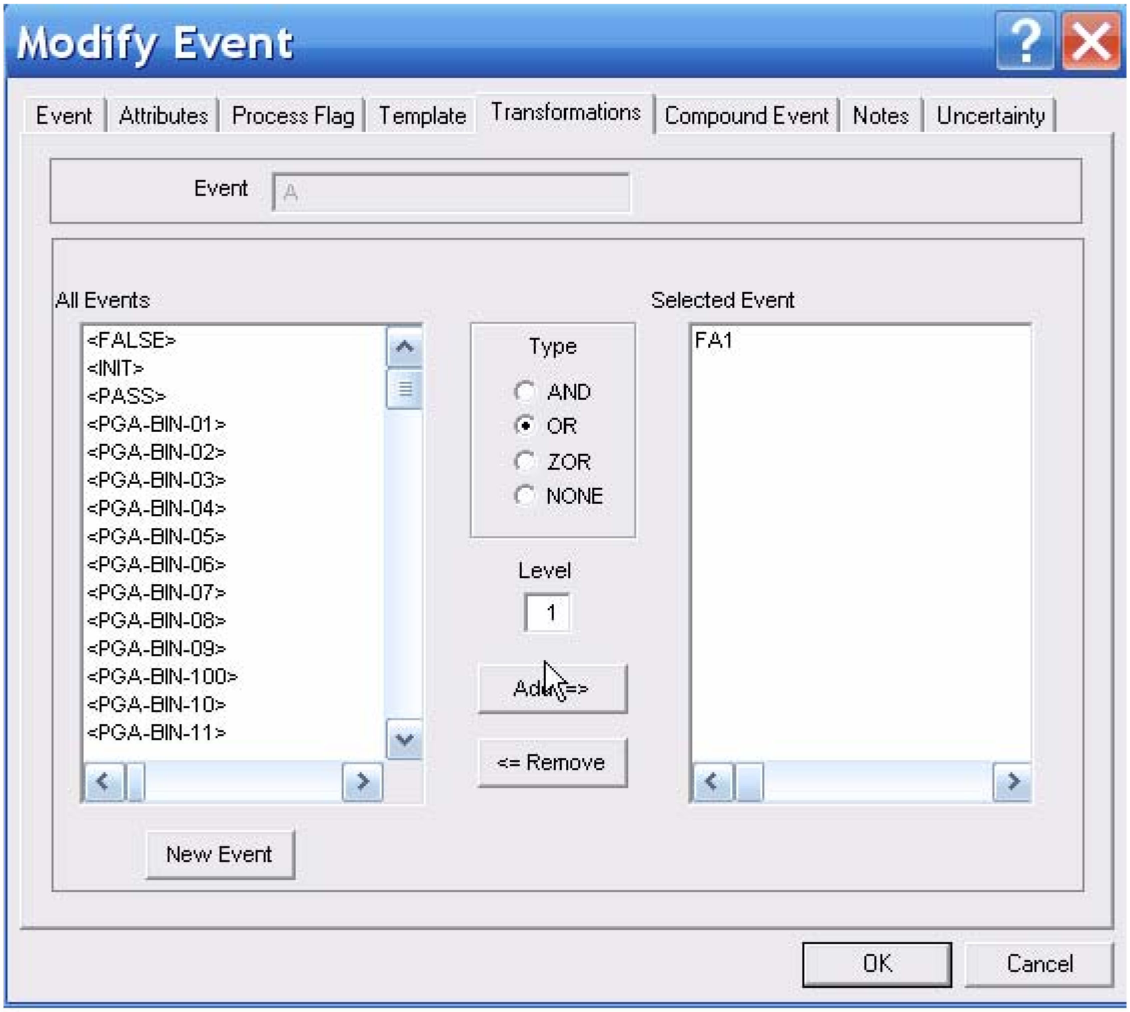


Figure 5: Basic Event A Transformation Mapping

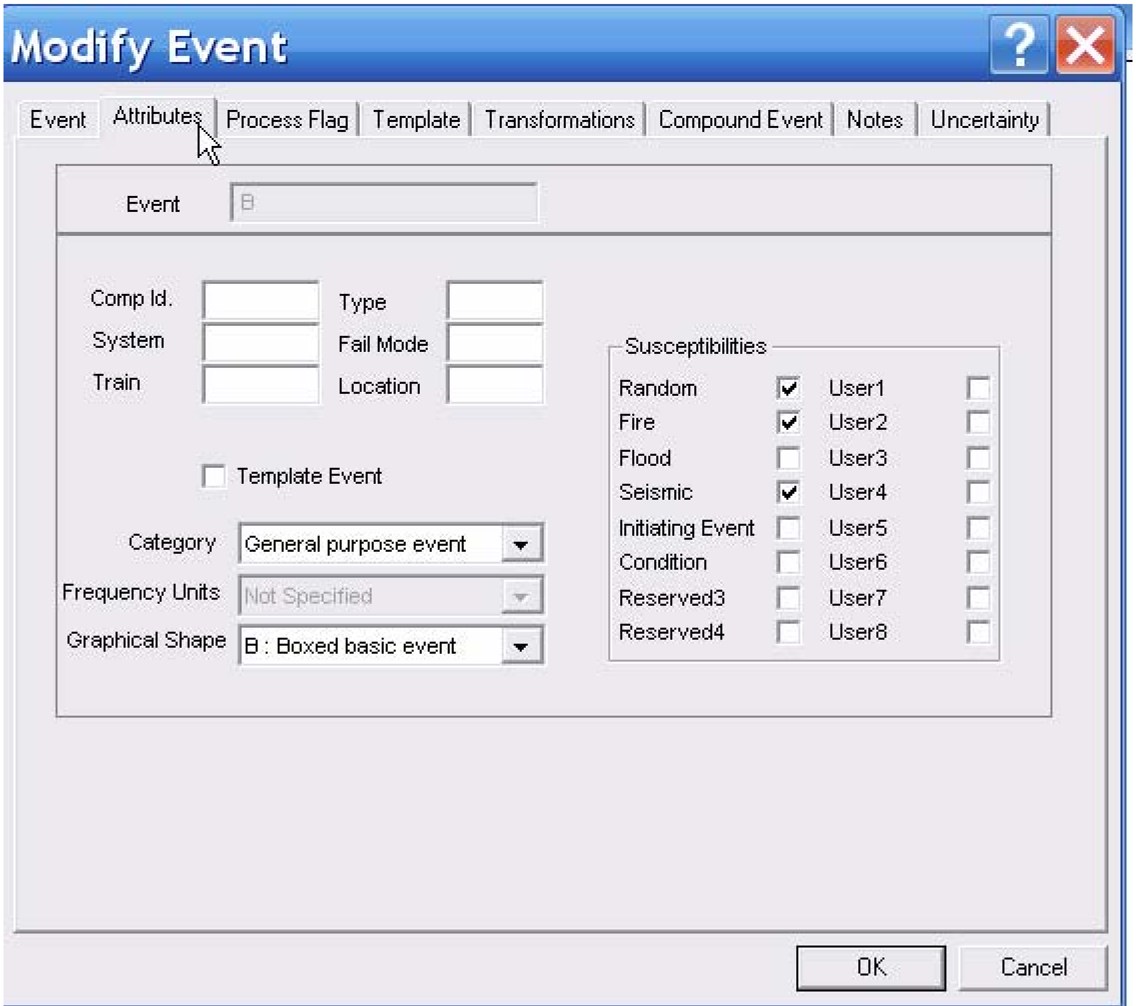


Figure 6: Basic Event B Attributes

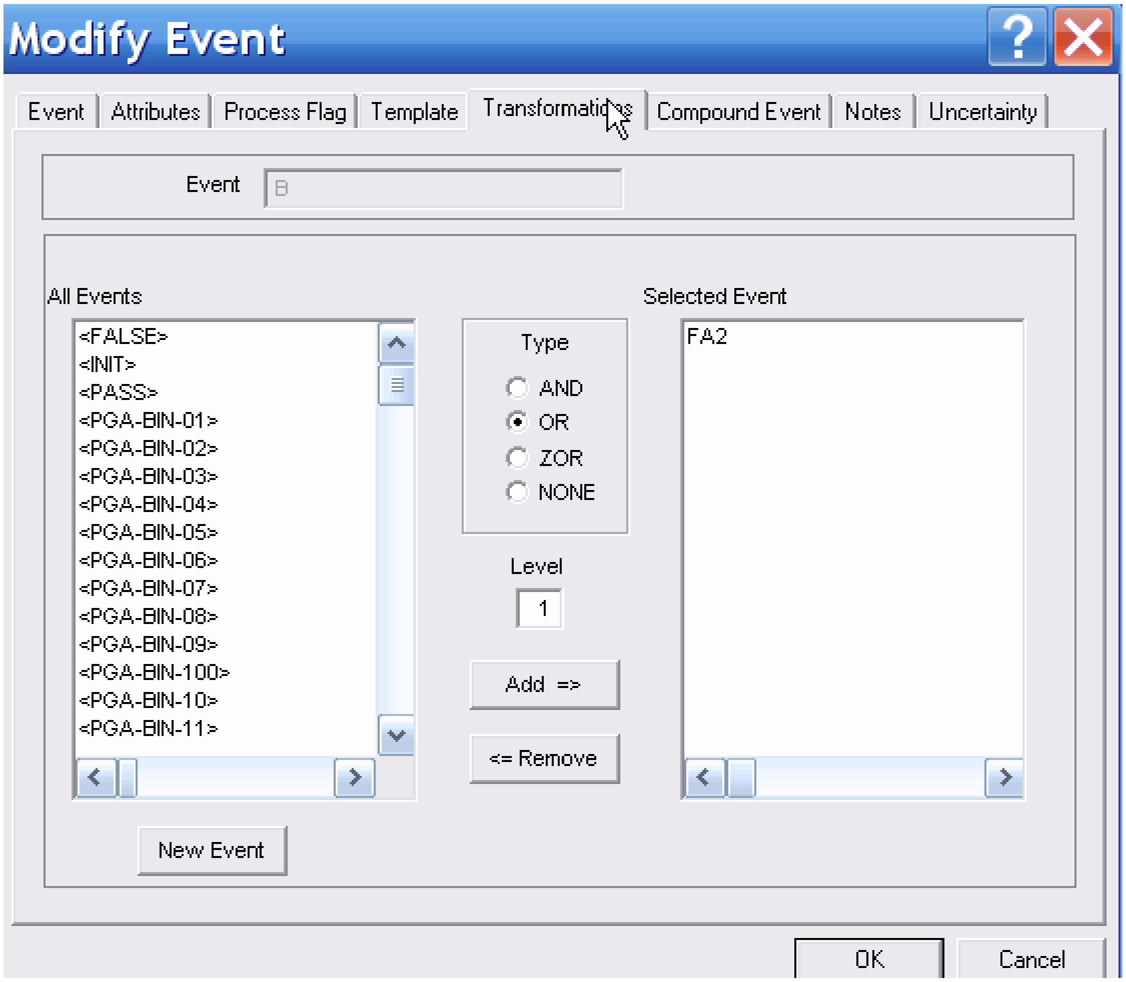


Figure 7: Basic Event B Transformation Mapping

