

## Human Reliability Screening Analysis ANO Fire Issue

### Background

During the triennial fire inspection, the team determined that the licensee had not implemented appropriate procedural controls for a fire in Fire Areas 99-M (Green Train switchgear room) and 98-J (corridor with Red and Green Train conduit). Specifically, the licensee relied solely on a symptomatic response to a fire in these areas. For example, if control room operator became aware of a loss of feedwater condition, then operators would respond by aligning auxiliary feedwater (AFW) from either the control room or locally. This approach differed from other alternate shutdown areas of the plant. For these areas, specific procedural guidance (Procedure 1203.002, "Alternate Shutdown") existed to direct the operators to isolate and then restore potentially affected components.

The following four broad classes of operator actions were evaluated:

- Manual alignment of emergency feedwater to the steam generators.
- Restoration of service water to the affected emergency diesel generators (EDG).
- Isolation of letdown flow and inventory control.
- Local start of an EDG without DC control power.

For each of the above classes, an operator would be required to successfully diagnose the system failure, determine the appropriate procedure, and then take the appropriate series of operator actions to mitigate the failure. There were several complicating factors in completing the analysis because the operator actions would be required following a major fire. Specifically the fire could result in:

- Suspect indications associated with critical plant parameters.
- Spurious actuations of plant equipment which are detrimental to the event.
- Failure of plant equipment to respond automatically.
- Inability to remotely operate plant equipment from the main control room.
- Previously implemented operator actions could become over-ridden by subsequent operator actions through the use of multiple procedures in lieu of a single prioritized procedure.

### Assumptions

1. An "Extreme Stress" classification was used for each class of operator actions. This level of stress is likely to occur when the onset of the stressor is sudden and the stressing situation persists for long periods.

K/2

2. An "Available, But Poor" classification was used for the procedural actions necessary to recover failed or degraded mitigating equipment. This classification is used for conditions where a procedure is available but inadequate. This classification level was chosen because of the symptomatic response of operators to a fire instead of a having a pre-planned alternate shutdown procedure. If properly diagnosed, procedures existed for operators to implement the individual system recovery actions. However, there may be dependencies between the procedures which are not accounted for. Specifically, to recover AC power, the operators may need to open the individual breakers on various switchgear. This activity could affect previous actions to restore mitigating systems. A single pre-planned procedure would account for the dependencies between procedures such that subsequent recovery actions do not affect previously implemented recovery actions.
3. A "Barely Adequate Time" classification was used for diagnosing a loss of flow to the steam generators and establishing AFW flow. This classification level was chosen based on the potential for indications and controls not being available in the control room. The timing associated with initiating AFW flow is dependent on operator actions to secure reactor coolant pumps. In addition, the flow rate to the steam generators must be controlled to prevent over-cooling and shrinkage of the reactor coolant system.
4. A "Barely Adequate Time" classification was used for diagnosing an EDG without service water and for securing the affected EDG. The EDG without service water flow must be secured within 7 minutes to prevent overheating and mechanical damage. The failure to secure the EDG could potentially prevent recovery of an emergency AC power source.
5. A "Barely Adequate Time" classification was used for diagnosing the failure of letdown to isolate and for securing letdown. If letdown is isolated within 4 minutes, then inventory control may not be required for 40 minutes. The failure to isolate letdown directly impacts the time available to initiate inventory control.
6. A "Highly Complex" classification was used for a local start of the EDG without DC power. This procedure is infrequently performed, requires a high degree of skill, and includes multiple steps to complete.
7. A "Moderately Complex" classification was used for a local manual start of an AFW pump and for local manual control of AFW flow to a steam generator. This activity is infrequently performed and would require constant communication with personnel monitoring important plant parameters to ensure the appropriate heat removal rate was maintained.
8. Limited personnel would be available during the first hour following a fire. Two individuals would be available for field operations (1 main control room reactor operator and 1 auxiliary operator). The remaining personnel would be assigned other functions. Specifically, the shift manager would be assigned emergency response organization duties, the control room supervisor and one reactor operator would remain in the main control room, the waste control operator and 1 auxiliary operator would be assigned to the fire brigade. The shift engineer would be available to provide assistance where necessary. A Unit 2 operator would be dispatched to start the alternate EDG. The

licensee did not credit the use of Unit 2 operators in the performance of Unit 1 plant manipulations.

