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AUTH.NAME AUTHOR AFFILIATION
VAN BRUNT,E.E. Arizona Public Service Co.
RECIP.NAME RECIPIENT AFFILIATION
KNIGHTON,G. Licensing Branch 3

SUBJECT: Forwards response to Question 6,re reactor protection sys/ESF response times per NRC 841006 request for addl info. 566 RPV

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Palo Verde Nuclear Station, Unit 3, Arizona

Arizona Public Service Co.

Arizona Public Service Company

ANPP-31119-EEVBJr/WFQ
November 13, 1984

Director of Nuclear Reactor Regulation
Attention: Mr. George Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Docket Nos. STN-50-528/529/530
Response to NRC Question 6
File: 84-056-026; G.1.01.10

Reference: Letter from G.W. Knighton (NRC) to E.E. Van Brunt, Jr. (APS), dated October 6, 1984; Subject: Request for Additional Information - Palo Verde Unit 1 Technical Specifications

Dear Mr. Knighton:

Attached for your information is our response to NRC Question 6 from the reference letter.

Please contact me if you have any questions.

Very truly yours,

E. E. Van Brunt

E. E. Van Brunt, Jr.
APS Vice President
Nuclear Production
ANPP Project Director

EEVBJr/WFQ/no
Attachment

cc: E. A. Licitra w/a
A. C. Gehr w/a
R. P. Zimmerman w/a

B001
1/1

8411160316 841113
PDR ADOCK 05000528
A PDR

ANPP-31119-EEVBJr/WFQ
November 13, 1984

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, Edwin E. Van Brunt, Jr., represent that I am Vice President, Nuclear Production of Arizona Public Service Company, that the foregoing document has been signed by me on behalf of Arizona Public Service Company with full authority to do so, that I have read such document and know its contents, and that to the best of my knowledge and belief, the statements made therein are true.

Edwin E. Van Brunt, Jr.

Sworn to before me this 13 day of November, 1984.

Nora E. Meador
Notary Public

My Commission Expires:
My Commission Expires April 6, 1987

Question

6. RPS/ESF Response Times (Table 3.3-2, page 3/4 3-9 and 3.3-5, page 3/4 3-24 through 3/4 3-26)

(A) Provide the bases for RPS/ESF response times listed in these tables or refer to the assumptions made in Chapter 15 of FSAR.

(B) Provide time lines for all the transients discussed in the response to this question.

(C) Why are the neutron detectors exempt from response time testing?

(D) Verify that the response time testing procedures include sensor and signal delays.

Response

A. The Reactor Protection System/Engineering Safety Features (RPS/ESF) response times listed in PVNGS proof and review Technical Specification (T/S), dated August 13, 1984, Tables 3.3-2 and 3.3-5, respectively, and as modified by this response are based on the assumptions made in Chapter 15 of the PVNGS FSAR. This is demonstrated by Enclosure 1 which tabulates the proposed response time values and the corresponding sequence of events tables(s) in the FSAR (either PVNGS or CESSAR as appropriate).

Please note that several discrepancies were observed between previously proposed response times and the Chapter 15 response times existing at that time. The following concurrent actions are being taken to address those discrepancies.

1. The discrepancies in the CPC, variable overpower trip, MSIV and MFIV response times were the subject of an October 4, 1984 meeting with the NRC staff. At that time the discrepancies and their root causes were discussed. It was concluded that the response times given in Enclosure 1 are appropriate pending: 1) CESSAR change to the MSIV and MFIV closure time and 2) APS submission of a parallel FSAR change on the valve closure times. A summary of the meeting and corrective action will be submitted to the NRC on the CESSAR docket.

2. The discrepancies in MFIV and AFW were also discussed in that same meeting. These discrepancies were due to recent changes brought about by startup testing for which PVNGS FSAR change packages had been initiated but not been submitted. These changes are being submitted to the the NRC under separate cover.

3. Sequence of events tables are being revised to demonstrate that the response times were consistent with the Chapter 15 analysis. These changes are included in Enclosure 2 and will be transmitted by separate letter on the appropriate docket.

B. The necessary information to construct a response time line for all transients discussed in the response to Question 6A above is included in Enclosure 2.

8411160316

C. The neutron detectors are exempt from response time testing for the following reasons:

1. The neutron detectors utilized at Palo Verde are fission chambers. The response time of a fission chamber is primarily dependent on neutron interaction time in the chamber and neutron flight time from the core. Both of these times are several orders of magnitude lower than the signal delay times assumed in the Safety Analysis for trip functions which use these detectors;

2. In-situ response time testing of the neutron detectors is not practicable. Detector input (neutron flux) can neither be varied nor measured with sufficient speed and accuracy to allow any meaningful determination of detector response time, (typically $<<1$ ms).

D. The Palo Verde Safety Systems Response Time Testing Procedures include the measurement of both sensor and signal delays. These values are combined to determine an overall channel response time. The Neutron Detectors and Reactor Pump Speed Sensors are specifically excluded from response time testing in the Technical Specifications and are not included in the response time testing procedures.

ENCLOSURE 1

CORRELATION BETWEEN PVNGS TECHNICAL SPECIFICATION TABLE 3.3-2
RESPONSE TIMES AND FSAR SEQUENCE OF EVENTS TABLE AND FSAR SECTION

FUNCTIONAL UNIT	RESPONSE TIME (Seconds)	SAFETY ANALYSIS REFERENCED (e)
I. TRIP GENERATION		
A. Process		
1. Pressurizer Pressure - High	≤1.15	CESSAR Tables 15.2.3-1, 15.5.2-1, 15.B-2, 15.B-4
2. Pressurizer Pressure - Low	≤1.15	CESSAR Table 6.3.3.5-1
3. Steam Generator Level - Low	≤1.15	CESSAR Tables 15.B-2, 15.B-4
4. Steam Generator Level - High	≤1.15	CESSAR Section 15.1.2.2(b)
5. Steam Generator Pressure - Low	≤1.15	CESSAR Table 15.1.5-4
6. Containment Pressure - High	≤1.15	PVNGS FSAR Tables 6.2.1-10 Sheets 4 and 5(d), 6.2.1-28(d), CESSAR Tables 6.2.1-11 thru 20
7. Reactor Coolant Flow - Low	≤0.65	PVNGS FSAR Table 15.1-1(d)
8. Local Power Density - High		
a. Neutron Flux Power from Excore Neutron Detectors	≤0.75	CESSAR Section 15.1.2.2(b)
b. CEA Positions	≤1.35	CESSAR Section 15.1.2.2(b)
c. CEA Positions: CEAC Penalty Factor	≤0.75	CESSAR Section 15.1.2.2(b)
9. DNBR - Low		
a. Neutron Flux Power from Excore Neutron Detectors	≤0.75	CESSAR Tables 15.1.4-2, 15.1.5-2, 15.1.5-3, 15.1.5-5, 15.3.1-1, 15.3.3-1, 15.6.3-1, 15.6.3-6, 15D-1
b. CEA Positions	≤1.35	CESSAR Table 15.4.2-1
c. Cold Leg Temperature	≤0.75	See Item 9a
d. Hot Leg Temperature	≤0.75	See Item 9a
e. Primary Coolant Pump Shaft Speed	≤0.75	See Item 9a
f. Reactor Coolant Pressure from Pressurizer	≤0.75	See Item 9a
g. CEA Positions: CEAC Penalty Factor	≤0.75	See Item 9a

CORRELATION BETWEEN PVNGS TECH[redacted]L SPECIFICATION TABLE 3.3-2
RESPONSE TIMES AND FSAR SEQUENCE OF EVENTS TABLE AND FSAR SECTION
(CONTINUED)

FUNCTIONAL UNIT	RESPONSE TIME (Seconds)	SAFETY ANALYSIS REFERENCED (e)
B. Excore Neutron Flux		
1. Variable Overpower Trip	≤0.55	CESSAR Tables 15.4.1-1, 15.4.8-1, PVNGS FSAR Section 15.1.5(d)
2. Logarithmic Power level - High		
a. Startup and Operating	≤0.55	CESSAR Section 15.4.1.6
C. Core Protection Calculator System		
1. CEA Calculators	N/A	
2. Core Protection System	N/A	
D. Supplementary Protection System		
1. Pressurizer Pressure - High	≤1.15	Response to NRC Question 440.5(b)
II. RPS LOGIC		
A. Matrix Logic	N/A	
B. Initiation Logic	N/A	
III. RPS ACTUATION DEVICES		
A. Reactor Trip Breakers	N/A	
B. Manual Trip	N/A	

CORRELATION BETWEEN PVNGS TECHNICAL SPECIFICATION TABLE 3.3-5
RESPONSE TIMES AND FSAR SEQUENCE OF EVENT TABLE AND FSAR SECTION