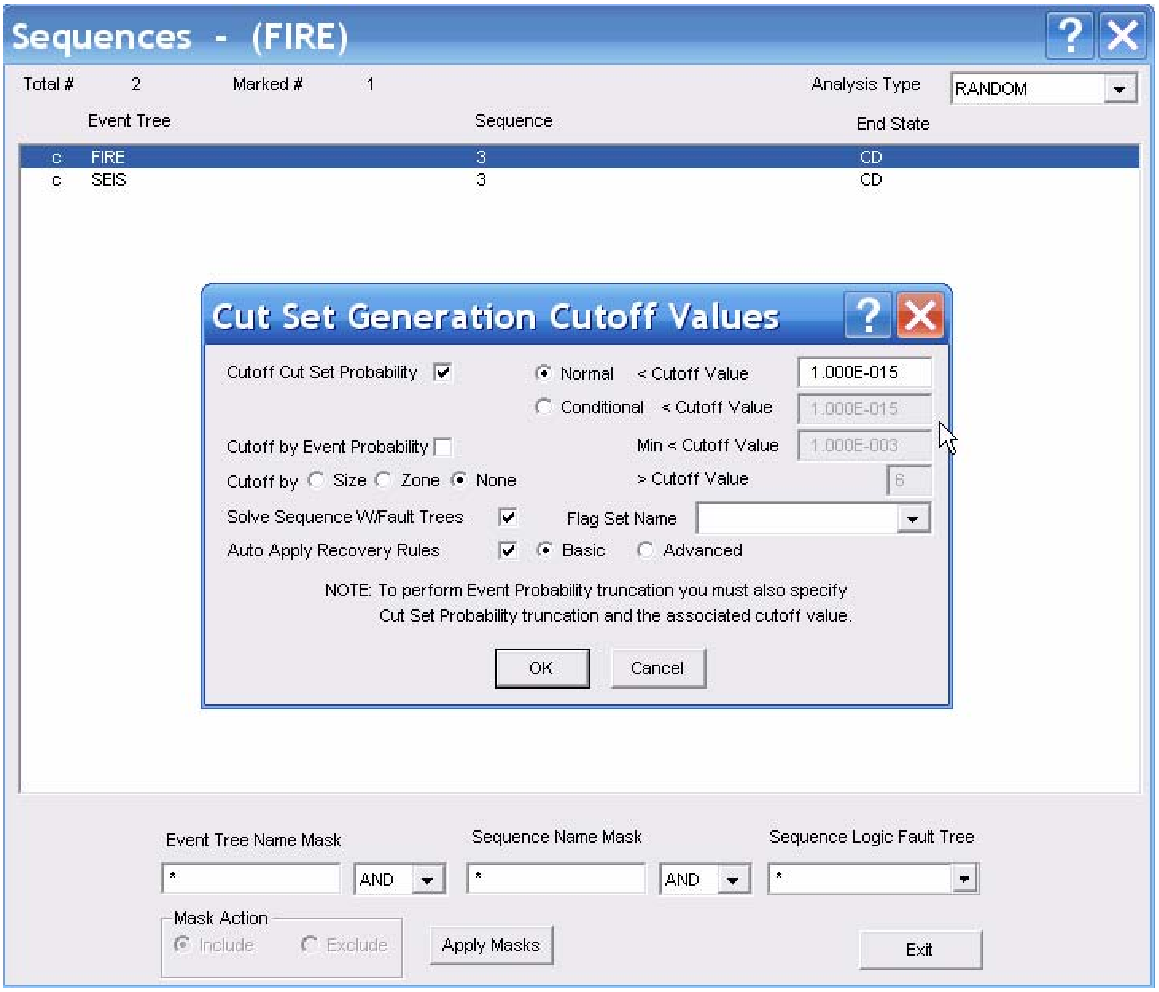


Figure 8: Quantification Specifications for Random Basic Events Only

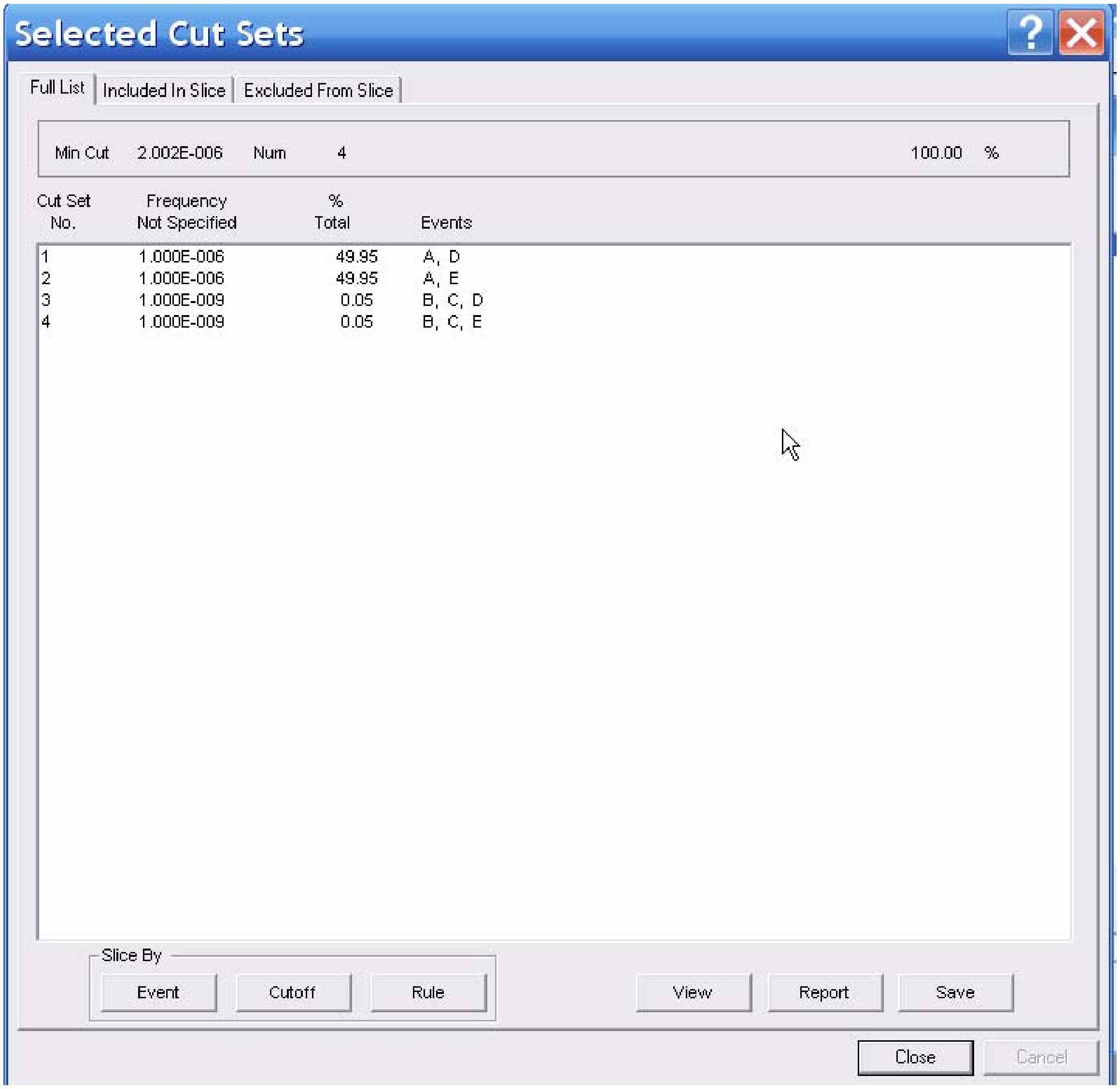


Figure 9: Cutsets for Random Events Only

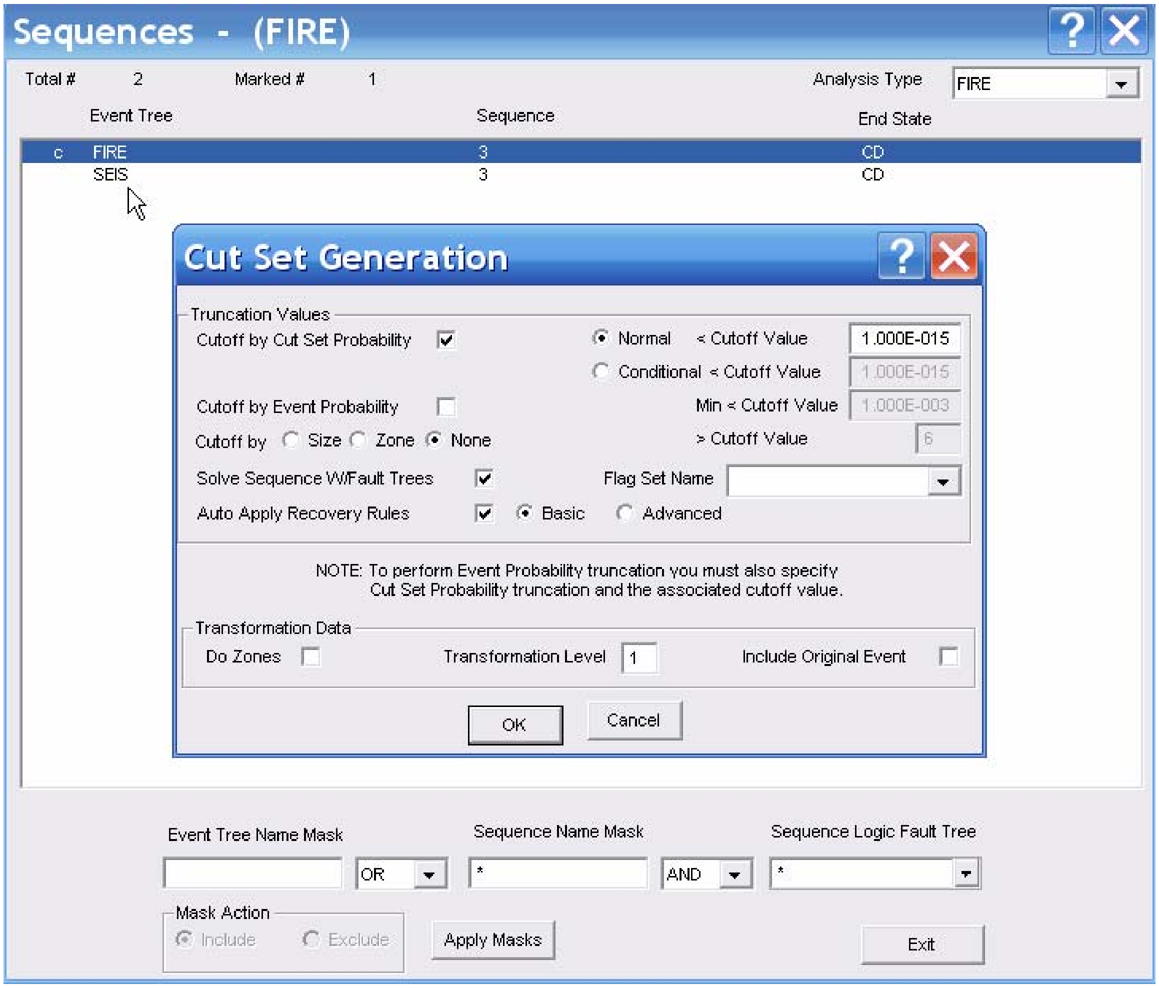