The analyst determined that 1 operator would need to be dedicated to the restoration of AFW and the operation of the AFW flow control valves. The remaining operator would be required to complete all other evolutions (Isolate letdown, local start of the EDG, and all breaker manipulations). In contrast, the alternate shutdown procedure requires four operators, as a minimum, for successful completion. The analyst determined that the majority of actions specified in the alternate shutdown procedure could potentially be required for a major fire in Fire Areas 99-M or 98-J.

#### References

1. INEEL/EXT-99-0041, "Revision of the 1994 ASP HRA Methodology (Draft)," January 1999
2. Procedure 1203.002, "Alternate Shutdown"
3. Procedure 1104.036, "Emergency Diesel Generator Operation"
4. Procedure 1106.006, "Emergency Feedwater Pump Operation"
5. Procedure 1202.008, "Blackout"
6. Procedure 1202.007, "Degraded Power"
7. Procedure 2104.037, "Alternate AC Diesel Generator Operations"
8. Procedure 1107.001, "Electrical System Operations"
9. Procedure 1107.002, "ES Electrical System Operation"
10. Procedure 1104.002, "Makeup & Purification System Operation"
11. Procedure 2104.028, "Component Cooling Water System Operation"
12. Fire Hazards Analysis
13. IPEEE Fire Calculation 85-E-0053-47
14. ANO Appendix R Position Paper, "Emergency Diesel Generator Access Corridor Fire Zone 98-J"

Diagnosis Failure Probability										
Recovery Action	Diagnosis Factor	Time	Stress	Complexity	Experience & Training	Procedures	Ergonomics	Fitness For Duty	Work Processes	Diagnosis Failure Probability
Establish AFW	1E-2	10	5	1	1	1	1	1	1	0.5
Secure EDG Without Service Water	1E-2	10	5	1	1	1	1	1	1	0.5
Local EDG Start	1E-2	1	5	1	1	1	1	1	1	0.05
Isolate Letdown and Inventory Control	1E-2	10	5	1	1	1	1	1	1	0.5

Action Failure Probability Without Adequate Procedures										
Recovery Action	Action Factor	Time	Stress	Complexity	Experience & Training	Procedures	Ergonomics	Fitness For Duty	Work Processes	Action Failure Probability
Establish AFW	1E-3	10	5	2	1	5	1	1	1	0.5
Secure EDG Without Service Water	1E-3	10	5	1	1	5	1	1	1	0.25
Local EDG Start	1E-3	1	5	5	1	5	1	1	1	0.125
Isolate Letdown and Inventory Control	1E-3	10	5	1	1	5	1	1	1	0.25

Task Failure Probability Without Adequate Procedures			
Recovery Action	Diagnosis Failure Probability	Action Failure Probability	Task Failure Probability Without Formal Dependence
Establish AFW	0.5	0.5	1.0
Secure EDG Without Service Water	0.5	0.25	0.75
Local EDG Start	0.05	0.125	0.13
Isolate Letdown and Inventory Control	0.5	0.25	0.75

Action Failure Probability With Adequate Procedures										
Recovery Action	Action Factor	Time	Stress	Complexity	Experience & Training	Procedures	Ergonomics	Fitness For Duty	Work Processes	Action Failure Probability
Establish AFW	1E-3	10	5	2	1	1	1	1	1	0.1
Secure EDG Without Service Water	1E-3	10	5	1	1	1	1	1	1	0.05
Local EDG Start	1E-3	1	5	5	1	1	1	1	1	0.025
Isolate Letdown and Inventory Control	1E-3	10	5	1	1	1	1	1	1	0.05

Task Failure Probability With Adequate Procedures			
Recovery Action	Diagnosis Failure Probability	Action Failure Probability	Task Failure Probability Without Formal Dependence
Establish AFW	0.5	0.1	0.6
Secure EDG Without Service Water	0.5	0.05	0.55
Local EDG Start	0.05	0.025	<del>0.08</del> .075
Isolate Letdown and Inventory Control	0.5	0.05	0.55