INITIATING SIGNAL AND FUNCTION	RESPONSE TIMES (f) (SECONDS)	SAFETY ANALYSIS REFERENCED (e)
1. Manual	N/A	
2. Pressurizer Pressure - Low		
a. Safety Injection (HPSI)	≤30/30	CESSAR Tables 6.3.3.2-1(c), 6.3.3.3-6, 6.3.3.5-1, 15.1.5-1, 15.1.5-2, 15.1.5-3, 15.1.5-4, 15.1.5-5, 15.2.3-1, 15.4.8-1, 15.6.3-1, 15.6.3-6, 15.D-1
b. Safety Injection (LPSI)	≤30/30	CESSAR Tables 6.3.3.2-1(c), 6.3.3.3-6, 6.3.3.5-1
c. Containment Isolation		
1. CIAS Actuated Mini-Purge Valves	≤10.6/10.6	Not Credited for Pzr Pressure-Low, see Item 3.c.1
2. Other CIAS Actuated Valves	≤59/59	PVNGS FSAR Section 6.2.4(b)
3. Containment Pressure - High		
a. Safety Injection (HSPI)	≤30/30	Not Credited for High Containment Pressure, see Item 2.a.
b. Safety Injection (LPSI)	≤30/30	Not Credited for High Containment Pressure, see Item 2.b
c. Containment Isolation		
1. CIAS Actuated Mini-Purge Valves	≤10.6/10.6	PVNGS FSAR Section 6.2.1,5
2. Other CIAS Actuated Valves	≤59/59	PVNGS FSAR Section 6.2,4(b)
d. Main Steam Isolation		
1. MSIS Actuated MSIV's	≤5.6/5.6	CESSAR Tables 6.2.1-11 thru.20 PVNGS FSAR Tables 6.2.1-10, Sheets 4 & 5(d), 6.2.1-28(d)
2. MSIS Actuated MFIV's	≤5.6/5.6 (CESSAR) ≤10.6/10.6 (PVNGS)	CESSAR Tables 6.2.1-11 thru.20, PVNGS FSAR Tables 6.2.1-10, Sheets 4 & 5(d), Table 6.2.1-28(d)

CORRELATION BETWEEN PVNGS TECHNICAL SPECIFICATION TABLE 3.3-5
RESPONSE TIMES AND FSAR SEQUENCE OF EVENT TABLE AND FSAR SECTION
(CONTINUED)

INITIATING SIGNAL AND FUNCTION	RESPONSE TIMES (f) (SECONDS)	SAFETY ANALYSIS REFERENCED (e)
e. Containment Spray Pump	≤27/17	PVNGS FSAR Table 6.2.1-10, Sheets 4 & 5[(d)], Table 6.2.1-28[(d)]
4. Containment Pressure - High - High		
a. Containment Spray Valves	≤33/23	CESSAR Sections 6.3.3.2[(a)], 6.3.3.3[(a)], PVNGS FSAR Table 6.2.1-10, Sheets 4 & 5[(d)], Table 6.2.1-28[(d)]
5. Steam Generator Pressure - Low		
a. Main Steam Isolation		
1. MSIS Actuated MSIV's	≤5.6/5.6	CESSAR Tables 15.1.4-1, 15.1.4-2, 15.1.5-1, 15.1.5-2, 15.1.5-2, 15.1.5-3, 15.1.5-4, 15.1.5-5, 15.6.3-1, 15.B-2, PVNGS FSAR Tables 15.1.5-1[(d)], 15.2-1[(d)]
2. MSIS Actuated MFIV's	≤5.6/5.6 (CESSAR) ≤10.6/10.6(PVNGS)	CESSAR Tables 15.1.4-1, 15.1.4-2, 15.1.5-1, 15.1.5-2, 15.1.5-3, 15.1.5-4, 15.1.5-5, PVNGS FSAR Tables 15.1-1[(d)]
6. Refueling Water Storage Tank-Low		
a. Containment Sump Recirculation	≤45/45	CESSAR Table 6.3.3.5-1
7. Steam Generator Level-Low		
a. Auxiliary Feedwater (Motor Drive)	≤46/11 (CESSAR) ≤46/23 (PVNGS)	CESSAR Tables 15.1.5-1[(a)], 15.1.5-2[(a)], 15.1.5-3[(a)], 15.1.5-4[(a)], 15.1.5-5[(a)], 15.2.3-1, 15.3.3-1, 15.6.3-6, 15.D.1, 15.B-2, PVNGS FSAR Table 15.2-1[(d)]

CORRELATION BETWEEN PVNGS TECHNICAL SPECIFICATION TABLE 3.3-5
RESPONSE TIMES AND FSAR SEQUENCE OF EVENT TABLE AND FSAR SECTION
(CONTINUED)

INITIATING SIGNAL AND FUNCTION	RESPONSE TIMES (f) (SECONDS)	SAFETY ANALYSIS REFERENCED (e)
b. Auxiliary Feedwater (Turbine Drive)	≤46/11 (CESSAR) ≤30/30 (PVNGS)	CESSAR Tables 15.1.5-1[a], 15.1.5-2[a], 15.1.5-3[a], 15.1.5-4[a], 15.1.5-5[a], 15.2.3-1, 15.3.3-1, 15.6.3-6, 15.D.1, 15.B-2, PVNGS FSAR Table 15.2-1[d]
8. Steam Generator Level-High		
a. Main Steam Isolation		
1. MSIS Actuated MSIV's	≤5.6/5.6	CESSAR Section 15.1.2.2
2. MSIS Actuated MFIV's	≤5.6/5.6	CESSAR Section 15.1.2.2
9. Steam Generator Delta P-High Coincident with Steam Generator Level Low		
a. Auxiliary Feedwater Isolation from the Rupture Generator	≤16.0/16.0	PVNGS FSAR Table 15.2-1[d]
10. Control Room Essential Filtration Actuation Signal	≤45/45	PVNGS FSAR Section 9.4

ENCLOSURE 2

TABLE 6.2.1-11

DATA FOR CONTAINMENT PEAK PRESSURE/TEMPERATURE ANALYSES
102% POWER/SLOT/8.78 SQ. FT./LOSS OF CONTAINMENT COOLING

PART D. Accident Chronology

Time (Seconds)	Event
0.00	Break Occurs
3.80	Reactor Trip Signal
3.80	Main Steam Isolation Signal
3.80	Main Feedwater Isolation Signal
4.70	Turbine Admission Valve Closed
4.70	Reactor Trip Begins
4.70	Main Steam Isolation Valves Start To Close
4.70	Main Feedwater Isolation Valves Start To Close
9.70	Main Steam Isolation Valves Closed
9.70	Main Feedwater Isolation Valves Closed
A*	Containment Spray Actuation Signal
A*	Peak Containment Temperature
A*	Peak Containment Pressure
170.00	End Of Blowdown

Setpoint for Rapids with Unit A Unit

* See Applicant's SAR

Insert A

3.80 Containment Pressure Reaches 6.0 psig
Reactor Trip Analysis Setpoint

3.80 Containment Pressure Reaches 60 psig
Main Steam Isolation Signal
(MSIS) Analysis Setpoint

4.80 High Containment Pressure Reactor
Trip Signal Generated and MSIS

4.95 Reactor Trip Breakers Open
4.95 < Turbine Admission Valves Closed

TABLE 6.2.1-12

DATA FOR CONTAINMENT PEAK PRESSURE/TEMPERATURE ANALYSES
102% POWER/GUILLOTINE/8.78 SQ. FT./LOSS OF CONTAINMENT COOLING

PART D: Accident Chronology

Time (Seconds)	Event
0.00	Break Occurs
5.25	Reactor Trip Signal
5.25	Main Steam Isolation Signal
5.25	Main Feedwater Isolation Signal
6.15	Turbine Admisssion Valve Closed
6.15	Reactor Trip Begins
6.15	Main Steam Isolation Valves Start To Close
6.15	Main Feedwater Isolation Valves Start To Close
11.15	Main Steam Isolation Valves Closed
11.15	Main Feedwater Isolation Valves Closed
A*	Containment Spray Actuation Signal
A*	Peak Containment Temperature
A*	Peak Containment Pressure
175.00	End Of Blowdown

* See Applicant's SAR

Insert B

5.25	Containment Pressure Reaches Reactor Trip Analysis Setpoint	6.0 psig
5.25	Containment Pressure Reaches Main Steam Isolation Signal (MSIS) Analysis Setpoint	6.0 psig
6.25	High Containment Pressure Reactor Trip Signal Generated and MSIS	
6.40	Reactor Trip Breakers Open	
6.40	Turbine Admission valves Closed	

TABLE 6.2.1-13

DATA FOR CONTAINMENT PEAK PRESSURE/TEMPERATURE ANALYSES
75% POWER/SLOT/8.78 SQ. FT./LOSS OF CONTAINMENT COOLING

PART D: Accident Chronology

Time (Seconds)	Event
0.00	Break Occurs
3.70	Reactor Trip Signal
3.70	Main Steam Isolation Signal
3.70	Main Feedwater Isolation Signal
4.60	Turbine Admission Valve Closed
4.60	Reactor Trip Begins
4.60	Main Steam Isolation Valves Start To Close
4.60	Main Feedwater Isolation Valves Start To Close
9.60	Main Steam Isol. Valves Closed
9.60	Main Feedwater Isol. Valves Closed
A*	Containment Spray Actuation Signal
A*	Peak Containment Temperature
A*	Peak Containment Pressure
185.00	End Of Blowdown

