Table _-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-AS-001-R	1-4	None	None	None
1-AS-003-R	1-4, 6-11, 13-18	• 6" Break on MS Class F line after 1MS-82/1MS-84 • (2) 6" Breaks on EFW lines to 1A SG	• Loss of U1 TDEFWP	None
1-AS-005-R	1	2 -3/4" SD lines on 1B MS Class G line after 1MS-36	None	None
1-AS-007-R	9-14	None	• Loss of U1 TDEFWP	None
1-AS-012-R	1-4	None	• Failed open TBV (1MS-22)	None
1-AS-015-R	1-2	None	None	None
1-AS-015-R	3-4	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U1 EFW • Loss of AFIS trip signal to FWPTs	None
1-AS-015-R	7	None	None	None
1-AS-016-R	1	None	None	None
1-AS-019-R	1-3	• 6" Break on 1B MS Class F Pipe (1MS-33) • 6" Break on MS Class G Pipe after 1MS-24/1MS-33	None	None
1-AS-020-R	1-3	2" Break on MS Class G pipe after 1MS-24/1MS-33	None	None
1-AS-021-R	3-5	2" Break on MS Class G pipe after 1MS-24/1MS-33	• TBVs may fail open • Loss of U1 EFW • Loss of AFIS trip signal to FWPTs	None
1-AS-021-R	1,2,2L-5L	2" Break on MS Class G pipe after 1MS-24/1MS-33	None	None
1-AS-022-R	1-5	6" 1A MS Class F line before 1MS-24	• TBVs may fail open • Loss of U1 EFW • Loss of AFIS trip signal to FWPTs	None

Table _-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-AS-022-R	10L	1FDW-32 Operator	None	None
1-AS-022-R	11-11A	None	None	None
1-AS-022-R	12,12L	• 1FDW-41 Operator • 6" FDW Line Break in SU Path before 1FDW-44.	None	None
1-AS-022-R	13-17, 15L-16L	None	• Loss of 1MFB1 and 1MFB2.	None
1-AS-022-R	18,19	None	• Loss of 1MFB1 and 1MFB2.	None
1-AS-022-R	19L-22L	None	• Loss of 1MFB1 and 1MFB2.	None
1-AS-022-R	22,23	None	• Loss of 1MFB1 and 1MFB2.	None
1-AS-022-R	24-27	None	• Loss of 1MFB1 and 1MFB2.	None
1-AS-022-R	27A,28	4" SSW Header 'A' pipe rupture	None	None
1-AS-022-R	29-37	4" SSW Header 'A' pipe rupture	• A and B LPSW pumps are lost • Loss of 1A and 1B MDEFWPs • Possible loss of CCW on Unit 1 • Both trains of control area cooling lost. • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
1-AS-022-R	38-39	4" SSW Header 'A' pipe rupture	None	None
1-AS-023-R01	1-9	None	• Loss of 'A' Chiller	None
1-AS-023-R02	13L-14L	None	None	None
1-AS-023-R02	15-17	6" Break on MS Class G Pipe after 1MS-24/1MS-33	None	None

Table ..2-1
Potential Damage to Shutdown Equipment Caused by Auxiliary Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-AS-023-R02	21A-22	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U1 EFW • Loss of AFIS trip signal to FWPTs	None
1-AS-023-R02	24-26,28-31	None	None	None
1-AS-024-R	1,3, 5-7	None	• Loss of 'A' Chiller	None
1-AS-025-R	1-6	• Loss of TDEFWP • 1.5" LPSW line break to Vac Pumps • 2" HPSW/LPSW line break to TDEFWP • 3" CCW line break to TDEFWP	None	None
1-AS-025-R	7,8	None	• Loss of CT1, CT2, CT3 • Loss of 230kV Red and Yellow buses • Loss of U1 EFW • Loss of 'A' Chiller • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
1-AS-025-R	13,14	3" 1B MS Class G Pipe break after 1MS-36	None	None
1-AS-028-R	1-5	None	• Loss of U1 TDEFWP • MS to SSRHs fail open	None
1-AS-029-R	1-4, 7-8	None	None	None
1-AS-033-R	1	None	None	None
1-AS-035-R	1-9	None	None	None
1-AS-036-R	1,2	None	None	None
1-AS-038-R01	1	None	None	None
1-AS-038-R01	3-6	None	• MS to SSRHs may fail open	None

Table _-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-AS-038-R01	7-9	None	None	None
1-AS-038-R01	22, 25	None	• Loss of 'A' Chiller	None
1-AS-038-R01	23-24	None	None	None
1-AS-038-R01	27-28	None	None	None
1-AS-038-R02	12-13, 15-16	None	None	None
1-AS-039-R01	2-3	6" C line (CST & EFWP recirc) to UST	None	None
1-AS-039-R01	4-7	None	• Loss of 'A' LPSW Pump • MS to SSRH may fail open • Loss of 'A' Chiller	None
1-AS-039-R01	8	None	None	None
1-AS-039-R01	9-17	None	• Loss of 'A' LPSW Pump • MS to SSRHs may fail open • Loss of U1 EFW • Loss of 'A' Chiller • Loss of AFIS trip signal to FWPTs	None
1-AS-039-R01	21	8" TDEFWP Suction line break downstream of valve 1C-157	None	None
1-AS-039-R01	23-24	None	• Loss of 1A MDEFWP • Loss of 'A' LPSW Pump	None
1-AS-039-R02	1,2,4,5	6" 1B MS Class F line break on 1MS-33	• Loss of U1 EFW • TBVs may fail open • Loss of AFIS trip signal to FWPTs	None
1-AS-039-R02	1L-4L	None	• Loss of U1 EFW • TBVs may fail open • Loss of AFIS trip signal to FWPTs	None
1-AS-039-R02	5L-6L, 7-8	8" MS Class G line after 1MS-24/1MS-33	None	None

Table _-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-AS-039-R02	9-10	6" MS Class G line after 1MS-24/1MS-33	None	None
1-AS-039-R02	11-12	6" MS Class G line after 1MS-24/1MS-33	None	None
1-AS-039-R02	6, 6A, 13-19	• 6" 1B MS Class F pipe with 1MS-33 • 6" FDW Line with 1FDW-38	None	None
1-AS-040-R	2-4	None	None	None
1-AS-043-R	1-6	6" 1B MS Class F pipe with 1MS-33	None	None

Table -2
Potential Damage to Shutdown Equipment Caused by Condensate System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-C-001-R	1-2	None	None	None
1-C-001-R	3-14, 16	2" HPSW/LPSW line break to TDEFWP	• Loss of U1 EFW • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs • Loss of 'B' LPSW pump • Loss of 'A' Chiller	None
1-C-001-R	15	None	• Loss of U1 EFW • MS to SSRHs may fail open • Loss of 'A' Chiller • Loss of AFIS trip signal to FWPTs	None
1-C-005-R	1-5	None	Loss of 'B' LPSW pump	None
1-C-005-R	6	None	• Loss of U1 EFW • MS to SSRHs may fail open • Loss of 'A' Chiller • Loss of AFIS trip signal to FWPTs	None
1-C-006-R	1-5R	None	Loss of 'B' LPSW pump	None
1-C-006-R	5L-7	None	None	None
1-C-007-R	1-7	None	Loss of 'B' LPSW pump	None
1-C-011-R	1, 2	2" HPSW/LPSW line break to TDEFWP	None	None
1-C-011-R	3	None	Loss of '1B' MDEFW pump	None
1-C-019-R	3, 4, 5	None	None	Floor Beam between Kb-18 and Kb-19
1-C-020-R	6, 7, 8	None	None	Floor Beam between Kb-17 and Kb-18

Table . .-2
Potential Damage to Shutdown Equipment Caused by Condensate System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-C-024-R	1	None	• Loss of 'A' Chiller	None
1-C-026-R01	1, 2	None	• Loss of 'A' Chiller	None
1-C-026-R02	3	None	• MS to AS may fail open	None
1-C-028-R	1-2	None	• Loss of 'A' Chiller	None
1-C-031-R	1	None	• Loss of 'A' Chiller	None
1-C-032-R	2-3	None	• Loss of 'A' Chiller	None
1-C-033-R01	1-6	None	• Loss of 'A' Chiller	None
1-C-033-R02	1, 1L	• 8" - 1B MS Class G Pipe after MS-36 • 12" - 1B MS Class F Pipe at 1MS-76 • 24" - MS Pipe after 1MS-105 • 24" - MS Pipe after 1MS-104	• Loss of CT5 • Loss of 1TE SWGR • Loss of U1 EFW • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs • TBVs may fail open	None
1-C-033-R02	2, 2L	• 8" - 1B MS Class G Pipe at 1MS-77 • 8" - 1B MS Class G Pipe at 1MS-78 • 8" - 1B MS Class G Pipe at 1MS-112 • 1" - 1B MS Class G Pipe 1SD-297	None	None
1-C-033-R02	3, 4L	None	• Loss of CT1, CT2, and CT3 • Loss of 230KV Red and Yellow Buses • MS to SSRHs may fail open • Loss of U1 EFW • Loss of 'A' Chiller	None
1-C-037-R	1, 1L	• 2 - 4" WC Lines; • 16" CCW Ret from RCW; • 12" CCW supply to RCW	• Loss of 'A' LPSW pump • MS to SSRHs may fail open	None
1-C-037-R	2-4, 2L-4L, 8	• 2" HPSW/LPSW to TDEFWP; • 24" CCW Ret from RCW	Loss of 'B' LPSW pump	None

Table _-2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-C-037-R	5-7, 7L	• 12" CCW Supply to RCW; • 16" CCW Return from RCW	None	None
1-C-041-R	-	None	None	None
1-C-042-R	2, 3	None	None	Floor Beam between Kb-16 and Kb-17
1-C-044-R	1	None	• Loss of 'A' Chiller	None
1-C-045-R	2-3	None	• Loss of 'A' Chiller	None
1-C-046-R	1	None	• Loss of 'A' Chiller	None
1-C-047-R	1	• 8" - 1B MS Class G Pipe at 1MS-77 • 8" - 1B MS Class G Pipe at 1MS-78 • 8" - 1B MS Class G Pipe at 1MS-112 • 1" - 1B MS Class G Pipe 1SD-297	None	None
1-C-065-R01	1	None	• Loss of 'A' Chiller	None
1-C-071-R	1	None	None	None
1-C-076-R	1	None	None	None
1-C-085-R	1	None	None	None
1-C-087-R01	3	• 6" TDEFWP Recirc Line	None	None
1-C-087-R02	1-3, 1L-3L	None	• Loss of CT1, CT2, and CT3 • Loss of 230KV Red and Yellow Buses • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of 'A' Chiller • Loss of U1 EFW	None
1-C-088-R01	1-2	None	None	None

Table _-2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-C-088-R02	1, 2, 1L, 2L	None	• Loss of CT1, CT2, and CT3 • Loss of 230KV Red and Yellow Buses • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of 'A' Chiller • Loss of U1 EFW	None
1-C-088-R02	5, 5L	• 12" LPSW Line at 1LPSW-945	• Loss of CT1, CT2 and CT3 • Loss of 230KV Red and Yellow Buses • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT • Loss of 'A' Chiller • Loss of U1 TDEFWP	None
1-C-088-R02	6, 6L	• 6" TDEFWP Recirc Line; • 4" MDEFWP Recirc Line; • 18" CCW at 1CCW-85; • 12" LPSW at 1LPSW-945; • 2" LPSW Ret from MDEFWPs	• Loss of 'A' Chiller • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open	None
1-C-088-R02	7, 7L	• 6" TDEFWP Recirc Line; • 12" LPSW at 1LPSW-945; • 2" LPSW Ret from MDEFWPs	None	None
1-C-089-R	4	None	None	None
1-C-090-R	8-9, 8L	• 6" TDEFWP Recirc Line; • 12" LPSW at 1LPSW-945	• Loss of CT1 • Loss of 1MFB1 and 1MFB2 • Loss of U1 TDEFWP • Loss of SBB1 and SBB2 • Loss of 2MFB2	None

Table _-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-ES-002-R	1	None	None	None
1-ES-003-R	18-20, 22	• 6" 1A EFW Line • 2 chilled water lines downstream of WC-209, WC-40	• MS to SSRHs may fail open • Loss of U1 EFW	None
1-ES-004-R	1-4	2 chilled water lines downstream of WC-209, WC-40	None	None
1-ES-004-R	5, 6	8" 1A MS Class G Line with 1MS-173	MS to SSRHs may fail open	None
1-ES-004-R	7, 8	8" 1A MS Class F Line with 1MS-35	None	None
1-ES-007-R	8-9	2 chilled water lines downstream of WC-209, WC-40	• MS to SSRHs may fail open • Loss of U1 EFW	None
1-ES-010-R	1, 2, 4-7	None	• Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of U1 TDEFWP	None
1-ES-010-R	3	None	• Loss of 1TE SWGR • Loss of U1 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs • TBVs may fail open	None
1-ES-011-R	4	None	None	None
1-ES-012-R	1-3	None	None	None
1-ES-012-R	4-6	• 8" 1A MS Class G line with 1MS-173 • 8" 1A MS Class F line with MS-35 • 2" SD Class G line off 1A MS to SD-340	• Loss of AFIS trip signal to FWPTs • Loss of U1 EFW • TBVs may fail open • MS to SSRHs may fail open • Loss of 1TE SWGR	None
1-ES-012-R	7-10	None	Loss of U1 TDEFWP	None

Table .-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-ES-012-R	11-13	None	None	None
1-ES-013-R	1-6	None	• Loss of AFIS trip signal to FWPTs • Loss of U1 TDEFWP • MS to SSRHs may fail open	None
1-ES-014-R	1	• 8" 1A MS Class G line after 1MS-35 • 8" 1B MS Class G line after 1MS-36	• Loss of U1 TDEFWP • Loss of SBB2 to Unit 2 • MS to SSRHs may fail open	None
1-ES-014-R	2,3	None	• Loss of SBB1 • Loss of SBB2 to Unit 2 • Loss of 2MFB2 • Loss of AFIS trip signal to FWPTs • Loss of U1 TDEFWP • MS to SSRHs may fail open	None
1-ES-014-R	4,5	• 8" 1A MS Class G line after 1MS-35; • 8" 1B MS Class G line after 1MS-36; • 6" MS Class F line after 1MS-89	None	None
1-ES-014-R	6-8	None	None	None
1-ES-015-R	2,3	• 6" 1A EFW Line after 1FDW-373 • 24" Cond line from SPE	• Loss of U1 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
1-ES-015-R	1	• 6" 1A EFW Line after 1FDW-373 • (3) 24" Cond lines • 8", 10", 18" HD Lines	• Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of LPSW Pump B • Loss of U1 EFW • Loss of 1TE SWGR	Column H-17
1-ES-016-R	1-4	None	• Loss of SBB1 • Loss of SBB2 to Unit 2 • Loss of 2MFB2 • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of U1 TDEFWP	None

Table _-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-ES-017-R	1-6	None	• Loss of SBB1 • Loss of SBB2 to Unit 2 • Loss of 2MFB2 • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of U1 TDEFWP	None
1-ES-017-R	7	8" 1A MS Class G Line after 1MS-35	• Loss of SBB1 • Loss of SBB2 to Unit 2 • Loss of 2MFB2 • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of U1 TDEFWP	None
1-ES-017-R	8-14	• 6" FDWP Recirc line with 1FDW-53 • 12" CCW line with 1CCW-3	Loss of U1 EFW	None
1-ES-018-R	1-4	None	• Loss of U1 EFW • TBVs may fail open • MS to SSRHs may fail open • Loss of 1TE SWGR • Loss of AFIS trip signal to FWPTs	None
1-ES-019-R	1-8	None	• Loss of U1 TDEFWP • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs • Loss of 1TE SWGR	None
1-ES-019-R	9-11	None	• Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of U1 TDEFWP	None
1-ES-020-R	1-4, 6-10	None	• Loss of U1 EFW • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs • Loss of 1TE SWGR	None

Table _-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-ES-020-R	5	• 1A Condenser • 78" CCW line to 1A1 Condenser • 6" 1A EFW line	• TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs • Loss of 1TE SWGR • Loss of U1 EFW • Loss of 'B' LPSW pump	Column G-17
1-ES-021-R	1-2	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs • Loss of U1 EFW • Loss of 1TE SWGR	None
1-ES-021-R	3-5	None	• MS to SSRHs may fail open • Loss of U1 EFW	None
1-ES-021-R	6	None	• MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs • Loss of U1 EFW	None
1-ES-022-R	4-10	None	• Loss of SBB1 • Loss of SBB2 to Unit 2 • Loss of 2MFB2 • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of U1 TDEFWP	None
1-ES-022-R	11-15	12" CCW line with 1CCW-5	None	None
1-ES-023-R	6, 6L	None	• Loss of SBB1 • Loss of SBB2 to Unit 2 • Loss of 2MFB2 • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of U1 TDEFWP	None
1-ES-024-R	1-6	• 8" 1A MS Class G line after MS-35 • 8" 1B MS Class G line after MS-36	None	None

Table _-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-ES-027-R	1	• 8" 1A MS Class G line after MS-35 • 8" 1B MS Class G line after MS-36 • 6" MS Class F line after 1MS-87	• Loss of SBB1 • Loss of SBB2 to Unit 2 • Loss of 2MFB2 • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of U1 TDEFWP	None
1-ES-027-R	7-8, 7L-8L	6" 1B FDWP Recirc line with FDW-65;	• Loss of SBB1 • Loss of SBB2 to Unit 2 • Loss of 2MFB2 • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of U1 TDEFWP	None
1-ES-028-R	1	None	• Loss of 1TE SWGR • TBVs may fail open • Loss of U1 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
1-ES-028-R	2-5	None	MS to SSRHs may fail open	None
1-ES-031-R	7-12, 15, 16	None	None	None
1-ES-031-R	14	None	• Loss of 1TE SWGR • Loss of U1 TDEFWP • MS to SSRHs may fail open • TBVs may fail open • Loss of AFIS trip signal to FWPTs	None
1-ES-032-R	7-14	None	None	None
1-ES-045-R	7-12	None	None	None

Table _-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-ES-045-R	14	None	• Loss of 1TE SWGR • Loss of U1 TDEFWP • MS to SSRHs may fail open • TBVs may fail open • Loss of AFIS trip signal to FWPTs	None
1-ES-046-R	7-13	None	None	None
1-ES-046-R	14	None	• Loss of 1TE SWGR • Loss of U1 TDEFWP • MS to SSRHs may fail open • TBVs may fail open • Loss of AFIS trip signal to FWPTs	None
1-ES-059-R	7-12	None	None	None
1-ES-059-R	13-14	None	• Loss of 1TE SWGR • MS to SSRHs may fail open • TBVs may fail open • Loss of AFIS trip signal to FWPTs • Loss of U1 EFW	None
1-ES-060-R	7-11	None	None	None
1-ES-060-R	12-16	None	• Loss of 1TE SWGR • Loss of U1 EFW • MS to SSRHs may fail open	None
1-ES-073-R	1-10	2 chilled water lines downstream of WC-209, WC-40	None	None
1-ES-074-R	1-5	None	• Loss of U1 TDEFWP • MS to SSRHs may fail open	None
1-ES-075-R	1-5	None	None	None

Table 2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-ES-078-R	1-2	None	• Loss of 1TE SWGR • Loss of U1 TDEFWP • MS to SSRHs may fail open • TBVs may fail open • Loss of AFIS trip signal to FWPTs	None
1-ES-078-R	3	None	None	None
1-ES-079-R	1-3	None	• Loss of 1TE SWGR • Loss of U1 EFW • MS to SSRHs may fail open • TBVs may fail open • Loss of AFIS trip signal to FWPTs	None
1-ES-080-R	1-5	None	• Loss of 1TE SWGR • Loss of U1 EFW • MS to SSRHs may fail open • TBVs may fail open • Loss of AFIS trip signal to FWPTs	None
1-ES-081-R	1-2, 2L-3L	None	• Loss of 1TE SWGR • Loss of U1 EFW • MS to SSRHs may fail open • TBVs may fail open • Loss of AFIS trip signal to FWPTs	None
1-ES-081-R	3-4	• 24" Cond from CSAEs; • 24" Turb Byp to 1A Cond;	• Loss of U1 EFW • MS to SSRHs may fail open	None
1-ES-082-R	1-2, 2L-3L	• 24" Turb Byp to 1A Cond; • 6" 1A EFW Hdr; • 24" Cond from CSAE;	• Loss of U1 EFW • MS to SSRHs may fail open	None
1-ES-082-R	3	24" Turb Byp to 1A Cond;	• Loss of U1 TDEFWP • MS to SSRHs may fail open	None
1-ES-082-R	3L-4L, 5-6, 7-8	6" 1A EFW Line	None	None