OK

# OPERATOR RECOVERY ACTIONS FOR ELECTRIC AND EFW SET TO 1.0

## CASE 1 98-J/ALL TRAINS/RECOVERY/SF APPLIED

COMPONENT	IF	SF	AS	MS	CCDP	CDF
CABINET	1.90E-03	0.75	0.05	0.5	5.42E-04	1.93088E-08
CHARGER	7.60E-04	0.75	0.05	0.5	5.42E-04	7.7235E-09
VENTILATION	2.10E-04	0.08	0.05	0.5	5.42E-04	2.2764E-10
FP PANEL	1.10E-04	0.12	0.05	0.5	5.42E-04	1.7886E-10
						2.74388E-08

## CASE 2 98-J/RED TRAIN PROTECTED/RECOVERY/SF APPLIED

COMPONENT	IF	SF	AS	MS	CCDP	CDF
CABINET	1.90E-03	0.75	0.05	0.5	4.62E-04	1.64588E-08
CHARGER	7.60E-04	0.75	0.05	0.5	4.62E-04	6.5835E-09
VENTILATION	2.10E-04	0.08	0.05	0.5	4.62E-04	1.9404E-10
FP PANEL	1.10E-04	0.12	0.05	0.5	4.62E-04	1.5246E-10
						2.33888E-08

CASE 1 AND CASE 2 DELTA CDF 4.05E-09

## CASE 3 98-J/ALL TRAINS/RECOVERY/SF NOT APPLIED

COMPONENT	IF	AS	MS	CCDP	CDF
CABINET	1.90E-03	0.05	0.1	5.42E-04	5.149E-09
CHARGER	7.60E-04	0.05	0.1	5.42E-04	2.0596E-09
VENTILATION	2.10E-04	0.05	0.1	5.42E-04	5.69E-10
FP PANEL	1.10E-04	0.05	0.1	5.42E-04	2.98E-10
					8.08E-09

## CASE 4 98-J/RED TRAIN PROTECTED/RECOVERY/SF NOT APPLIED

COMPONENT	IF	AS	MS	CCDP	CDF
CABINET	1.90E-03	0.05	0.1	4.62E-04	4.389E-09
CHARGER	7.60E-04	0.05	0.1	4.62E-04	1.7556E-09
VENTILATION	2.10E-04	0.05	0.1	4.62E-04	4.85E-10
FP PANEL	1.10E-04	0.05	0.1	4.62E-04	2.54E-10
					6.88E-09

CASE 3 AND 4 DELTA CDF 1.19E-09

## CASE 5 98-J/ALL TRAINS/NO RECOVERY/SF APPLIED

COMPONENT	IF	SF	AS	MS	CCDP	CDF
CABINET	1.90E-03	0.75	0.05	0.5	1.43E-02	5.09438E-07
CHARGER	7.60E-04	0.75	0.05	0.5	1.43E-02	2.03775E-07
VENTILATION	2.10E-04	0.08	0.05	0.5	1.43E-02	6.006E-09
FP PANEL	1.10E-04	0.12	0.05	0.5	1.43E-02	4.719E-09
						7.23938E-07

CASE 6 98-J/RED TRAIN PROTECTED/NO RECOVERY/SF APPLIED

COMPONENT	IF	SF	AS	MS	CCDP	CDF
CABINET	1.90E-03	0.75	0.05	0.5	9.18E-03	3.27038E-07
CHARGER	7.60E-04	0.75	0.05	0.5	9.18E-03	1.30815E-07
VENTILATION	2.10E-04	0.08	0.05	0.5	9.18E-03	3.8556E-09
FP PANEL	1.10E-04	0.12	0.05	0.5	9.18E-03	3.0294E-09
						4.64738E-07

CASE 5 AND 6 DELTA CDF

2.59E-07

CASE 7 98-J/ALL TRAINS/NO RECOVERY/SF NOT APPLIED

COMPONENT	IF	AS	MS	CCDP	CDF
CABINET	1.90E-03	0.05	0.1	1.43E-02	1.3585E-07
CHARGER	7.60E-04	0.05	0.1	1.43E-02	5.434E-08
VENTILATION	2.10E-04	0.05	0.1	1.43E-02	1.50E-08
FP PANEL	1.10E-04	0.05	0.1	1.43E-02	7.87E-09
					2.1307E-07