Replace with insert C

* See Applicant's SAR

Insert C

3.70	Containment Pressure Reaches Reactor Trip Analysis Setpoint	6.0 psig
3.70	Containment Pressure Reaches Main Steam Isolation Signal (MSIS) Analysis Setpoint	6.0 psig
4.70	High Containment Pressure Reactor Trip Signal Generated and MSIS	
4.85	Reactor Trip Breakers Open	
4.85	Turbine Admission Valves Closed	

TABLE 6.2.1-14

DATA FOR CONTAINMENT PEAK PRESSURE/TEMPERATURE ANALYSES
75% POWER/GUILLOTINE/8.78 SQ. FT./LOSS OF CONTAINMENT COOLING

PART D: Accident Chronology

Time (Seconds)	Event
0.00	Break Occurs
5.15	Reactor Trip Signal
5.15	Main Steam Isolation Signal
5.15	Main Feedwater Isolation Signal
6.05	Turbine Admission Valve Closed
6.05	Reactor Trip Begins
6.05	Main Steam Isolation Valves Start To Close
6.05	Main Feedwater Isolation Valves Start To Close
11.05	Main Steam Isol. Valves Closed
11.05	Main Feedwater Isol. Valves Closed
A*	Containment Spray Actuation Signal
A*	Peak Containment Temperature
A*	Peak Containment Pressure
190.00	End of Blowdown

* See Applicant's SAR

Insert D

5.15 Containment Pressure Reaches 6.0 psig
Reactor Trip Analysis Setpoint

5.15 Containment Pressure Reaches 6.0 psig
Main Steam Isolation Signal
(MSIS) Analysis Setpoint

6.15 High Containment Pressure Reactor
Trip Signal Generated
and MSIS

6.30 Reactor Trip Breakers Open
6.30 Turbine Admission Valves Closed

TABLE 6.2.1-15

DATA FOR CONTAINMENT PEAK PRESSURE/TEMPERATURE ANALYSES
50% POWER/SLOT/8.78 SQ. FT./LOSS OF CONTAINMENT COOLING

PART D: Accident Chronology

Time (Seconds)	Event
0.00	Break Occurs
3.55	Reactor Trip Signal
3.55	Main Steam Isolation Signal
3.55	Main Feedwater Isolation Signal
4.45	Turbine Admission Valve Closed
4.45	Reactor Trip Begins
4.45	Main Steam Isolation Valves Start To Close
4.45	Main Feedwater Isolation Valves Start To Close
9.45	Main Steam Isol. Valves Closed
9.45	Main Feedwater Isol. Valves Closed
A*	Containment Spray Actuation Signal
A*	Peak Containment Temperature
A*	Peak Containment Pressure
215.00	End of Blowdown

* See Applicant's SAR

Insert E

3.55	Containment Pressure Reaches Reactor Trip Analysis Setpoint	6.0 psig
3.55	Containment Pressure Reaches Main Steam Isolation Signal (MSIS) Analysis Setpoint	6.0 psig
4.55	High Containment Pressure Reactor Trip Signal Generated and MSIS	
4.70	Reactor Trip Breakers Open	
4.70	Turbine Admission Valves Closed	

TABLE 6.2.1-16

DATA FOR CONTAINMENT PEAK PRESSURE/TEMPERATURE ANALYSES
50% POWER/GUILLOTINE/8.78 SQ. FT./LOSS OF CONT. COOLING

PART D: Accident Chronology

Time (Seconds)	Event
0.00	Break Occurs
5.00	Reactor Trip Signal
5.00	Main Steam Isolation Signal
5.00	Main Feedwater Isolation Signal
5.90	Turbine Admission Valve Closed
5.90	Reactor Trip Begins
5.90	Main Steam Isolation Valves Start To Close
5.90	Main Feedwater Isolation Valves Start To Close
10.90	Main Steam Isol. Valves Closed
10.90	Main Feedwater Isol. Valves Closed
A*	Containment Spray Actuation Signal
A*	Peak Containment Temperature
A*	Peak Containment Pressure
220.000	End of Blowdown

* See Applicant's SAR

Insert F

5.00 Containment Pressure Reaches 6.0 psig
Reactor Trip Analysis Setpoint

5.00 Containment Pressure Reaches 6.0 psig
Main Steam Isolation Signal
(MSIS) Analysis Setpoint

6.00 High Containment Pressure Reactor
Trip Signal and MSIS Generated

6.15 Reactor Trip Breakers Open
6.15 Turbine Admission Valves Closed.

TABLE 6.2.1-17

DATA FOR CONTAINMENT PEAK PRESSURE/TEMPERATURE ANALYSES
25% POWER/SLOT/8.78 SQ. FT./LOSS OF CONTAINMENT COOLING

PART D: Accident Chronology

Time (Seconds)	Event
0.00	Break Occurs
3.45	Reactor Trip Signal
3.45	Main Steam Isolation Signal
3.45	Main Feedwater Isolation Signal
4.35	Turbine Admission Valve Closed
4.35	Reactor Trip Begins
4.35	Main Steam Isolation Valves Start To Close
4.35	Main Feedwater Isolation Valves Start To Close
9.35	Main Steam Isol. Valves Closed
9.35	Main Feedwater Isol. Valves Closed
A*	Containment Spray Actuation Signal
A*	Peak Containment Temperature
A*	Peak Containment Pressure
315.8	End of Blowdown

* See Applicant's SAR

Insert G

3.45	Containment Pressure Reaches Reactor Trip Analysis Setpoint	6.0 psig
3.45	Containment Pressure Reaches Main Steam Isolation Signal (MSIS) Analysis Setpoint	6.0 psig
4.45	High Containment Pressure Reactor Trip Signal Generated and MSIS	
4.60	Reactor Trip Breakers Open	
4.60	Turbine Admission Valves Closed	

TABLE 6.2.1-18

DATA FOR CONTAINMENT PEAK PRESSURE/TEMPERATURE ANALYSES
25% POWER/GUILLOTINE/8.78 SQ. FT./LOSS OF CONTAINMENT COOLING

PART D: Accident Chronology

Time (Seconds)	Event
0.00	Break Occurs
4.86	Reactor Trip Signal
4.86	Main Steam Isolation Signal
4.86	Main Feedwater Isolation Signal
5.76	Turbine Admission Valve Closed
5.76	Reactor Trip Begins
5.76	Main Steam Isolation Valves Start To Close
5.76	Main Feedwater Isolation Valves Start To Close
10.76	Main Steam Isol. Valves Closed
10.76	Main Feedwater Isol. Valves Closed
A*	Containment Spray Actuation Signal
A*	Peak Containment Temperature
A*	Peak Containment Pressure
315.80	End of Blowdown

Replace with Insert H

* See Applicant's SAR

Insert H

4.86	Containment Pressure Reaches Reactor Trip Analysis Setpoint	6.0 psig
4.86	Containment Pressure Reaches Main Steam Isolation Signal (MSIS) Analysis Setpoint	6.0 psig
5.86	High Containment Pressure Reactor Trip Signal Generated and MSIS	
6.01	Reactor Trip Breakers Open	
6.01	Turbine Admission Valves Closed.	

TABLE 6.2.1-19

DATA FOR CONTAINMENT PEAK PRESSURE/TEMPERATURE ANALYSES
0% POWER/SLOT/4.00 SQ. FT./LOSS OF CONTAINMENT COOLING

PART D: Accident Chronology

Time (Seconds)	Event
0.00	Break Occurs
4.55	Reactor Trip Signal
4.55	Main Steam Isolation Signal
4.55	Main Feedwater Isolation Signal
5.45	Turbine Admission Valve Closed
5.45	Reactor Trip Begins
5.45	Main Steam Isolation Valves Start To Close
5.45	Main Feedwater Isolation Valves Start To Close
10.45	Main Steam Isol. Valves Closed
10.45	Main Feedwater Isol. Valves Closed
A*	Containment Spray Actuation Signal
A*	Peak Containment Temperature
A*	Peak Containment Pressure
210.00	End of Blowdown