Table ..-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-ES-082-R	4, 6L, 7L	None	• Loss of U1 EFW • TBV may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs • MS to AS may fail open	None
1-ES-083-R	1-4	18" Cond Line before 1C-124	MS to AS may fail open	None
1-ES-085-R	1-5	None	None	None
1-ES-087-R	1-8	None	None	None
1-ES-094-R	1-2, 5	8" 1A MS Class F line with MS-35	None	None
1-ES-094-R	3-4	None	• Loss of U1 EFW • MS to SSRHs may fail open	None
1-ES-094-R	6-9	• 8" 1A MS Class G line after MS-35; • 6" MS Class F line after MS-87	None	None
1-ES-094-R	10	None	• Loss of U1 TDEFWP	None
1-ES-095-R	5-12, 20, 23-25a	None	• Loss of U1 EFW • MS to SSRHs may fail open	None
1-ES-098-R	2a-5, 15, 17-18	None	MS to SSRHs may fail open	None
1-ES-098-R	6-11	None	• MS to SSRHs may fail open • Loss of U1 TDEFWP	None
1-ES-100-R	1	None	• Loss of U1 TDEFWP	None
1-ES-211-R	8-10	None	None	None
1-ES-274-R	1, 2, 5-8	6" 1A SU Hdr with 1FDW-33;	None	None
1-ES-274-R	3-4	6" FDW with 1FDW-33;	• Loss of U1 TDEFWP • MS to SSRHs may fail open	None

Table _-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-ES-275-R	1-7	• 8" 1A MS Class G line with 1MS-18 • 8" 1A MS Class G line with 1MS-21 • 8" 1B MS Class G line with 1MS-27	TBVs may fail open	None
1-ES-283-R	1	• 18" C Recirc line • 8" AS line • 6" 1A EFW line • 24" C line to "C" Dr clrs; etc	None	None
1-ES-283-R	2-4	• 18" C Recirc line; • 12" AS line; • 6" 1A EFW line; • 24" C line to "C" Dr clrs; etc	• Loss of U1 EFW • TBVs may fail open • Loss of AFIS trip signal to FWPTs	None
1-ES-287-R	1-7	None	None	None
1-ES-501-R	1-6, 9-11	None	• Loss of U1 TDEFWP • MS to SSRHs may fail open	None
1-ES-501-R	7, 8	None	Loss of U1 EFW	None
1-ES-502-R	1,6	None	• Loss of 1MFB1 and 1MFB2 • Loss of U1 TDEFWP	None
1-ES-502-R	2-5	None	None	None
1-ES-503-R01	1-5	None	None	None
1-ES-503-R01	6-7	• 8" Cond Line with 1C-157; • 6" 1A MDEFWP Disch Line; • 6" 1B MDEFWP Disch Line; • 6" EFWP Recirc with 1FDW-88	None	None
1-ES-503-R02	3, 4	Loss of U1 EFW piping	None	Db-23-Db-24
1-ES-503-R02	5	• 8" Cond line before C-157, C-160; • 6" 1A MDEFWP Disch Line; • 6" 1B MDEFWP Disch Line; • 6" Cond Line with C-160	None	None

Table . _-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-ES-504-R01	1-3	• 8" Cond Line before 1C-157; • 6" 1A MDEFW Disch; • 6" 1B MDEFW Disch; • 6" Cond Line with C-160	None	None
1-ES-504-R01	4-7	4" EFWP Recirc piping	Loss of AFIS trip signal to FWPTs	None
1-ES-504-R02	2, 3	Loss of U1 EFW piping	None	Floor Beam from Column Dd23 to Dd24
1-ES-504-R02	4	• 6" 1A MDEFWP Disch. • 6" 1B MDEFWP Disch. • 8" C Line before C-157 • 6" C Line with C-160	None	None

Table ..._-4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-FDW-005-R	1-4	None	• Loss of U1 EFW • Loss of AFIS trip signal to FWPTs • Loss of 'A' Chiller • MS to SSRHs may fail open	None
1-FDW-006-R	1-2	None	• Loss of 'A' LPSW Pump • MS to SSRHs may fail open	None
1-FDW-006-R	3-9	14" LPSW line after 1LPSW-45	• Loss of U1 EFW • Loss of AFIS trip signal to FWPTs • Loss of 'A' Chiller • MS to SSRHs may fail open	None
1-FDW-006-R	10-15	None	None	None
1-FDW-007-R	1-4	None	• Loss of 'A' Chiller	None
1-FDW-008-R	1-5, 8-14	2 - 12" CCW lines on outlet from RCW Coolers	• Loss of 'A' Chiller	None
1-FDW-008-R	6-7	18" LPSW line before 1LPSW-108	None	None
1-FDW-022-R	2-3	None	• Loss of CT1 • Loss of SBB1 and SBB2 • Loss of 1MFB1 and 1MFB2 • Loss of U1 TDEFWP • Loss of 2MFB2	None
1-FDW-024		1FDW-32 operator	None	None
1-FDW-026		None	• Loss of 1A1 and 1A2 RCPs	None
1-FDW-027		None	None	None
1-FDW-028		None	None	None
1-FDW-029-R	2	None	• Loss of AFIS trip signal to FWPTs	None

Table ...-4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-FDW-029-R	3	8" 1A MS Class G line after 1MS-35	None	None
1-FDW-029-R	4	None	• Loss of 230KV Red and Yellow Buses • Loss of CT1, CT2, and CT3 • Loss of AFIS trip signal to FWPTs • Loss of U1 TDEFWP • Loss of 'A' Chiller • MS to SSRHs may fail open	None
1-FDW-029-R	5-7	None	• Loss of 230KV Red and Yellow Buses • Loss of CT1, CT2, and CT3 • Loss of AFIS trip signal to FWPTs • Loss of U1 EFW • Loss of 'A' Chiller • MS to SSRHs may fail open	None
1-FDW-029-R	8-12	None	• Loss of 230KV Red and Yellow Buses • Loss of CT1, CT2, and CT3 • Loss of SBB1 and SBB2 • Loss of 1MFB1 and 1MFB2 • Loss of U1 TDEFWP • Loss of 2MFB1 and 2MFB2	None
1-FDW-029-R	14-15	None	• Loss of CT1 • Loss of SBB1 and SBB2 • Loss of 1MFB1 and 1MFB2 • Loss of U1 and U2 TDEFWPs • Loss of 2MFB1 and 2MFB2	None
1-FDW-030-R	1	• 18" CCW Line after 1CCW-85, • 2" LPSW line with 1LPSW-527	• Loss of CT1 • Loss of SBB1 and SBB2 • Loss of 1MFB1 and 1MFB2 • Loss 2MFB2 • Loss of U1 and U2 TDEFWPs	None
1-FDW-030-R	2-5	4" EFW recirc line break between 1FDW-91 & 1FDW-92.	None	None

Table _-4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-FDW-030-R	6-7	• 8" 1B MS Class G line after 1MS-36 • 12" LPSW line after 1LPSW-945.	None	None
1-FDW-030-R	8	None	• Loss of SBB1 and SBB2 • Loss of 1MFB2 • Loss of 2MFB2	None
1-FDW-030-R	9-11	8" 1B MS Class G line after 1MS-36	• Loss of CT1 • Loss of SBB1 and SBB2 • Loss of 1MFB1 and 1MFB2 • Loss of U1 and U2 TDEFWPs • Loss of 2MFB1 and 2MFB2	None
1-FDW-030-R	12-13	• 8" 1B MS Class G line after 1MS-36 • 30", 18", 16" CCW return line from Cond. Cooler • 6" EFW Recirc line from TDEFWP • 4" EFW Recirc line from MDEFWPs • 12" LPSW Line	• Loss of 230kV Red and Yellow Buses • Loss of CT1, CT2, and CT3 • Loss of SBB1 and SBB2 • Loss of 1MFB1 and 1MFB2 • Loss of U1 and U2 TDEFWPs • Loss of 2MFB1 and 2MFB2	Col. D-26
1-FDW-031-R	3	None	• Loss of SBB1 • Loss of SBB2 to Unit 2 • Loss of 2MFB2 • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of U1 TDEFWP	None
1-FDW-031-R	4	None	None	None
1-FDW-031-R	6-7	• All Condensate lines to HWPs & EFW • 30" CCW line to 'B' LPSW Pump • 1LPSW-139 • 6" EFW Header • LPSW Essential Header 'B' (24", 16", 2")	• Loss of 1TE SWGR • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs • Loss of U1 TDEFWP • Loss of 'B' LPSW Pump	Col. Ga-24

Table ¯-4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-FDW-031-R	8	• All Condensate lines to HWPs & EFW • 2" LPSW line break	• Loss of 1TE SWGR • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs • Loss of U1 TDEFWP • Loss of 'B' LPSW Pump	Beam W21X55-Ga 23-Ga 24
1-FDW-031-R	9	• All Condensate lines to HWPs & EFW • 78" CCW line • (2) 3" CCW lines • 2" CCW line • (2) 1" CCW lines • 2" LPSW line	• Loss of 1TE SWGR • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs • Loss of U1 TDEFWP • Loss of 'B' LPSW Pump	Col. G-23
1-FDW-031-R	10	Possible Upper Surge Tank failure and Condensate line breaks; loss of all EFW suction	• Loss of 1TE SWGR • TBVs may fail open • MS to SSRHs may fail open • MS to AS may fail open • Loss of AFIS trip signal to FWPTs • Loss of U1 EFW • Loss of 'A' LPSW Pump	Col. L-22
1-FDW-031-R	11	42" CCW line	• Loss of 1TC, 1TD, and 1TE SWGRs • Loss of U1 TDEFWP • TBVs may fail open • MS to AS may fail open	Col. K-23
1-FDW-031-R	12-15	None	TBVs may fail open	None
1-FDW-032-R	1-10	None	• Loss of U1 EFW • Loss of AFIS trip signal to FWPTs • Loss of 'A' Chiller • MS to SSRHs may fail open.	None
1-FDW-034-R	1-2	None	• Loss of 'A' Chiller	None
1-FDW-034-R	3-6	None	None	None

Table _-4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-FDW-034-R	7-10	None	None	None
1-FDW-035-R	1-3	None	• Loss of U1 EFW • Loss of AFIS trip signal to FWPTs • Loss of 'A' Chiller • MS to SSRHs may fail open	None
1-FDW-035-R	4, 6, 7	4" Chilled Water line breaks on the supply and return lines from the Admin Bldg.	None	None
1-FDW-035-R	5	4" Chilled Water line breaks on the supply and return lines from the Admin Bldg.	MS to SSRHs may fail open	Col. K-20
1-FDW-036-R	1, 2, 4	None	• Loss of 'A' Chiller	None
1-FDW-036-R	3, 5, 6	12" 1B MS Class G line after 1MS-26	• Loss of 'A' Chiller • Loss of U1 EFW • TBVs may fail open	Col. L-20
1-FDW-039-R01	1	None	None	None
1-FDW-039-R01	6, 7	None	None	None
1-FDW-039-R01	9-19	None	• Loss of 230kV Red and Yellow Buses • Loss of CT1, CT2, and CT3 • Loss of U1 EFW • Loss of 'A' Chiller • MS to SSRHs may fail open	None
1-FDW-039-R01	20-23	None	Loss of 'A' Chiller	None
1-FDW-039-R01	24-32	None	None	None
1-FDW-039-R02	2	None	None	None
1-FDW-041-R01	1-8	None	• Loss of AFIS trip signal to FWPTs • Loss of 'A' Chiller	None

Table ...-4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-FDW-041-R01	9-14	None	• Loss of 230kV Red and Yellow Buses • Loss of CT1, CT2, and CT3 • Loss of U1 EFW • Loss of 'A' Chiller • MS to SSRHs may fail open	None
1-FDW-041-R01	15-19	None	Loss of 'A' Chiller	None
1-FDW-041-R01	20-25	None	None	None
1-FDW-041-R02	2-7	None	• Loss of U1 EFW	None
1-FDW-042-R	1-3	1FDW-31 Operator	None	None
1-FDW-043-R	1-3	1FDW-31 Operator	None	None
1-FDW-057-CR		1PR-8 Operator	None	None
1-FDW-058-CR		None	• Loss of Pressurizer Htr. Banks 3 and 4 • Loss of 1HP-410 Control	None
1-FDW-059-CR		None	None	None

Table ..2-5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-HD-001-R	1-3	None	None	None
1-HD-002-R	1	None	None	None
1-HD-008-R	1	None	• Loss of AFIS trip signal to FWPTs • Loss of 'A' Chiller • MS to SSRHs may fail open • Loss of U1 EFW	None
1-HD-011-R	1-2	None	None	None
1-HD-020-R	1-4	None	None	None
1-HD-020-R	5	• 36" 1A MS Class F line • 36" 1B MS Class F line • Loss of Condensate Piping	None	Col. L-17
1-HD-021-R	1	None	None	None
1-HD-022-R	4	None	None	None
1-HD-023-R	3	None	• Loss of AFIS trip signal to FWPTs • Loss of 'A' Chiller • MS to SSRHs may fail open • Loss of U1 EFW	None
1-HD-025-R	1-4	None	• Loss of AFIS trip signal to FWPTs • Loss of 'A' Chiller • MS to SSRHs may fail open • Loss of U1 EFW	None
1-HD-026-R	1	None	None	None
1-HD-026-R	2	None	• Loss of AFIS trip signal to FWPTs • Loss of 'A' Chiller • MS to SSRHs may fail open • Loss of U1 EFW	None

Table _-5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-HD-027-R	5	None	• Loss of AFIS trip signal to FWPTs • Loss of 'A' Chiller • MS to SSRHs may fail open • Loss of U1 EFW	None
1-HD-028-R	4	None	• Loss of AFIS trip signal to FWPTs • Loss of 'A' Chiller • MS to SSRHs may fail open • Loss of U1 EFW	None
1-HD-029-R	3	None	• Loss of AFIS trip signal to FWPTs • Loss of 'A' Chiller • MS to SSRHs may fail open • Loss of U1 EFW	None
1-HD-031-R	1, 2	14" LPSW line after 1LPSW-139	None	None
1-HD-031-R	3	• 14" LPSW line after 1LPSW-139 • 16" Condensate Line	None	None
1-HD-034-R	1	None	• Loss of 'A' Chiller	None
1-HD-036-R	2-4	6" EFW Cross-Connect Line	• MS to SSRHs may fail open • Loss of one train of Control Area Cooling	None
1-HD-037-R	1-2	None	• Loss of 'A' Chiller	None
1-HD-039-R	4	None	• Loss of 'A' Chiller	None
1-HD-040-R	3	None	• Loss of 'A' Chiller	None
1-HD-042-R	1-4, 6	None	• Loss of U1 EFW • Loss of 'A' Chiller • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open	None
1-HD-042-R	5	None	• Loss of U1 TDEFWP • Loss of 'B' LPSW Pump	None
1-HD-045-R	1-3	6" 1A EFW line	None	None

Table _-5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-HD-047-R	1-4	6" 1A EFW Line	• Loss of U1 EFW • Loss of AFIS trip signal to FWPTs • TBVs may fail open • MS to AS may fail open	None
1-HD-049-R	1-2	• 6" 1A EFW Line • 24" Cond Line	• Loss of U1 EFW • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of 'A' Chiller	None
1-HD-051-R	1	None	• Loss of 'A' Chiller	None
1-HD-052-R	2-5	None	• Loss of 'A' Chiller	None
1-HD-056-R	2-6, 9	None	• Loss of 'A' Chiller	None
1-HD-056-R	10	None	None	None
1-HD-057-R	7-8	None	• Loss of 'A' Chiller	None
1-HD-058-R	1	None	• Loss of 'A' Chiller	None
1-HD-062-R	1, 3, 4	None	• Loss of 'A' Chiller	None
1-HD-063-R	2	None	• Loss of 'A' Chiller	None
1-HD-065-R	1-4	None	• Loss of 'A' Chiller	None
1-HD-066-R	1	None	None	None
1-HD-067-R	1-3	None	• Loss of 'A' Chiller	None
1-HD-068-R	1	None	• Loss of 'A' Chiller	None

Table 2-5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-HD-069-R	1-3	8" AS line after 1MS-126	• TBVs may fail open • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of U1 EFW	None
1-HD-070-R	1-4	2 - WC Lines	• MS to SSRHs may fail open • Loss of U1 EFW	None
1-HD-071-R	1-4	None	• Loss of 'A' Chiller	None
1-HD-075-R	1-3, 5-8	• 6" EFW Cross-Connect line • 2½" AS Class G Pipe after 1MS-126	TBVs may fail open	None
1-HD-075-R	4	• 36" 1A MS Class F line • 36" 1B MS Class F line • Loss of Condensate Piping	None	Col. L-18
1-HD-076-R	3	None	None	None
1-HD-078-R	1-2	None	• Loss of 'A' Chiller	None
1-HD-080-R	1-6	14" LPSW line between 1LPSW-968 & 979	• Loss of U1 EFW • MS to SSRH may fail open • Loss of 'A' Chiller • Loss of AFIS trip signal to FWPTs	None
1-HD-081-R	4	None	• Loss of U1 EFW • MS to SSRHs may fail open • Loss of 'A' Chiller • Loss of AFIS trip signal to FWPTs	None
1-HD-083-R	1-3	None	• Loss of U1 EFW • MS to SSRHs may fail open • Loss of 'A' Chiller • Loss of AFIS trip signal to FWPTs	None
1-HD-086-R	2	None	None	None
1-HD-087-R	1	None	None	None

Table 2-5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-HD-090-R	1-2	None	• Loss of U1 EFW • MS to SSRHs may fail open • Loss of 'A' Chiller • Loss of AFIS trip signal to FWPTs	None
1-HD-095	11	8" AS Class G Pipe after 1MS-126	None	None
1-HD-115-R	1-2	None	• Loss of 'A' Chiller	None
1-HD-116-R	5-6	None	• Loss of 'A' Chiller	None
1-HD-117-R	4	None	None	None
1-HD-120-R	3, 8-9	None	• Loss of 'A' Chiller	None
1-HD-122-R	2-4	None	None	None
1-HD-126-R	1, 7-8	None	None	None
1-HD-127-R	7, 10	None	• Loss of 'A' Chiller	None
1-HD-128-R	5-6	None	• Loss of U1 EFW • MS to SSRHs may fail open • Loss of 'A' Chiller • Loss of AFIS trip signal to FWPTs	None
1-HD-137-R	1-2	None	None	None
1-HD-138-R	1-7	None	None	None
1-HD-139-R	5, 6, 10, 12	None	None	None
1-HD-140-R	3	None	None	None

Table .-6
Potential Damage to Shutdown Equipment
Caused by Heater Vent System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-HV-017-R	1-7	None	• TBVs may fail open • Loss of AFIS trip signal to FWPTs • MS to SSRH may fail open • Loss of U1 EFW	None

Table 2-7
Potential Damage to Shutdown Equipment
Caused by High Pressure Injection System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-HPI-003		None	Loss of power/control for 1HP-26	None
1-HPI-004		None	Loss of power/control for 1HP-27	None
1-HPI-005		1BS-2 Operator	None	None
1-HPI-006		None	Loss of power/control for 1HP-26	None
1-HPI-007		• 1.5" 1A1 Seal Inj line break; • 1.5" 1A2 Seal Inj line break	Loss of power/control for 1FDW-315	None
1-HPI-008		None	None	None
1-HPI-015-R	8, 9	None	Loss of power/control for 1HP-115	None
1-HPI-016-R	7	None	Loss of power/control for 1HP-115	None

Table 2-8
Potential Damage to Shutdown Equipment
Caused by Main Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-MS-001		None	None	None
1-MS-002		None	None	None
1-MS-004		None	None	None
1-MS-009		None	None	None
1-MS-012		• 30" Cond line from 'C' heaters • 36" 1A MS Class F Line • 36" 1B MS Class F Line	• Loss of 1TE SWGR • Loss of U1 EFW • Loss of AFIS trip signal to FWPTs	Floor Beam between Col Fb13/Fb14 at 822 elevation
1-MS-016		None	None	None
1-MS-018		None	None	None
1-MS-020		None	None	None
1-MS-022		None	• Loss of AFIS signal to FWCVs • Loss of AFIS signal to 1TO-145	None
1-MS-023		None	None	None
1-MS-024		None	None	None
1-MS-037-R	1-3	None	None	None
1-MS-065		None	None	None
1-MS-077-R	7	None	• Loss of CT1 • Loss of SBB1 and SBB2 • Loss of 1MFB1 and 1MFB2 • Loss of U1 TDEFWP • Loss of 2MFB1 and 2MFB2 • Loss of U2 TDEFWP	None

Table ..2-8
Potential Damage to Shutdown Equipment
Caused by Main Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-MS-080-R	1-6, 8, 9	None	• Loss of CT1 • Loss of SBB1 and SBB2 • Loss of 1MFB1 and 1MFB2 • Loss of U1 TDEFWP • Loss of 2MFB1 and 2MFB2 • Loss of U2 TDEFWP • TBVs may fail open	None
1-MS-084-R	1,2	None	None	None
1-MS-085-R	1, 2	None	None	None
1-MS-086-R	1,2	None	None	None
1-MS-087-R	1	None	None	None
1-MS-089-R	1	None	None	None
1-MS-091-R	1	None	None	None
1-MS-093-R	7, 12, 15	3" AS Class G Line	• MS to SSRHs may fail open	None
1-MS-094-R	1-5	6" 1A EFW Line	• Loss of U1 EFW • Loss of AFIS trip signal to FWPTs • TBVs may fail open	None
1-MS-096-R	2	None	• Loss of U1 EFW • Loss of AFIS trip signal to FWPTs • TBVs may fail open	None
1-MS-097-R	3	None	• Loss of U1 EFW • Loss of AFIS trip signal to FWPTs • TBVs may fail open	None
1-MS-208		None	• Loss of U1 TDEFWP • MS to SSRHs may fail open	None
1-MS-211-CR	1-2	None	None	None