Figure 10:Quantification Specifications for Fire

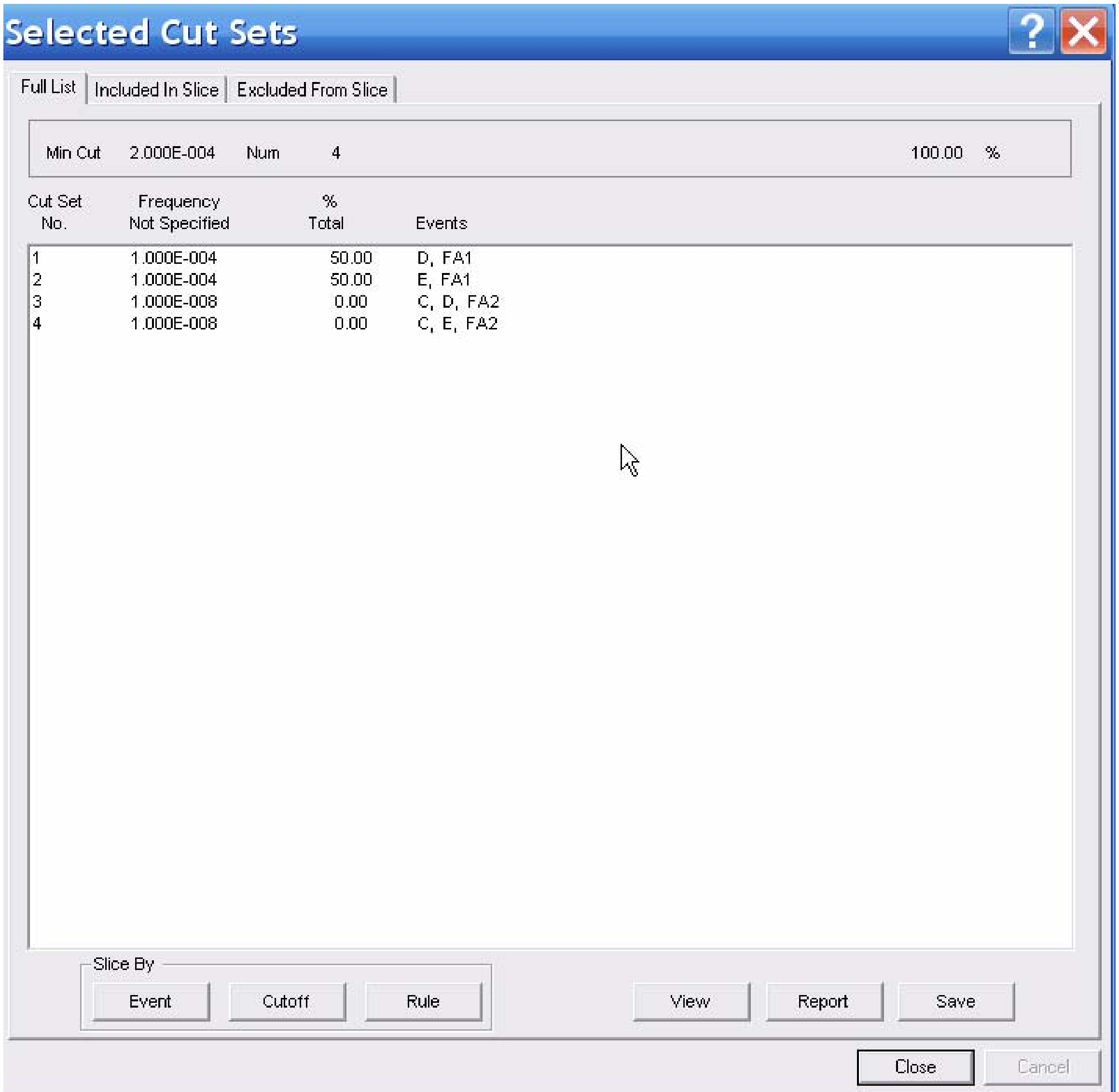
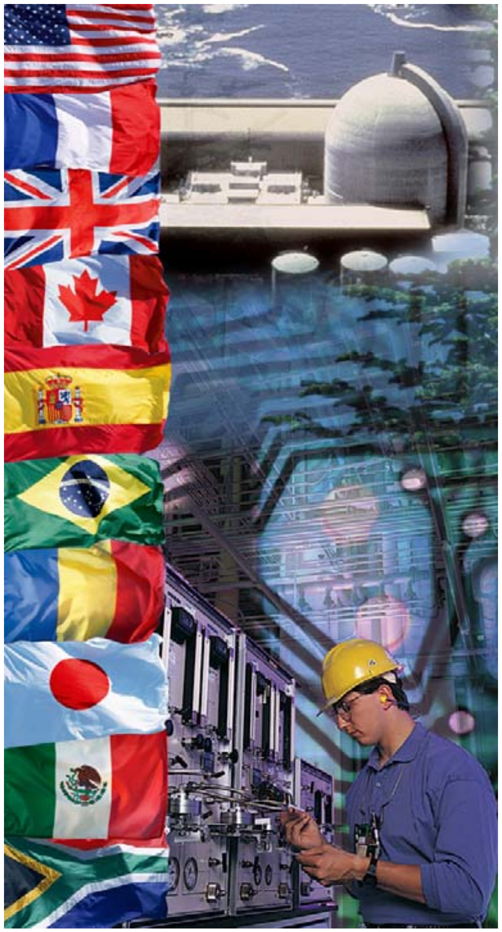


Figure 11: Cutsets for Fire



EPRI/NRC-RES FIRE PRA METHODOLOGY

Task 12b – Post-Fire HRA Detailed Analysis

Joint RES/EPRI Fire PRA Workshop
2007
Palo Alto, CA

A Collaboration of U.S. NRC Office of Nuclear Regulatory Research (RES) & Electric Power Research Institute (EPRI)

Post-Fire HRA Detailed Analysis
Scope

- Task 12b: Post-Fire Human Reliability Analysis (Detailed Analysis)
  - Obtaining more realistic human error probabilities (i.e., not screening values)

Task 12b: Post-Fire HRA Detailed Analysis
General Objectives

Purpose: assign best-estimate HEPs to allow more realistic estimate of fire risk.