* See Applicant's SAR

Insert I

4.55 Containment Pressure Reaches Reactor Trip Analysis Setpoint 6.0 psig.

4.55 Containment Pressure Reaches Main Steam Isolation Signal (MSIS) Analysis Setpoint 6.0 psig.

5.55 High Containment Pressure Reactor Trip Signal Generated and MSIS

5.70 Reactor Trip Breakers Open

5.70 Turbine Admission Valves Closed.

TABLE 6.2.1-20

DATA FOR CONTAINMENT PEAK PRESSURE/TEMPERATURE ANALYSES
0% POWER/GUILLOTINE/8.78 SQ. FT./LOSS OF CONTAINMENT COOLING

PART D: Accident Chronology

Time (Seconds)	Event
0.00	Break Occurs
4.75	Reactor Trip Signal
4.75	Main Steam Isolation Signal
4.75	Main Feedwater Isolation Signal
5.65	Turbine Admission Valve Closed
5.65	Reactor Trip Begins
5.65	Main Steam Isolation Valves Start To Close
5.65	Main Feedwater Isolation Valves Start To Close
10.65	Main Steam Isol. Valves Closed
10.65	Main Feedwater Isol. Valves Closed
A*	Containment Spray Actuation Signal
A*	Peak Containment Temperature
A*	Peak Containment Pressure
210.00	End of Blowdown

* See Applicant's SAR

Insert J

4.75	Containment Pressure Reaches Reactor Trip Analysis Setpoint	6.0 psig
4.75	Containment Pressure Reaches Main Steam Isolation Signal (MSIS) Analysis Setpoint	6.0 psig
5.75	High Containment Pressure Reactor Trip Signal Generated and MSIS	
5.90	Reactor Trip Breakers Open	
5.90	Turbine Admission Valves Closed	

TABLE 6.3.3.3-6

TIMES OF INTEREST FOR SMALL BREAKS

(Seconds)

Break Size (ft^2)	~~HPSI Pump On~~ HPSI PUMP FLOW DELIVERED TO RCS (c)	~~LPSI Pump On~~ LPSI PUMP FLOW DELIVERED TO ECS (c)	~~SI Tanks On~~ SI TANKS FLOW DELIVERED TO RCS	Hot Spot Peak Clad Temp. Occurs	
0.50 ft^2/PD	46.5	158.0	142.0	160.0	ECCSA
0.35 ft^2/PD	50.0	248.0	204.0	235.0	
0.20 ft^2/PD	62.0	a.	400.0	442.0	
0.05 ft^2/PD	208.0	a.	b.	2010.0	ECCSA
0.02 ft^2/PD	~~492.0~~ 486.0	a.	b.	437.0	
0.03 ft^2/HL	585.0	a.	b.	540.0	

(a) Calculation terminated before time of LPSI pump activation.

(b) Calculation terminated before initiation of SI tank discharge.

(c) THIS TIME INCLUDES A 30 SECOND DELAY FROM THE TIME THAT THE PRESSURIZER PRESSURE REACHES THE LOW PRESSURIZER PRESSURE SIAS ANALYSIS SETPOINT. till the time when the SI pump flow is delivered to RCS at design capacity. ECCSA

TABLE 6.3.3.5-1
(Sheet 1 of 2)

SEQUENCE OF EVENTS FOR REPRESENTATIVE LARGE AND SMALL BREAK LOCAs

Event	Large Break (0.8 DEG/PD) Setpoint Or Value	Large Break (0.8 DEG/PD) Time, Seconds	Small Break (0.02 ft^2) Setpoint Or Value	Small Break (0.02 ft^2) Time, Seconds	Success Path
Break occurs		0.0		0.0	
Core peak power	117%	0.15	105%	96.0	
~~Low pressurizer pressure trip signal~~ INSERT 1	1600 psia	9.43	1600 psia	456.0	Reactivity Control / ECCSA
Safety injection actuation signal REACTOR TRIP AND SGNFCATED	~~1600 psia~~	10.43 ~~9.43~~	~~1600 psia~~	457.0 ~~456.0~~	Reactivity Control / ECCSA
SIT discharge begins	607.7 psia	16.2	607.7 psia	7500	Reactivity Control
Reflood begins		37.7		NA	
Main steam safety valves begin to open		NA	1295 psia	456.0	Sec. Sys. Integrity
Maximum secondary pressure	1239 psia		1340 psia	184.0	
HPSI pumps ~~start to deliver~~ flow delivered to RCS		68.2		486.0 ~~492.0~~	Reactivity Control / ECCSA
SITs empty		68.2		NA	
LPSI pumps ~~start to deliver~~ flow DELIVERED to RCS		68.2		NA	Reactivity Control / ECCSA

INSERT 1 TO TABLE 6.3.3.5-1.

PRESSURIZER PRESSURE HIGH NEUTRON REACTOR TRIP + BIAS ANALYSIS SETPOINT	ECCSA

TABLE 15.1.4-1
SEQUENCE OF EVENTS FOR FULL POWER
INADVERTENT OPENING OF A STEAM GENERATOR
ATMOSPHERIC DUMP VALVE (IOSGADV)

Time (sec)	Event	Setpoint or Value
1.0	One atmospheric dump valve opens fully	--
30.0	Steady-state hot channel DNBR achieved	1.19
1850.4	Operator initiates manual trip ~~signal~~	--
1850.55	Trip breakers open	--
~~1850.89~~	~~CEA's begin to drop~~	~~--~~
1858	Main steam safety valves open, psia	1282
1886	Main steam safety valves close, psia	1213
1872	Void begins to form in RV upper head	--
2150.4	Main steam isolation signal ~~point~~ generated	~~---~~
2155	MFIV's close completely	--
2155	MSIV's close completely	--
2650	Affected steam generator dries out	--
3000	Operator manually closes ADV	--
3600	Operator initiates plants cooldown	--
2149.4	Steam Generator pressure reaches main steam isolation signal (HSIS) analysis setpoint, psia	820

TABLE 15.1.4-2

SEQUENCE OF EVENTS FOR FULL POWER INADVERTENT OPENING OF A STEAM GENERATOR ATMOSPHERIC DUMP VALVE WITH LOSS OF OFFSITE POWER AFTER TURBINE TRIP

Time (sec)	Event	Setpoint or Value
0.0	One atmospheric dump valve opens fully	--
30.0	Steady state hot channel DNBR achieved	1.19
45.0	Turbine trips	--
45.0	Loss of offsite power occurs	--
45.6	Low DNBR trip ~~occurs~~ signal generated	--
45.75	Trip breakers open	--
~~46.09~~	~~CEA's begin to drop~~	
46.1	Minimum transient DNBR	1.05
48	Hot channel DNBR increases above 1.195	--
~~50.5~~	~~CEA's fully inserted~~	
52	Main steam safety valves open, psia	1292
81	Main steam safety valves close, psia	1218
74	Void begin to form in RV upper head	--
~~315~~ 313.4	Main steam isolation signal ~~psia~~ generated	~~--~~
318	MFIV's close completely	--
318	MSIV's close completely	--
1150	Affected steam generator dries out	--
1800	Operator manually closes ADV	
3600	Operator initiates plant cooldown	--
312.4	Steam generator pressure reaches main steam isolation signal (MSIS) analysis setpoint, psia	820

TABLE 15.1.5-1

SEQUENCE OF EVENTS FOR A LARGE STEAM LINE BREAK DURING FULL POWER OPERATION WITH CONCURRENT LOSS OF OFFSITE POWER (SLBFPLOP)

Time (Sec)	Event	Setpoint or Value
0.0	Steam Line Break and Loss of Offsite Power Occur	--
0.6	Low DNBR Trip ~~Condition Occurs~~ Signal Generated, Projected DNBR	1.19
0.75	Trip Breakers Open	--
~~1.09~~	~~CEAs Begin to Drop~~	~~--~~
8.0	Voids Begin to Form in RV Upper Head	--
~~8.5~~ 8.7	Main Steam Isolation Signal (sgia) Generated	~~210~~
13.3	MFIVs Close Completely	--
13.3	MSIVs Close Completely	--
13.3	EFW Initiated to Intact Steam Generator	--
120	Pressurizer Empties	--
~~178~~ 178.4	Safety Injection Actuation Signal (sgia) Generated	~~1600~~
208	Safety Injection Flow Begins	--
237	Affected Steam Generator Empties	--
259	Maximum Transient Reactivity, 10^{-2} $\Delta\rho$	+0.09
277	Minimum Post-Trip DNBR	2.7
280	Safety Injection Boron Begins to Reach Reactor Core	--
1800	Operator Initiates Cooldown	--

INSERT "A"

INSERT "C"

INSERT "B"

T. 15.1.5-1

"A" 7.7 Steam Generator Pressure Reaches Main Steam Isolation Signal (MSIS) Analysis Setpoint, psia 810

"B" 17.4 Pressurizer Pressure Reaches Safety Injection Actuation Signal (SIAS) Analysis Setpoint, psia 1600

13.3 Steam Generator Level Reaches Emergency Feedwater Actuation Signal Analysis Setpoint, % of wide range

25

TABLE 15.1.5-2

SEQUENCE OF EVENTS FOR A LARGE STEAM LINE BREAK DURING FULL POWER OPERATION WITH OFFSITE POWER AVAILABLE (SLBFP)