CASE 8 98-J/RED TRAIN PROTECTED/NO RECOVERY/SF NOT APPLIED

COMPONENT	IF	AS	MS	CCDP	CDF
CABINET	1.90E-03	0.05	0.1	9.18E-03	8.721E-08
CHARGER	7.60E-04	0.05	0.1	9.18E-03	3.4884E-08
VENTILATION	2.10E-04	0.05	0.1	9.18E-03	9.64E-09
FP PANEL	1.10E-04	0.05	0.1	9.18E-03	5.05E-09
					1.36782E-07

CASE 7 AND 8 DELTA CDF

7.63E-08

CASE 5 AND 1 DELTA CDF

6.96E-07

CASE 7 AND 2 DELTA CDF

2.09E-07



# OPERATOR RECOVERY ACTIONS FOR ELECTRIC AND EFW SET TO 1.0

## CASE 1 99-M/ALL TRAINS/RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	1.27E-03	2.9E-07
CHARGER	3.20E-04	0.1	0.5	1.27E-03	2.03E-08
VENTILATION	1.10E-04	0.08	0.5	1.27E-03	5.59E-09

3.15E-07

## CASE 2 99-M/RED TRAIN PROTECTED/RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	8.32E-04	1.9E-07
CHARGER	3.20E-04	0.1	0.5	8.32E-04	1.33E-08
VENTILATION	1.10E-04	0.08	0.5	8.32E-04	3.66E-09

2.07E-07

CASE 1 AND CASE 2 DELTA CDF 1.09E-07

## CASE 3 99-M/ALL TRAINS/RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	1.27E-03	4.83E-07
CHARGER	3.20E-04	0.1	1.27E-03	4.06E-08
VENTILATION	1.10E-04	0.1	1.27E-03	1.40E-08

5.37E-07

## CASE 4 99-M/RED TRAIN PROTECTED/RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	8.32E-04	3.16E-07
CHARGER	3.20E-04	0.1	8.32E-04	2.66E-08
VENTILATION	1.10E-04	0.1	8.32E-04	9.15E-09

3.52E-07

CASE 3 AND 4 DELTA CDF 1.85E-07

## CASE 5 99-M/ALL TRAINS/NO RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	5.76E-02	1.31E-05
CHARGER	3.20E-04	0.1	0.5	5.76E-02	9.22E-07
VENTILATION	1.10E-04	0.08	0.5	5.76E-02	2.53E-07

1.43E-05

CASE 6 99-M/RED TRAIN PROTECTED/NO RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	7.96E-03	1.81E-06
CHARGER	3.20E-04	0.1	0.5	7.96E-03	1.27E-07
VENTILATION	1.10E-04	0.08	0.5	7.96E-03	3.5E-08

1.98E-06

CASE 5 AND 6 DELTA CDF 1.23E-05

CASE 7 99-M/ALL TRAINS/NO RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	5.76E-02	2.19E-05
CHARGER	3.20E-04	0.1	5.76E-02	1.84E-06
VENTILATION	1.10E-04	0.1	5.76E-02	6.34E-07

2.44E-05

CASE 8 99-M/RED TRAIN PROTECTED/NO RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	7.96E-03	3.02E-06
CHARGER	3.20E-04	0.1	7.96E-03	2.55E-07
VENTILATION	1.10E-04	0.1	7.96E-03	8.76E-08

3.37E-06

\*\*CASE 5 AND 1 DELTA CDF 1.40E-05

\*\*CASE 7 AND 3 DELTA CDF 2.44E-05

# OPERATOR RECOVERY ACTIONS FOR ELECTRIC AND EFW SET TO 0.3

## CASE 1 99-M/ALL TRAINS/RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	1.27E-03	2.9E-07
CHARGER	3.20E-04	0.1	0.5	1.27E-03	2.03E-08
VENTILATION	1.10E-04	0.08	0.5	1.27E-03	5.59E-09

3.15E-07

## CASE 2 99-M/ALL TRAINS/RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	1.27E-03	4.83E-07
CHARGER	3.20E-04	0.1	1.27E-03	4.06E-08
VENTILATION	1.10E-04	0.1	1.27E-03	1.40E-08

5.37E-07

## CASE 3 99-M/ALL TRAINS/NO RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	2.87E-03	6.54E-07
CHARGER	3.20E-04	0.1	0.5	2.87E-03	4.59E-08
VENTILATION	1.10E-04	0.08	0.5	2.87E-03	1.26E-08