- Current procedures do not specify an HRA method to use
  - There are too many methods analysts might use (THERP, ASEP, CBDT…) and each is unique in what it treats and how to determine HEPs
  - Hence, procedure outlines what should be addressed but not how to specifically incorporate into existing HRA methods because there are too many of them
- Addresses fire-scenario-induced changes in assumptions, model structure, and performance shaping factors
- Addresses need to use procedures (e.g., FEPs) beyond those modeled in the Internal Events PRA

Task 12b: Post-Fire HRA Detailed Analysis
Inputs/Outputs

Task inputs and outputs:

- Inputs from other tasks: feedback from Task 7 (Quantitative Screening) identifying HFEs needing detailed analysis

- Outputs to other tasks: best-estimate HEPs for Task 14 (Fire Risk Quantification)

Task 12b: Post-Fire HRA Detailed Analysis
ASME PRA Standard & Possible Team Addition

- Overall approach is not new
  - Continue to follow the basic HRA approach addressed in ASME PRA Standard as it will be referenced in the ANS Fire PRA Std.

- Recommends individual with experience in human behavior during fires (firefighter trainers, etc.) be involved in quantification IF useful for safe shutdown considerations (e.g., for local actions)
  - But need to recognize the difference between operator safe shutdown actions generally in the MCR vs. fire-fighting actions in the vicinity of the fire

Task 12b: Post-Fire HRA Detailed Analysis
PSFs and Fire Effects to Consider

Guidance focuses on identification of fire-relevant performance shaping factors (PSFs) and potential interactions among the PSFs (fire conditions could make PSFs different than those for internal events):

- Available staffing resources
  - Fire situation may need more staffing than responding to an internal event
  - "Nominal" staffing for internal event could be less than adequate for fire
- Applicability and suitability of training/experience
  - Extent of familiarity/training may be less for fire than for internal events for both in-MCR and local actions

more…

Task 12b: Post-Fire HRA Detailed Analysis
PSFs and Fire Effects to Consider

- Suitability of relevant procedures and administrative controls
  - Fires may require multiple procedures be used at the same time (e.g., EOPs and Fire Procedures) that may be more burdensome and together take more time to implement
  - There may be less detailed or no procedures available for some actions (e.g., local action steps are not spelled out but require more skill-of-the-craft or memory)

- Availability and clarity of instrumentation
  - Possibility of spurious or failed indications more likely for fires than for internal events

Task 12b: Post-Fire HRA Detailed Analysis
PSFs and Fire Effects to Consider

- Time available and needed to complete action, including impact of concurrent and competing activities
  - Timing of scenario could be different from comparable internal events scenario due to spurious events and introduction of new/different procedures and actions
  - Actions themselves may have different execution times (e.g., have to disable before reposition, may require more sequencing of actions, etc.)
- Environment in which action is to be performed
  - Fires can introduce new considerations (smoke, heat, chemicals, toxic gases…)
- Accessibility and operability of equipment
  - Fires can eliminate or delay the ability to take actions due to accessibility or damage considerations

Task 12b: Post-Fire HRA Detailed Analysis
PSFs and Fire Effects to Consider

- Need for special tools and clothing
  - Fires may increase these requirements (e.g., breathing gear, protective clothing, ladders, keys…)
  - Need to ensure access to these, and consider potential increase in execution of similar actions than that estimated for internal events
- Communications
  - Could be greater demand and potential need for different form (e.g., runners)
- Team/crew dynamics and crew characteristics
  - Potential for different roles/responsibilities, less frequent or different timing of plant status checks (could affect recoveries), etc.
- Special fitness needs
  - Ensure no new fitness needs required (especially for local actions)

Task 12b: Post-Fire HRA Detailed Analysis
MCR Abandonment

Should consider as part of the PSF evaluations:

- Procedural/training approach and explicitness/clarity of criteria for abandoning MCR
  - Could be confusion about need to evacuate MCR
  - Impact of crew reluctance to abandon MCR
  - Timeliness of decision and problems associated with delays in abandoning MCR
  - Inappropriate abandonment of MCR (e.g., premature or less viable option)

Task 12b: Post-Fire HRA Detailed Analysis
MCR Abandonment (cont'd)

- Effects of crew no longer having access to complete MCR indications and the information they provide
- Number and complexity of actions to shift control and carry out subsequent activities
- Number of different locations to be visited
- Extent to which multiple actions need to be coordinated or sequentially performed
- Ability to communicate between different locations
- Need to wear breathing apparatus or special clothing
- Adequacy of human-machine interface at remote shutdown and local panels

