

Bob Palla
Review Notes

* ALTERNATIVE DEFINITIONS FOR "LARGE" INCLUDE: (1) ALL EARLY CF OR BYPASS, AND (2) EARLY FAILURES AND BYPASS FAILURES WITH I & Cs REL FRACS $\geq 2.5-3\%$. TREATING MODERATE AS CONTRIBUTORS RELEASE SEVERITY AND TIMING CLASSIFICATION SCHEME (SEVERITY, TIMING) TO LERF WOULD INCREASE THE DELERF RESULT

Release Severity Source Term Release Fraction		Release Timing	
Classification Category	Cs Iodide % in Release	Classification Category	Time of Release ⁽¹⁾ (noble gases or CsI)
High (H)	greater than 10	Late (L)	greater than 24 hours
Moderate (M)	1 to 10	Intermediate (I)	4 to 24 hours
Low (L)	0.1 to 1	Early (E)	less than 4 hours
Low-low (LL)	less than 0.1		
Negligible (OK)	<< 0.1		

Three timing classifications are used, as follows:

1. Early (E) less than 4 hours after General Emergency Declaration
2. Intermediate (I) greater than or equal to 4 hours, but less than 24 hours
3. Late (L) greater than or equal to 24 hours after General Emergency declaration.

The definition of the categories is based upon past experience with offsite responses:

- 0-4 hours is conservatively assumed to include cases in which minimal offsite protective measures have been observed to be performed in non-nuclear accidents.
- 4-24 hours is a time frame in which much of the offsite nuclear plant protective measures can be assured to be accomplished.
- > 24 hours are times at which the offsite measures can be assumed to be fully effective.

There are four classes of Emergency Action Levels: Notification of Unusual Event, Alert, Site Emergency and General Emergency. The General Emergency action level is used in this analysis as the timing reference point as it is the level associated with the declaration of public evacuation.

⁽¹⁾ Time relative to declaration of General Emergency

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Table 3.5-1 provides a summary of the estimated time to declare a General Emergency during the different accident scenarios. As can be seen from Table 3.5-1, the time to the declaration of a General Emergency is an hour or less for most accident types.

Using the information in Table 3.5-1 and CNS accident progression timings, Table 3.5-2 provides a useful summary of the release timing characteristic for the different plant damage states and various release modes. For example, a containment isolation failure release for a TQUV accident results in an Early release. As another example, a SBO accident with in-vessel recovery but no containment heat removal methods (and subsequent containment failure) results in a late release.

In the event of multiple containment release pathways (e.g., containment overtemperature failure and subsequent sump melt-through), the release timing is classified consistent with the earlier release mode (overtemperature failure in this example).

Table 3.5-1

CNS GENERAL EMERGENCY DECLARATION TIMING

PDS	General Emergency Declaration		
	Sequence Characteristics	Est. Time to Declare	Basis
TQUX	w/IS failure	30-60 min	EAL 2.4.1: level below TAF <u>and</u> containment unisolated
	w/IS and VF successful, but RHR unsuccessful	3-4 hrs.	EAL 2.4.1: clad failure <u>and</u> DW press. >25 psig
	w/IS successful, but VF and RHR unsuccessful	~ 2 hrs.	EAL 2.4.1: clad failure, RCS failure, <u>and</u> H2% above 4%
TPUX	w/IS failure	30-60 min.	EAL 2.4.1: level below TAF <u>and</u> containment unisolated
	w/IS and VF successful, but RHR unsuccessful	~ 1 hr.	EAL 2.4.1: clad failure, SORV, <u>and</u> H2% above 4%
	w/IS successful, but VF and RHR unsuccessful	~ 1 hr.	EAL 2.4.1: clad failure, SORV, <u>and</u> H2% above 4%
TQUV	w/IS failure	30-60 min.	EAL 2.4.1: level below TAF <u>and</u> containment unisolated
	w/IS and VF successful, but RHR unsuccessful	3-4 hrs.	EAL 2.4.1: clad failure <u>and</u> DW press. >25 psig
	w/IS successful, but VF and RHR unsuccessful	~ 2 hrs.	EAL 2.4.1: clad failure, RCS failure, <u>and</u> H2% above 4%
TPUV	w/IS failure	30-60 min.	EAL 2.4.1: level below TAF <u>and</u> containment unisolated
	w/IS and VF successful, but RHR unsuccessful	~ 1 hr.	EAL 2.4.1: clad failure, SORV, <u>and</u> H2% above 4%
	w/IS successful, but VF and RHR unsuccessful	~ 1 hr.	EAL 2.4.1: clad failure, SORV, <u>and</u> H2% above 4%
ST-SBLP	All sequences	0-30 min.	EAL 4.4.1: SBO <u>and</u> failure of HPCI/RCIC
ST-SBHP	All sequences	0-30 min.	EAL 4.4.1: SBO <u>and</u> failure of HPCI/RCIC
DT-SBHP	All sequences	3-4 hrs.	EAL 4.4.1: SBO <u>and</u> HPCI/RCIC failure following DC depletion
DT-SBLP	All sequences	3-4 hrs.	EAL 4.4.1: SBO <u>and</u> HPCI/RCIC failure following DC depletion
TWDT	All sequences	3-4 hrs.	EAL 3.4.2: Failure of all DHR systems indicated when vent attempted
TPWLT	All sequences	3-4 hrs.	EAL 3.4.2: Failure of all DHR systems indicated when vent attempted
TWLT	All sequences	3-4 hrs.	EAL 3.4.2: Failure of all DHR systems indicated when vent attempted
LOCA	All sequences	0-30 min.	EAL 3.4.2: LOCA <u>and</u> ECCS unsuccessful
ATWS	All sequences	0-30 min.	EAL 3.4.1: Failure to scram
ATSLC	w/IS failure	30-60 min.	EAL 2.4.1: level below TAF <u>and</u> containment unisolated