7.13E-07

## CASE 4 99-M/ALL TRAINS/NO RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	2.87E-03	1.09E-06
CHARGER	3.20E-04	0.1	2.87E-03	9.18E-08
VENTILATION	1.10E-04	0.1	2.87E-03	3.16E-08

1.21E-06

CASE 3 AND 1 DELTA CDF 3.97E-07

CASE 4 AND 2 DELTA CDF 6.77E-07

# OPERATOR RECOVERY ACTIONS FOR ELECTRIC AND EFW SET TO 0.6

## CASE 1 99-M/ALL TRAINS/RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	1.27E-03	2.9E-07
CHARGER	3.20E-04	0.1	0.5	1.27E-03	2.03E-08
VENTILATION	1.10E-04	0.08	0.5	1.27E-03	5.59E-09

3.15E-07

## CASE 2 99-M/ALL TRAINS/RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	1.27E-03	4.83E-07
CHARGER	3.20E-04	0.1	1.27E-03	4.06E-08
VENTILATION	1.10E-04	0.1	1.27E-03	1.40E-08

5.37E-07

## CASE 3 99-M/ALL TRAINS/NO RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	1.48E-02	3.37E-06
CHARGER	3.20E-04	0.1	0.5	1.48E-02	4.74E-06
VENTILATION	1.10E-04	0.08	0.5	1.48E-02	1.63E-06

9.74E-06

## CASE 4 99-M/ALL TRAINS/NO RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	1.48E-02	5.62E-06
CHARGER	3.20E-04	0.1	1.48E-02	4.74E-07
VENTILATION	1.10E-04	0.1	1.48E-02	1.63E-06

7.73E-06

CASE 3 AND 1 DELTA CDF 9.42E-06

CASE 4 AND 2 DELTA CDF 7.19E-06

EFW RECOVERY ACTIONS SET TO 1.0 ALL OTHERS NOMINAL

CASE 1 99-M/ALL TRAINS/RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	1.27E-03	2.9E-07
CHARGER	3.20E-04	0.1	0.5	1.27E-03	2.03E-08
VENTILATION	1.10E-04	0.08	0.5	1.27E-03	5.59E-09

3.15E-07

CASE 2 99-M/ALL TRAINS/RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	1.27E-03	4.83E-07
CHARGER	3.20E-04	0.1	1.27E-03	4.06E-08
VENTILATION	1.10E-04	0.1	1.27E-03	1.40E-08

5.37E-07

CASE 3 99-M/ALL TRAINS/NO RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	5.40E-02	1.23E-05
CHARGER	3.20E-04	0.1	0.5	5.40E-02	8.64E-07
VENTILATION	1.10E-04	0.08	0.5	5.40E-02	2.38E-07

1.34E-05

CASE 4 99-M/ALL TRAINS/NO RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	5.40E-02	2.05E-05
CHARGER	3.20E-04	0.1	5.40E-02	1.73E-06
VENTILATION	1.10E-04	0.1	5.40E-02	5.94E-07

2.28E-05

CASE 3 AND 1 DELTA CDF 1.31E-05

CASE 4 AND 2 DELTA CDF 2.23E-05

EFW RECOVERY SET TO 0.6 AND ELEC SET TO 0.3

CASE 1 99-M/ALL TRAINS/RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	1.27E-03	2.9E-07
CHARGER	3.20E-04	0.1	0.5	1.27E-03	2.03E-08
VENTILATION	1.10E-04	0.08	0.5	1.27E-03	5.59E-09

3.15E-07

CASE 2 99-M/ALL TRAINS/RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	1.27E-03	4.83E-07
CHARGER	3.20E-04	0.1	1.27E-03	4.06E-08
VENTILATION	1.10E-04	0.1	1.27E-03	1.40E-08

5.37E-07

CASE 3 99-M/ALL TRAINS/NO RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	1.43E-02	3.26E-06
CHARGER	3.20E-04	0.1	0.5	1.43E-02	2.29E-07
VENTILATION	1.10E-04	0.08	0.5	1.43E-02	6.29E-08

