SINGLE ACTIVE FAILURE ANALYSIS EMERGENCY CORE COOLING SYSTEM RECIRCULATION PHASE

Component	Malfunction	Comments
A. Accumulator	Deliver to broken loop	Totally passive system with one accumulator per loop. Evaluation based on three accumulators delivering to the core and one spilling from ruptured loop.
B. Pump:		
1) Centrifugal Charging	Fails to start	Two provided. Evaluation based on operation of one.
2) Safety Injection	Fails to start	Two provided. Evaluation based on operation of one.
3) Residual Heat Removal	Fails to start	Two provided. Evaluation based on operation of one.
C. Automatically Operated Valves:		
1) Boron injection tank isolation		
a) inlet valve	Fails to open	Two parallel lines; one valve in either line is required to open.
b) outlet valve	Fails to open	Two parallel lines; one valve in either line is required to open.
2) Centrifugal Charging pumps		
a) suction line from RWST isolation valve	Fails to open	Two parallel lines; only one valve in either line is required to open.
b) discharge line to the normal charging path isolation valve[1]	Fails to close	Two valves in series; only one valve required to close.
c) minimum flow line isolation valve	Fails to close	Two trains in parallel; only one train required.
d) suction from volume control tank isolation valve	Fails to close	Two valves in series; only one valve required to close.

[1] The reactor coolant pump seal water path is left open.

SINGLE ACTIVE FAILURE ANALYSIS EMERGENCY CORE COOLING SYSTEM RECIRCULATION PHASE

Component	Malfunction	Comments
Recirculation Phase		
A. Valves operated From Control Room for Recirculation:		
1) Containment sump recirculation isolation	Fails to open	Two lines parallel; only one valve in either line is required to open.
2) Residual heat removal pumps suction line from RWST isolation	Fails to close	Check valve in series with two gate valves; operation of only one valve required.
3) Safety injection pumps suction line from RWST	Fails to close	Check valve in series with gate valve; operation of only one valve required.
4) Centrifugal Charging pumps suction line from RWST isolation valve	Fails to close	Check valve in series with two parallel gate valves. Operating of either the check valve or the gate valves required.
5) Safety injection pump suction line isolation valve at discharge of the west residual heat exchanger	Fails to open	Separate and independent high head injection path via the centrifugal charging pumps taking suction from discharge of the East residual heat residual head exchanger. A cross over line allows the flow from one heat exchanger to reach both safety injection and charging pumps if necessary.
6) Residual Heat Removal discharge bypass line	Fails to close	The second isolation valve for RWST backflow is still available.

SINGLE ACTIVE FAILURE ANALYSIS EMERGENCY CORE COOLING SYSTEM RECIRCULATION PHASE

Component	Malfunction	Comments
B. Pumps:		
1) Component Cooling Water Pump	Fails to start	Two provided. Evaluation based on operation of one. One pump is running during normal operation. An additional shared pump is available.
2) Essential Service Water Pump	Fails to start	Four provided for both units. Two pumps are required for normal operation.
3) Residual Heat Removal Pump	Fails to start	Two provided. Evaluation based on operation of one.
4) Charging Pump	Fails to operate	Same as injection phase.
5) Safety Injection Pumps	Fails to operate	Same as injection phase.