Table ..2-8
Potential Damage to Shutdown Equipment
Caused by Main Steam System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-MS-212-CR	1-2	None	None	None
1-MS-213-CR		None	• Loss of U1 TDEFWP	None
1-MS-215-CR01		None	None	None
1-MS-215-CR02		None	None	None
1-MS-217-CR		None	• MS to SSRHs may fail open	None
1-MS-221-CR		None	None	None
1-MS-222-CR		None	• Loss of AFIS signal to FWCVs	None
1-MS-231-CR		None	• Loss of U1 TDEFWP	None
1-MS-233-CR		None	• MS to SSRHs may fail open	None
1-MS-235-CR		None	None	None
1-MS-236-CR		None	None	None
1-MS-238-CR	1-2	None	• MS to SSRHs may fail open	None
1-MS-245-CR		None	None	None
1-MS-252-CR		None	None	None
1-MS-259-CR		None	None	None
1-MS-260-CR		None	None	None

Table 2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-MSRD-011-R	8	None	Loss of 'B' LPSW pump	None
1-MSRD-020-R	2,3	• 8" 1B MS to 1MS-28 • 8" 1B MS to 1MS-31 • (2) 6", (1) 12", (2) 20", (4) 24", and (1) 30" Main FDW lines • Loss of U1 EFW • Upper Surge Tank '1A' • (1) 6", (1) 8", and (2) 24" Condensate lines	• TBVs may fail open • Loss of 'A' LPSW pump • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	Column L-21
1-MSRD-020-R	4	None	None	None
1-MSRD-021-R	8	None	MS to SSRHs may fail open	None
1-MSRD-033-R	1,2	None	Loss of 'B' LPSW pump	None
1-MSRD-036-R	2,3	None	Loss of 'B' LPSW pump	None
1-MSRD-043-R	6,7	None	Loss of 'B' LPSW pump	None
1-MSRD-044-R	6,7	None	Loss of 'B' LPSW pump	None
1-MSRD-045		• 8" AS Line • (2) 6", (1) 12", (2) 20", (4) 24", and (1) 30" Main FDW lines • Loss of U1 EFW • Upper Surge Tank '1A' • (1) 6", (1) 8", and (2) 24" Condensate lines	• TBVs may fail open • Loss of 'A' LPSW pump • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	Column L-21
1-MSRD-046-R	3	None	None	None
1-MSRD-047-R	3	None	None	None
1-MSRD-049-R	2-4	None	MS to SSRHs may fail open	None

Table 2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-MSRD-050-R	3	None	• Loss of U1 EFW • MS to SSRHs may fail open	None
1-MSRD-068		1" LPSW line downstream of 1LPSW-139	None	None
1-MSRD-069-R	1,2	None	• Loss of U1 EFW • Loss of 'B' LPSW pump • Loss of 'A' Chiller • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open	None
1-MSRD-070-R	1-3	None	None	None
1-MSRD-071-R	1	None	Loss of 'B' LPSW pump	None
1-MSRD-073-R	1	(2) 1.5" LPSW line breaks downstream of 1LPSW-139	None	None
1-MSRD-074-R	1-2	14" and 1.5" LPSW line breaks downstream of 1LPSW-139	Loss of 'B' LPSW pump	None
1-MSRD-080-R	1	None	MS to SSRHs may fail open	None
1-MSRD-083-R	1-3	1.5" LPSW line break downstream of 1LPSW-139	None	None
1-MSRD-087-R	1-2	(2) 1" LPSW line breaks downstream of 1LPSW-139	None	None
1-MSRD-092-R	2-4	1.5" LPSW line break downstream of 1LPSW-139	None	None
1-MSRD-095-R	1-3	1" LPSW line break downstream of 1LPSW-139	None	None
1-MSRD-095-R	7	None	Loss of 'B' LPSW pump	None
1-MSRD-095-R	9,10	None	• Loss of 'A' Train of Control Area Cooling	None
1-MSRD-096-R	1-3	1" LPSW line break downstream of 1LPSW-139	None	None

Table 2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-MSRD-097-R	1	None	• Loss of 'A' Train of Control Area Cooling	None
1-MSRD-099-R	1-3	(2) 1" LPSW line breaks downstream of 1LPSW-139	None	None
1-MSRD-101-R	1-2	1.5" LPSW line break downstream of 1LPSW-139	None	None
1-MSRD-102-R	2-5,3L	None	None	None
1-MSRD-103-R	2-3	1.5" LPSW line break downstream of 1LPSW-139	None	None
1-MSRD-104-R	1-2	None	None	None
1-MSRD-105-R	1-3	1" LPSW line break downstream of 1LPSW-139	None	None
1-MSRD-106-R	16,17	None	None	None
1-MSRD-109-R01	9,10	None	None	None
1-MSRD-109-R02	22-26	None	None	None
1-MSRD-110-R01	10-12	None	None	None
1-MSRD-110-R02	8,9	None	MS to SSRHs may fail open	None
1-MSRD-111-R01	1,2	None	None	None
1-MSRD-111-R01	9-11	None	MS to SSRHs may fail open	None
1-MSRD-111-R02	12-14,21	None	MS to SSRHs may fail open	None
1-MSRD-113-R	5-10,21,22	None	None	None
1-MSRD-115-R	1,2, 4-10	None	None	None
1-MSRD-115-R	15,16	None	None	None

Table 2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-MSRD-115-R	17,18	None	None	None
1-MSRD-115-R	21-24,27,28	6" 1A EFW Line	None	None
1-MSRD-116-R	3-7	None	None	None
1-MSRD-116-R	8,14-17	None	None	None
1-MSRD-117-R	3-13	None	None	None
1-MSRD-118-R	1-3,5,6	None	None	None
1-MSRD-119-R02	6,7,13,14	None	None	None
1-MSRD-122-R01	10-16	None	None	None
1-MSRD-123-R	1,4-7	None	None	None
1-MSRD-124-R	1,4-7	None	None	None
1-MSRD-125-R	1-7	None	None	None
1-MSRD-126-R01	5-8	None	Loss of 'B' LPSW pump	None
1-MSRD-126-R01	10-18	None	• Loss of U1 EFW • MS to SSRHs may fail open • Loss of 'A' Chiller • Loss of AFIS trip signal to FWPTs	None
1-MSRD-126-R02	19,24-26	None	None	None
1-MSRD-127-R	12-15	1.5" 1A MS Class G line after 1MS-17	None	None
1-MSRD-130-R	17	None	None	None
1-MSRD-131-R	6	None	None	None

Table .2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-MSRD-132-R	6-12	None	None	None
1-MSRD-133-R01	11-15	None	None	None
1-MSRD-133-R02	1-10	None	None	None
1-MSRD-134-R01	12,13	None	None	Mezz Floor Beam between C-14 and C-15
1-MSRD-134-R01	14,15	None	None	None
1-MSRD-134-R02	1-9	None	None	None
1-MSRD-135-R01	10-12	None	MS to SSRHs may fail open	None
1-MSRD-135-R02	13-35	None	None	None
1-MSRD-136-R	9,10,13,14	None	None	None
1-MSRD-136-R	17-20	6" 1A EFW Line	None	None
1-MSRD-137-R	4,5	None	None	None
1-MSRD-137-R	7-9	6" 1A EFW Line	None	None
1-MSRD-137-R	12-15	None	None	None
1-MSRD-139-R	2-9	• 2 - 8" AS Lines • 4" AS Line	None	None
1-MSRD-139-R	10-28	None	None	None
1-MSRD-140-R	2,3	None	None	None
1-MSRD-141-R02	4,5,12,13	None	None	None

Table 2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-MSRD-142-R02	1-7	None	None	None
1-MSRD-142-R02	8-9	None	None	None
1-MSRD-143-R02	31,32	None	None	None
1-MSRD-144-R	1,4-7	None	None	None
1-MSRD-145-R	1,4-7	None	None	None
1-MSRD-146-R	1-9	None	None	None
1-MSRD-147-R	8,9	None	None	None
1-MSRD-149-R	16,17	None	None	None
1-MSRD-150-R	7-8	6" 1A EFW Line	None	None
1-MSRD-151-R01	1-7	6" 1A EFW Line	None	None
1-MSRD-151-R02	8	None	• MS to SSRHs may fail open • Loss of U1 TDEFWP	None
1-MSRD-151-R02	8/9L-11	6" 1A EFW Line	• Loss of U1 EFW • MS to SSRHs may fail open	None
1-MSRD-151-R02	12	None	None	None
1-MSRD-151-R02	13,27	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U1 EFW • Loss of AFIS trip signal to FWPTs • MS to AS may fail open	None
1-MSRD-151-R02	15-16,27/28L	None	None	None
1-MSRD-151-R02	17-24	2" AS Line	TBVs may fail open	None

Table 2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-MSRD-151-R02	25	• 8" AS Line • 2" AS Line • (2) 6", (1) 12", (2) 20", (4) 24", and (1) 30" Main FDW lines • Loss of U1 EFW • Upper Surge Tank '1A' • (1) 6", (1) 8" and (2) 24" Condensate lines	• TBVs may fail open • Loss of 'A' LPSW pump • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	Column L-21

Table . .-10
Potential Damage to Shutdown Equipment
Caused by Plant Heating System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-PH-005-R	3-4	None	None	None
1-PH-006-R	5a, 6b	None	None	None
1-PH-009-R	8-9	None	None	None
1-PH-010-R	10-11	None	None	None

Table ..2-11
Potential Damage to Shutdown Equipment Caused by Steam Drain System HELBs (Unit 1)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
1-SD-001		None	• Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of U1 TDEFWP	None
1-SD-002		None	• Loss of U1 EFW • MS to SSRHs may fail open	None
1-SD-007		None	None	None
1-SD-030-R	1	None	None	None
1-SD-031-R	1	None	• Loss of 1A1 and 1A2 RCPs	None
1-SD-072-R	1	None	None	None
1-SD-088-R	1	None	None	None
1-SD-089-R	1	None	None	None

5.0 UNIT 2 – ANALYSIS

For Unit 2 a total of twelve (12) systems have been identified as having high energy lines and postulated break locations outside of the Containment. These systems are as follows:

- Auxiliary Steam System
- Condensate System
- Extraction Steam System
- Feedwater System
- Heater Drain System
- Heater Vent System
- High Pressure Injection System
- Main Steam System
- Moisture Separator Reheater Drain System
- Plant Heating System
- Steam Drain System
- Steam Seal Header System

These systems were identified and their break locations and break types were generated based upon the criteria provided in Section 2. The Unit 2 HE Systems, the HE Lines on these systems, and the HE boundaries for each HE piping run are identified and documented in Calculation OSC-8385 (Reference 10.2.1). The break locations, and break types for each HE piping run are compiled and documented in Calculation OSC–7517.01 (Reference 10.2.39). Additional break location details are provided in Calculation OSC-7517.02 (Reference 10.2.40), and additional information on excluded piping sections and/or break locations is provided in Calculations OSC-8385 & OSC–7517.04 (References 10.2.1 & 10.2.42, respectively). The analysis of each system follows.

5.1 High Energy Systems (HE Lines, Boundaries & Break Locations)

For each HE System the following parameters are provided:

- HE Lines
- The HE Line boundaries
- HELB locations

5.1.1 Auxiliary Steam System

The purpose of the Auxiliary Steam (AS) System is to supply steam as necessary to various plant components and systems. The AS System supplies steam for startup of the unit, when the Main Steam System is not available. In particular, the AS System provides a backup steam supply to the Turbine-Driven Emergency Feedwater Pump. The AS System also provides steam to the Condensate Steam Air Ejectors, the Main Feedwater Pump Turbines, the Steam Seal Header, the Low-Pressure Feedwater "E" Heaters and various station heating & radwaste system loads. The AS System is shared by all three ONS Units. Steam for the AS System is supplied from the Main Steam System of any Unit or an Auxiliary Boiler, which is shared with all three (3) units. A simplified functional configuration of the Unit 2 AS System is shown on Figure 5.1-1.

The high energy portions of the AS System include essentially all Unit 2 AS piping that exceeds 1" nominal pipe size. All Unit 2 AS High Energy piping is located in the Turbine Building. The major HE piping boundaries of the AS System include:

- Valves 2MS-127, 2MS-131, and 2MS-130 from the Main Steam System
- Valve AS-5, which separates the Unit 1 and Unit 2 AS Systems
- Valve 2AS-5, which separates the Unit 2 and Unit 3 AS Systems
- The 12" AS header at Column 29, which separates the Unit 1 and Unit 2 AS Systems
- The 12" AS header between Columns 42 and 43, which separates the Unit 2 and Unit 3 AS Systems
- Branch connection to the Unit 2 Main Feedwater Pump Turbine piping
- Valve 2AS-38 to the Unit 2 Emergency Feedwater Pump Turbine

Other component boundaries for the Unit 2 AS System include valves 2AS-34, 2AS-26, 2AS-40, and 2AS-10. There are also boundaries at relief valves 2AS-23, 2AS-101, 2AS-468, and 2AS-469. These boundaries are described in References 10.2.1 & 10.2.39, and these boundaries are shown graphically on Figure 5.1-1.

On the Unit 2 AS System there are 41 Running Breaks that were considered for analysis. Of these 38 non-excluded, Running Breaks were identified (References 10.2.1, 10.2.39, 10.2.40 & 10.2.42). A compilation of the non-excluded, Running Breaks (38) and their physical parameters are provided in Table 5.1-1. The AS System has no seismically analyzed lines, and all of the individual breaks are located in the Unit 2 section of the Turbine Building. The majority of these individual breaks are located on the mezzanine level (796'-6" Elev.) of the Turbine Building with the remainder located on the Turbine Building basement level (775'-0" Elev.). Three (3) of the Running Breaks, 2-AS-011-R, 2-AS-012-R, & 2-AS-013-R, were excluded based upon the normally closed position of valve 2AS-34 (Reference 10.2.42). The location of each of the non-excluded, Running Breaks is shown on Figure 5.1-1. There are no postulated critical crack locations on the Unit 2 AS System (Reference 10.2.39).

5.1.2 Condensate System

The purpose of the Condensate System is to deliver condensate water from the Condenser Hotwells to the suction of the Main Feedwater (MFDW) Pumps. The Hotwell and Condensate Booster Pumps raise the condensate water pressure to the net positive suction head (NPSH) of the MFDW Pumps. The Polishing Demineralizers purify the condensate water to meet the chemistry specifications of the Steam Generators, and the condensate water is heated in the Low Pressure Heaters between the Condensate Booster Pumps and the MFDW Pumps. A simplified functional configuration of the Unit 2 Condensate System is shown on Figure 5.1-2.

The high energy portions of the Condensate System include most of the Unit 2 piping that exceeds 1" nominal pipe size. All of the Unit 2 Condensate System HE piping is located in the Turbine Building. The major boundaries of the Condensate System HE piping are the discharge nozzles of the Condensate Booster pumps, the inlet and outlet nozzles of the Low Pressure heaters, and the suction nozzles on the MFDW Pumps. The other HE piping boundaries on the Condensate System include Control Valves 2C-425, 2C-426, & 2C-427; valves 2C-98 & 2C-99; valve 2C-124; and relief valves 2FDW-50 & 2FDW-62. The MFDW Pump Seal Injection piping has boundaries at the seal inlet nozzles to the MFDW Pumps; valves 2C-320 & 2C-321; and MFDW Seal Injection Pump valves 2C-311, 2C-313, 2C-314 & 2C-316. The HE lines and their boundaries for the Condensate System are described in References 10.2.1 & 10.2.39 and are shown graphically on Figure 5.1-2.

For the Unit 2 Condensate System 107 Running Breaks were considered for the analysis, and 90 Running Breaks were identified as non-excluded (References 10.2.1, 10.2.39, 10.2.40, & 10.2.42). A compilation of the non-excluded, Running Breaks (90) and the location and physical parameters of each of these Running Breaks are provided in Table 5.1–2. The Condensate System has no seismically analyzed piping lines, and all of the individual breaks are located in the Unit 2 portion of the Turbine Building. Twelve (12) of the Running Breaks are located on the mezzanine level (796'-6" Elev.) and the balance of the Running Breaks are located on the basement level (775'-0" Elev.) of the Turbine Building. Seventeen (17) of the Running Breaks (2-C-034-R01, 2-C-034-R02, 2-C-035-R, 2-C-048-R to 2-C-051-R, 2-C-054-R to 2-C-057-R, 2-C-060-R to 2-C-064-R, and 2-C-069-R) were excluded based upon either being isolated by a closed valve or not meeting the definition of a HE Line during Normal Plant Conditions. The location of each of the non-excluded, Running Breaks is shown on Figure 5.1-2. No critical crack locations are required to be postulated on the Unit 2 Condensate System (Reference 10.2.39).

5.1.3 Extraction Steam System

The Extraction Steam System includes:

- 'A' Extraction - supplies steam to 'A' FDW Heaters and FSRHs
- 'B' Extraction - supplies steam to 'B' FDW Heaters
- 'C' Extraction - supplies steam to 'C' FDW Heaters
- HP Turbine Exhaust (Cold Reheat - Inlet to MSRH)
- LP Turbine Inlet (Hot Reheat - Outlet from MSRH)
- 'D' Extraction - supplies steam to 'D' Feedwater Heaters
- 'E' Extraction - supplies steam to 'E' Feedwater Heaters

The purpose of the Extraction Steam (ES) System is to provide heating steam for the Condensate and Feedwater Systems, in order to heat the water being supplied to the shell side of the Steam Generators. Steam is removed from various points on the Turbine Cycle for the steam. The system can also supply steam to the Plant Heating System, if desired. A simplified functional configuration of the Unit 2 Extraction Steam System is shown on Figure 5.1-3.

The high energy portions of the ES System include most of the Unit 2 piping that operates at elevated pressures and exceeds 1" nominal pipe size. All of the Unit 2 ES System HE piping is located in the Turbine Building. The major HE piping boundaries of the ES System include connections to steam supply piping line at the (Main) Feedwater Pumps and the connection points to HP & LP Heaters. The ES System also shares boundaries with the AS System, MS System, MSRD System, PH System, and the SD System. The other HE Boundaries on the ES System include valves 2HPE-20, 2MS-117, 2MS-118, 2MS-114, 2MS-121, 2MS-113, 2MS-122, & 2HPE-

35. The HE lines and their boundaries for the ES System are described in References 10.2.1, 10.2.39, &10.2.40 and are shown graphically on Figure 5.1-3.
For the Unit 2 ES System 112 Running Breaks were considered for analysis, and 82 Running Breaks were identified as non-excluded, Running Breaks (References 10.2.1, 10.2.39, 10.2.40 & 10.2.42). A compilation of these non-excluded Running Breaks, their locations, and their physical parameters are provided in Table 5.1-3. The ES System has no seismically analyzed piping lines, and all of the individual breaks on the ES System are located in the Unit 2 Turbine Building. All but two (2) of the Running Breaks are located on the mezzanine level (796'-6" Elevation), and the remaining two (2) Running Breaks are located on the basement level (775'-0" Elevation) of the Turbine Building. Thirty (30) of the Running Breaks (2-ES-035-040, 049-054, 067-072, 088-093, 101-102, 189, 289, 292, & 293-R) were excluded based upon the lack of pressure in these piping sections. These piping sections have a normal operating pressure below atmospheric pressure (≤ 0 psig). The location and break number of each of the non-excluded Running Breaks are shown on Figure 5.1-3. No critical crack locations are required to be postulated on the Unit 2 ES System (Reference 10.3.17).

5.1.4 Feedwater System

The purpose of the Feedwater System (also identified as the "Main Feedwater System") is to increase the temperature and pressure of the water received from the Condensate System, so that the water can be used on the shell side of the Steam Generators. The MFDW System also controls the flow rate of the water, which is supplied to the shell side of the Steam Generators. A simplified functional configuration of the Unit 2 Feedwater System is provided in Figure 5.1- 4.

The high energy portions of the MFDW System include essentially all of the Unit 2 MFDW System piping that exceeds 1" nominal pipe size. Most of the MFDW System HE piping is located in the Turbine Building. The two (2) Main Feedwater piping lines are routed out of the Turbine Building into the Auxiliary Building, and these piping lines are routed to Containment Penetrations #25 & #27 in the EPR. The major boundaries of the high energy sections of the MFDW System include the discharge nozzles of the Main Feedwater Pumps "2A" & "2B," the connections to the "A" & "B" HP Heaters, and the Containment Penetrations #25 & #27. The other HE boundaries on the MFDW System include valves 2FDW-53, 2FDW-65, 2FDW- 262, 2FDW-263, 2FDW-279, 2FDW-280, 2FDW-283, 2FDW-74, 2FDW-76, 2FDW-200, 2FDW-38, 2FDW-47, 2FDW-99, and 2FDW-101. The HE piping lines and their boundaries for the MFDW System are described in References 10.2.1 & 10.2.39 and are shown graphically on Figure 5.1-4.