3.55E-06

CASE 4 99-M/ALL TRAINS/NO RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	1.43E-02	5.43E-06
CHARGER	3.20E-04	0.1	1.43E-02	4.58E-07
VENTILATION	1.10E-04	0.1	1.43E-02	1.57E-07

6.05E-06

CASE 3 AND 1 DELTA CDF 3.24E-06

CASE 4 AND 2 DELTA CDF 5.51E-06

EFW SET TO 0.6 ELEC SET TO 0.3 AND FB SET TO 0.1

CASE 1 99-M/ALL TRAINS/RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	1.27E-03	2.9E-07
CHARGER	3.20E-04	0.1	0.5	1.27E-03	2.03E-08
VENTILATION	1.10E-04	0.08	0.5	1.27E-03	5.59E-09

3.15E-07

CASE 2 99-M/ALL TRAINS/RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	1.27E-03	4.83E-07
CHARGER	3.20E-04	0.1	1.27E-03	4.06E-08
VENTILATION	1.10E-04	0.1	1.27E-03	1.40E-08

5.37E-07

CASE 3 99-M/ALL TRAINS/NO RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	2.00E-02	4.56E-06
CHARGER	3.20E-04	0.1	0.5	2.00E-02	3.2E-07
VENTILATION	1.10E-04	0.08	0.5	2.00E-02	8.8E-08

4.97E-06

CASE 4 99-M/ALL TRAINS/NO RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	2.00E-02	7.6E-06
CHARGER	3.20E-04	0.1	2.00E-02	6.4E-07
VENTILATION	1.10E-04	0.1	2.00E-02	2.20E-07

8.46E-06

CASE 3 AND 1 DELTA CDF 4.65E-06

CASE 4 AND 2 DELTA CDF 7.92E-06

EFW SET TO 0.6 ELEC SET TO 0.3 AND FB SET TO 0.3

CASE 1 99-M/ALL TRAINS/RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	1.27E-03	2.9E-07
CHARGER	3.20E-04	0.1	0.5	1.27E-03	2.03E-08
VENTILATION	1.10E-04	0.08	0.5	1.27E-03	5.59E-09

3.15E-07

CASE 2 99-M/ALL TRAINS/RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	1.27E-03	4.83E-07
CHARGER	3.20E-04	0.1	1.27E-03	4.06E-08
VENTILATION	1.10E-04	0.1	1.27E-03	1.40E-08

5.37E-07

CASE 3 99-M/ALL TRAINS/NO RECOVERY/SF APPLIED

COMPONENT	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	3.60E-02	8.21E-06
CHARGER	3.20E-04	0.1	0.5	3.60E-02	5.76E-07
VENTILATION	1.10E-04	0.08	0.5	3.60E-02	1.58E-07

8.94E-06

CASE 4 99-M/ALL TRAINS/NO RECOVERY/SF NOT APPLIED

COMPONENT	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	3.60E-02	1.37E-05
CHARGER	3.20E-04	0.1	3.60E-02	1.15E-06
VENTILATION	1.10E-04	0.1	3.60E-02	3.96E-07

1.52E-05

CASE 3 AND 1 DELTA CDF 8.63E-06

CASE 4 AND 2 DELTA CDF 1.47E-05



UPPER BOUND: EFW SET TO 1.0 ELEC SET TO 0.75 AND FB SET TO 0.75

CASE 1 99-M/ALL TRAINS/RECOVERY/SF APPLIED

COMPONI	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	1.27E-03	2.9E-07
CHARGEF	3.20E-04	0.1	0.5	1.27E-03	2.03E-08
VENTILAT	1.10E-04	0.08	0.5	1.27E-03	5.59E-09

3.15E-07

CASE 2 99-M/ALL TRAINS/RECOVERY/SF NOT APPLIED

COMPONI	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	1.27E-03	4.83E-07
CHARGEF	3.20E-04	0.1	1.27E-03	4.06E-08
VENTILAT	1.10E-04	0.1	1.27E-03	1.40E-08

5.37E-07

CASE 3 99-M/ALL TRAINS/NO RECOVERY/SF APPLIED

COMPONI	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	2.54E-01	5.79E-05
CHARGEF	3.20E-04	0.1	0.5	2.54E-01	4.06E-06
VENTILAT	1.10E-04	0.08	0.5	2.54E-01	1.12E-06