Table 3.5-1

CNS GENERAL EMERGENCY DECLARATION TIMING

PDS	General Emergency Declaration		
	Sequence Characteristics	Est. Time to Declare	Basis
	w/IS and VF successful, but RHR unsuccessful	3-4 hrs.	EAL 2.4.1: clad failure <u>and</u> DW press. 25 psig
	w/IS successful, but VF and RHR unsuccessful	~ 2 hrs.	EAL 2.4.1: clad failure, RCS failure, <u>and</u> H2% above 4%
ISLOCA	All sequences	0-30 min.	EAL 3.4.2: LOCA <u>and</u> ECCS unsuccessful
PSS	All sequences	0-30 min.	EAL 3.4.2: LOCA <u>and</u> containment unsuccessful

Table 3.5-2
Summary of Sequence Characteristics vs. Release Timing

	Timing of Release (Release Category; hrs. after t=0; basis)												
	PDS Cont. Failure	Cont. Isolation Failure	Cont. Vent Prior to RPV Breach	FCI Fails Cont.	CFE Over-Pressure	DW Shell Melt	RPV Vent for Flooding	Late Cont. Vent	w/o Debris Cooling			w/Debris Cooling	No RPV Failure
									Failure Through Sump	High Temp. Failure	CFL Over-Pressure	CFL Over-Pressure	CFL Over-Pressure
--	(#2)	(#30)	(#35)	(#37)	(#38)	(#52)	(#55)	(#57)	(#56)	(#58)	(#58)	(#58)	
PDS	Entry Condition	+ nIS	+ E-Vent	+ FCI->CF	137,4,1 + 137,5,1 + 137,6,1	+ DWMELT	+ CFLOOD	+ L-Vent	+ SUMP	+ TEMP	158,3,1	158,7,1	158,8,1
TQUX	n/a	EARLY <5 (Case 2)	EARLY 2.25 (est. at VF)	EARLY 2.25 (NEDC 92-048)	EARLY 2.25 (est. at VF)	EARLY 2.35 (IPE,p.4.6-3)	EARLY 5.00 (est. 4000gpm, begin @ TAF)	INTER. 8.00 (est. core block, vent @ 50 lbs)	EARLY 7 (est. p.110, NEDC 92-137)	EARLY 4.08 (NEDC 92-048)	INTER. 20.0 (est. Case 6 + noncond. gases)	INTER. 20.0 (est. Case 6 + noncond. gases)	LATE 30.0 (est. Case 6)
TPUX	n/a	EARLY Y <5 (Case 2)	EARLY Y 2.25 (est. at VF)	EARLY Y 2.25 (NEDC 92-048)	EARLY Y 2.25 (est. at VF)	EARLY Y 2.35 (IPE,p.4.6-3)	EARLY Y 5.00 (est. 4000gpm, begin @ TAF)	INTER. 8.00 (est. core block, vent @ 50 lbs)	INTER. 7 (est. p.110, NEDC 92-137)	EARLY Y 4.08 (NEDC 92-048)	INTER. 20.0 (est. Case 6 + noncond. gases)	INTER. 20.0 (est. Case 6 + noncond. gases)	LATE 30.0 (est. Case 6)
TQUV	n/a	EARLY Y <5 (Case 2)	EARLY Y 2.25 (est. at VF)	EARLY Y 2.25 (NEDC 92-048)	EARLY Y 2.25 (est. at VF)	EARLY Y 2.35 (IPE,p.4.6-3)	EARLY Y 5.00 (est. 4000gpm, begin @ TAF)	INTER. 8.00 (est. core block, vent @ 50 lbs)	EARLY 7 (est. p.110, NEDC 92-137)	EARLY Y 4.08 (NEDC 92-048)	INTER. 20.0 (est. Case 6 + noncond. gases)	INTER. 20.0 (est. Case 6 + noncond. gases)	LATE 30.0 (est. Case 6)
TPUV	n/a	EARLY Y <5 (Case 2)	EARLY Y 2.25 (est. at VF)	EARLY Y 2.25 (NEDC 92-048)	EARLY Y 2.25 (est. at VF)	EARLY Y 2.35 (IPE,p.4.6-3)	EARLY Y 5.00 (est. 4000gpm, begin @ TAF)	INTER. 8.00 (est. core block, vent @ 50 lbs)	INTER. 7 (est. p.110, NEDC 92-137)	EARLY Y 4.08 (NEDC 92-048)	INTER. 20.0 (est. Case 6 + noncond. gases)	INTER. 20.0 (est. Case 6 + noncond. gases)	LATE 30.0 (est. Case 6)
ST-SBLP	n/a	EARLY Y <5 (Case 2)	EARLY Y 3.25 (est. at VF)	EARLY Y 3.25 (NEDC 92-038)	EARLY Y 3.25 (est. at VF)	EARLY Y 3.35 (IPE,p.4.6-3)	INTER. 5.00 (est. 4000gpm, begin @ TAF)	INTER. 8.00 (est. core block, vent @ 50 lbs)	INTER. 10 (est. p.110, NEDC 92-137)	INTER. 5.14 (NEDC 92-038)	INTER. 20.0 (est. Case 6 + noncond. gases)	INTER. 20.0 (est. Case 6 + noncond. gases)	LATE 30.0 (est. Case 6)