For the Unit 2 MFDW System ten (10) Terminal End Breaks, three (3) Intermediate Breaks, twenty-six (26) Critical Cracks, and 33 Running Breaks were considered in the analysis. The non-excluded breaks on the MFDW System include ten (10) Terminal End Breaks, twenty-six (26) Critical Cracks, three (3) Intermediate Breaks, and 33 Running Breaks (References 10.2.1, 10.2.39, 10.2.40 & 10.2.42). A compilation of these non-excluded breaks, their locations, and their physical parameters are provided in Table 5.1-4. The MFDW System piping is seismically analyzed from valves 2FDW-26 & 2FDW-21 to the Containment Penetrations, #25 & #27, respectively. This accounts for the TE & CR breaks and the number of Running Breaks on the system. The postulated break locations on the MFDW System are located in both the Turbine Building and the Auxiliary Building. Within the Auxiliary Building the MFDW System is seismically analyzed. There are two

(2) postulated TE break locations in the Auxiliary Building, 2-FDW-030 and 2-FDW-031 at Penetrations #27 and #25, respectively, at Elevation 828'-6". There are also five (5) Critical Cracks in the Auxiliary Building on the Main Feedwater piping lines to Penetrations #25 and #27. Four (4) of these critical cracks, 2-FDW-055-CR, 2-FDW-056-CR, 2-FDW-057-CR and 2-FDW-075-CR are located on the Main Feedwater piping line to Penetration #25, and the other critical crack, 2-FDW-050-CR, is located on the Main Feedwater piping line to penetration #27. All of the non-analyzed piping, and hence, the Running Breaks are located in the Turbine Building on the basement level (775'-0" Elevation) and the mezzanine level (796'-6" Elevation). The MFDW System TE breaks and the CRs in the Turbine Building are also located on the basement and mezzanine levels. The location and break number of each of the non-excluded HELBs on the MFDW System are shown on Figure 5.1-4. No critical crack locations are required to be postulated on the non-analyzed portions of the Unit 2 Main Feedwater System (References 10.2.39 & 10.3.17)

5.1.5 Heater Drain System

The purpose of the Heater Drain (HD) System is to collect the condensed extraction steam from the Feedwater Heaters and to transport the condensate to the Condensate System. A simplified functional configuration of the portions of the HD System that contain HE piping is shown of Figure 5.1-5.

The High Energy portions of the HD System consist of most of the piping on the HD System that exceeds 1" nominal pipe size. The major portions of the HD System that are not HE piping include the "E" Heater Drain Pumps suction piping from the "E" LP Heaters to the drain pumps and the HD Piping from the "F" LP Heaters to the Condenser. The major HE piping boundaries of the HD System are the two (2) connections to the Condensate System; the outlet nozzles on the Heaters, Flash Tanks and Drain Coolers; and the outlet nozzles of the Heater Drain Pumps. The other HE piping boundaries of the HD System are the numerous closed valves and relief valves. The HE Lines and their boundaries for the HD System are described in References 10.2.1 & 10.2.39 and are shown graphically on Figure 5.1- 5.

The Heater Drain System break locations consist of four (4) Terminal End (TE) breaks with two (2) of the TE breaks at the inlet to the "B" HP Heaters and the other two (2) TE Breaks on the outlets to the "C" Heater Drain Coolers. The remaining breaks are all Running Breaks. The analysis considered 129 Running Breaks, and there are 129 non-excluded Running Breaks on the Heater Drain System (References 10.2.1, 10.2.39, 10.2.40 & 10.2.42). A compilation of the non-excluded TE breaks and the non-excluded Running Breaks, their location, and physical parameters associated with each break is provided in Table 5.1-5. The Heater Drain System has no seismically analyzed piping lines, and all of the Running Breaks and the four (4) TE breaks are located in the Turbine Building. The majority of the postulated Running Breaks on the HD System are located on the basement level of the Turbine Building (775'-0" Elevation). The remaining Running Breaks are located on the Mezzanine level of the Turbine Building (796'-6" Elevation). The two (2) TE breaks on the "C" Heater Drain Coolers are located on the 803'-3" Elevation of the Turbine Building, and the two (2) TE breaks on the "B" HP Heaters are located on the 799'-6" Elevation of the Turbine Building. The location of each of the Terminal End Breaks and the non-excluded, Running Breaks are shown on Figure 5.1-5. There are no postulated critical crack locations on the Unit 2 HD System (Reference 10.2.39).

5.1.6 Heater Vent System

The purpose of the Heater Vent (HV) System is to remove non-condensable gases from the shell side of the "A", "B", "C", & "D" Heaters, the Heater Drain Coolers, and the Heater Drain lines and to transport these non-condensable gases to the Main Condenser. A simplified functional configuration of the portions of the HV System that contain HE piping is shown of Figure 5.1-6.

The high energy portions of the HV System include most of the Unit 2 piping on the HV System, whose normal operating pressure is greater than atmospheric and greater than 1" nominal pipe size. All of the Unit 2 Heater Vent System piping is in the Turbine Building. The major boundaries of the HV System HE piping are the vent piping lines from the "A", "B", "C", & "D" heaters to the first closed valve, relief valve, or pressure reducing orifice. There are also two boundaries from the "C" Heater Drain Cooler drain lines to relief valves 2HV-76 & 2HV-79. Some parts of the piping on the HV System normally operates at atmospheric or sub-atmospheric pressure, and therefore, these sections of pipe are incapable of generating pipe whips, jet impingement, flooding, or compartmental pressurization effects. The HV System HE piping line sections and their boundaries are described in References 10.2.1 & 10.2.39 and shown graphically on Figure 5.1-6.

For the Unit 2 Heater Vent System 44 Running Breaks were considered (Reference 10.2.39 & 10.2.40), and there are a total of 28 non-excluded, Running Breaks on the system (References 10.2.1, 10.2.39, 10.2.40 & 10.2.42). A compilation of the non-excluded, Running Breaks, their locations, and their physical parameters are provided in Table 5.1-6. The Heater Vent System has no seismically analyzed piping lines, and all of the individual breaks on the HV System are located in the Unit 2 portion of the Turbine Building. Most of the Running Breaks are located on the mezzanine level (796'-6" Elevation) and the remaining postulated breaks are located on the basement level (775' – 0" Elevation) of the Turbine Building. Sixteen (16) of the Running Breaks (2-HV-023-R to 030-R; 2-HV-031-R01 & R02; 2-HV-032-R; 2-HV-033-R01 & R02; 2-HV-034-R to 2-HV-036-R) were excluded based upon the lack of pressure in these piping sections. These Running Breaks had a normal operating pressure of less than or equal to atmospheric pressure (≤ 0 psig) (Reference 10.2.1). The location and break number of each of the non-excluded, Running Breaks are shown on Figure 5.1-6. There are no postulated critical crack locations on the Unit 2 HV System (Reference 10.2.39).

5.1.7 High Pressure Injection System

The purpose of the High Pressure Injection (HPI) System is to maintain the RCS coolant inventory (i.e. maintain RCS level), regulate the boric acid concentration in the RCS water, and maintain the RCP seal integrity. The HPI System adds RCS inventory as necessary through both the normal HPI Injection Line and through the RCP seals via the individual seal injection lines. The RCS inventory is normally removed through the Letdown Line. Each ONS Unit has its own HPI System. Each ONS Unit has three (3) HPI pumps, two (2) injection flow headers outside of the Containment, and the RCP Seal Injection flow paths. The only potential interface between any of the Units' HPI Systems is that the Unit 1 & Unit 2 HPI Pumps are located in the same compartment (room). A simplified functional configuration of the Unit 2 HPI System is shown on Figure 5.1-7.

With the exception of the HPI Pump mini-flow lines all of the Unit 2 HPI System piping is seismically analyzed. The high energy portions of the HPI System include:

- The HPI Pump discharge piping from the HPI Pumps 2A & 2B to Containment Penetration #9 for the HPI Injection Lines & to Containment Penetrations #10A, #10B, #23A, & #23B (RCP Seal Injection Lines).
- The Letdown Line from the Containment Penetration #6 to the pressure reducing device or a closed valve
- The HPI Pump mini-flow lines for HPI Pumps 2A & 2B from the branch connection on the HPI Pump discharge line to beyond the block orifices

The RCP Seal Return Piping and the HPI Pump Suction Piping have been excluded as HE piping, because under Normal Plant Conditions the piping does not exceed the HE piping temperature or pressure limits (See Section 2.2.1). The HPI Pump 2C discharge piping from the pump to Containment Penetration #52 and its mini-flow line are excluded as HE piping with postulated HELBs, because this piping is not pressurized more than 1% of the total operating time of the unit. Also, all HPI Piping with a nominal pipe size of 1" and smaller is excluded (Reference 10.1.1).

The primary boundaries for the HE HPI Pump discharge piping are the discharge nozzles for HPI Pumps 2A & 2B, Containment Penetration #9, and the four (4) RCP Seal Injection Lines Containment Penetrations #10A & #10B (WPR) and #23A & #23B (EPR). The primary boundaries on the Letdown Line are Containment Penetration #6, valve 2HP-42, the Block Orifice (2HPIFE0040), and valve 2HP-41. The other HPI System HE pipe boundaries are valve 2HP-62, valve 2HP-116, valve 2HP-409 and the HPI Pumps 2A & 2B mini-flow line stop check valves 2HP-248 & 2HP-250, respectively. The High Energy Piping and the boundaries of the Unit 2 HPI System are described in References 10.2.1 & 10.2.39 and are shown on Figure 5.1-7.

The Unit 2 HPI System has 14 Terminal End break locations and three (3) Running Breaks that were considered during the analysis. There are a total of 8 non-excluded, Terminal End Breaks and two (2) non-excluded Running Breaks on the system (References 10.2.1, 10.2.39, 10.2.40 & 10.2.42). A compilation of the non-excluded breaks, their locations, and their physical parameters are provided in Table 5.1-6. No other HELBs or Critical Cracks have been postulated, because no other locations on the HE piping on the HPI System exceeded the stress limits (References 10.2.1 & 10.2.39). All of the listed break locations are on the HPI Pump Discharge Piping, except for break location 2-HPI-008, which is on the Letdown Line at Containment Penetration #6. The three (3) postulated Running Breaks, 2-HPI-015-R, 2-HPI-016-R, & 2-HPI-017-R are on the HPI Pump mini-flow lines. Because the piping on the RCP Seal Return Line did not meet the temperature or pressure criteria for a HE Line, Terminal End break, 2-HPI-011 on the RCP Seal Return Line was excluded from further analysis. The HPI Pump 2C Discharge Piping did not meet the criteria for operation in excess of 1% of the total operating time of the unit. Hence, the postulated HELBs on these lines, locations 2-HPI-009 & 2-HPI-010, were excluded as break locations. The postulated Running Break, 2-HPI-017-R on the HPI Pump 2C Mini-Flow Line, is also excluded for the same reason. Postulated break locations on the HPI Pumps Suction Piping, 2-HPI-012, 2-HPI-013, and 2-HPI-014, were excluded because the normal operating fluid conditions in this piping did not meet the definition for HE Piping (References 10.2.1 & 10.2.42). The remaining individual break locations (TEs) and Running Breaks are listed in Table 5.1-7.

5.1.8 Main Steam System

The purpose of the Main Steam System is to provide steam at specified thermodynamic conditions and at specified flow rates to the Main Turbine. The MS System is also used to remove heat from the RCS and to supply steam to the Main Feedwater and TDEFW Pumps, Condenser Air Ejectors, SSH, the 2nd Stage of the MSRH, and miscellaneous auxiliary equipment. A simplified functional configuration of the Unit 2 Main Steam System is shown on Figure 5.1-8.

The high energy portions of the MS System include essentially all of the Unit 2 MS System piping that exceeds 1" nominal pipe size. Most of the MS System HE piping is located in the Turbine Building. A section of the MS piping line from Containment Penetration #28 is routed through the Yard outside of any building before entering the Turbine Building. The other MS piping line exits the containment from Containment Penetration #26 into the EPR in the Auxiliary Building. It is then routed out of the Auxiliary Building through the Yard and into the Turbine Building. The major boundaries to the MS System include Containment Penetrations #26 & #28 and the connections to the Main Turbine, the TDEFWP, the Main Feedwater Pump Turbines, the 2nd Stage Reheaters, the steam separators, steam drains, and safety valves for the Condenser Steam Air Ejectors, and the Emergency Steam Air Ejector. The MS System HE piping also has boundaries at the MSRVs, TBVs, ADVs, and valves 2MS-127, 2MS-131, & 2MS-130 to the AS System, valves 2MS-37, 2MS-38, 2AS-38, 2AS-40, 3MS-138, 2MS-92, 2SSH-1 & 2SSH-3. The HE piping lines and their boundaries for the Unit 2 MS System are described in References 10.2.1 & 10.2.39 and are shown graphically on Figure 5.1-8.

For the Unit 2 Main Steam System twenty-six (26) Terminal End Breaks, eleven (11) Intermediate Breaks, forty-three (43) Critical Cracks (CR), and thirty (30) Running Breaks were considered for analysis. The non-excluded HELBs on the MS System include twenty-three (23) Terminal End Breaks, ten (10) Intermediate Breaks, forty-three (43) Critical Cracks (CR), and thirty (30) Running Breaks (References 10.2.1, 10.2.39, 10.2.40 & 10.2.42). A compilation of these non-excluded breaks, their locations, and their physical parameters are provided in Table 5.1-8. The MS System HE piping is, for the most part, seismically analyzed. The Main Steam Lines and the branch lines of the Main Steam Lines to the first isolation valve are seismically analyzed. The only non-seismically analyzed sections are the piping to the Emergency Steam Air Ejector, the piping to the Steam Separators for the Condenser Steam Air Ejectors, the piping to the Start-up Steam Header (AS System), and the piping to the Steam Seal Header System. The MS System is seismically analyzed for the HE piping in the Yard and in the Auxiliary Building. The only HELB on the MS System in the Auxiliary Building is the Terminal End Break 2-MS-064 (835'-0" Elevation) at Containment Penetration #26 in the EPR. The HELBs in the Yard are the TE Break, 2-MS-063 (853'-9" Elevation) at Containment Penetration #28 and Critical Cracks 2-MS-234-CR and 2-MS-230-CR (827'-0" Elevation). The remaining MS System HE piping break locations are in the Turbine Building. The Running Breaks are located almost exclusively on the mezzanine level (796'-6" Elevation), and the TE, IB, and CRs in the Turbine Building are found on the basement, mezzanine, and turbine operating floor levels. Three (3) Terminal End Breaks (2-MS-005, 2-MS-006, & 2-MS-007) and one Intermediate Break (2-MS-206) have been excluded because they are located downstream of the TBVs. These sections of the MS piping lines downstream of the TBVs are not HE piping because they are not pressurized during Normal Plant Conditions more than 2%

of the operating time of the MS System. The location and break number of each of the non-excluded HELBs on the MS System are shown on Figure 5.1-8. There are no postulated critical crack locations on the non-analyzed portions of the Unit 2 Main Steam System (References 10.2.39 & 10.3.17).

5.1.9 Moisture Separator Reheater Drain (MSRD) System

The MSRD System consists of the following three sub-systems:

- Moisture Separator Reheater (MSRH) Drains
- First Stage Reheater (FSRH) Drains
- Second Stage Reheater (SSRH) Drains

Steam from the HP turbine exhaust passes through the moisture separator portion of the MSRHs, where condensate is removed from the wet steam. The condensate is routed to the MSRH Drain System. The dry steam is then heated by the FSRH tube bundle. The "A" extraction steam inside the FSRH tubes condenses as it transmits heat to the HP turbine exhaust steam. The condensate from the FSRH tubes is routed to the FSRH drain system. The steam from the HP turbine exhaust is then heated by the SSRH tube bundle before it leaves the MSRH to the LP turbine inlet. The main steam inside the SSRH tubes condenses as it transmits heat to the HP turbine exhaust steam. The condensate from the SSRH tubes is routed to the SSRH drain system.

The purpose of the MSRD System is to collect the condensate from the moisture separators and reheater tube bundles and transport the condensate back to the feedwater heaters for heat recovery. A simplified functional configuration of the Unit 2 MSRD System is shown on Figure 5.1-9.

The high energy portions of the MSRD System include most of the Unit 2 piping that exceeds 1" nominal pipe size. All of the Unit 2 MSRD System HE piping is located in the Turbine Building. The major boundaries of the MSRD System HE piping are the connections to the Moisture Separator Reheaters, Reheater Drain Tanks, Moisture Separator Drain Tank Pumps, "A" HP heaters, Moisture Separator Drain Tank Demineralizer Heat Exchanger, and the Heater Drain piping lines. The other HE boundaries include valves 2HD-29, 2HD-30, 2HD-26, 2HD-25, 2HD-601, 2HD-102, 2HD-103, 2HD-27, 2HD-28, 2HD-56, 2HD-58, 2HD-41, and 2HD-43. The HE piping lines and their boundaries for the MSRD System are described in References 10.2.1, 10.2.39, & 10.2.40 and are shown graphically on Figure 5.1-9.

For the Unit 2 MSRD System 187 Running Breaks were considered for analysis, and all of these postulated breaks, except for two (2) Running Breaks, were identified as non-excluded. There are 185 non-excluded, Running Breaks (References 10.2.1, 10.2.39, 10.2.40 & 10.2.42). A compilation of these non-excluded postulated breaks on the MSRD System, their locations, and physical parameters is provided in Table 5.1-9. The MSRD System has no seismically analyzed piping lines, and all of the postulated break locations are located in the Turbine Building. The postulated MSRD System breaks are located on the basement and mezzanine floors of the Turbine Building. Two (2) Running Breaks were excluded from evaluation (2-MSRD-064-R & 2-MSRD-065-R) because their normal operating pressure was sub-atmospheric, and they could not cause any HELB adverse effects. The locations of each of the postulated MSRD System break locations are shown on Figure

5.1-9. There are no postulated critical crack locations on the Unit 2 MSRD System (Reference 10.2.39).

5.1.10 Plant Heating System

The purpose of the Plant Heating (PH) System is to distribute low pressure steam (~27 psig) to space heaters, Air Handling Units (AHUs), Reactor Building Purge Heaters, Condensate Storage Tanks, and the Auxiliary Boiler. The Unit 2 PH System also supplies steam to the Package Steam Fired Water Heater. A simplified function configuration of the Unit 2 Plant Heating System is shown on Figure 5.1-10.

The high energy sections of the PH System include essentially all of the PH System piping greater than 1" nominal pipe size on the supply side (inlet side) of the equipment supplied with steam. The PH System HE piping is located in the Turbine Building and the Auxiliary Building. The major boundaries of the PH System HE piping include the connections of the Units 1 & 3 PH System piping with the Unit 2 PH System piping, and the connections to the equipment supplied by the PH System. Other boundaries include valves 2HPE-35, 2AS-108, and PH-619. The HE piping line sections and their boundaries are described in References 10.2.1 & 10.2.39 and are shown graphically on Figure 5.1-10.

On the Unit 2 Plant Heating System there are 70 Running Breaks that were considered for the analysis, and 69 non-excluded, Running Breaks were identified (References 10.2.1, 10.2.39, 10.2.40 & 10.2.42). A compilation of these non-excluded, Running Breaks, their locations, and their physical parameters are provided in Table 5.1-10. The PH System has no seismically analyzed lines, and majority of the individual breaks are located in the Unit 2 section of the Turbine Building. The remaining HELBs on the PH System are located in the Auxiliary Building. In the Auxiliary Building, there are three separate PH System HE piping lines. The physical routing of each piping line is as follows:

- From the Turbine Building directly into the Ventilation Equipment Room – 520.
- The Reactor Building Purge Heater steam supply line is routed through the Unit 2 East and West Penetration Rooms.
- From the Turbine Building directly into the Storage (Room) – 408B.

One of the Running Breaks, 2-PH-061-R was excluded. Running Break 2-PH-061-R was excluded because this Running Break could be combined with another Running Break without losing consistency of break identification criteria (Reference 10.2.42). The location of each of the non-excluded, Running Breaks and their designated identification numbers are shown on Figure 5.1-10. There are no postulated critical crack locations on the Unit 2 PH System (Reference 10.2.39).

5.1.11 Steam Drain System

The purpose of the Steam Drain (SD) System is to remove condensate from the Main Steam System, Extraction Steam system, and the Steam Seal Header System. A simplified functional configuration of the SD System is shown of Figure 5.1-11. Since the SD System is directly connected to the MS, ES, & SSH Systems the SD piping is shown on the diagrams for these other systems.

The high energy portions of the Steam Drain System are, in general, those sections directly connected to the HE sections of the MS and ES Systems. The HE piping line identified sections of the SD System extend to a closed valve, steam trap, or an excluded section of piping that is 1" or less in nominal pipe size. The extent of the HE piping lines and their boundaries are described in References 10.2.1 & 10.2.39 and are shown graphically on Figure 5.1-11.

On the Unit 2 SD System seven (7) Terminal End Breaks and 74 Running Breaks were considered for analysis. Of these seven (7) Terminal End Breaks and forty-two (42) Running Breaks were identified as non-excluded (References 10.2.1, 10.2.39, 10.2.40 & 10.2.42). A compilation of these non-excluded postulated HELBs, their physical location, and their physical parameters are provided in Table 5.1-11. All of the individual breaks are located in the Unit 2 portion of the Turbine Building. Three (3) of Running Breaks and one of the Terminal End Breaks are located on the basement level (775'-0" Elev.), and the balance of the postulated breaks are located on the mezzanine level (796'-6" Elev.). Thirty-two (32) postulated Running Breaks on the SD System have been excluded as HE line break locations. Some of these Running Breaks have been excluded because each of these is connected to a piping line that had an internal pressure at atmospheric pressure (~0 psig). The remaining excluded Running Breaks on the SD System are excluded because they are connected to a section of the MS System that had been excluded as HE piping. The locations of the SD System postulated HELBs and their break numbers are shown on Figure 5.1-11. There are no Critical Crack locations postulated on the non-analyzed portions of the Unit 2 SD System (References 10.2.39 & 10.3.17).