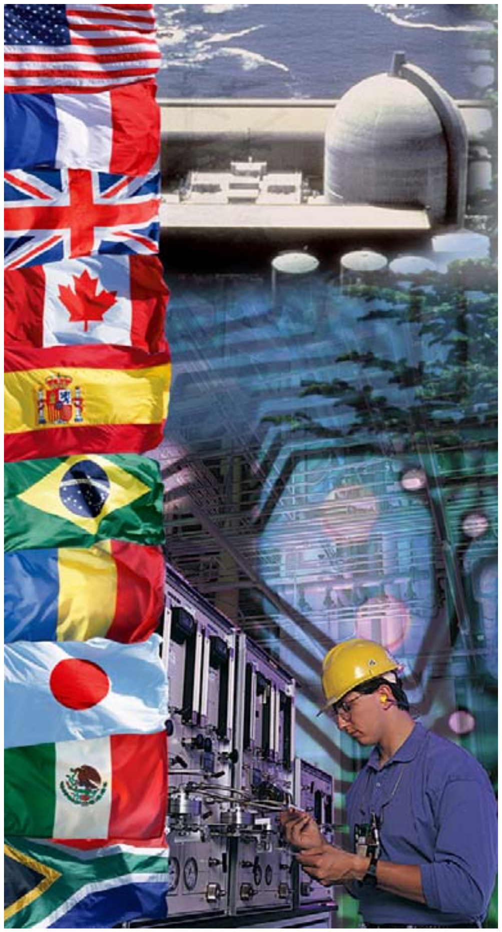
Task 12b: Post-Fire HRA Detailed Analysis
Cases Where Little or No Credit Should be Allowed

- Tasks needing significant interaction/communication between individuals wearing SCBAs unless can be justified as not a problem
- Fire causes numerous spurious actuations (or stops) of equipment including instruments
- Actions performed in fire areas or requiring travel through fire areas
- Actions requiring use of damaged equipment
- Actions without procedural direction or training, lacking necessary tools, or with inadequate time available

Task 12b: Post-Fire HRA Detailed Analysis
Documentation

Product of this task is a calculation package, which should contain (per the ANS Fire PRA Std. that will incorporate by reference the ASME PRA Std.):

- All human actions and HFEs considered, including descriptions in context of fire scenarios
- Quantification approach and method/tools used
- HEP results and bases for HEP calculations, including dependencies, PSFs, and uncertainty
- Important sensitivities



EPRI/NRC-RES FIRE PRA METHODOLOGY

Task 14 – Fire Risk Quantification

Joint RES/EPRI Fire PRA Workshop
2007
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A Collaboration of U.S. NRC Office of Nuclear Regulatory Research (RES) & Electric Power Research Institute (EPRI)

Fire Risk Quantification
Scope

- Task 14: Fire Risk Quantification
  - Obtaining best-estimate quantification of fire risk

Task 14: Fire Risk Quantification
General Objectives

Purpose: perform final (best-estimate) quantification of fire risk

- Calculate CDF/LERF as the primary risk metrics
- Include uncertainty analysis / sensitivity results (see Task 15)
- Identify significant contributors to fire risk
- Carry along insights from Task 13 to documentation but this is not an explicit part of "quantifying" the Fire PRA model
- Carry along residual risk from screened compartments and scenarios (Task 7); both (final fire risk and residual risk) are documented in Task 16 to provide total risk perspective

Task 14: Fire Risk Quantification
Inputs/Outputs

Task inputs:

- Inputs from other tasks:
  - Task 5 (Fire-Induced Risk Model) as modified/run thru Task 7 (Quantitative Screening),
  - Task 10 (Circuit Failure Mode Likelihood Analysis),
  - Task 11 (Detailed Fire Modeling), and
  - Task 12 (Post-Fire HRA Detailed Analysis)

Task 14: Fire Risk Quantification
Inputs/Outputs

- Output is the quantified fire risk results including the uncertainty and sensitivity analyses directed by Task 15 (Uncertainty and Sensitivity Analysis), all of which is documented per Task 16 (Fire PRA Documentation)

Task 14: Fire Risk Quantification
Steps in Procedure

Four major steps in the procedure*:

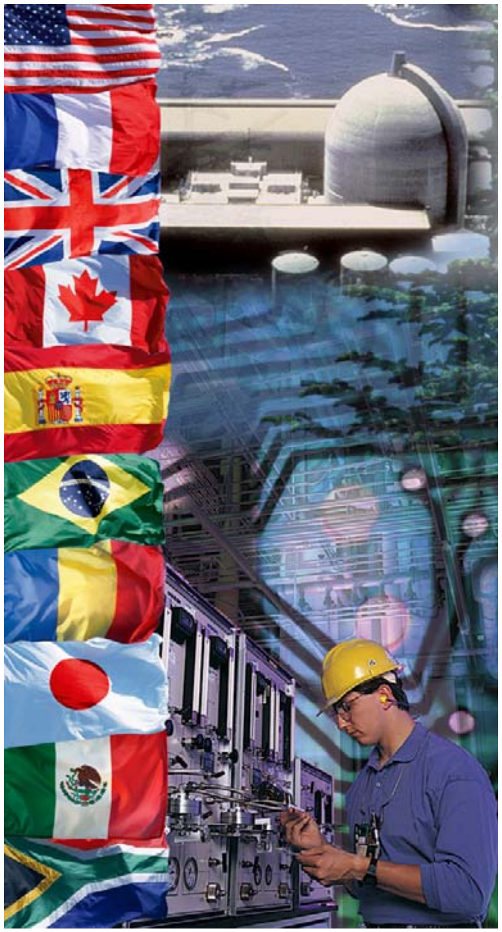
- Step 1: Quantify CDF
- Step 2: Quantify LERF
- Step 3: Perform uncertainty analyses including propagation of uncertainty bounds as directed under step 4 of Task 15
- Step 4: Perform sensitivity analyses as directed under step 4 of Task 15

* In each case, significant contributors are also identified

Task 14: Fire Risk Quantification
Quantification Process

Characteristics of the quantification process:

- Procedure is "general"; i.e., not tied to a specific method (event tree with boundary conditions, fault tree linking…)
- Can calculate CDF/LERF directly by explicitly including fire scenario frequencies or first calculate CCDP/CLERP and then combine with fire scenario frequencies
- Quantification is to be done in conformance with relevant ASME PRA Standard requirements and supporting requirements (especially sections 4.5.8 and 4.5.9) as incorporated by reference in the ANS Fire PRA Std.