OK

OK

OK

Table 3.5-2
Summary of Sequence Characteristics vs. Release Timing

PDS	Timing of Release (Release Category; hrs. after t=0; basis)												
	PDS Cont. Failure	Cont. Isolation Failure	Cont. Vent Prior to RPV Breach	FCI Fails Cont.	CFE Over-Pressure	DW Shell Melt	RPV Vent for Flooding	Late Cont. Vent	w/o Debris Cooling			w/Debris Cooling	No RPV Failure
									Failure Through Sump	High Temp. Failure	CFL Over-Pressure	CFL Over-Pressure	CFL Over-Pressure
									(#57)	(#56)	(#58)	(#58)	(#58)
--	(#2)	(#30)	(#35)	(#37)	(#38)	(#52)	(#55)	(#57)	(#56)	(#58)	(#58)	(#58)	
Entry Condition	+ nIS	+ E-Vent	+ FCI->CF	137,4,1 + 137,5,1 + 137,6,1	+ DWMELT	+ CFLLOOD	+ L-Vent	+ SUMPF	+ TEMP	158,3,1	158,7,1	158,8,1	
ST-SBHP	n/a	EARL Y <5 (Case 2)	EARL Y 3.25 (est. at VF)	EARL Y 3.25 (NEDC 92-038)	EARL Y 3.25 (est. at VF)	EARL Y 3.35 (IPE,p.4.6-3)	INTER. 5.00 (est., 4000gpm, begin @ TAF)	INTER. 8.00 (est., core block, vent @ 50 lbs)	INTER. 10 (est., p.110, NEDC 92-137)	INTER. 5.14 (NEDC 92-038)	INTER. 20.0 (est., Case 6 + noncond. gases)	INTER. 20.0 (est., Case 6 + noncond. gases)	LATE 30.0 (est., Case 6)
DT-SBLP	n/a	EARL Y <5 (conservative est., Case 2)	INTER. 8.70 (est. at VF)	INTER. 8.70 (NEDC 92-038)	INTER. 8.70 (est. at VF)	INTER. 8.80 (IPE,p.4.6-3)	EARL Y 7.04 (est., 4000gpm, begin @ TAF)	INTER. 10.00 (est., core block, vent @ 50 lbs)	INTER. 17 (est., p.110, NEDC 92-137)	- INTER- 11.40 (NEDC 92-038)	LATE 30.0 (est., Case 6 + DTSBO + gases)	LATE 30.0 (est., Case 6 + DTSBO + gases)	LATE >30.0 (est., TW case + DTSBO + gases)
DT-SBHP	n/a	EARL Y <5 (conservative est., Case 2)	INTER. 9.74 (est. at VF)	INTER. 9.74 (NEDC 92-038)	INTER. 9.74 (est. at VF)	INTER. 9.84 (IPE,p.4.6-3)	INTER. 9.42 (est., 4000gpm, begin @ TAF)	INTER. 10.00 (est., core block, vent @ 50 lbs)	INTER. 17 (est., p.110, NEDC 92-137)	INTER. 11.20 (NEDC 92-038)	LATE 30.0 (est., Case 6 + DTSBO + gases)	LATE 30.0 (est., Case 6 + DTSBO + gases)	LATE 30.0 (est., TW case + DTSBO + gases)
TWDT	n/a	n/a	n/a	INTER. 14.60 (NEDC 92-044)	INTER. 14.60 (est. at VF)	INTER. 14.70 (IPE,p.4.6-3)	n/a	n/a	INTER. 23 (est., p.110, NEDC 92-137)	INTER. 17.80 (NEDC 92-044)	INTER. 20.0 (est., Case 6 + noncond. gases)	INTER. 20.0 (est., Case 6 + noncond. gases)	LATE 30.0 (est., Case 6)
TPWLT	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	LATE 32 (Case 6)
TWLT	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	LATE 30 (Case 5)