6.31E-05

CASE 4 99-M/ALL TRAINS/NO RECOVERY/SF NOT APPLIED

COMPONI	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	2.54E-01	9.65E-05
CHARGEF	3.20E-04	0.1	2.54E-01	8.13E-06
VENTILAT	1.10E-04	0.1	2.54E-01	2.79E-06

0.000107

CASE 3 AND 1 DELTA CDF 6.28E-05

CASE 4 AND 2 DELTA CDF 1.07E-04

APPROXIMATE NOMINAL FIRE VALUES LICENSEE = EFW 0.26, FEED AND BLEED 0.32, ELECTRIC POW

CASE 1 99-M/ALL TRAINS/RECOVERY/SF APPLIED

COMPONI	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	1.27E-03	2.9E-07
CHARGEF	3.20E-04	0.1	0.5	1.27E-03	2.03E-08
VENTILAT	1.10E-04	0.08	0.5	1.27E-03	5.59E-09

3.15E-07

CASE 2 99-M/ALL TRAINS/RECOVERY/SF NOT APPLIED

COMPONI	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	1.27E-03	4.83E-07
CHARGEF	3.20E-04	0.1	1.27E-03	4.06E-08
VENTILAT	1.10E-04	0.1	1.27E-03	1.40E-08

5.37E-07

CASE 3 99-M/ALL TRAINS/NO RECOVERY/SF APPLIED

COMPONI	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	5.40E-03	1.23E-06
CHARGEF	3.20E-04	0.1	0.5	5.40E-03	8.64E-08
VENTILAT	1.10E-04	0.08	0.5	5.40E-03	2.38E-08

1.34E-06

CASE 4 99-M/ALL TRAINS/NO RECOVERY/SF NOT APPLIED

COMPONI	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	5.40E-03	2.05E-06
CHARGEF	3.20E-04	0.1	5.40E-03	1.73E-07
VENTILAT	1.10E-04	0.1	5.40E-03	5.94E-08

2.28E-06

CASE 3 AND 1 DELTA CDF 1.03E-06

CASE 4 AND 2 DELTA CDF 1.75E-06

VER 0.1

APPROXIMATE NOMINAL FIRE VALUES SPAR HRA = EFW 0.6, FEED AND BLEED 0.55, ELECTRIC POWE

CASE 1 99-M/ALL TRAINS/RECOVERY/SF APPLIED

COMPONI	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	1.27E-03	2.9E-07
CHARGEF	3.20E-04	0.1	0.5	1.27E-03	2.03E-08
VENTILAT	1.10E-04	0.08	0.5	1.27E-03	5.59E-09

3.15E-07

CASE 2 99-M/ALL TRAINS/RECOVERY/SF NOT APPLIED

COMPONI	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	1.27E-03	4.83E-07
CHARGEF	3.20E-04	0.1	1.27E-03	4.06E-08
VENTILAT	1.10E-04	0.1	1.27E-03	1.40E-08

5.37E-07

CASE 3 99-M/ALL TRAINS/NO RECOVERY/SF APPLIED

COMPONI	IF	SF	MS	CCDP	CDF
CABINET	3.80E-03	0.12	0.5	5.40E-02	1.23E-05
CHARGEF	3.20E-04	0.1	0.5	5.40E-02	8.64E-07
VENTILAT	1.10E-04	0.08	0.5	5.40E-02	2.38E-07

1.34E-05

CASE 4 99-M/ALL TRAINS/NO RECOVERY/SF NOT APPLIED

COMPONI	IF	MS	CCDP	CDF
CABINET	3.80E-03	0.1	5.40E-02	2.05E-05
CHARGEF	3.20E-04	0.1	5.40E-02	1.73E-06
VENTILAT	1.10E-04	0.1	5.40E-02	5.94E-07