Time (Sec)	Event	Setpoint or Value
0.0	Steam Line Break Occurs	--
6.95	Low DNBR Trip ~~Condition Occurs~~ Signal Generated, Projected DNBR	1.19
7.10	Trip Breakers Open	--
~~7.44~~	~~CEAs Begin to Drop~~	~~--~~
11.9	Voids Begin to Form in RV Upper Head	--
INSERT "A" → ~~13.5~~ 13.9	Main Steam Isolation Signal (p51a) Generated	~~900~~
18.5	MFIVs Close Completely	--
INSERT "B" → 18.5	MSIVs Close Completely	--
18.5	EFW Initiated to Intact Steam Generator	--
INSERT "C" → ~~88~~ 90.4	Safety Injection Actuation Signal (p54) Generated	~~1680~~
120	Safety Injection Flow Begins	--
149	Affected Steam Generator Empties	--
151	Maximum Transient Reactivity, 10^{-2} $\Delta\rho$	-0.18
151	Minimum Post-Trip DNBR	26
160	Safety Injection Boron Begins to Reach Reactor Core	--
1800	Operator Initiates Cooldown	--

T. 15.1.5-2

"A"		
12.9	Steam Generator Pressure Reaches Main Steam Isolation Signal Analysis Setpoint, psia	810
"B"		
18.5	Steam Generator Water Level Reaches Emergency Feedwater Actuation Signal Analysis Setpoint, percent of wide range	25
"C"		
-89.4	Pressurizer Pressure Reaches Safety Injection Actuation Signal Analysis Setpoint, psia	1600

TABLE 15.1.5-3

SEQUENCE OF EVENTS FOR A LARGE STEAM LINE BREAK DURING ZERO POWER OPERATION WITH CONCURRENT LOSS OF OFFSITE POWER (SLBZPLOP AND SLBZPLOPD).

Time (Sec)	Event	Setpoint or Value
0.0	Steam Line Break and Loss of Offsite Power Occur	--
0.6	Low DNBR Trip ~~Condition Occurs~~ Signal Generated, Projected DNBR	1.19
0.75	Trip Breakers Open	--
~~1.09~~	~~CEAs Begin to Drop~~	~~--~~
INSERT "A" ~~5.7~~ 6.0	Main Steam Isolation Signal (~~psia~~) Generated	~~210~~
~~10.7~~ 10.6	MFIVs Close Completely	--
~~10.7~~ 10.6	MSIVs Close Completety	--
INSERT "B" ~~10.7~~ 10.6	EFW Initiated to Intact Steam Generator	--
INSERT "C" ~~15~~ 45.6	Safety Injection Actuation Signal (~~psia~~) Generated	~~1520~~
55	Voids Begin to Form in RV Upper Head	--
59	Pressurizer Empties	
75.2	Safety Injection Flow Begins	--
120	Safety Injection Boron Begins to Reach Reactor core	--
189	Maximum Transient Reactivity, 10^{-2} $\Delta\rho$	-0.06
1240	Affected Steam Generator Empties	--
1800	Operator Initiates Cooldown	--

T 15.1.5-3

"A"	5.0	Steam Generator Pressure Reaches Main Steam Isolation Signal Analysis Setpoint, psia	810
(B)	10.6	Steam Generator Level Reaches Emergency Feedwater Actuation Signal Analysis Setpoints, % wide range	25
(C)	44.6	Pressurizer Pressure Reaches Safety Injection Actuation Signal Analysis Setpoint, psia	1600

TABLE 15.1.5-4

SEQUENCE OF EVENTS FOR A LARGE STEAM LINE BREAK DURING ZERO POWER OPERATION WITH OFFSITE POWER AVAILABLE (SL8ZP)

Time (Sec)	Event	Setpoint or Value
0.0	Steam Line Break Occurs	--
~~6.24~~ 6.64	Low Steam Generator Pressure Reactor ~~SIAS~~ Trip and Main Steam Isolation Signal ~~(SIAS)~~ Generated	
6.79	Trip Breakers Open	--
~~7.12~~	~~CEAs Begin to Drop~~	
~~11.5~~ 11.2	MFIVs Close Completely	--
~~11.5~~ 11.2	MSIVs Close Completely	--
~~11.5~~ 11.2	EFW Initiated to Intact Steam Generator	--
~~41~~ 41.6	Safety Injection Actuation Signal ~~(SIAS)~~ Generated	~~1600~~
48	Voids Begin to Form in RV Upper Head	--
52	Pressurizer Empties	--
~~71~~ 71.2	Safety Injection Flow Begins	
110	Safety Injection Boron Begins to Reach Reactor Core	--
310	Maximum Transient Reactivity, 10^{-2} $\Delta\rho$	-0.02
418	Affected Steam Generator Empties	--
1800	Operator Initiates Cooldown	--

INSERT "A"

INSERT "B"

INSERT "C"

Table 15.1.5-4

"A"		
5.64	Steam Generator Pressure Reaches Reactor Trip Analysis Setpoint, psia	810
5.64	Steam Generator Pressure Reaches Main Steam Isolation Analysis Setpoint, psia ↑ Signal	810
"B"		
11.2	Steam Generator Water Level Reaches ~~Emergency Feedwater~~ Actuation Signal Analysis Setpoint, % wide range	25
"C"		
40.6	Pressurizer Pressure Reaches Safety Injection Actuation Signal. Analysis Setpoint, Psia	1600

TABLE 15.1.5-5

SEQUENCE OF EVENTS FOR A STEAM LINE BREAK OUTSIDE CONTAINMENT DURING FULL POWER OPERATION WITH OFFSITE POWER AVAILABLE (SLBFPO)

Time (Sec)	Event	Setpoint or Value
0.0	Steam Line Break Occurs	--
5.85	Low ONBR Trip ~~Condition~~ Projected ONBR Signal Generated	1.19
6.00	Trip Breakers Open	--
~~6.34~~	~~CEAs Begin to Drop~~	~~--~~
7.49	Minimum Transient ONBR	1.11
8.94	Voids Begin to Form in RV Upper Head	--
~~12.8~~ 13.2	Main Steam Isolation Signal Generated	~~--~~
17.8	EFW Initiated to Intact Steam Generator	
17.8	MFIVs Close Completely	--
17.8	MSIVs Close Completely	--
~~55~~ 65.6	Safety Injection Actuation Signal ~~(SIS)~~ Generated	~~1600~~
75	Maximum Post-trip Transient Reactivity, 10^{-2} $\Delta\rho$	1.92
~~88~~ 95.2	Safety Injection Flow Begins	—
100	Affected Steam Generator Empties	—
200	Safety Injection Boron Begins to Reach Reactor Core	—
430	Secondary Post-trip Transient Reactivity Peak, 10^{-2} $\Delta\rho$	-2.06
1800	Operator Initiates Cooldown	--

INSERT "A"

INSERT "B"

INSERT "C"

9

T. 15.1.5-5

"A" 12.2 Steam Generator Pressure Reaches Main Steam Isolation Signal Analysis Setpoint, psia 810

"B" 17.8 Steam Generator Water Level Reaches Emergency Feedwater Actuation Signal Analysis Setpoint, percent of wide range 25

"C" 6.6 Pressurizer Pressure Reaches Safety Injection Actuation Signal (SIAS) Analysis Setpoint, psia 1600

TABLE 15.2.3-1

SEQUENCE OF EVENTS FOR THE LOCV

Time (Sec)	Event	Setpoint or Value	Success Path
0.0	Loss of Condenser Vacuum		
~~6.4~~ 6.84	High Pressurizer Pressure Trip Signal, psia Generated	~~2355~~	Reactivity Control
6.7	Main Steam Safety Valves Open psia	1282	Secondary System Integrity
* ~~6.7~~	~~Low Steam Generator Water Level, percent of wide range~~	~~25~~	~~Reactivity Control~~
6.8	Maximum Core Power, % of Design Power	102	Reactivity Control
6.9	Pressurizer Safety Valves, Open, psia	2525	Priamry Integrity System
~~7.3~~ 6.99	Trip Breakers Open ~~CEA's Begin To Drop~~		Reactivity Control
8.6	Maximum RCS Pressure, psia	2742	
12.0	Pressurizer Safety Valves Close, psia	2462	Primary System Integrity
14.0	Maximum Steam Generator Pressure, psia	1353	
~~32.0~~ 34.1	Emergency Feedwater Actuation Signal, percent of wide range Generated	~~25~~	
~~43.0~~ 44.1	Emergency Feedwater Flow Initiated, gpm	875	Secondary System Integrity
346.0	Main Safety Valves Close, psia	1218	Secondary System Integrity
~~960.0~~ 964.1	Safety Injection Actuation Signal, psia Generated	~~1755~~	Reactor Heat Removal
~~1005.0~~ 993.7	Safety Injection Flow Initiated		Primary System Integrity

"A" Pressurizer Pressure Reaches Reactor
5.84 Trip Analysis Setpoint, psia

2450 Reactivity Control

"B" Steam Generator Water Level Reaches
6.7 Reactor Trip Analysis Setpoint, percent of wide range

40

"C" Steam Generator Water Level Reaches Emergency Feedwater Actuation Signal
33.1 Analysis Setpoint, percent of wide range