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Summary of Sequence Characteristics vs. Release Timing**

PDS	Timing of Release (Release Category; hrs. after t=0; basis)												
	PDS Cont. Failure	Cont. Isolation Failure	Cont. Vent Prior to RPV Breach	FCI Fails Cont.	CFE Over-Pressure	DW Shell Melt	RPV Vent for Flooding	Late Cont. Vent	w/o Debris Cooling			w/Debris Cooling	No RPV Failure
									Failure Through Sump	High Temp. Failure	CFL Over-Pressure	CFL Over-Pressure	CFL Over-Pressure
	--	(#2)	(#30)	(#35)	(#37)	(#38)	(#52)	(#55)	(#57)	(#56)	(#58)	(#58)	(#58)
Entry Condition	+ nIS	+ E-Vent	+ FCI->CF	137,4,1 + 137,5,1 + 137,6,1	+ DWMELT	+ CFLOOD	+ L-Vent	+ SUMP	+ TEMP	158,3,1	158,7,1	158,8,1	
LOCA	n/a	EARL Y <5 (Case 2)	EARL Y 2.25 (est. at VF)	EARL Y 2.25 (NEDC 92-048)	EARL Y 2.25 (est. at VF)	EARL Y 2.35 (IPE,p.4.6-3)	INTER. 5.00 (est., 4000gpm, begin @ TAF)	INTER. 8.00 (est., core block, vent @50 lbs)	INTER. 7 (est., p.110, NEDC 92-137)	EARL Y 4.08 (NEDC 92-048)	INTER. 20.0 (est., Case 6 + noncond. gases)	INTER. 20.0 (est., Case 6 + noncond. gases)	LATE 30.0 (est., Case 6)
ATWS	EARLY 1 (estimate)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
ATSLC	n/a	EARL Y <5 (Case 2)	EARL Y 2.25 (est. at VF)	EARL Y 2.25 (NEDC 92-048)	EARL Y 2.25 (est. at VF)	EARL Y 2.35 (IPE,p.4.6-3)	EARL Y 5.00 (est., 4000gpm, begin @ TAF)	INTER. 8.00 (est., core block, vent @50 lbs)	INTER. 7 (est., p.110, NEDC 92-137)	EARL Y 4.08 (NEDC 92-048)	INTER. 20.0 (est., Case 6 + noncond. gases)	INTER. 20.0 (est., Case 6 + noncond. gases)	LATE 30.0 (est., Case 6)
ISLOCA	EARLY 2 (Case 4)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
PSS	EARLY 1 (estimate)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

(1) Reference numbers below column headings refer to EVNTRE CET input file question numbers (refer to Appendix E).

(2) Parameters below EVNTRE CET question numbers refer to a specific "answer" (i.e., CET pathway). For example, the parameter + nIS indicates the sequence path for "containment not isolated;" the parameter !37,4,1 (written in EVNTRE format) indicates question 37, case #4, answer #1 (refer to Appendix E).