EPRI/NRC-RES FIRE PRA METHODOLOGY

Task 15 - Uncertainty and Sensitivity Analysis

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A Collaboration of U.S. NRC Office of Nuclear Regulatory Research (RES) & Electric Power Research Institute (EPRI)

Uncertainty and Sensitivity Analysis
Scope

Task 15 covers uncertainty and sensitivity analyses

- Identify range of possible result values
- Identify parameters that had the strongest influence on the final results
- Fire risk can be quantified without explicit quantification of uncertainties, but the risk results cannot be considered as complete without it
- Sensitivity analysis provides an added perspective beyond the largest contributors to risk

Task 15:Uncertainty and Sensitivity Analysis
General Objectives & Inputs and Outputs

Purpose: Provide a process for identifying and treating uncertainties in the Fire PRA, and identifying sensitivity analysis cases

- Inputs from other tasks: identification of uncertainties from other tasks worthy of uncertainty/sensitivity analysis
- Outputs to other tasks: analysis results to be reflected in documentation of Fire PRA (Task 16)
- Aleatory and epistemic uncertainties
- Modeling and parameter uncertainties

Task 15:Uncertainty and Sensitivity Analysis
General Procedure

Addresses a process to be followed rather than a pre-defined list of uncertainties and sensitivity analyses, since these could be plant analysis specific

- Step 1: Identify uncertainties associated with each task
- Step 2: Develop strategies for addressing uncertainties
- Step 3: Review uncertainties to decide which uncertainties to address and how
- Step 4: Perform uncertainty and sensitivity analyses
- Step 5: Include results of uncertainty and sensitivity analyses in Fire PRA documentation

Task 15:Uncertainty and Sensitivity Analysis
Steps in Procedure/Details

See Appendix U to NUREG/CR-6850 for background on uncertainty analysis. See Appendix V for details for each task.

Step 1: Identify uncertainties for each task

- Initial assessment of uncertainties to be treated is provided in Appendix V to NUREG/CR-6850 (but consider plant specific analysis for other uncertainties such as specific assumptions…)
- From a practical standpoint, characterize uncertainties as modeling and data uncertainties
- Outcome is a list of issues, by task, leading to potentially important uncertainties (note whether modeling or data uncertainty)

Task 15:Uncertainty and Sensitivity Analysis
Steps in Procedure/Details

Step 2: Develop strategies for addressing uncertainties

- Strategy can range from no action to explicit quantitative modeling
- Each task analyst is expected to provide suggested strategies
- Possible strategies include propagation of data uncertainties, developing multiple models, addressing uncertainties qualitatively, quality review process, and basis for excluding some uncertainties
- Basis for strategy should be noted and may include importance of uncertainty on overall results, effects on future applications, resource and schedule constraints

Task 15:Uncertainty and Sensitivity Analysis
Steps in Procedure/Details

Step 3: Review uncertainties to decide which uncertainties to address and how

- Review carried out by team of analysts familiar with issues, perhaps meeting more than once

- Review has multiple objectives: (see next slide)

Task 15:Uncertainty and Sensitivity Analysis
Steps in Procedure/Details

- Review has multiple objectives:
  - Identify uncertainties that will not be addressed, and reasons why
  - Identify uncertainties to be addressed, and strategies to be used
  - Identify uncertainties to be grouped into single assessment
  - Identify issues to be treated via sensitivity analysis
  - Instructions to task analysts to perform the analyses

Task 15:Uncertainty and Sensitivity Analysis
Sensitivity Analysis

- Sensitivity analysis can provide a perspective that cannot be obtained from a review of significant risk contributors.
  - Each task analyst can provide a list of parameters that had the strongest influence in their part of the analysis
  - Experiment with modified parameter to demonstrate impact on the final risk results
  - Modeling uncertainties can be demonstrated through sensitivity analysis

Task 15:Uncertainty and Sensitivity Analysis
Steps in Procedure/Details

Step 4: Perform uncertainty and sensitivity analyses

- Following items should be made explicit:
  - Uncertainties being addressed
  - Strategy being followed
  - Specific methods, references, computer programs, etc. being used (to allow traceability)
  - Results of analyses, including conclusions relative to overall results of Fire PRA
  - Potential impacts on anticipated applications of results

Task 15:Uncertainty and Sensitivity Analysis
Steps in Procedure/Details

Step 5: Include results in PRA documentation

- Adequate documentation of uncertainties and sensitivities is as important as documentation of baseline results
- Adequate documentation leads to improved decision-making
- Documentation covered more fully under Task 16

Task 15:Uncertainty and Sensitivity Analysis *Expectations*

- Minimum set of uncertainties expected to have a formal treatment:
  - Fire PRA model structure itself, representing the uncertainty with regard to how fires could result in core damage and/or large early release outcomes (Tasks 5/7)
  - Uncertainty in each significant fire ignition frequency (Task 6)
  - Uncertainty in each significant circuit failure mode probability (Task 10)
  - Uncertainty in each significant target failure probability (Task 11)
    - Heat release rate
    - Suppression failure model and failure rate
    - Position of the target set vs. ignition sources
  - Uncertainty in each significant human error probability (Task 12)
  - Uncertainty in each sequence core damage and large early release frequency based on the above inputs as well as uncertainties for other significant equipment failures/modes (Task 14)

Task 15:Uncertainty and Sensitivity Analysis *Expectations*

- Other uncertainties may be relevant to address
- Sensitivity analyses should be performed where important to show robustness in results (i.e., demonstrate where results are / are not sensitive to reasonable changes in the inputs)
- While not really a source of uncertainty, per se, technical quality issues and recommended reviews are also addressed