2.28E-05

CASE 3 AND 1 DELTA CDF 1.31E-05

CASE 4 AND 2 DELTA CDF 2.23E-05

ER 0.55

# SUMMARY TABLE FOR FIRE ZONE 99M

APPROXIMATE NOMINAL NON-FIRE VALUES = EFW 0.186, FEED AND BLEED 0.006, AND ELECTRIC POWER 0.1

APPROXIMATE NOMINAL FIRE VALUES LICENSEE = EFW 0.26, FEED AND BLEED 0.32, ELECTRIC POWER 0.1

APPROXIMATE NOMINAL FIRE VALUES SPAR HRA = EFW 0.6, FEED AND BLEED 0.55, ELECTRIC POWER 0.55

FIRE ZONE 99M SEVERITY FACTOR NOT APPLIED				
RECOVERY TERM	CDF	DELTA CDF NON-FIRE HRA	DELTA CDF SPAR HRA	DELTA CDF FIRE HRA
NOMINAL VALUES	5.37E-07	N/A	N/A	N/A
REVISED HRA NOMINAL VALUE (SPAR)	2.23E-05	N/A	N/A	N/A
REVISED HRA NOMINAL VALUE ESTIMATE (LICENSEE)	2.28E-06	N/A	N/A	N/A
ELECTRIC POWER 0.3, EFW 0.3, FEED AND BLEED 6E-3	1.21E-06	6.73E-07	N/A	N/A
ELECTRIC POWER 0.3, EFW 0.6, FEED AND BLEED 6E-3	6.05E-06	5.51E-06	N/A	3.77E-06
ELECTRIC POWER 0.6, EFW 0.6, FEED AND BLEED 6E-3	7.73E-06	7.19E-06	N/A	5.45E-06
ELECTRIC POWER 0.3, EFW 0.6, FEED AND BLEED 0.1	8.46E-06	7.92E-06	N/A	6.18E-06
ELECTRIC POWER 0.3, EFW 0.6, FEED AND BLEED 0.3	1.52E-05	1.47E-05	N/A	1.29E-05
ELECTRIC POWER 0.55, EFW 0.6, FEED AND BLEED 0.55	2.23E-05	2.18E-05	N/A	2.00E-05
ELECTRIC POWER 0.1, EFW 1.0, FEED AND BLEED 6E-3	2.28E-05	2.23E-05	5.00E-07	2.05E-05
ELECTRIC POWER 1.0, EFW 1.0, FEED AND BLEED 6E-3	2.44E-05	2.39E-05	2.10E-06	2.21E-05
ELECTRIC POWER 0.75, EFW 1.0, FEED AND BLEED 0.75	1.07E-04	1.06E-04	8.47E-05	1.05E-04

FIRE ZONE 99M SEVERITY FACTOR APPLIED				
RECOVERY TERM	CDF	DELTA CDF NON-FIRE HRA	DELTA CDF SPAR HRA	DELTA CDF FIRE HRA
NOMINAL VALUES	3.15E-07	N/A	N/A	N/A
REVISED HRA NOMINAL VALUE (SPAR)	1.31E-05	N/A	N/A	N/A
REVISED HRA NOMINAL VALUE ESTIMATE (LICENSEE)	1.34E-06	N/A	N/A	N/A
ELECTRIC POWER 0.3, EFW 0.3, FEED AND BLEED 6E-3	7.13E-07	3.98E-07	N/A	N/A
ELECTRIC POWER 0.3, EFW 0.6, FEED AND BLEED 6E-3	3.55E-06	3.24E-06	N/A	2.21E-06
ELECTRIC POWER 0.6, EFW 0.6, FEED AND BLEED 6E-3	4.97E-06	4.66E-06	N/A	3.63E-06
ELECTRIC POWER 0.3, EFW 0.6, FEED AND BLEED 0.1	8.94E-06	8.63E-06	N/A	7.60E-06
ELECTRIC POWER 0.3, EFW 0.6, FEED AND BLEED 0.3	9.74E-06	9.43E-06	N/A	8.40E-06
ELECTRIC POWER 0.55, EFW 0.6, FEED AND BLEED 0.55	1.31E-05	1.28E-05	N/A	1.18E-05
ELECTRIC POWER 0.1, EFW 1.0, FEED AND BLEED 6E-3	1.34E-05	1.31E-05	3.00E-07	1.21E-05
ELECTRIC POWER 1.0, EFW 1.0, FEED AND BLEED 6E-3	1.43E-05	1.40E-05	1.20E-06	1.30E-05
ELECTRIC POWER 0.75, EFW 1.0, FEED AND BLEED 0.75	6.31E-05	6.28E-05	5.00E-05	6.18E-05