15

"D" Pressurizer Pressure Reaches Safety Injection Actuation Signal
963.1 Analysis Setpoint, psia

1580 Reactor Heat Removal

TABLE 15.2.3-1 (Cont'd)

SEQUENCE OF EVENTS FOR THE LOCV

Time (Sec)	Event	Setpoint or Value	Success Path
1150.0	Borated HPSI Flow Enters the Core		Reactivity Control
1408.0	~~EFAS Withdrawn, percent of wide range~~ Steam Generator Water Level Reaches EFAS Reset Analysis Setpoint, percent of wide range	80	Secondary System Integrity
1800.0	Operator Initiates Plant Cooldown		Reactor Heat Removal

TABLE 15B-2

(Sheet 1 of 2)

SEQUENCE OF EVENTS FOR THE LIMITING CASE LOSS OF FEEDWATER INVENTORY EVENT

Time (Sec)	Event	Setpoint or Value
0.0	Break in the Main Feedwater Line, ft^2	0.2 ~~ft²~~
0.0	Instantaneous Loss of All Feedwater Flow to Both Steam Generators	
0.0	Instantaneous Development of Critical Flow from the Ruptured Steam Generator to the Break	
33.82	Instantaneous Loss of All Heat Transfer to the Ruptured Steam Generator (INSERT "A")	
~~34.4~~ 34.82	Low Water Level Trip Signal ~~from the Ruptured Steam Generator~~ Generated	~~[illegible]~~
~~34.4~~ 34.82	Emergency Feedwater Actuation Signal ~~from the Ruptured Steam Generator~~ Generated	~~[illegible]~~
~~34.4~~ 34.82	High Pressurizer Pressure Trip Signal Generated	~~2475 psia~~
34.6	Pressurizer Safety Valves Open, psia	2525 ~~psia~~
~~35.0~~ 34.97	Trip Breakers Open	--
~~35.3~~	~~CEA's Begin to Drop~~	
35.8	Instantaneous Closure of the Turbine Stop Valves	--
35.8	Loss of Normal On-Site and Off-Site Electrical Power	--
~~35.8~~	(INSERT "B") ~~Low Water Level Trip Signal from the Intact Steam Generator~~	~~35% of wide range instrument span~~
38.2	Maximum Reactor Coolant Pressure, psia	2843 ~~psia~~
	Maximum Pressurizer Pressure, psia	2587 ~~psia~~
	Maximum Pressurizer Surge Line Flow, lbm/sec	2206 ~~lbm/sec~~

SEQUENCE OF EVENTS FOR THE LIMITING CASE LOSS OF FEEDWATER INVENTORY EVENT

Time (Sec)	Event	Setpoint or Value
40.5	Main Steam Safety Valves Open, psia	1282 ~~psia~~.
INSERT "C" → ~~34.6~~ 45.0	Emergency Feedwater Actuation Signal Generated ~~from the Intact Steam Generator~~	~~10% of wide range instrument span~~
44.8	Maximum Steam Generator Pressure, psia	1318 ~~psia~~
45.4	Pressurizer Safety Valves Close, psia	2525 ~~psia~~
45.8	Minimum Pressurizer Steam Volume, ft^3	138 ~~ft^3~~
73.8	Main Steam Safety Valves Close, psia	1218 ~~psia~~
~~79.4~~	~~Emergency Feedwater Flow Initiated to the Ruptured Steam Generator~~	~~375 gpm~~
~~80.6~~ 90.0	Emergency Feedwater Flow Initiated to the Intact Steam Generator, gpm	875 ~~gpm~~
INSERT "D" → ~~115.6~~	~~Low Pressure Trip Signal from the Ruptured Steam Generator~~	~~810 psia~~
~~115.6~~ 166.0	Main Steam Isolation Signal Generated	~~800 psia~~
170.6	Minimum Intact Steam Generator Liquid Mass, lbm	8100 ~~lbm~~
~~171.6~~	~~Emergency Feedwater Flow Terminated to the Ruptured Steam Generator~~	~~150 psi~~
314.2	Main Steam Safety Valves Open, psia	1282 ~~psia~~
1800.0	Operator Opens the Atmospheric Steam Dump Valves to Begin Plant Cooldown to Shutdown Cooling	

170.6 Main Steam Isolation Valves Closed

"A"

33.82	Steam Generator Water Level Reaches Reactor Trip Analysis Setpoint in the Ruptured Generator	Empty
33.82	Steam Generator Water Level Reaches Emergency Feedwater Actuation Signal Analysis Setpoint in the Ruptured Generator	Empty
33.82	Pressurizer Pressure Reaches Reactor Trip Analysis Setpoint, psia	2475

"B"

3[redacted]	Steam Generator Water Level Reaches Reactor Trip Analysis Setpoint in the Intact Generator, percent of wide range	35

"C"

44.0	Steam Generator Water Level Reaches Emergency Feedwater Actuation Signal Analysis Setpoint in the Intact Generator, percent of wide range	10

"D"

[redacted].0	Steam Generator Pressure Reaches Main Steam Isolation Signal Analysis Setpoint, psia	810

TABLE 15B-4

SEQUENCE OF EVENTS FOR THE REANALYSIS OF THE LIMITING SMALL BREAK LOSS OF FEEDWATER INVENTORY EVENT

Time (sec)	Event	Setpoint or Value
0.0	Rupture in the Main Feedwater Line, ft^2	0.20
0.0	Complete Loss of Feedwater to Both Steam Generators	----
0.0	Initial Steam Generator Break Flow, lbm/sec	1979
~~26.0~~ 25.98	~~High~~ Pressurizer Pressure Trip ~~Condition Reached, psia~~ Analysis Reaches Reactor Setpoint, psia	2475
~~26.6~~ 26.98	High Pressurizer Pressure Trip Signal Generated	----
~~26.6~~ 26.98	Low Level Trip Signal ~~in Ruptured SG~~ Water Generated	----
~~26.6~~ 25.98	Heat Transfer Degradation in Ruptured SG Begins	----
~~27.5~~ 27.13	Reactor Trip Breakers Open	----
~~27.5~~ 27.97	Turbine Trip on Reactor Trip	----
~~27.5~~ 27.97	Failure to Fast Transfer - Two Reactor Coolant Pumps Coast Down	----
~~27.8~~	~~CEAs Begin to Drop into Core~~	~~----~~
28.3	Pressurizer Safety Valves, psia	2525
30.0	Main Steam Safety Valves Open	1282
30.2	Maximum Surge Line Flow, lbm/sec	1458
30.2	Maximum RCS Pressure, psia	2712
33.8	Maximum Steam Generator Pressure, psia	1342
36.8	Ruptured SG Dries Out	----
37.4	Primary Safety Valves Close, psia	2523
25.98	Steam Generator Water Level Reaches Reactor Trip Analysis Setpoint in the Ruptured Generator, lb_m liquid remaining	35000

TABLE 15.3.1-1

SEQUENCE OF EVENTS FOR TOTAL LOSS OF REACTOR COOLANT FLOW

Time (Sec)	Event	Setpoint Or Value	Success Path
0.0	Loss of Offsite Power - Turbine Trip - Diesel Generator Starting Signal - Reactor Coolant Pumps Coast Down - ~~Main Feedwater Is Lost~~ Loss of Main Feedwater		
0.6	Low DNBR Trip Signal Generated, Projected DNBR	1.19 ~~Projected~~	Reactivity Control
0.75	Trip Breakers Open		Reactivity Control
1.09	CEA's Begin to Drop		Reactivity Control
2.6	Minimum Transient DNBR	1.19	
4.3	Pressurizer Safety Valves Open, psia	2525	Primary System Integrity
5.3	Maximum RCS Pressure, psia	2576	
5.4	Main Steam ~~Steam Generator~~ Safety Valves Open, psia	1282	Secondary System Integrity
11.7	Maximum Steam Generator Pressure, psia	1338	
12.2	Pressurizer Safety Valves Closed, psia	2463	Primary System Integrity
1800.0	Operator Initiates Plant Cooldown		

Table 15.3.3-1

(Sheet 1 of 2)

SEQUENCE OF EVENTS FOR THE SINGLE REACTOR COOLANT PUMP ROTOR SEIZURE WITH LOSS OF OFFSITE POWER RESULTING FROM TURBINE TRIP

Time (sec.)	Event	Setpoint or Value	Total Integrated Safety Valve Flow (lbm)	Success Path	
0.0	Seizure of a Single Reactor Coolant Pump	—	—	—	
0.76	Low ONBR Trip Signal Generated, projected	1.19	—	Reactivity Control	
1.25	CEAs Begin to Drop Into the Core	—	—	Reactivity Control	3
1.25	Turbine Trip/Generator Trip	—	—	—	
1.4	Minimum Transient ONBR	0.967	—	—	
4.1	Main Steam Safety Valves Open, Unaffected Loop, psia	1280	—	Secondary System Integrity	
4.2	Maximum RCS Pressure, psia	2387	—	—	
4.25	Loss of Offsite Power Occurs	—	—	—	3
4.5	Main Steam Safety Valves Open, Affected Loop, psia	1280	—	Secondary System Integrity	
6.8	Maximum Steam Generator Pressure, Unaffected Loop, psia	1347	3,492	—	
7.4	Maximum Steam Generator Pressure, Affected Loop, psia	1340	5,451	—	
0.91	Reactor Trip Breakers Open	—	—	Reactivity Control	