5.1.12 Steam Seal Header System

The purpose of the Steam Seal Header (SSH) System is to provide steam to the Low Pressure Turbine (Main Turbine) seals and the (Main) Feedwater Pump Turbine seals to prevent in leakage of air into the turbines. A simplified functional configuration of the Unit 2 SSH System is shown on Figure 5.1.-12.

The high energy sections of the SSH System include all of the inlet piping to the Main Feedwater Pump Turbines, the inlets to the Low Pressure Turbines, the connection to the Main Steam System, and the connection to the Auxiliary Steam System at valve 2AS-10. The other HE piping boundaries on the SSH System include valves 2SSH-8, 2SSH-9, 2SSH-14, 2SSH-15, 2SSH-19, 2SSH-22, 2SSH-1 and 2SSH-3. The HE piping lines and their boundaries are described in References 10.2.1 & 10.2.39 and are shown graphically on Figure 5.1-12.

The analysis considered fifty-three (53) Running Breaks on the SSH System, and there are a total of twenty-nine (29) non-excluded, Running Breaks on the Unit 2 SSH System (References 10.2.1, 10.2.39, 10.2.40 & 10.2.42). There are no other types of HELBs on the SSH System, because the SSH System has no seismically analyzed piping lines. A compilation of the non-excluded, Running Breaks, their location, and their physical parameters are provided in Table 5.1-12. All of the individual breaks are located in the Unit 2 section of the Turbine Building. All but three (3) of the Running Breaks are located on the Mezzanine Level (796'-6" Elevation) of the Turbine Building, and the other three (3) Running Breaks are located on the Basement Level (775'-0" Elevation) of the Turbine Building. Twenty-four (24) postulated Running Breaks (2-SSH-001, 009-013, 033-049, & 052-R) were excluded as having postulated HELBs on them. These Running Breaks were excluded because during Normal Plant Conditions these sections of piping are operating below atmospheric pressure (~0 psig) (Reference 10.2.1). There are no postulated critical crack locations on the Unit 2 SSH System (Reference 10.2.39).

5.2 Interaction Analysis

For each of the systems listed in the previous section the interactions with the Shutdown Equipment and the defined pathway, for achieving and maintaining a Safe Shutdown condition and then proceeding to the Cold Shutdown Condition, are provided. Because of the large number of individual break locations an analysis for each break is not provided. Instead the individual breaks are grouped according to their effects on the Shutdown Equipment and a pathway to achieving a Safe Shutdown condition and then proceeding to the Cold Shutdown Condition is described for each group. A comprehensive evaluation of each individual non-excluded break location on each of the HE Systems in Unit 2 is provided in Calculations OSC-7517.04, OSC-7517.08, & OSC-7517.10 (References 10.2.42, 10.2.45, & 10.2.47). Input for these evaluations was generated in Calculations OSC-7517.01, OSC-7517.02, OSC-7517.06, OSC-7517.07 & OSC-7517.09 (References 10.2.39, 10.2.40, 10.2.43, 10.2.44, & 10.2.46)

There are six (6) areas of Unit 2, where HELBs are postulated. These areas are as follows:

- East Penetration Room (Auxiliary Building)
- West Penetration Room (Auxiliary Building)
- HPI Pump Room (Auxiliary Building)
- Ventilation Equipment Room 520 & Storage (Room) 408B (Auxiliary Building)
- Station Yard
- Turbine Building

It should be noted that Section 5.2 provides the interaction analysis of only the Unit 2 postulated HELBs and their effects on the ONS. A description of the HELB interactions for each system in each area follows. Each postulated HELB with identified targets is listed in the Shutdown Interaction Tables, 5.2-1 to 5.2-9 and 5.2-11. These tables identify all of the Shutdown Equipment damaged by individual HELBs. The direct effects from pipe whip and jet impingement, as well as the collateral damage created by the structural component failure, have been included in these tables. The HPI System has postulated HELBs in three (3) different areas of the Auxiliary Building, and its interaction Table is 5.2-7. The Feedwater System, Main Steam System, and the Plant Heating System have postulated HELBs both in the Turbine Building and the Auxiliary Building. The Main Steam System is the only HE System in the Yard. The interaction tables for the Main Feedwater and the Main Steam Systems are Tables 5.2-4 and 5.2-8 respectively. The Plant Heating System and the Steam Seal Header System have no table, because the PH and SSH Systems have no direct interactions with any Shutdown Equipment.

5.2.1 HELB Interactions in the Auxiliary Building & Station Yard

5.2.1.1 HELB Interactions in the East Penetration Room

The information in this section describes the HELBs that affect the Shutdown Equipment in the East Penetration Room and the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these HELBs. The information is separated by HE System with a write up for each system. The only HE Systems in the East Penetration Room are the Main Steam System, the (Main) Feedwater System, Plant Heating System, and the High Pressure Injection System. A detailed discussion of the postulated HELBs for these systems and their interactions are provided.

5.2.1.1.1 High Pressure Injection System

There are four (4) postulated HPI HELBs in the EPR. These breaks are the TE break on the HPI Charging Line at Containment Penetration #9 (2-HPI-007), the TE breaks on the RCP Seal Injection Lines at Containment Penetrations # 23A & #23B (2-HPI-003 & 2-HPI-006, respectively), and the TE break on the Letdown Line at Containment Penetration #6 (2-HPI-008). For any of these postulated break locations a pathway to the Safe Shutdown/Cold Shutdown Conditions exists.

For the Seal Injection Line breaks once either of the breaks occurs, the detection of the break would be made by the alarm of high seal flow in one of the lines and low flow in the other three lines. The break would be isolated by taking manual control of valve 2HP-31 and closing this valve from the Control Room. If valve 2HP-31 (RCP Seal Flow Control Valve) fails to close from the Control Room, operators can isolate the break by closing manually operated valves, which are located outside of the break area (Reference 10.3.20). Since the Component Cooling System is available, RCP seal cooling is not lost. Moreover, any flooding in the EPR would remain in the EPR for a significant period of time. The flood level in the EPR would not exceed the top of the curb around the Flood Outlet Device (FOD) for 1 hour and 40 minutes (References 10.2.20 & 10.2.24). Hence, sufficient time exists to get the seal injection line isolated. Damage to cabling for valve 2HP-21 (RCP Seal Return Penetration #7 Isolation Valve) may result in the valve failing in either position. Damage to cabling for valve 2HP-410 (Bypass Valve for valve 2HP-26) may result in a loss of function for the valve. Since this valve is normally closed, the operators would be unable to open the valve. However, these valves are not required for these postulated HELBs, and their failure does not affect the operation of the HPI System to perform its shutdown functions.

Because the Seal Injection flow is normally from the Letdown Storage Tank (LDST) or possibly from the BWST, the temperature of the water would have a maximum temperature of approximately 100-105°F. This temperature water flowing out of the break would not flash to steam and cause compartmental pressurization in the EPR. Without the compartmental pressurization, the water and any radioactive materials in the water would remain in the EPR.

Upon isolation of the break, the EPR could be drained to the Low Activity Waste Tank, and the ruptured RCP Seal Injection line is isolated from the rest of the HPI System. Seal injection flow could then be restored to the other three seal injection lines. Unit shutdown would be conducted with all of the identified Shutdown Systems available. Shutdown from the Initial Plant Conditions to the Cold Shutdown Condition can be achieved.

For the HPI Charging Line Break at Containment Penetration #9, the HELB (2-HPI-007) would be detected by the loss of inventory from the LDST and the low pressure in the HPI Discharge. The postulated HELB is isolated by taking remote manual control of valve 2HP-120 (RC Volume Control Valve) and closing this valve.

If valve 2HP-120 cannot be closed from the Control Room, operators are directed to isolate the break by closing 2HP-115 (HPI Pumps 2A & 2B Discharge Header Cross Connection Isolation Valve) and stopping the HPI Pumps. These actions can be performed from the Control Room. These actions will significantly reduce the break flow rate. However, flow will continue through the break until the break is isolated by closing a manually operated valve on the discharge of the HPI pump. This manually operated valve is located outside of the break area. With the break isolated, the HPI charging flow could be restored through the alternate charging line with, at least, two (2) HPI Pumps available and two throttling valves (2HP-27 & 2HP-409) available. This postulated HELB may affect valve 2HP-410 (bypass valve for valve 2HP-26) and prevent 2HP-410 from opening. However, valve 2HP-410 would not be used to re-establish charging flow and loss of function of this valve is of no consequence. It should be noted that this configuration allows the LDST to remain aligned to the HPI Pumps suction header to prevent overflow of the LDST to other areas of the Auxiliary Building.

As a result of this HELB on the Charging Line at Penetration #9, the EPR would flood to above the FOD curb in approximately 10.6 minutes (Reference 10.2.24), if the break had not been isolated. At this time water from the LDST and possibly the BWST would begin to flow out of the Auxiliary Building. The radiological consequences of the flooding would be bounded by the Letdown Line Break, because of the much smaller source term.

Following the isolation of the charging line break by using valve 2HP-120 or a manually operated valve on the HPI discharge piping outside of the break area, unit shutdown would be conducted. Any flooding in the EPR could then be drained to the Low Activity Waste Tank, and RCP Seal Injection can be reestablished. All of the identified Shutdown Systems would be available to support the unit shutdown. Shutdown from the Initial Plant Conditions to the Cold Shutdown Condition can be achieved.

There is one other postulated HPI HELB in the EPR. There is a postulated TE break at the Letdown Line Containment Penetration #6. The detection and isolation of the Letdown Line is important, since the isolation of the Letdown Line would eliminate the loss of RCS inventory. Upon rupture of the Letdown Line, the flow from the break will enter the EPR. The Letdown Line break flow will flash to steam. The EPR blowout panels were postulated to fail, so that a conservative offsite dose would be calculated (Reference 10.2.26). The Letdown Line break results in a relatively fast depressurization of the RCS as primary inventory is lost through the break (See Section 7.3 of this report). With the RCS pressure decreasing, a reactor trip is initiated on either the low RCS pressure or on variable low pressure trip function. The continued RCS pressure reduction results in the RCS pressure dropping to the Engineered Safeguards actuation point. The Engineered Safeguards System actuation isolates the break by closing valves 2HP-3 (2A Letdown Cooler Outlet &

Containment Isolation Valve) and 2HP-4 (2B Letdown Cooler Outlet & Containment Isolation Valve). If the Single Active Failure is either a 2HP-3 or 2HP-4 failure to close, procedures are provided to have valves 2HP-1 (2A Letdown Cooler Inlet Isolation Valve) and 2HP-2 (2B Letdown Cooler Inlet Isolation Valve) closed to isolate the break. The procedures are updated to assure that if an SAF of either 2HP-3 or 2HP-4 occurs, isolation by closing 2HP-1 and 2HP-2 is conducted prior to exceeding offsite or Control Room dose limits (References 10.2.25 &10.2.26). This postulated HELB would also affect 2HP-5 (Letdown Line Outboard Containment Isolation Valve) and potentially prevent the 2HP-5 from closing. However, since the postulated HELB is upstream of valve 2HP-5, this valve cannot isolate the break and the loss of function of 2HP-5 is of no consequence. Following the isolation of the Letdown Line, unit shutdown would be conducted with the normal Shutdown Systems available. Shutdown from the Initial Plant Conditions to the Cold Shutdown Condition can be achieved (See Section 7.3 of this report).

5.2.1.1.2 Feedwater System

Both the 2A and the 2B Main Feedwater lines pass through the EPR. Each Main Feedwater line contains an isolation check valve. The purpose of the check valve is to provide SG pressure boundary integrity for breaks upstream of the isolation check valve. Should a break occur downstream of the feedwater isolation check valve (i.e., between the check valve and the SG), the plant response would be similar to a loss of Main Feedwater event (Reference 10.2.27) except one SG will not have an intact pressure boundary. Should a break occur upstream of the feedwater isolation check valve, the check valve will close to prevent the blow-down of the SG. Both SGs will have intact pressure boundaries. The plant response would be comparable to a loss of Main Feedwater event.

The only postulated breaks in the Main Feedwater piping inside the EPR are at the terminal end of each Main Feedwater pipe (identified as 2-FDW-030 and 2-FDW-031). A break at this location is downstream of the feedwater isolation check valve. The analysis of this break is similar to that of a loss of Main Feedwater event. The analysis for a feedwater line break at this location is described in OSC-7726 (Reference 10.2.27). The RPS would trip the reactor on high RCS pressure. The main turbine would trip causing the main turbine stop valves to close, separating the Main Steam lines such that only one SG would continue to blow-down. Main and Emergency Feedwater would be automatically terminated to the faulted SG by AFIS. RCS pressure will not decrease to the point where Engineered Safeguards System Digital Channels 1 and 2 would actuate the HPI System. However, the HPI System is credited for normal makeup and RCP seal injection. The HPI System may also be needed for core decay heat removal following a single active failure to the EFW flow control valve to the intact SG. A single active failure on the EFW flow control valve to the intact SG would result in a loss of secondary side decay heat removal. Operator actions would need to be taken to restore a source of feedwater to the intact SG. Either the PSW or the SSF Systems could be used as a source to provide secondary side cooling to the intact Steam Generator.

There is no damage from the direct effects (pipe whip and jet impingement) to systems, structures or components needed to mitigate the consequences of these breaks. Whip restraints have been installed at these postulated break locations to prevent pipe whip. Guard pipes have been installed around the break location to limit and direct break flow away from critical equipment inside the EPR (Reference 10.2.34). Blowout panels have been installed in exterior walls of the EPR that are designed to relieve steam from the feedwater line breaks to outside. The blowout panels are designed to limit the pressure inside the penetration rooms to prevent structural failure due to compartmental pressurization. However, a number of unreinforced block walls are assumed to fail. Their failure would result in unacceptable flooding consequences for other areas in the Auxiliary Building. This adverse consequence has been addressed by plant modifications. A Flood Outlet Device has been installed inside the EPR to release water to outside to prevent flooding of critical electrical equipment inside the EPR. Flood barriers have been installed inside the EPR to address the failure of the unreinforced block walls. The flood barriers act to contain water inside the room so that it can be directed to the FOD and to limit the amount of water that could be released to other areas of the Auxiliary Building.

Adverse environmental conditions will be created inside the penetration room. The environmental profiles have been determined. The electrical equipment required during the Shutdown Sequence and located inside the penetration rooms, have been evaluated (Calculation OSC-8505, Reference 10.2.17) to the calculated environmental conditions and have been found to be acceptable. In addition, the non-safety control systems that could be affected by the harsh environment inside the EPR have been evaluated and determined to have no significant impact to the safety analysis.

"Critical Cracks" have been postulated on both the "2A" and "2B" Main Feedwater piping lines inside of the EPR. These cracks are postulate downstream of the Main Feedwater isolation check valves on the "2A" line and both downstream and upstream of the Main Feedwater isolation check valves on the "2B" line. These cracks include:

- 2-FDW-050-CR ("2A" Line)
- 2-FDW-055-CR ("2B" Line)
- 2-FDW-056-CR ("2B" Line)
- 2-FDW-057-CR ("2B" Line)
- 2-FDW-075-CR ("2B" Line)

Unlike the postulated Main Feedwater line breaks, guard pipes are not installed at these locations. Therefore, the effects of jet impingement require analysis.

The postulated crack 2-FDW-050-CR causes the loss of the RCPs 2A2, 2B1, & 2B2 and valve 2BS-1 (RBU Spray Header 2A Isolation) to open. The RCPs are not required for achieving and maintaining a Safe Shutdown condition, and the loss of BWST inventory through valve 2BS-1 can be mitigated by closing 2BS-3 (BS Pump Suction Isolation) or manually closing 2BS-1.

For the Critical Crack 2-FDW-055-CR, the following valves fail – 2HP-5 (Letdown Line Outboard Containment Isolation Valve), 2HP-21 (RCP Seal Return Penetration #7 Isolation Valve), 2HP-26 (HPI Loop 2A Injection), & 2LP-17 (LPI Train 2A Injection Isolation). This bounds the effects from Critical Cracks 2-FDW-057-CR and 2-FDW-075-CR. The failure of the HPI valves is of no consequence, since these valves are not required for the shutdown sequence for these postulated Critical Cracks. 2LP-17 is normally closed and an adverse cable interaction may prevent this valve from being opened from the control room. However, this valve can be manually opened. With valve 2LP-17 open LPI train "A" is used for unit cooldown. If valve 2LP-17 cannot be manually opened Train "B" can be used for unit cooldown.

For Critical Crack 2-FDW-056-CR the following Shutdown Components are affected:

- Valves 2HP-21 & 2HP-410 (bypass valve for valve 2HP-26)
- Valves 2CC-5 & 2CC-6 (RCP Cooler Outlet valves)
- Loss of Pressurizer Heaters except Bank 2 Group B
- Loss of 2A LPI Flow indication

The failure of valves 2HP-21 & 2HP-410 is of no consequence, since these valves are not required for HPI operation during the Shutdown Sequence. Two (2) trains of HPI are available. Closure of valves 2CC-5 & 2CC-6 results in loss of CC system cooling for the RCP seals, but seal cooling is still maintained with HPI Seal injection. The loss of the Pressurizer Heaters is discussed in the following paragraph, and the LPI system is not affected by the loss of the Train "2A" flow indication.

The environmental effects created by the postulated critical cracks are bounded by the postulated Main Feedwater line breaks. The environmental effects created by either the Main Feedwater line breaks or the critical cracks in Main Feedwater piping may lead to a loss of all pressurizer heaters with the exception of Bank 2 Groups B and C heaters. Bank 2 Group B heaters can be controlled from the plant Control Room. Both groups (B and C) can be controlled from the SSF Control Room (if control has been transferred to the SSF). If the heat loss from the pressurizer exceeds the capacity of the remaining group B heaters, a plant cooldown would be initiated from the plant Control Room.

5.2.1.1.3 Main Steam System

Only the 2A Main Steam Line passes through the EPR. The only postulated break in the Main Steam piping inside the EPR is at the terminal end of the 2A Main Steam pipe (identified as 2-MS-064). The analysis for a MSLB is described in UFSAR Section 15.13. The RPS would trip the reactor on low or variable low RCS pressure. The main turbine would trip causing the main turbine stop valves to close, separating the Main Steam lines such that only one SG would continue to blow-down. Main and Emergency Feedwater should be automatically terminated to the faulted SG by AFIS. However, if feedwater flow continued to the faulted SG, the faulted SG would continue to depressurize the RCS to the point where Engineered Safeguards System Digital Channels 1 and 2 would actuate the HPI System. RCS pressure continues to decrease to the point where the CF tanks automatically inject borated water into the RCS. RCS pressure may decrease to the point where Engineered Safeguards System Digital Channels 3 and 4 actuate the LPI System. However, the LPI System is not credited in the mitigation of a MSLB.

There is no damage from the direct effects (pipe whip and jet impingement) to systems, structures or components needed to mitigate the consequences of these breaks. Blowout panels have been installed in exterior walls of the EPR that are designed to relieve steam from a Main Steam line break to outside. The blowout panels are designed to limit the pressure inside the EPR & WPR to prevent structural failure.

Adverse environmental conditions will be created inside the EPR. The environmental profiles have been determined. The electrical equipment required during the Shutdown Sequence, located inside the penetration rooms have been evaluated (Calculation OSC-8505, Reference 10.2.17) to the calculated environmental conditions and have been found to be acceptable. In addition, the non-safety control systems that could be affected by the harsh environment inside the penetration room have been evaluated and determined to have no significant impact to the safety analysis.

The environmental effects created by the Main Steam line break may lead to a loss of all pressurizer heaters with the exception of Bank 2 Groups B and C heaters. Bank 2 Group B heaters can be controlled from the plant Control Room. Both groups (B and C) can be controlled from the SSF Control Room (if control has been transferred to the SSF). If the heat loss from the pressurizer exceeds the capacity of the remaining group B heaters, a plant cooldown would be initiated from the plant Control Room

5.2.1.1.4 Plant Heating System

The Plant Heating System HE piping in the EPR is excluded from analysis. The section of piping is isolated in the Turbine Building at valve 2AS-182 during Normal Plant Conditions. Hence, HELBs are not required to be postulated on the Plant Heating System piping lines in the EPR.

5.2.1.2 HELB Interactions in the West Penetration Room

The information in this section describes the HELBs that affect the Shutdown Equipment in the West Penetration Room and the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these HELBs. The information is separated by HE System with a write up for each system. The only HE Systems in the West Penetration Room are the HPI System and the Plant Heating System.

5.2.1.2.1 High Pressure Injection System

There are two (2) postulated HELBs in the West Penetration Room. These two (2) breaks are the TE breaks on the RCP Seal Injection Lines at Containment Penetrations # 10A & #10B (2-HPI-004 & 2-HPI-005, respectively). The detection, isolation, and Unit shutdown for an RCP Seal Injection line break in the WPR would be the same as that for a RCP Seal Injection line break in the EPR with one difference. Because of the smaller size of the WPR, the flooding of the WPR would not have the same scenario. The WPR has an emergency exit door and stairwell, which leads to the outside of the Auxiliary Building. Immediately in front of the door is a 5.75 inch flood barrier that would retain any flood water in the WPR as long as the level did not exceed 5.75 inches. Based upon the postulated HELBs in the WPR the flooding would start to enter the stairwell approximately 1 hour and 4 minutes after the initiation of the HELB (Reference 10.2.24). This is sufficient time to isolate the HELB.

