

APPENDIX 2

TABLE 2
SUBCATEGORY A.1 EVENTS (SINGLE/DUAL FAILURE ANALYSIS)

EVENT	SDS IMPAIRMENTS		ECC IMPAIRMENTS		CONTAINMENT IMPAIRMENTS ⁽¹⁾			
	SDS1	SDS2	INJECTION AND CRASH COOL	LOOP ISOLATION	ISOLATION DAMPERS	DOUSING	LOCAL AIR COOLING	DEFLATED AIRLOCK SEALS
Large loss of coolant	X	X	X	X	X	X	X	X
Small loss of coolant	X	X	X	X	X	X	X	X
Steamline break	X	X	NR ⁽²⁾	NR ⁽²⁾	NR ⁽³⁾	X	X	NR ⁽³⁾
Pressure tube rupture	X	X	X	X	X	X	X	X
End fitting failure	X	X	X	X	X	X	X	X
Loss of reactivity control	X	X	NR ⁽⁴⁾	NR ⁽⁴⁾	NR ⁽⁴⁾	NR ⁽⁴⁾	NR ⁽⁴⁾	NR ⁽⁴⁾
Single channel flow reduction	X	X	X	X	X	X	X	X
Steam generator tube rupture	X	X	X	X	NR ⁽⁵⁾	NR ⁽⁵⁾	NR ⁽⁵⁾	NR ⁽⁵⁾

NR = not relevant, see notes for explanation

X = analysis to be performed

Notes for Table 2:

1. Containment impairments are as follows:

- isolation dampers - failure of isolation logic (all dampers in inlet and outlet ventilation system ducting fail to close),
- dousing - failure of one subsystem,
- local air cooling - failure of all local air coolers inside the reactor building, and
- deflated airlock seals - failure of seals in both inner and outer doors of airlock.

2. ECCS is not initiated for a steam main break outside containment and, therefore, its impairments are not relevant.

ECCS is initiated and beneficial for steam main break inside containment. However, it is not credited in the analysis and, therefore, its impairments are not relevant.

3. It is conservative to assume isolation of containment for a steam main break inside containment. Therefore, its impairment is not considered.

Containment impairments are not relevant for the steam main break outside containment because containment systems are neither required nor initiated.

4. ECCS or containment are not initiated or credited. Therefore, these impairments need not be considered.

5. This event leads to loss of coolant outside containment; therefore, containment impairment is not relevant.

TABLE 3
SUBCATEGORY A.2 EVENTS (TRIP COVERAGE)

1. Loss of Class IV power
2. Single heat transport pump trip
3. Single heat transport pump seizure
4. Small loss of coolant
5. Pressure tube rupture
6. Large loss of coolant
7. Loss of reactivity control
8. Loss of primary circuit inventory control
9. Loss of primary circuit pressure control
10. Loss of secondary circuit pressure control
11. Feedwater line break
12. Steamline break
13. Loss of service water to moderator
14. Moderator system pipe break
15. Loss of end-shield cooling

TABLE 4
SUBCATEGORY A.3 EVENTS - LOCA WITH LOSS OF CLASS IV POWER

EVENT	SDS IMPAIRMENTS		ECC IMPAIRMENTS		CONTAINMENT IMPAIRMENTS		
	SDS1	SDS2	INJECTION AND CRASH COOL	LOOP ISOLATION	ISOLATION DAMPERS	DOUSING	LOCAL AIR COOLING
Large LOCA	X	X	X	X	X	X	X
Small LOCA	X	X	X	X	X	X	X

Note: Containment impairments are as follows:

1. Isolation dampers - failure of isolation logic (all dampers in inlet and outlet ventilation system ducting fail to close),
2. dousing - failure of one subsystem, and
3. local air cooling - failure of all local air coolers inside the reactor building.

TABLE 5
SUBCATEGORY A.3 EVENTS (SPECIAL CONTAINMENT IMPAIRMENTS)

	TOTAL LOSS OF DOUSING	OPEN AIRLOCK DOORS
Large LOCA	X	X
End fitting failure	X	X

TABLE 6
CATEGORY B EVENTS FOR PROBABILISTIC SAFETY ASSESSMENT

1. Failure of electrical power supplies
 2. Instrument air system failures
 3. Failure of service water supplies*
 4. Failures of plant computer control
 5. Loss of steam generators as a heat sink*
 6. Moderator and shield cooling system failures*
 7. Large loss of coolant*
 8. Small loss of coolant*
 9. Fuel handling system failures
 10. Failures during reactor shutdown
- * Consequential flooding will be addressed for each of these events.