Table 15.3.3-1 (Continued)

(Sheet 2 of 2)

SEQUENCE OF EVENTS FOR THE SINGLE REACTOR COOLANT PUMP ROTOR SEIZURE WITH LOSS OF OFFSITE POWER RESULTING FROM TURBINE TRIP

INSERT "A"

Time (Sec.)	Event	Setpoint or Value	Total Integrated Safety Valve Flow (lbm)	Success Path
218	~~Low Water Level EFAS Setpoint Reached in the Steam Generator, Unaffected Loop, percent of wide range~~ Replace with "B"	~~---~~	85,679	Secondary System Integrity
263	Emergency Feedwater Begins Entering Steam Generator, Unaffected Loop, lbm/sec	119	91,407	Secondary System Integrity
INSERT "C"				
[illegible]97	~~Low Water Level EFAS Setpoint Reached in the Steam Generator, Affected Loop, percent of wide range~~ Replace with "D"	~~---~~	115,189	Secondary System Integrity
	Emergency Feedwater Begins Entering the Steam Generator, Affected Loop, lbm/sec	119		
821	Steam Generator Safety Valves Close, Affected and Unaffected Loop, psia	1218	120,398	Secondary System Integrity
1800	Atmospheric Dump Valves Opened to Initiate Plant Cooldown, °F/hour. One Atmospheric Dump Valve Sticks Open	-100.0	120,398	Secondary System Integrity
7200	Total Steam Release to Atmosphere, lbm	---	1,128,293	---

3

T 15.3.3-1 (2)

217	"A" Steam Generator Water Level Reaches Emergency Feedwater Actuation Signal Analysis Setpoint in the Unaffected Loop, percent of wide range	20	Secondary System Integrity
	"B" Emergency Feedwater Actuation Signal Generated			
696	"C" Steam Generator Water Level Reaches Emergency Feedwater Actuation Signal Analysis Setpoint in the Affected Loop, percent of wide range	20	Secondary System Integrity
	"D" Emergency Feedwater Actuation Signal Generated			

TABLE 15.4.1-1

SEQUENCE OF EVENTS FOR THE SEQUENTIAL CEA WITHDRAWAL EVENT

Time(sec)	Event	Setpoint or Value	Success Path
0.00	Withdrawal of CEA's - Initiating Event	--	Reactivity Control
23.4 (23.75)	Variable Overpower Trip, ~~% of Design Power~~ Signal Generated	~~17.0~~	Reactivity Control
23.90	~~CEDM Power Supply~~ Trip Breakers Open	--	Reactivity Control
~~24.2~~	~~CEA's Begin to Drop~~	--	~~Reactivity Control~~
25.2 (25.40)	Maximum Core Power, % of Design Power	43.5 → 45.8	
26.7 (26.65)	Maximum Core Average Heat Flux, % of Full Power Heat Flux	16.9 → 17.53	
27.0	Minimum DNBR	5.40 → 4.84	
35.20	Maximum Pressurizer Pressure, psia	1894	
23.35	Core Power Reaches Variable Overpower Reactor Trip Analysis Setpoint, percent of design power.	17.0	Reactivity Control

TABLE 15.4.2-1

SEQUENCE OF EVENTS FOR THE SEQUENTIAL CEA WITHDRAWAL EVENT

TIME(sec)	Event	SETPOINT OR VALUE	SUCCESS PATH
0.0	Withdrawal of CEA's - Initiating Event	--	Reactivity Control
9.51 ← (9.5)	Low DNBR Trip Signal Generated, projected DNBR	1.19	Reactivity Control
9.66 ← (9.7)	~~CEDM Power Supply~~ TRIP Breakers Open	--	Reactivity Control
~~10.0~~	~~CEA's Begin to Drop~~	--	Reactivity Control
10.1	Maximum Core Power, % of Design Power	108.2	
11.0	Minimum DNBR	1.19	
11.4	Maximum Core Average Heat Flux, % of Full Power Heat Flux	105.6	
12.3	Maximum Pressurizer Pressure, psia	2363	

TABLE 15.4.8-1
(Sheet 1 of 2)

SEQUENCE OF EVENTS FOR
THE CEA EJECTION EVENT

Time (sec)	Event	Setpoint or Value	Success Path
0.0	Mechanical Failure of CEDM Causes CEA to Eject	--	
~~0.83~~ 0.43	~~High Power~~ Variable overpower Trip ~~% of design power~~ Signal Generated	RT	Reactivity Control
0.05	CEA Fully Ejected	--	
0.08	Maximum Core power, % of design power	138.3	
~~0.92~~ 0.58	~~CEAs Begin to Drop~~ Trip Breakers open	--	Reactivity Control
0.92	Turbine Trip Occurs	--	Secondary Integrity
2.53	Main Steam Safety Valves Open, psia	1282	Secondary System Integrity
2.6	Maximum Clad Surface Temperature in the Hot Node, F	936	
3.8	Maximum Fuel Centerline Temperature in the Hot Node, F	3779	
3.9	Pressurizer Safety Valves Open, psia	2525	Primary System Integrity
0.03	Core Power Reaches Variable Overpower Reactor Trip Analysis Setpoint, percent of design power	117	Reactivity Control

TABLE 15.4.8-1 (Cont'd) (Sheet 2 of 2)

SEQUENCE OF EVENTS FOR
THE CEA EJECTION EVENT

Time (Sec)	Event	Setpoint or Value	Success Path
3.9	Maximum Pressurizer Pressure, psia	2525	
4.7	Pressurizer Safety Valves Closed, psia	2462	Primary System Integrity
4.9	Maximum Steam Generator Pressure, psia	1348	
~~5.3~~ INSERT "A"	~~CEAs Fully Inserted; Core Power Reduced to below 15% of design power~~	~~1.~~	
40.2 (40.5)	Safety Injection Actuation Signal (SIAS) (P84a) Generated	~~1280~~	Reactor Heat Removal
850 INSERT "B"	Main Steam Safety Valves Closed, psia	1250	Secondary System Integrity
1800	Operator begins plant cooldown	--	Secondary System Integrity
12230	Shutdown cooling initiated, RCS pressure, temperature, ^{o}F	400/350	Reactor Heat Removal

T. 15.4.8-1

"A"

39.5	Pressurizer Pressure Reaches Safety Injection Actuation Signal Analysis Setpoint, psia	1580	Reactor Heat Removal

"B"

70.1	Safety Injection Flow Initiated	--	Reactor Heat Removal

TABLE 15.5.2-1

SEQUENCE OF EVENTS FOR THE PLCS MALFUNCTION WITH A LOSS OF OFFSITE POWER AT TURBINE TRIP

Time (Sec)	Event	Setpoint or Value	Success Path
0	Charging Flow Maximized & Letdown Flow Minimized	--	
1250.7	High Pressurizer Pressure Trip and Loss of A.C. at the Time of Turbine Trip, psia	2450	Reactivity Control
1252.7	Pressurizer Safety Valves open, psia	2525	Primary System Integrity
1253.2	Maximum Pressurizer Pressure, psia	2561	
1262.3	Pressurizer Safety Valves Close, psia	2525	Secondary System Integrity
1265.5	Main Steam Safety Valves Open, psia	1282	Secondary System Integrity
1270.3	Maximum Steam Generator Pressure, psia	1298	
1800.0	Operator Initiates Plant Cooldown	--	Reactor Heat Removal

REPLACE WITH "A"

"A"

1250.1	Pressurizer Pressure Reaches Reactor Trip Analysis Setpoint, psia	2450	Reactivity Control
1251.1	High Pressurizer Pressure Trip Signal Generated	--	
1251.25	Trip Breakers Open	--	Reactivity Control
1251.6	Turbine Trip, Loss of Offsite Power	--	

TABLE 15.6.3-6
(Sheet 1 of 2)