These postulated HELBs can damage the closed valve 2BS-2 (RBU Spray Header 2B Isolation) from a direct interaction. If valve 2BS-2 were to open, the BWST inventory would start to drain to the Reactor Building. The loss of BWST inventory through valve 2BS-2 can be mitigated by closing 2BS-4 (BS Pump Suction Isolation).

Upon isolation of the break, the WPR could be drained to the LPI Room 62 Sump Pumps A & B and then the water pumped to the High Activity Waste Tank. The ruptured RCP Seal Injection line would be isolated from the rest of the HPI System. Seal injection flow could then be restored to the other three seal injection lines. Unit shutdown would be conducted with all the identified Shutdown Systems available without impact to these Shutdown Systems. Shutdown from the Initial Plant Conditions to the Cold Shutdown Condition can be achieved.

5.2.1.2.2 Plant Heating System

The Plant Heating System HE piping in the WPR is excluded from analysis. The section of piping is isolated in the Turbine Building at valve 2AS-182 during Normal Plant Conditions. Hence, HELBs are not required to be postulated on the Plant Heating System piping lines in the WPR.

5.2.1.3 HELB Interactions in the HPI Pump Room

The information in this section describes the postulated HELBs that affect the Shutdown Equipment in the HPI Pump Room and the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these HELBs. The only HE System in the HPI Pump Room is HPI System itself. No discussion is required for any other system.

There are four (4) postulated HPI HELBs in the HPI Pump Room. These HELBs include the Terminal end breaks on the HPI Pump discharge Nozzles (2-HPI-001 & 2-HPI-002) and the breaks on the mini-flow recirculation line for HPI Pumps 2A & 2B (2-HPI-015-R & 2-HPI-016-R). For these four (4) postulated HELBs the other HPI Pumps and their throttling valves are not impacted by pipe whips or jet impingements. As such, the redundancy in the HPI System is not lost. Hence, there is no loss in the capability to achieve a Safe Shutdown condition or to have Unit 2 achieve the Cold Shutdown Condition. The only adverse interaction from these breaks is the flooding in the HPI Pump Room. A discussion of this interaction follows.

For a postulated HELB at the discharge nozzle of the HPI Pump, the immediate response is the loss of charging flow and the auto-start of a second HPI Pump. Upon the start of the second HPI Pump, the charging flow would be restored to the RCS. The HPI Pump, on which the HELB is postulated, would immediately increase flow to its full run out flow at the cavitation condition. At this flow rate the minimum time to flood the HPI Pump Room to an unacceptable level is 39 minutes (Reference 10.2.21). However, there is sufficient time to identify the HPI Pump that is operating at run out conditions and trip that HPI Pump. At these run out conditions the flow is approximately 650 gpm, and once tripped, the flooding rate is reduced to approximately 35 gpm (Reference 10.2.21). This reduction would give plant personnel sufficient time to isolate the break.

The postulated HELB at the discharge nozzle of an operating HPI Pump can be quickly detected and diagnosed. There would be alarms related to low HPI header pressure, low flow in the RCP Seal Injection Lines, a low level alarm for the LDST (Reference 10.3.20), and an alarm when HPI suction is automatically transferred to the BWST. Moreover, the Control Room indication would show two (2) HPI Pumps operating. The HPI Pump, on which the HELB occurred, would be the pump in the "ON" position, and this pump would be manually tripped. The HPI Pump that automatically started on loss of charging flow would have its control switch in the "AUTO" position. Thus, the operator would know which pump to trip (Reference 10.3.32).

Once the break location has been identified, the affected HPI Pump would be tripped by the operator. If the HPI Pump 2A had the postulated HELB, the HELB would be isolated by closing valve 2HP-103 (2A HPI Pump Suction Valve). If the break is postulated on the 2B HPI Pump, the break would be isolated by closing valve 2HP-107 (2B HPI Pump Suction Valve). Closure of the suction valve on the affected HPI Pump suction piping line is necessary to allow the LDST to stay aligned to the HPI Pump suction piping, and thus, prevents an overflow of the LDST inventory. If the SAF is either 2HP-103 or 2HP-107, a second valve is provided in series with these valves on the HPI Pump suction line. With this planned modification, described in Section 9.0 of this report, the operators can isolate the break with redundant isolation valves that do not require entry into the HPI Pump Rooms. By isolating the postulated HELB with the HPI Pump suction valve, both of the remaining HPI Pumps are available to supply charging flow and RCP Seal injection flow. In addition, any SAF of an HPI MOV on the HPI Pump suction piping would not adversely affect the isolation of the postulated HELB or the ability to provide borated water from either the LDST or the BWST to either of the remaining HPI Pumps.

Once the postulated HPI Pump discharge nozzle break is isolated, the other two (2) HPI Pumps and either charging line would be available to support the achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition. Likewise, RCP Seal injection could be accomplished from either of the available HPI Pumps. With no other Shutdown Systems or Components targeted, the shutdown of the unit could proceed to a Safe Shutdown condition and to the Cold Shutdown Condition.

The postulated HELBs on the HPI Pump mini-flow lines are Running Breaks with multiple break locations postulated on both mini-flow lines. Each mini-flow piping line has a pair of in-series, restricting orifices that reduce the internal pressure in the mini-flow line to the fluid pressure in the RCP Seal Return piping lines. Any postulated individual HELBs downstream of both of the restricting orifices are excluded because this section of piping does not meet the HE piping definition during Normal Plant Conditions. The remaining postulated HELBs on the mini-flow lines do not target any SSD equipment, but these postulated HELBs would be a potential flooding hazard in the HPI Pump Room.

For a (non-excluded) postulated HELB on either of the HPI Pump mini-flow lines, the detection of this postulated HELB would be very similar to a postulated break at the HPI Pump discharge nozzle. These postulated mini-flow line breaks would cause low HPI header pressure, low RCP Seal Injection flow, and the auto-start of a second HPI Pump. Isolation would be the same as for the HPI Pump discharge nozzle break, and the previously postulated SAFs would be mitigated in the same way. With no other Shutdown Systems or Components targeted, the unit can achieve and maintain the Safe Shutdown condition and could, subsequently, proceed to the Cold Shutdown Condition.

5.2.1.4 HELB Interactions in the Storage (Room) 408B & Ventilation Equipment Room 520

The information in this section describes the postulated HELBs in Rooms 408B and 520. The only HE pipes in these rooms are the 24" Main Feedwater System pipes to Steam Generators 2A and 2B and the Plant Heating System pipes (References 10.2.48 & 10.2.49). A detailed discussion of the postulated HELBS in these rooms and the subsequent interactions are provided.

Storage (Room) – 408B

The HE piping in this room consists of the 24" Main Feedwater System pipe to Steam Generator 2B and a 2 ½" Plant Heating System pipe that supplies heating steam to the Package Steam Fired Water Heater. A discussion of each system follows.

The Main Feedwater pipe to Steam Generator 2B passes through this room, but there are no postulated breaks or critical crack locations on this pipe in the room (References 10.2.39 & 10.2.40).

The PH System HE pipe is routed directly from the Turbine Building into Room 408B to the water heater. There are no direct interactions with the Shutdown Equipment (Main Feedwater pipe and Emergency Feedwater pipe) in the room (References 10.2.39 & 10.2.40). The indirect effects of any postulated HELB cannot adversely affect these pipes, because they are passive components. Flooding, compartmental pressurization, or environmental effects could not damage these pipes.

Beyond the Room 408B the indirect HELB effects of a PH System HELB within Room 408B could affect the batteries in the adjacent Room 408 or affect the cable trays along Row M in the Turbine Building. The batteries would not be subject to flooding since the batteries are located approximately nine (9) inches above the floor level. Any steam condensing in the Battery Room or water entering the Battery Room from Room 408B would not accumulate in the Battery Room, because the water could flow out of the Battery Room under the room door that opens to Stairwell 408A. If Room 408B were to pressurize, the HELB barrier (blast shield) wall between Rooms 408B and 408 would provide protection for the batteries housed in Room 408. Any steam from a PH System HELB in Room 408B and entering Room 408 through the HVAC duct could not pressurize the Battery Room. The Battery Room has an exhaust fan opening and an open area under the room door. The environmental effects from the steam in the Battery Room may reduce battery performance, but the Panelboards for the Unit 2 125VDC Vital Instrumentation and Control Power System would not be affected because of the alternate power from the Unit 3 125VDC Vital Power System (Reference 10.2.50).

It was conservatively assumed that the east wall of Room 408B along Row N would fail and could potentially affect several cable trays in the Turbine Building. The only Shutdown Equipment affected by damage to these cables would be valves 2HP-939 & 2HP-940 (LDST to Rector Building Emergency Sump Isolation Valves) and various AFIS cables. Achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition is not affected by loss of these cables or an inadvertent spurious actuation. If valve(s) 2HP-939 and/or 2HP-940 were to open, the LDST inventory would begin to drain to the Reactor Building Emergency Sump

(RBES). This loss of inventory from the LDST would not affect the HPI System, since the HPI pumps would have suction transferred to the BWST, which is not affected by these postulated HELBs. The level alarms for the LDST and the RBES would identify the draining, and the draining would be terminated by manual closure of valves 2HP-939 & 2HP-940 or one of their isolation valves. The loss of the AFIS signals would not affect the safe shutdown of the unit. No part of the Main Steam, Main Feedwater, or the Emergency Feedwater System would be affected by the postulated HELBs, and AFIS actuation would not be required. If AFIS did actuate, the EFW System would be available to maintain Steam Generator level. Hence, there are no conditions created by the failure of wall along Row N, which would prevent the achieving and maintaining a Safe Shutdown condition and the subsequent cooldown to the Cold Shutdown Condition.

Ventilation Equipment Room - 520

The HE piping in this room consists of the 24" Main Feedwater System pipe to Steam Generator 2A and the 3" Plant Heating system pipe that supplies steam to the Air Handling Unit 16 (AHU-16). A discussion of each system follows.

The Main Feedwater pipe to Steam Generator 2A passes through this room, but there are no postulated breaks or critical crack locations on this pipe in the room (References 10.2.39).

The PH System HE pipe is routed directly from the Turbine Building into Room 520 to the AHU. There are no direct interactions with the Safe Shutdown pipes (Main Feedwater and Emergency Feedwater) in the Room (References 10.2.39 & 10.2.40). The indirect effects of any postulated PH System HELB in this room cannot adversely affect these pipes because they are passive components. Flooding, compartmental pressurization, or environmental effects could not damage these pipes.

The compartmental pressurization of Room 520 would not cause an adverse condition. The floor and ceiling of the room are reinforced concrete slabs. The walls to this room are unreinforced block or brick walls. The only wall, whose failure could adversely impact any Shutdown Equipment, is the west wall (along Column P). However, transient analysis performed for Room 520 shows that the peak pressure created by a postulated PH System HELB will not cause the west wall to fail (References 10.2.50 & 10.2.51).

Hence, it can be concluded that for any postulated HELB on the PH System pipe in Room 520 a pathway for achieving and maintaining a Safe Shutdown condition and the subsequent cooldown to the Cold Shutdown Condition exists.

5.2.1.5 HELB Interactions in the Station Yard

The only HE piping in the Unit 2 section of the Station Yard is the Unit 2 Main Steam Lines. There are no Shutdown Systems or Components in the Station Yard. A postulated break at this location would result in an unisolable break in one of the MS lines. Because there is no Shutdown Equipment in the station yard, there are no HELB interactions. The sequence used to shutdown the unit would be the same as that provided in UFSAR Section 15.13 for a single MSLB.

5.2.2 HELB Interactions in the Turbine Building

Most of the postulated HELBs at the ONS are postulated to occur in the Turbine Building. As such, a detailed discussion of the interactions and pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition is provided for all of the HE Systems, except the HPI System. The HE piping associated with the HPI System is not located in the Turbine Building, and no further discussion is required.

5.2.2.1 Auxiliary Steam System

Some of the break locations on the Unit 2 AS System in the Turbine Building were identified as targeting no Shutdown Equipment. For these breaks the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cool down of the Unit to ~250°F RCS temperature would be the normal shutdown sequence using the EFW and HPI Systems. Moreover, the SSF-ASW and PSW Systems could also be used to support the cool down of the Unit to ~250°F RCS temperature condition and maintain ~250°F RCS temperature. After the unit is cooled to ~250°F RCS temperature, the LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

Table 5.2-1 lists the Unit 2 individual breaks and the damage to the station SSD equipment and/or station structures. Some of the individual break locations with identified damage will target some Shutdown Equipment. However, these interactions do not prevent the Unit from proceeding to the Cold Shutdown Condition because only a small number of Shutdown Components were adversely affected by the postulated HELB. The pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these breaks would be similar to the methodology described for the non-interacting HELBs above.

Some of the breaks in the AS system target cabling associated with the emergency power distribution system. The bounding postulated interactions could result in the loss of the 230KV Switchyard as well as the loss of both Standby Buses. The result would be a loss of all AC power (i.e., station blackout). The Unit 2 TDEFWP is postulated to fail due to other cable interactions. In addition, the TBVs are postulated to fail open creating an open flow path for both Unit 2 MS lines to the condenser. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The loss of all AC power results in a loss of HPI, EFW, LPI, and LPSW functions. Safe shutdown can be established and maintained using the PSW and HPI (powered from PSW) systems. An alternate means of safe shutdown is the SSF in combination with the MSIVs. The PSW and HPI systems would be utilized to cool the unit(s) down to LPI entry conditions. Damage repair procedures are utilized to restore power to one CCW pump, one LPI pump per unit, one LPSW pump shared by Units 1 and 2 and one LPSW pump for Unit 3. If PSW/HPI is unavailable and the SSF is being used to maintain safe shutdown, damage repair procedures are utilized to restore power to one HPI pump per unit in addition to the CCW, LPSW and LPI pumps prior to initiating a cooldown. As previously discussed, the LPI and LPSW Systems are credited for achieving the Cold Shutdown Condition.

Some breaks in the AS System can create small steam line breaks inside the Turbine Building, due to pipe whips. In addition, direct effects to non-safety control systems that impact the TBVs and the MS to SSRHs could lead to blow-down of both SGs. The postulated small steam line breaks, as well as the failures in the non-safety control systems for the TBVs and SSRHs would normally be isolated by a single MS branch line isolation valve. However, the power supply and/or controls to these valves may be impacted by the same break. If the capability to close the MS branch line isolation valve from the Control Room is lost, the MSIV could be closed from the control room to isolate the break. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. If local environmental conditions allow access, local manual operation to close the TBVs and the valves on the MS to SSRH lines can be achieved. The functions performed by HPI, EFW, LPI, and LPSW are not impacted by the direct interactions from these postulated breaks in the AS system and are assumed to remain available.

Some breaks in the AS System can result in a loss of Unit 2 EFW. EFW function would normally be met by manual valve alignment to cross-connect EFW between units. However, certain postulated breaks in the AS system may result in a rupture of the 2A or 2B EFW header, rendering the cross-connection between units unavailable. The PSW or SSF-ASW systems would be credited to perform the EFW function for Unit 2.

Some breaks in the AS System can result in a rupture of a SSW header. A rupture in a SSW header may result in a loss of cooling to all three units' CCW pumps requiring the pumps to be secured. In addition, the loss of SSW would result in a loss of essential siphon vacuum (ESV) system. Emergency CCW siphon flow cannot be assured without the ESV system. The LPSW System is assumed to be unavailable should forced CCW flow and emergency siphon flow be lost. The loss of LPSW is assumed to result in the loss of HPI function. The loss of the LPSW System also results in the loss of the Unit 2 MDEFWPs. The EFW System function is met by the operation of the TDEFWPs on each unit. The PSW System is credited to provide cooling water to the HPI pumps and to provide a backup to the TDEFWP. If the PSW System is not available, the SSF in combination with the MSIVs would provide an alternate means of maintaining safe shutdown. Damage repair procedures are credited to provide an alternate means of cooling to a CCW pump to allow its restart and thus restoration of LPSW function for plant cooldown and the establishment of the Cold Shutdown Condition.

A potential indirect HELB interaction caused by the Unit 2 Auxiliary Steam System postulated HELBs is the loss of the Unit 2 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated AS System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF (in combination with the MSIVs) is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

Shutdown equipment located outside the Turbine Building is protected from the effects of postulated AS System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. None of the postulated AS System HELBs could cause a Turbine Building flood; therefore, damage repair procedures could be implemented as needed when the steam environment has dissipated. None of the postulated HELBs on the AS System cause any collateral damage.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated AS System HELBs. However, as previously discussed (Refer to Section 3.8.1) alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost.

The Containment Boundary is unaffected by the postulated AS System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

5.2.2.2 Condensate System

All of the non-excluded individual break locations on the Unit 2 Condensate System are located in the Turbine Building. Most of these postulated breaks were identified as targeting no Shutdown Equipment. However, it should be noted that these breaks do result in a "Loss of Main Feedwater" event. The RPS is expected to trip the reactor on high RCS pressure and trip the main turbine which closes the main turbine stop valves to prevent overcooling. The pressurizer code safety valves will lift to relieve excess RCS pressure until a source of feedwater can be reestablished to the SG. The EFW System is expected to automatically start following the loss of Main Feedwater, but its operation is impacted by the breaks. The Condensate System line breaks also deplete the condensate inventory stored in the Hotwell. The only condensate inventory credited for the affected unit's EFW is the minimum inventory stored in the UST (30,000 gallons). Some interactions resulting from these postulated HELBs will result in the complete loss of Unit 2 EFW. If the HPI system is available, HPI forced cooling could be utilized to provide decay heat removal until a source of feedwater can be established to the SG(s). Feedwater to the SGs relies upon EFW from an alternate unit (if the cross-connect is available), the new PSW System, or the SSF-ASW System. For these postulated breaks the EFW function for enabling a plant cooldown to LPI entry conditions is satisfied by the PSW System or the SSF ASW system. The PSW System would be the primary means for achieving a Safe Shutdown condition and cooling down the Unit to ~250°F. The SSF-ASW System would serve as a back-up to PSW System. The HPI System is credited for RCS makeup during the plant cooldown. The LPI System is credited for placing the unit in the Cold Shutdown Condition. The LPSW System is credited for supporting the HPI and LPI functions.

Any postulated HELB on the Unit 2 Condensate System with an interaction with Shutdown Equipment is listed in Table 5.2-2. Some of the postulated break locations in the table identify no damage to Shutdown Equipment. The pathway to a Safe Shutdown condition for these breaks would be the same as for the breaks with no targets. The remaining break locations target Shutdown Equipment. However, these interactions do not prevent the unit from proceeding to the Cold Shutdown Condition because only a small number of Shutdown Components were adversely affected by the postulated HELBs. The pathway to a Safe Shutdown condition for these breaks would be similar to the methodology described for breaks with no targets.

Some of the breaks in the Condensate System target cabling associated with the emergency power distribution system. The bounding postulated interactions could result in the loss of the 230KV Switchyard as well as the loss of both Standby Buses. The result would be a loss of all AC power (i.e., station blackout). The Unit 2 TDEFWP is postulated to fail due to other cable interactions. In addition, pipe ruptures may occur in both 36-inch 2A and 2B MS lines. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. Safe shutdown can be established and maintained using the PSW and HPI (powered from PSW) systems. An alternate means of safe shutdown is the SSF in combination with the MSIVs. The PSW and HPI systems would be utilized to cool the unit(s) down to LPI entry conditions. Damage repair procedures are utilized to restore power to one CCW pump, one LPI pump per unit, one LPSW pump shared by Units 1 and 2 and one LPSW pump for Unit 3. If PSW/HPI is unavailable and the SSF is being used to maintain safe shutdown, damage repair procedures are utilized to restore power to one HPI pump per unit in addition to the CCW, LPSW and LPI pumps prior to initiating a cooldown. As previously discussed, the LPI and LPSW Systems are credited for achieving the Cold Shutdown Condition.

Several interactions from condensate line breaks were identified with the SSW header. A rupture in the SSW header may result in a loss of cooling to all three units CCW pumps requiring the pumps to be stopped. In addition, the loss of SSW would result in a loss of essential siphon vacuum (ESV) system. Emergency CCW siphon flow cannot be assured without the ESV system. The LPSW System is assumed to be unavailable should forced CCW flow and emergency siphon flow be lost. The loss of LPSW is assumed to result in the loss of HPI function. The loss of the LPSW System also results in the loss of the Unit 2 MDEFWPs. EFW function is met by the operation of the TDEFWPs on each unit. The PSW System is credited to provide cooling water to the HPI pumps and to provide a backup to the TDEFWP. If the PSW System is not available, the SSF in combination with the MSIVs would provide an alternate means of maintaining safe shutdown. Damage repair procedures are credited to provide an alternate means of cooling to a CCW pump to allow its restart and thus restoration of LPSW function for plant cooldown and the establishment of the Cold Shutdown Condition.

