

## Basis for BWR Mark I/II Core Damage Event Tree Branch Probabilities

Top Event	Description	Condition(s)	Probability	Inputs to the Assumed Failure Probability
ELAP	ELAP Condition	All	3.00E-05/yr	Reasonable estimate of average, based on SECY 12-0157. Will vary from site to site.
EARLY-RCIC	RCIC Provides Initial Core Cooling	ELAP/BDBEE	9.4E-02	RCIC reliability for 4 hrs = 0.025 based on SPAR reliability data. Other failures assumed limited by seismic DC loss @ (0.07)
FLEX	Planned Transition to FLEX	RCIC Success	0.07	Dominated by human action. HFE considered using SPAR-H worksheet. Equipment failures assumed to be small contributor due to N+1.
		RCIC Failure	0.93	Credit only for the fraction of RCIC failures > 4 hrs. New HFE considered using SPAR-H worksheet with less time.
WW-VENT	SP Temperature Control Using WW Vent	RCIC & FLEX Success	2.2E-02	See SPAR-H worksheet for HFE. Vent hardware = 2E-3
DW-VENT	SP Temperature Controlled with DW Vent	WW Vent Failed	0.51	High dependence of operator actions is primary contributor
RPV-PRESS	Operators Control RPV Pressure	RCIC, FLEX, Vent Success	0.05	Human action dominates. See SPAR-H worksheet
		RCIC & FLEX Success, Vent Failed	0.76	High dependence with operator action to vent.
		RCIC Failed Early	0.27	Human action (SPAR-H worksheet) and fraction of RCIC losses due to loss of DC (0.07).
EARLY-FLEX	Early RPV Injection w/FLEX	RCIC Failed Early, Depress Success	9.22E-01	Based on fraction of RCIC failures > 4hrs and HEP for FLEX
LATE-FLEX	Late RPV Injection w/FLEX	FLEX, Venting, RPV Press Success	1.3E-02	Requires failure of RCIC. Assume 72 hr mission time using SPAR model (66 hrs @ 1.67/hr = 0.11) ANDed with FLEX failure dominated by FLEX hardware (0.1) and human reliability, but based on prior successful human actions.
		FLEX & Venting Success, RPV Press Failed	0.20	Moderate dependence with RPV pressure control. Same crew, not close in time, different cue.
		FLEX Success, Vent Failed	1.00	Vent failure is dominated by human action. Assume complete dependence.
CONT-ISOL	Containment Re-isolated Upon Entry to SAGs	RCIC, initial FLEX, Vent Success, Equipment Failures	0.20	Dominated by human action to diagnose. See SPAR-H worksheet
		RCIC, initial FLEX, Vent Success, RCIC Lost on Operator Error	0.31	Moderate dependence with RPV pressure control. Same crew, not close in time, different cue.

**Assumptions:**

1) SPAR-H applicable to FLEX

2 HRA Boundary Conditions:

- Extreme Stress
- Nominal Training
- Poor work processes for field actions
- Poor ergonomics due to limited instruments
- Moderate complexity due to coordination needed