SEQUENCE OF EVENTS FOR A
STEAM GENERATOR TUBE RUPTURE WITH A
LOSS OF OFFSITE POWER

Time (Sec)	Event	Setpoint or Value	Success Path
0.0	Tube Rupture Occurs	--	
30.0	Third Charging Pump Started, feet below program level	-0.75	Primary System Integrity
30.0	Letdown Control Valve Throttled Back to Minimum Flow, feet below program level	-0.75	Primary System Integrity
53.8	Backup Heaters Energized, psia	2360	Primary System Integrity
560.0	Pressurizer Heaters De-energized due to Low Pressurizer Liquid Volume, ft^3	400	
INSERT A 1186.75	~~1187~~ CPC Low Pressure Boundary Trip Signal ~~Setpoint~~ Generated	~~1785~~	Reactivity Control
1188	Turbine/Generator Trip ~~Setpoint~~ ~~Turbine Stop Valves Close~~ ~~CEAs Begin to Drop~~	--	Secondary System Integrity ~~Reactivity Control~~
~~1191~~	~~Turbine Stop Valves Closed~~	--	~~Secondary System~~
1191	Loss of Offsite Power	--	Integrity
1197	LH Main Steam Safety Valves open, psia	1282	Secondary System Integrity
1197	RH Main Steam Safety Valves open, psia	1282	Secondary Sytem Integrity
1201	Pressurizer Empties	--	
1205	Maximum Steam Generator Pressures Both Steam Generator, psia	1310	
1563.2	Safety Injection Actuation Signal ~~Setpoint~~ Generated	~~1578~~	Reactivity Control

INSERT B"

1563.2 Safety Injection Flow Initiates -- Reactivity Control

TABLE 15.6.3-6
(Sheet 2 of 2)

SEQUENCE OF EVENTS FOR THE
STEAM GENERATOR TUBE RUPTURE WITH A
LOSS OF OFFSITE POWER

Time (Sec)	Event	Setpoint or Value	Success Path
~~1563~~ 1563.2	Letdown Isolation Valves Closed on SIAS	--	Primary System Integrity
~~1613~~	~~Safety Injection Flow Initiated~~	~~--~~	~~Reactivity Control Reactor Heat Removal~~
1714.6	Emergency Feedwater Actuation ~~on Low Steam Generator Level Trip Signal ft above tube sheet~~ Signal Generated	~~[illegible]~~	Secondary System Integrity
1721	Main Steam Safety Values Closed, psia	1218	Secondary System Integrity
1759.6	Emergency Feedwater Flow Begins	--	Secondary System Integrity
1800	Operator Isolates the Damaged Steam Generator and Initiates Plant Cooldown	--	Reactor Heat Removal
28,800	Shutdown Cooling Entry Conditions are Assumed to be Reached, RCS Pressure, psia/Temperature, °F	400/350	Reactor Heat Removal
1713.6	Steam Generator Water Level Reaches Emergency Feedwater Actuation Signal Analysis Setpoint, Percent of wide range	25	Secondary System Integrity

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"A"

1186.90	Trip Breakers Open	–	Reactivity Control

"B"

1562.2	Pressurizer Pressure Reaches Safety Injection Actuation Signal Analysis Setpoint, psia	1578	Reactivity Control

TABLE 15.6.3-1
(Sheet 1 of 2)

SEQUENCE OF EVENTS FOR THE
STEAM GENERATOR TUBE RUPTURE

Time (Sec)	Event	Setpoint or Value	Success Path
0.0	Tube Rupture Occurs	--	
30.0	Third Charging Pump Started, feet below program level	-0.75	Primary System Integrity
30.0	Letdown Control Valve Throttled Back to Minimum Flow, feet below program level	-0.75	Primary System
53.8	Backup Heaters Energized, psia	2360	Primary System Integrity
560.0	Pressurizer Heaters De-energized due to Low Pressurizer Liquid Volume, ft^3	400	
1148.3	CPC Low Pressure Boundary Trip Signal psia Generated	~~2000~~	Reactivity Control
INSERT "A"	Feedwater Flow Starts Ramp Down to 5% of Initial Full power Flow		
~~1149~~	~~CEAs Begin to Drop~~	~~--~~	~~Reactivity~~
1149	Turbine Trip: Stop Valves Start to Close	-- --	Control Secondary System Integrity
1151	Pressurizer Empties	--	--
1152	Turbine Stop Valves Closed	--	Secondary System Integrity
INSERT "B"			
1181.8	Safety Injection Actuation Signal psia Generated	~~1600~~	Reactivity Control and Reactor Heat Removal
INSERT "C"			
1181.8	Letdown Isolation Valves Closed on SIAS	--	Primary System Integrity

TABLE 15.6.3-1 (Cont'd.) (Sheet 2 of 2)

SEQUENCE OF EVENTS FOR THE STEAM GENERATOR TUBE RUPTURE

Time (Sec)	Event	Setpoint or Value	Success Path
1209	Main Steam Safety Valves Open, psia	1282	Secondary System Integrity
1210	Maximum Steam Generator Pressure, psia	1283	
~~1231~~	~~Safety Injection Flow Initiated~~	--	
1316	Main Steam Safety Valves Close, psia	1218	Secondary System Integrity
1447	Pressurizer begins to refill	--	
1690	HLO Mode Terminates Feedwater Flow to Damaged Steam Generator, % wide range	80	Secondary System Integrity
1778	HLO Mode Terminates Feedwater Flow to Intact Steam Generator, % wide range	80	Secondary System Integrity
1800	Operator Isolates the Damaged Steam Generator and Initiates Plant Cooldown at 100°F/hr for the 1.5 hour time period	--	Reactor Heat Removal
28,800	Shutdown Cooling Entry Conditions are Assumed to be reached, RCS Pressure, psia/RCS Temperature, °F	400/350	Reactor Heat Removal

T 15.6.3-1

"A"

1148.45	Trip Breakers Open	--	Reactivity Control

"B"

1180.8	Pressurizer Pressure Reactor Safety Injection Actuation Signal (SIAS) Analysis Setpoint, psia	1578	Reactor Heat Removal

"C"

1181.8	Safety Injection Flow Initiated	--	

TABLE 15D-1

SEQUENCE OF EVENTS FOR A STEAM GENERATOR TUBE RUPTURE WITH A LOSS OF OFFSITE POWER AND STUCK OPEN ADV

Time (Sec)	Event	Setpoint or Value	Success Path
0.0	Tube Rupture Occurs	---	
40	Third Charging Pump Started, feet below program level	-0.75	Primary System Integrity
40	Letdown Control Valve Throttled Back to Minimum Flow, feet below program level	-0.75	Primary System Integrity
INSERT 47	CPC Hot Leg Saturation Trip Signal	---	Reactivity Control
'A' 48	Turbine/Generator Trip ~~Turbine Stop Valves Start to Close~~	---	Secondary System Integrity
	~~CEAs Begin to Drop~~	---	Reactivity Control
~~51~~	~~Turbine Stop Valves Closed~~	---	~~Secondary System Integrity~~
51	Loss of Offsite Power	---	
52	LH Main Steam Safety Valves open, psia	1265	Secondary System Integrity
52	RH Main Steam Safety Valves open, psia	1265	Secondary System Integrity
56	Maximum Steam Generator Pressures Both Steam Generator, psia	1330	
95	Main Steam Safety Valves Closed, psia	1218	Secondary System Integrity
167	Auxiliary Feedwater Actuation on Low Steam Generator Level Trip Signal, Intact Steam Generator, feet above tube sheet	19.76	Secondary System Integrity
177	Auxiliary Feedwater Actuation on Low Steam Generator Level Trip Signal, Ruptured Steam Generator, feet above tube sheet	19.76	Secondary System Integrity

Replace with "B"

TABLE 15D-1 (Cont'd.)

Time (Sec)	Event	Setpoint or Value	Success Path
460	Operator Initiates Plant Cooldown by Opening One ADV on each SG	---	Reactor Heat Removal
546	Pressurizer Empties	---	
570	Safety Injection Actuation Signal ~~(SIAS)~~ Generated	~~1578~~	Reactivity Control
570 ~~578~~	Safety Injection Flow Initiated	---	Reactivity Control
2100	Operator Attempts to Isolate the Damaged Generator, RCS Tem., °F	550	Secondary System Integrity
3900	Operator Closes the ADV Block Valve	---	Secondary System Integrity
4020	Operator Initiates Auxiliary Spray Flow		Primary System Inventory
00	Operator Controls Auxiliary Spray Flow, Backup Pressurizer Heater Output, and HPSI Flow to Reduce RCS Pressure and Control Subcooling, °F	20	Primary System Integrity
28,800	Shutdown Cooling Entry Conditions Reached, RCS Pressure, psia/ Temperature, °F	400/350	Reactor Heat Removal

570 Pressurizer Pressure Reaches Safety Injection Actuation Signal (SIAS) Analysis Setpoint, psia — 1578 — Reactivity Control

T15D-1

"A"

47.15	Trip Breakers Open	--	Reactivity Control

"B"

121.0	Steam Generator Water Level Reaches Emergency Feedwater Actuation Signal (EFAS) Analysis Setpoint in the Unaffected Generator, percent wide range	25	Secondary System Integrity
122.0	EFAS Generated	--	
131.0	Steam Generator Water Level Reaches EFAS Analysis Setpoint in the affected Generator, percent wide range	25	Secondary System Integrity
132.0	EFAS Generated	--	
167.0	Emergency Feedwater Initiated to Unaffected Steam Generator	--	Secondary System Integrity
177.0	Emergency Feedwater Initiated to affected Steam Generator	--	Secondary System Integrity