A potential indirect HELB interaction caused by the Condensate System is the loss of the Unit 2 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated Condensate System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF (in combination with the MSIVs) is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

Postulated HELBs on the Unit 2 Condensate System can result in Turbine Building flooding. The Condensate System postulated HELBs are, in and of themselves, not the source of Turbine Building flooding due to the limited condensate inventory. However, interactions with CCW and LPSW piping can create a source for Turbine Building flooding. Flood protection measures have been incorporated into the design to protect equipment located inside the Auxiliary Building from flooding inside the Turbine Building, because these postulated HELBs causing flooding inside the Turbine Building can be mitigated with equipment located inside the Auxiliary Building. None of the postulated Condensate System HELBs could cause a Turbine Building flood that could exceed the Auxiliary Building flood barrier height limit of 20 feet (References 10.2.22 & 10.2.33). The PSW System would be credited for achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate method for achieving and maintaining a Safe Shutdown condition. The PSW System would be required for plant cooldown.

To achieve the Cold Shutdown Condition the source of the TB flooding would need to be isolated. The CCW Inlet Piping can be isolated by closure of the CCW Pump discharge valves (xCCW-10, xCCW-11, xCCW-12, & xCCW-13) in each unit. A single active failure of any of these valves to close would not result in an unacceptable flood height in the Turbine Building. This is because the flow rate out of the Turbine Building through the Turbine Building Drain will exceed the flooding rate prior to the flood height reaching the 20 foot in the Turbine Building Basement (References 10.2.22 & 10.2.33). If it is not possible to close the failed valve locally, the lake level needs to be lowered to below the 796' Elevation to isolate the inlet flow (References 10.2.36 & 10.2.37). The reverse flow from the CCW discharge piping would be isolated by dropping the CCW Discharge Gates or lowering the lake level below ~ 791' Elevation. Damage repair procedures (References 10.3.21 – 10.3.25) would be utilized to restore CCW and LPSW to an operational status once the TB basement has been drained.

Shutdown equipment located outside the Turbine Building is protected from the effects of postulated Condensate System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1. The potential flooding in the Turbine Building from postulated Condensate System HELBs has been previously discussed.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated Condensate System HELBs. However, as previously discussed (Refer to Section 3.8.1) alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost.

The Containment Boundary is unaffected by the postulated Condensate System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

5.2.2.3 Extraction Steam System

All of the non-excluded individual break locations on the Unit 2 ES System are located in the Turbine Building. Many of these individual breaks were identified as targeting no Shutdown Equipment. For these postulated HELBs, the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to approximately the 250°F RCS temperature. Moreover, the SSF-ASW and PSW Systems could also be used to support the EFW function for cool down of the Unit to approximately the 250°F RCS temperature condition and maintain the ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

Any postulated HELB on the Unit 2 ES System with an interaction with Shutdown Equipment is listed in Table 5.2-3. Some of the break locations in the table identify no damage. The pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these breaks would be the same as for the breaks with no targets described in the previous paragraph.

Some of the breaks in the Extraction Steam System target cabling associated with the emergency power distribution system. The bounding postulated interactions could result in the loss of the 230KV Switchyard as well as the loss of both Standby Buses. The result would be a station blackout. Safe shutdown can be established and maintained using the PSW and HPI systems. An alternate means of safe shutdown is the SSF in combination with the MSIVs. The PSW and HPI systems would be utilized to cool the unit(s) down to LPI entry conditions. If PSW/HPI is unavailable and the SSF is being used to maintain safe shutdown, damage repair procedures are utilized to restore power to one CCW pump, one HPI pump per unit, one LPI pump per unit, one LPSW pump shared by Units 1 and 2, and one LPSW pump for Unit 3 prior to initiating a cooldown. As previously discussed, the LPI and LPSW Systems are credited for achieving the Cold Shutdown Condition.

Some breaks in the Extraction Steam System can create small steam line breaks on the class F and class G portions of the MS system inside the Turbine Building, due to pipe whips. In addition, direct effects to non-safety control systems that impact the TBVs and the MS to SSRHs could lead to blow-down of both SGs. Some of the small steam line breaks occur on or before the MS branch line isolation valves. Other postulated small steam line breaks, as well as, the failures in the non-safety control systems for the TBVs and SSRHs would normally be isolated by a single MS branch line isolation valve. However, the power supply and/or controls to these valves may be impacted by the same break. If the capability to close the MS branch line isolation valve from the Control Room is lost, the MSIV could be closed from the control room to isolate the break. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The functions performed by HPI, EFW, LPI, and LPSW are not impacted by the direct interactions from these postulated breaks in the Extraction system and are assumed to remain available

Some breaks in the Extraction Steam System can result in a loss of Unit 2 EFW. EFW function would normally be met by manual valve alignment to cross-connect EFW between units. However, certain postulated breaks in the Extraction Steam system may result in a rupture of the 2A EFW header, rendering the cross-connection between units unavailable. The PSW or SSF-ASW systems would be credited to perform the EFW function for Unit 2.

Several interactions from extraction steam line breaks were identified with the SSW header. A rupture in the SSW header may result in a loss of cooling to all three units CCW pumps requiring the pumps to be stopped. In addition, the loss of SSW would result in a loss of essential siphon vacuum (ESV) system. Emergency CCW siphon flow cannot be assured without the ESV system. The LPSW System is assumed to be unavailable should forced CCW flow and emergency siphon flow be lost. The loss of LPSW is assumed to result in the loss of HPI function. The loss of the LPSW System also results in the loss of the Unit 2 MDEFWPs. EFW function is met by the operation of the TDEFWPs on each unit. The PSW System is credited to provide cooling water to the HPI pumps and to provide a backup to the TDEFWP. If the PSW System is not available, the SSF in combination with the MSIVs would provide an alternate means of maintaining safe shutdown. Damage repair procedures are credited to provide an alternate means of cooling to a CCW pump to allow its restart and thus restoration of LPSW function for plant cooldown and the establishment of the Cold Shutdown Condition.

A potential indirect HELB interaction caused by the ES System is the loss of the Unit 2 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated ES System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF (in combination with the MSIVs) is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

Shutdown equipment located outside the Turbine Building is protected from the effects of postulated ES System HELBs in the Turbine Building. However, if equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. None of the postulated ES System HELBs could cause a Turbine Building flood; therefore, damage repair procedures could be implemented as needed when the steam environment has dissipated.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated ES System HELBs. However, as previously discussed alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost (Refer to Section 3.8.1).

The Containment Boundary is unaffected by the postulated ES System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

5.2.2.4 Feedwater System

This section describes the consequences of postulated breaks of Main Feedwater piping located in the Turbine Building. Any postulated HELB on the Unit 2 MFDW System in the Turbine Building with an interaction with Shutdown Equipment is listed in Table 5.2-4. A number of breaks were excluded based on normal operating configuration. In addition, a number of Main Feedwater line breaks were found to have no Shutdown Equipment targets within the break zone of influence from pipe whip or jet impingement. However, it should be noted that these breaks result in a loss of Main Feedwater event. The RPS is expected to trip the reactor on high RCS pressure and trip the main turbine which closes the main turbine stop valves to prevent overcooling. The pressurizer code safety valves are credited to relieve excess RCS pressure until a source of feedwater can be reestablished to the SG (Reference 10.2.32). The EFW System is expected to automatically start following the loss of Main Feedwater, but its operation may be impacted by the breaks. The Main Feedwater line breaks also deplete the condensate inventory stored in the Hotwell. The only condensate inventory credited for the affected unit's EFW is the minimum inventory stored in the UST (30,000 gallons). Some interactions resulting from FWLBs will result in the complete loss of Unit 2 EFW, as well as the EFW cross-connect piping to other units. If the HPI system is available, HPI forced cooling could be utilized to provide decay heat removal until a source of feedwater can be established to the SG(s). Feedwater to the SGs relies upon EFW from an alternate unit (if the cross-connect is available), the new PSW System, or the SSF-ASW System. For these postulated breaks the EFW function for enabling a plant cooldown to LPI entry conditions is satisfied by the PSW System or the SSF-ASW system. The PSW System would be the primary means for achieving a Safe Shutdown condition and cooling down the Unit to ~250°F. The SSF-ASW System would serve as a back-up to PSW System. The HPI System is credited for RCS makeup during the plant cooldown. The LPI System is credited for placing the unit in the Cold Shutdown Condition. The LPSW System is credited for supporting the HPI and LPI functions.

Some of the breaks in the Main MFDW System target cabling associated with the emergency power distribution system. The bounding postulated interactions could result in the loss of the 230KV Switchyard as well as the loss of both Standby Buses. The result would be a station blackout. The Unit 2 TDEFWP is postulated to fail due to other cable interactions. Ruptures may occur in LPSW and CCW piping resulting in flooding of the turbine building. In addition, a 12-inch break on the 2B MS branch line to the 2B TBVs may occur, while the 2A TBVs are postulated to fail open creating an open flow path for both Unit 2 MS lines. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The loss of all AC power results in a loss of HPI, EFW, LPI, and LPSW functions. Safe shutdown can be established and maintained using the PSW and HPI systems. An alternate means of safe shutdown is the SSF in combination with the MSIVs. The PSW and HPI systems would be utilized to cool the unit(s) down to LPI entry conditions. Once the source of Turbine Building flooding has been isolated and the building has drained, damage repair procedures would be utilized to restore power to one CCW pump, one LPI pump per unit, one LPSW pump shared by Units 1 and 2 and one LPSW pump for Unit 3. LPSW motor replacement may also be necessary due to the consequences of Turbine Building flooding. If PSW/HPI is unavailable and the SSF is being used to maintain safe shutdown, damage repair procedures are utilized to restore power to one HPI pump per unit in addition to the CCW, LPSW and LPI pumps prior to initiating a cooldown. As previously discussed, the LPI and LPSW Systems are credited for achieving the Cold Shutdown Condition.

Some breaks in the Main MFDW System can create small steam line breaks inside the Turbine Building, due to pipe whips. In addition, direct effects to non-safety control systems that impact the TBVs and the MS to SSRHs could lead to blow-down of both SGs. The postulated small steam line breaks, as well as, the failures in the non-safety control systems for the TBVs and SSRHs would normally be isolated by a single MS branch line isolation valve. However, the power supply and/or controls to these valves may be impacted by the same break. If the capability to close the MS branch line isolation valve from the Control Room is lost, the MSIV could be closed from the control room to isolate the break. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The functions performed by HPI, EFW, LPI, and LPSW are not impacted by the direct interactions from these postulated breaks in the MFDW system and are assumed to remain available.

Several interactions from MFDW line breaks were identified with the SSW header. A rupture in the SSW header may result in a loss of cooling to all three units CCW pumps requiring the pumps to be stopped. In addition, the loss of SSW would result in a loss of essential siphon vacuum (ESV) system. Emergency CCW siphon flow cannot be assured without the ESV system. The LPSW System is assumed to be unavailable should forced CCW flow and emergency siphon flow be lost. The loss of LPSW is assumed to result in the loss of HPI function. The loss of the LPSW System also results in the loss of the Unit 2 MDEFWPs. EFW function is met by the operation of the TDEFWPs on each unit. The PSW System is credited to provide cooling water to the HPI pumps and to provide a backup to the TDEFWP. If the PSW System is not available, the SSF in combination with the MSIVs would provide an alternate means of maintaining safe shutdown. Damage repair procedures are credited to provide an alternate means of cooling to a CCW pump to allow its restart and thus restoration of LPSW function for plant cooldown and the establishment of the Cold Shutdown Condition.

FWLBs can result in Turbine Building flooding. The FWLBs, in and of themselves, are not the source of Turbine Building flooding due to the limited condensate inventory. However, interactions with CCW and LPSW piping can create a source for Turbine Building flooding. Flood protection measures have been incorporated into the design to protect equipment located inside the Auxiliary Building from flooding inside the Turbine Building, because these postulated HELBs causing flooding inside the Turbine Building can be mitigated with equipment located inside the Auxiliary Building. None of the postulated Main Feedwater System HELBs could cause a Turbine Building flood that could exceed the Auxiliary Building flood barrier height limit of 20 feet (References 10.2.22 & 10.2.33). The PSW System would be credited for achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate method for achieving and maintaining a Safe Shutdown condition. The PSW System would be required for plant cooldown.

To achieve the Cold Shutdown Condition the source of the TB flooding would need to be isolated. The CCW Inlet Piping can be isolated by closure of the CCW Pump discharge valves (xCCW-10, xCCW-11, xCCW-12, & xCCW-13) in each unit. A single active failure of any of these valves to close would not result in an unacceptable flood height in the Turbine Building. This is because the flow rate out of the Turbine Building through the Turbine Building Drain will exceed the flooding rate prior to the flood height reaching the 20 foot in the Turbine Building Basement (References 10.2.22 & 10.2.33). If it is not possible to close the failed valve locally, the lake level needs to be lowered to below the 796' Elevation to isolate the inlet flow (References 10.2.36 & 10.2.37). The reverse flow from the CCW discharge piping would be isolated by dropping the CCW Discharge Gates or lowering the lake level below ~ 791' Elevation. Damage repair procedures (References

10.3.21 – 10.3.25) would be utilized to restore CCW and LPSW to an operational status once the TB basement has been drained.

A potential indirect HELB interaction caused by the MFDW System is the loss of the Unit 2 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated MFDW System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF (in combination with the MSIVs) is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

Shutdown equipment located outside the Turbine Building is protected from postulated MFDW System HELBs in the Turbine Building. However, if equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The potential flooding in the Turbine Building from postulated MFDW System HELBs has been previously discussed.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated MFDW System HELBs. However, as previously discussed (Refer to Section 3.8.1) alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost.

The Containment Boundary is unaffected by the postulated MFDW System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

5.2.2.5 <u>Heater Drain System</u>

All of the non-excluded individual break locations on the Heater Drain System are located in the Turbine Building. Most of these postulated HELBs were identified as targeting no Shutdown Equipment. For these postulated HELBs the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to approximately the 250°F RCS temperature. Moreover, the SSF-ASW and PSW Systems could also be used to support the cool down of the Unit to approximately the 250°F RCS temperature condition and maintain the ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

However, it should be noted that postulated HELBs on the discharge of the 2E or 2D HD Pumps are similar to Condensate System line breaks in that they result in a "Loss of Main Feedwater" event and a loss of condensate inventory stored in the hotwell as described in Section 5.2.2.2. The only condensate inventory credited for the affected unit's EFW is the minimum inventory stored in the UST (30,000 gallons). This limited inventory would not be sufficient for EFW to support a plant cooldown to ~250°F. Feedwater to the SGs relies upon EFW from an alternate unit (if the cross-connect is available), the new PSW System, or the SSF-ASW System. For these postulated breaks the EFW function for enabling a plant cooldown to LPI entry conditions is satisfied by the PSW System or the SSF-ASW System. The PSW System would be the primary means for maintaining a Safe Shutdown condition and cooling down the Unit to ~250°F. The SSF-ASW System would serve as a back-up to PSW System.

Any postulated HELB on the HD System with an interaction with Shutdown Equipment is listed in Table 5.2-5. Several of the postulated break locations on the table identify no damage to Shutdown Equipment. The pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these breaks would be the same as for the breaks with no targets.

Some of the breaks in the HD System target cabling associated with the emergency power distribution system. The bounding postulated interactions could result in the loss of the 230KV Switchyard as well as the loss of both Standby Buses. The result would be a loss of all AC power (i.e., station blackout). The Unit 2 TDEFWP is postulated to fail due to other cable interactions. In addition, the TBVs are postulated to fail open creating an open flow path for both Unit 2 MS lines to the condenser. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The loss of all AC power results in a loss of HPI, EFW, LPI, and LPSW functions. Safe shutdown can be established and maintained using the PSW and HPI Systems. An alternate means of safe shutdown is the SSF in combination with the MSIVs. The PSW and HPI Systems would be utilized to cool the unit(s) down to LPI entry conditions. Damage repair procedures are utilized to restore power to one CCW pump, one LPI pump per unit, one LPSW pump shared by Units 1 and 2 and one LPSW pump for Unit 3. If PSW/HPI is unavailable and the SSF is being used to maintain safe shutdown, damage repair procedures are utilized to restore power to one HPI pump per unit in addition to the CCW, LPSW and LPI pumps prior to initiating a cooldown. As previously discussed, the LPI and LPSW Systems are credited for achieving the Cold Shutdown Condition.

A potential indirect HELB interaction caused by the Heater Drain System is the loss of the Unit 2 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated HD System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF (in combination with the MSIVs) is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

Shutdown equipment located outside the Turbine Building is protected from the effects of postulated HD System HELBs in the Turbine Building. However, if equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. None of the postulated HD System HELBs could cause a Turbine Building flood; therefore, damage repair procedures could be implemented as needed when the steam environment has dissipated.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated HD System HELBs. However, as previously discussed alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost (Refer to Section 3.8.1).

The Containment Boundary is unaffected by the postulated HD System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

5.2.2.6 Heater Vent System

All of the non-excluded Individual Break locations on the Heater Vent System are located in the Turbine Building. All of the postulated HELBs (See Table 5.2-6) were identified as targeting no Shutdown Equipment. For these postulated HELBs, the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to approximately the 250°F RCS temperature. Moreover, the SSF-ASW and PSW Systems could also be used to support the EFW function for cool down of the Unit to approximately the 250°F RCS temperature condition and maintain the ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

A potential indirect HELB interaction caused by the Heater Vent System is the loss of the Unit 2 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated HV System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF (in combination with the MSIVs) is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

The postulated HV System HELBs in the Turbine Building would not affect the Shutdown Equipment in the Auxiliary Building or Control Room Habitability. None of the postulated HV System HELBs could cause a Turbine Building flood. No postulated HELBs on the HV System target any CCW/LPSW System piping, and no HELBs on the HV System cause any collateral damage.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated HV System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated HV System HELBs. However, as previously discussed alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost (Refer to Section 3.8.1).

The Containment Boundary is unaffected by the postulated HV System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

5.2.2.7 High Pressure Injection System

There is no High Pressure Injection System HE piping in the Turbine Building.

5.2.2.8 Main Steam System

This section addresses the consequences of postulated ruptures of Main Steam piping located inside the Turbine Building. Any postulated HELB on the Unit 2 MS System in the Turbine Building with an interaction with Shutdown Equipment is listed in Table 5.2-8. The Main Steam piping inside the Turbine Building consists of Duke Class F and Class G piping. Ruptures in the Class F piping could be isolated by closure of the MSIVs. Ruptures in the Class G piping for Main Steam are normally isolated by the associated Main Steam branch line isolation valve. If the capability to close the MS branch line isolation valve from the Control Room is lost, the MSIV could be closed from the control room to isolate the break.

Typically, only one Main Steam line is affected by a single postulated break in the Main Steam System. A large break in the Main Steam piping will result in an automatic trip of the reactor from RPS due to low or variable low RCS pressure. Large Main Steam line breaks are described in UFSAR Section 15.13. Small breaks in the Main Steam piping may not result in an automatic trip of the reactor. However, operator action is credited to trip the reactor. Small Main Steam line breaks are described in UFSAR Section 15.17. Once the reactor and main turbine are tripped, the Main Steam lines are separated by the main turbine stop valves.

There is the potential for a single postulated break in the Main Steam System to affect both Main Steam headers even with the closure of the Main Turbine Stop Valves. Normally, both the 2A and 2B MS lines are cross connected through the steam supply to the TDEFW Pump. Breaks in the TDEFW Pump supply lines or postulated breaks that could affect the supply lines could result in a blow-down of both Main Steam lines. However, branch line isolation valves are provided on the MS supply lines to the TDEFW Pump to isolate ruptures in this piping.

Some of the breaks in the MS System target cabling associated with the emergency power distribution system. The bounding postulated interactions could result in the loss of the 230KV Switchyard as well as the loss of both Standby Buses. The result would be a station blackout. The safety consequences on the RCS due to an uncontrolled blow-down of one or both SGs are addressed in Section 7.1 of the report. The loss of all AC power results in the loss of HPI, EFW, LPI, and LPSW functions. Safe shutdown can be established and maintained using the PSW and HPI Systems. An alternate means of safe shutdown is the SSF in combination with the MSIVs. The PSW and HPI Systems would be utilized to cool the unit(s) down to LPI entry conditions. Damage repair procedures are utilized to restore power to one CCW pump, one LPI pump per unit, one LPSW pump shared by Units 1 and 2 and one LPSW pump for Unit 3. If PSW/HPI is unavailable and the SSF is being used to maintain safe shutdown, damage repair procedures are utilized to restore power to one HPI pump per unit in addition to the CCW, LPSW and LPI pumps prior to initiating a cooldown. As previously discussed, the LPI and LPSW Systems are credited for achieving the Cold Shutdown Condition.

A potential indirect interaction caused by a MS System HELB is the loss of the Unit 2 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated MS System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, the PSW System or the SSF (in combination with the MSIVs) is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

Shutdown equipment located outside the Turbine Building is protected from the effects of postulated MS System HELBs in the Turbine Building. However, if equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. None of the postulated MS System HELBs could cause a Turbine Building flood; therefore, damage repair procedures could be implemented as needed when the steam environment has dissipated.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated MS System HELBs. However, as previously discussed (Refer to Section 3.8.1) alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost.