Note for Table 6:

The ten events listed above are not single initiating events but a grouping of key events. Hence, an assessment of these events will cover many individual initiating events.

TABLE 7
CATEGORY C EVENTS

1. Earthquake
2. Site flooding from external sources
3. Station fires
4. Severe winds

TABLE 8
CATEGORY D EVENTS

1. Steam generator support failure
2. Steam generator shell failure
3. Turbine breakup
4. Massive failure of cooling water intake tunnel
5. Massive failure of cooling water discharge duct
6. Failure of heat transport pump casing or driveshaft
7. Pressurizer failure
8. Degasser-condenser failure

TABLE 9
ACCEPTANCE CRITERIA FOR SUBCATEGORY A.1 EVENTS

EVENT	SHUTDOWN REQUIREMENT	ECC FUEL COOLING REQUIREMENT*	CONTAINMENT REQUIREMENT*
Large loss of coolant	No channel failure ⁺	No channel failure ⁺	Single failure dose limit
Small loss of coolant	No fuel failure ⁺⁺	No fuel failure ⁺⁺	Single failure dose limit
Steamline break	No fuel failure ⁺⁺	No fuel failure ⁺⁺	Single failure dose limit
Pressure tube rupture ^{**}	No fuel failure ⁺⁺	No fuel failure ⁺⁺	Single failure dose limit
End fitting failure ^{**}	No fuel failure ⁺⁺	No fuel failure ⁺⁺	Single failure dose limit
Loss of reactivity control	No fuel failure ⁺⁺	Not Applicable	Single failure dose limit
Single channel flow reduction ^{**}	No fuel failure ⁺⁺	No fuel failure ⁺⁺	Single failure dose limit
Steam generator tube rupture	No fuel failure ⁺⁺	No fuel failure ⁺⁺	Not applicable

* For dual failure involving loss of ECCS, the fuel cooling requirement shall be no channel failure and the containment requirement shall be the dual failure dose limit. For those events involving containment failure, the containment requirement is the dual failure dose limit.

** No fuel failure in the other channels.

+ No channel failure means no loss of channel integrity.

++ No fuel failure means no systematic fuel failure as opposed to inherent fuel defect.

REFERENCE DOSE LIMITS FOR SINGLE/DUAL FAILURE EVENTS

EVENT	INDIVIDUAL DOSE LIMIT	POPULATION DOSE LIMIT
Single Failure	5 mSv whole body	100 man-sieverts, whole body
	30 mSv thyroid	100 man-sieverts, thyroid
Dual Failure	250 mSv whole body	10 ⁴ man-sieverts, whole body
	2500 mSv thyroid	10 ⁴ man-sieverts, thyroid

TABLE 10
ACCEPTANCE CRITERIA FOR SUBCATEGORY A.2 (TRIP COVERAGE) EVENTS

EVENT	TRIP COVERAGE REQUIREMENT
Loss of Class IV Power	No fuel failure
Partial loss of Class IV Power	No fuel failure
Heat transport pump seizure	No fuel failure
Small loss of coolant	No fuel failure
Pressure tube rupture	No fuel failure ¹
Large loss of coolant	No channel failure
Loss of reactivity control	No fuel failure
Loss of primary circuit inventory and pressure control	No fuel failure
Loss of secondary circuit pressure control	No fuel failure
Feedwater line breaks	No fuel failure
Steamline breaks	No fuel failure
Loss of service water to moderator	No fuel failure ²

Notes:

No fuel failure means no systematic fuel failure as opposed to inherent fuel defect.

No channel failure means no loss of channel integrity.

1. No systematic fuel failures in the other channels.
2. Calandria integrity needs to be assured.

TABLE 11
ACCEPTANCE CRITERIA FOR SUBCATEGORY A.3 EVENTS

EVENT	SHUTDOWN REQUIREMENT	ECCS FUEL COOLING REQUIREMENT	CONTAINMENT REQUIREMENT
Small loss of coolant with loss of Class IV power	No fuel failure	No channel failure	30X single failure limit
Large loss of coolant with loss of Class IV power	No channel failure	No channel failure	Dual failure limit

Note:

The containment requirement for the dual failures associated with the above events is the dual failure dose limit.