The Containment Boundary is unaffected by the postulated MS System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

5.2.2.9 Moisture Separator Reheater Drain System

All of the non-excluded, Running Breaks on the MSRD System are located in the Turbine Building. Most of these postulated HELBs were identified as targeting no Shutdown Equipment. For these postulated HELBs the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down of the Unit to approximately the 250°F RCS temperature. Moreover, the PSW and SSF-ASW Systems could also be used to support the cool down of the Unit to approximately the 250°F RCS temperature condition and maintain the ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

Any postulated HELB on the MSRD System with an interaction with Shutdown Equipment is listed in Table 5.2-9. Several of the break locations in the table identify no damage. The pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these breaks would be the same as for the breaks with no targets.

Some of the breaks in the MSRD System target cabling associated with the emergency power distribution system. The bounding postulated interactions could result in the loss of the 230KV Switchyard as well as the loss of both Standby Buses. The result would be a loss of all AC power (i.e., station blackout). The Unit 2 TDEFWP is postulated to fail due to other cable interactions. In addition, pipe ruptures may occur in the 36-inch 2A MS line and a 12-inch 2B MS branch line to the 2B TBVs. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The loss of all AC power results in the loss of HPI, EFW, LPI, and LPSW functions. Safe shutdown can be established and maintained using the PSW and HPI Systems. An alternate means of safe shutdown is the SSF in combination with the MSIVs. The PSW and HPI Systems would be utilized to cool the unit(s) down to LPI entry conditions. Damage repair procedures are utilized to restore power to one CCW pump, one LPI pump per unit, one LPSW pump shared by Units 1 and 2 and one LPSW pump for Unit 3. If PSW/HPI is unavailable and the SSF is being used to maintain safe shutdown, damage repair procedures are utilized to restore power to one HPI pump per unit in addition to the CCW, LPSW and LPI pumps prior to initiating a cooldown. As previously discussed, the LPI and LPSW Systems are credited for achieving the Cold Shutdown Condition.

Some breaks in the MSRD System can result in a rupture of the 2A EFW header. A rupture in the EFW piping renders the cross-connection between units unavailable. The PSW or SSF-ASW Systems would be credited to perform the EFW function for Unit 2.

MSRD System HELBs can result in Turbine Building flooding. These postulated HELBs in and of themselves, are not the source of Turbine Building flooding due to the limited condensate inventory. However, interactions with CCW and LPSW piping can create a source for Turbine Building flooding. Flood protection measures have been incorporated into the design to protect equipment located inside the Auxiliary Building from flooding inside the Turbine Building, because these postulated HELBs causing flooding inside the Turbine Building can be mitigated with equipment located inside the Auxiliary Building. The maximum flood height inside the Turbine Building is not expected to exceed the protected 20 foot height limit for these breaks (References

10.2.22 & 10.2.33). The PSW System would be credited for achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate method for achieving and maintaining a Safe Shutdown condition. The PSW System would be required for plant cooldown.

To achieve the Cold Shutdown Condition the source of the TB flooding would need to be isolated. The CCW Inlet Piping can be isolated by closure of the CCW Pump discharge valves (xCCW-10, xCCW-11, xCCW-12, & xCCW-13) in each unit. A single active failure of any of these valves to close would not result in an unacceptable flood height in the Turbine Building. This is because the flow rate out of the Turbine Building through the Turbine Building Drain will exceed the flooding rate prior to the flood height reaching the 20 foot in the Turbine Building Basement (References 10.2.22 & 10.2.33). If it is not possible to close the failed valve locally, the lake level needs to be lowered to below the 796' Elevation to isolate the inlet flow (References 10.2.36 & 10.2.37). The reverse flow from the CCW discharge piping would be isolated by dropping the CCW Discharge Gates or lowering the lake level below ~ 791' Elevation. Damage repair procedures (References 10.3.21 – 10.3.25) would be utilized to restore CCW and LPSW to an operational status once the TB basement has been drained.

A potential indirect HELB interaction caused by the MSRD System is the loss of the Unit 2 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated MSRD System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF (in combination with the MSIVs) is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

Shutdown equipment located outside the Turbine Building is protected from the effects of postulated MSRD System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1. The potential flooding in the Turbine Building from postulated MSRD System HELBs has been previously discussed.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated MSRD System HELBs. However, as previously discussed alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost (Refer to Section 3.8.1).

The Containment Boundary is unaffected by the postulated MSRD System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

5.2.2.10 Plant Heating System

Most of the PH System HE piping is in the Turbine Building. For those postulated PH System HELBs in the Turbine Building there are no direct HELB interactions with Shutdown Equipment. Hence, the pathway to achieving a Safe Shutdown condition and the subsequent cooldown to the Cold Shutdown Condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to approximately the 250°F RCS temperature. Moreover, the SSF-ASW and PSW Systems could also be used to support the cool down of the Unit to approximately the 250°F RCS temperature condition and maintain the ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

A potential indirect HELB interaction caused by the Plant Heating System is the loss of the Unit 2 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated PH System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF (in combination with the MSIVs) is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

The postulated PH System HELBs in the Turbine Building would not affect the Shutdown Equipment in the Auxiliary Building or Control Room Habitability. None of the postulated PH System HELBs could cause a Turbine Building flood. No postulated HELBs on the PH System target any CCW/LPSW System piping, and no HELBs on the PH System cause any collateral damage.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated PH System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated PH System HELBs. However, as previously discussed alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost (Refer to Section 3.8.1).

The Containment Boundary is unaffected by the postulated PH System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

5.2.2.11 Steam Drain System

All of the postulated HELB locations on the Steam Drain System are located in the Turbine Building. The postulated SD System HELBs are on piping connections to the MS System pressure boundary piping or the ES System pressure boundary piping. Most of the postulated HELBs do not interact with any Shutdown Equipment. For the postulated SD System HELBs connected to the MS pressure boundary, the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition is provided in Section 5.2.2.8 (MS System). For the postulated SD System HELBs connected to the ES pressure boundary, the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to approximately the 250°F RCS temperature. Moreover, the SSF-ASW and PSW Systems could also be used to support the cool down of the Unit to approximately the 250°F RCS temperature condition and maintain the ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

Any postulated HELB on the Steam Drain System with a possible interaction with Shutdown Equipment is provided in Table 5.2-11. The most adverse break results in the possible loss of the Unit 2 TDEFWP and loss of isolation capability for the MS to SSRH. Although the Unit 2 TDEFWP is not available both of the Unit 2 MDEFWPs are available as well as the cross connections to the EFW Systems in the other units. Should circumstances prevent the use of the Unit 2 MDEFW Pumps and prevent the alignment of the Unit 2 EFW System to an alternate unit, the PSW and SSF-ASW Systems provide a redundant means of establishing a source of feedwater to the SG(s). In addition, direct effects to the non-safety control system for the MS to SSRHs could result in a loss of isolation capability for these pathways from the control room. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report.

A potential indirect HELB interaction caused by the Steam Drain System is the loss of the Unit 2 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated SD System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF (in combination with the MSIVs) is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

The postulated SD System HELBs in the Turbine Building would not affect the Shutdown Equipment in the Auxiliary Building or Control Room Habitability. None of the postulated SD System HELBs could cause a Turbine Building flood. No postulated HELBs on the SD System target any CCW/LPSW System piping, and no HELBs on the SD System cause any collateral damage.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated SD System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated SD System HELBs. However, as previously discussed alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost (Refer to Section 3.8.1).

The Containment Boundary is unaffected by the postulated SD System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

5.2.2.12 Steam Seal Header System

All of the non-excluded individual break locations on the Steam Seal Header System are located in the Turbine Building. None of the non-excluded individual breaks cause adverse interactions with any Shutdown Equipment. The pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these postulated HELBs would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to approximately the 250°F RCS temperature. Moreover, the PSW and SSF-ASW Systems could also be used to support the cool down of the Unit to approximately the 250°F RCS temperature condition and maintain the ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

A potential indirect HELB interaction caused by the Steam Seal Header System is the loss of the Unit 2 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated SSH System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF (in combination with the MSIVs) is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

The postulated SSH System HELBs in the Turbine Building would not affect the Shutdown Equipment in the Auxiliary Building or Control Room Habitability. None of the postulated SSH System HELBs could cause a Turbine Building flood. No postulated HELBs on the SSH System target any CCW/LPSW System piping, and no HELBs on the SSH System cause any collateral damage.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated SSH System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated SSH System HELBs. However, as previously discussed alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost (Refer to Section 3.8.1).

The Containment Boundary is unaffected by the postulated SSH System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

5.3 Unit 2 HELB Interactions with Other Units

The effects of postulated HELBs from the Unit 2 HE lines on the Units 1 & 3 equipment and structures are identified in this section. The information in this section is based upon field inspections of the area of influence of each postulated HELB, and these interactions with Unit 1 and/or Unit 3 equipment are documented in Calculation OSC-7517.02 and evaluated in Calculations OSC-7517.04, OSC-7517.08, and OSC-7517.10 (References 10.2.40, 10.2.42, 10.2.45, & 10.2.47, respectively).

5.3.1 Interactions with Unit 1 Equipment and Structures

For each of the twelve (12) HE systems on Unit 2 the interactions with Unit 1 equipment and the pathway to Safe Shutdown in Unit 1 are described in this section.

5.3.1.1 Auxiliary Steam System

Some of the postulated HELBs on the Unit 2 AS System target cabling that cause a loss of the 230kV Switchyard Red and Yellow buses and the Unit 1 TBVs to fail open (see Table 5.2-1). This may result in blow-down of the 1A and 1B SGs. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The lockout of the 230kV Yellow bus also causes a loss of the emergency overhead path to the Startup Transformer

CT1 from the KHU. Emergency power source for Unit 1 systems needed for safe shutdown and plant cooldown would be from the standby buses powered by CT4 or CT5.

Some of the postulated HELBs on the Unit 2 AS System target cabling that cause a complete loss of AC power on Unit 1 and the Unit 1 TBVs to fail open. This may result in a blow-down of the 1A and 1B SGs. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The complete loss of AC power results in a loss of Unit 1 systems needed for achieving and maintaining the Safe Shutdown condition. The PSW System would provide the primary means of achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate means of achieving and maintaining a Safe Shutdown condition. Plant cooldown can be accomplished using the PSW System. However, in order to cooldown from ~250°F and establish the Cold Shutdown Condition, power would need to be restored to one LPI pump and one LPSW pump.

Several of the postulated HELBs on the Unit 2 AS System target cabling for both Standby Buses to Unit 1 and the Unit 1 TBVs. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The loss of both standby buses leaves Unit 1 with the startup transformer, CT1, as the only source of emergency power. This configuration is backed up with the PSW and SSF Systems, if the Startup Transformer CT1 is lost. If Startup Transformer CT1 is lost, the Shutdown Sequence to the Cold Shutdown Condition would be the same as that described for the loss of all AC power case. Some of these breaks also cause a loss of the Unit 1 & 2 CCW Systems. The Shared Units 1 & 2 LPSW System would not be adversely affected as long as the CCW System on another unit is available. The Unit 3 CCW System is not affected by these postulated HELBs.

Some of the postulated HELBs on the Unit 2 AS System target the Siphon Seal Water (SSW) 4" header. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 1 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 1 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 1. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 2 AS System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

Some of the postulated HELBs on the Unit 2 AS System target cabling for transformer CT5 and the Unit 1 TBVs. This may result in the blow-down of the 1A and 1B SGs. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. With transformer CT5 lost, power to both Standby Buses is available from CT4, and power to both Main Feeder Buses is available from CT1.

Some of the postulated HELBs on the Unit 2 AS System target cabling for the SBB#2 to Unit 1. This interaction renders the SBB#2 to Unit 1 unavailable. If this occurs, auxiliary power for Unit 1 would still be available from SBB#1 through MFB#1 or from the Startup Transformer CT1.

Postulated HELBs on the Unit 2 Auxiliary Steam System would release steam to the interior of the Turbine Building. The steam in the Turbine Building may cause loss of the Unit 1 Main Feeder Buses, in addition to the loss of the EFW and LPSW Pumps due to the postulated Auxiliary Steam System HELB. All three (3) ONS Units share a combined Turbine Building, and the Main Feeder Bus, Switchgear, the EFW Pumps, and the LPSW Pumps have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

5.3.1.2 Condensate System

Some of the postulated HELBs on the Unit 2 Condensate System target cabling that cause a loss of the 230kV Switchyard Red and Yellow buses (see Table 5.2-2). The lockout of the 230kV Yellow bus also causes a loss of the emergency overhead path to the Startup Transformer CT1 from the KHU. Emergency power source for Unit 1 systems needed for safe shutdown and plant cooldown would be from the standby buses powered by CT4 or CT5.

Some of the postulated HELBs on the Unit 2 Condensate System target cabling that cause a complete loss of all AC power on Unit 1. In addition, some of these breaks can also result in the Unit 1 TBVs failing open and a loss of the TDEFWP. This may result in blow-down of the 1A and 1B SGs. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The complete loss of all AC power results in a loss of Unit 1 systems needed for achieving and maintaining the Safe Shutdown condition. The PSW System will provide the primary means of achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate means of achieving and maintaining a Safe Shutdown condition. Plant cooldown can be accomplished using the PSW System. However, in order to cooldown from ~250°F and establish the Cold Shutdown Condition, power would need to be restored to one LPI pump and one LPSW pump.

Several of the postulated HELBs on the Unit 2 Condensate System target the Siphon Seal Water (SSW) 4" header. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 1 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 1 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 1. The loss of CCW and

LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 2 Condensate System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

Various postulated HELBs on the Unit 2 Condensate System cause a loss of either SBB#1 or SBB#2 to feed Unit 1. This condition causes no additional adverse consequences, because emergency power from either transformer CT4 or CT5 would be available from the alternate Standby Bus not affected by the postulated HELBs, or power from CT1 would be available.

The postulated HELBs on the Unit 2 Condensate System, due to interactions with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 1, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW System or the SSF (in combination with the MSIVs) until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System is achieved. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from Unit 2 Condensate System breaks may potentially result in a loss of the Unit 1 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

5.3.1.3 Extraction Steam System

Some of the postulated HELBs on the Unit 2 Extraction Steam System target cabling that cause a loss of the 230kV Switchyard Red and Yellow buses (See Table 5.2-3). The lockout of the 230kV Yellow bus also causes a loss of the emergency overhead path to the Startup Transformer CT1 from the KHU. Emergency power source for Unit 1 systems needed for safe shutdown and plant cooldown would be from the standby buses powered by CT4 or CT5. One of these breaks also causes the Unit 1 TBVs to fail open. This may result in blow-down of the 1A and 1B SGs. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report.

One of the postulated HELBs on the Unit 2 Extraction Steam System target cabling that causes a complete loss of all AC power on Unit 1. The complete loss of all AC power results in a loss of Unit 1 systems needed for achieving and maintaining the Safe Shutdown condition. The PSW System will provide the primary means of achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate means of achieving and maintaining a Safe Shutdown condition. Plant cooldown can be accomplished using the PSW System. However, in order to cooldown from ~250°F and establish the Cold Shutdown Condition, power would need to be restored to one LPI pump and one LPSW pump.

Several of the postulated HELBs on the Unit 2 Extraction Steam System target the Siphon Seal Water (SSW) 4" header. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 1 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 1 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 1. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 2 ES System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

Some of the postulated HELBs on the Unit 2 Extraction Steam System target cabling for the SBB#1 to Unit 1. This interaction renders the SBB#1 to Unit 1 unavailable. If this occurs, auxiliary power for Unit 1 would still be available from SBB#2 through MFB#2 or from the Startup Transformer CT1.

The steam-air environment created inside the Turbine Building from Unit 2 Extraction Steam System breaks may potentially result in a loss of the Unit 1 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

5.3.1.4 Feedwater System

Postulated HELBs on the Unit 2 MFDW System can cause a lockout of the 230kV Switchyard Red and Yellow buses. The lockout of the 230kV Yellow bus also causes a loss of the emergency overhead path to the startup transformer CT1 from the KHU. Emergency power source for Unit 1 systems needed for safe shutdown and plant cooldown would be from the standby buses powered by CT4 or CT5. One of these breaks also causes the loss of SBB#2 and the A & B Chillers. The loss of SBB#2 leaves only SBB#1 as the only source of emergency power. If the SAF is the failure of breaker S11 to close, the unit would have a loss of all AC power. The Safe shutdown Sequence would be the same as that described for the loss of all AC power case. The loss of the A& B

Chillers is described in Section 3.8.1 of this report. If Breaker S11 is not the SAF, the unit is shutdown in a normal manner with the unit power from MFB#1.

Some of the postulated HELBs on the Unit 2 MFDW System target cabling that cause a complete loss of AC power on Unit 1 and the Unit 1 TBVs to fail open. This may result in blow-down of the 1A and 1B SGs. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The complete loss of AC power results in a loss of Unit 1 systems needed for achieving and maintaining the Safe Shutdown condition. The PSW System will provide the primary means of achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate means of achieving and maintaining a Safe Shutdown condition. Plant cooldown can be accomplished using the PSW System. However, in order to cooldown from ~250°F and establish the Cold Shutdown Condition, power would need to be restored to one LPI pump and one LPSW pump.

Several of the postulated HELBs on the Unit 2 MFDW System target the Siphon Seal Water (SSW) 4" header. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 1 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 1 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 1. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 2 MFDW System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

The failure of the TBVs may result in blow-down of the 1A and 1B SGs. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The PSW System would be utilized to supply cooling to the HPI pumps. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 1.

Several of the postulated HELBs on the Unit 2 MFDW System target cabling for both standby buses and the Unit 1 MFB#2. The loss of the standby buses leaves Unit 1 with MFB#1 and with the startup transformer, CT1, as the only source of emergency power. If the SAF is the failure of breaker E11 to close, the unit would have a loss of all AC power. The Safe shutdown Sequence would be the same as that described for the loss of all AC power case.

Several of the postulated HELBs on the Unit 2 MFDW System target cabling for both standby buses and the Unit 1 TBVs. This may result in blow-down of the 1A and 1B SGs. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The loss of the standby buses leaves Unit 1 with the startup transformer, CT1, as the only source of emergency power. This configuration is backed up with the PSW System and the SSF (in combination with the MSIVs), if the Startup Transformer CT1 is lost. If Startup Transformer CT1 is lost, the Shutdown Sequence to the Cold Shutdown Condition would be the same as that described for the loss of all AC power case.

Some of the postulated HELBs on the Unit 2 MFDW System target cabling for the SBB#2 to Unit 1. This interaction renders the SBB#2 to Unit 1 unavailable. If this occurs, auxiliary power for Unit 1 would still be available from SBB#1 through MFB#1 or from the Startup Transformer CT1.

Some of the postulated HELBs on the Unit 2 MFDW System target cabling for the Unit 1 and Unit 2 CCW Systems. If the CCW System was lost, the Shared Units 1&2 LPSW System would not be adversely affected as long as the CCW System on another unit is available. The Unit 3 CCW System is not affected by these postulated HELBs. Hence, LPSW is available to support a unit shutdown. Some of these breaks also cause the loss of Transformer CT5. The loss of this transformer does not adversely affect the Shutdown Sequence for Unit 1. Emergency power is available to either standby bus through Transformer CT4 or directly to either of the main feeder buses from Transformer CT1.

The postulated HELBs on the Unit 2 Main Feedwater System, due to interaction with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 1, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW System or the SSF (in combination with the MSIVs) until such time as the flooding can be stopped, the water drained out of the Turbine Building, and the LPSW System restored. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from Unit 2 Main Feedwater System breaks may potentially result in a loss of the Unit 1 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

5.3.1.5 Heater Drain System

Three (3) of the postulated HELBs (See Table 5.2-5) on the Unit 2 Heater Drain System target cabling that causes a complete loss of AC power on Unit 1 and the Unit 1 TBVs to fail open. This may result in blow-down of the 1A and 1B SGs. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The complete loss of AC power results in a loss of Unit 1 systems needed for achieving and maintaining the Safe Shutdown condition. The PSW System will provide the primary means of achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate means of achieving and maintaining a Safe Shutdown condition. Plant cooldown can be accomplished using the PSW System. However, in order to cooldown from ~250°F and establish the Cold Shutdown Condition, power would need to be restored to one LPI pump and one LPSW pump.

The remaining postulated HELBs on the HD System, having direct interactions with Unit 1 Shutdown Equipment, interact in one or more of the following ways:

- Loss of Unit 1 & 2 Control Complex Chillers A & B
- Loss of SBB#2
- Loss of Unit 1 & 2 CCW System
- Loss of Transformer CT5

The most adverse case would the loss of all of these systems and components.

- If the A & B Chillers were lost, see Section 3.8.1 of this report
- If the SBB#2 was lost, auxiliary power for Unit 1 would still be available from SBB#1 through MFB#1 or from the Startup Transformer CT1
- If the CCW System was lost, the Shared Units 1&2 LPSW System would not be adversely affected as long as the CCW System on another unit is available. The Unit 3 CCW System is not affected by these postulated HELBs. Hence, the Shared Units 1&2 LPSW System is available to support a unit shutdown
- If Transformer CT5 was lost, power to both Standby Buses is still available from CT4, and power to both Main Feeder Buses is available from CT1

If all of these adverse interactions were to occur, the Unit 1 & 2 Control Complex would still habitable, but damage repair measures would be required. The Shared Units 1&2 LPSW System would still be available, and power for Unit 1 would be established using CT4 with Standby Bus 1 to power Main Feeder Bus 1 or using CT1 to power either Main feeder bus. For these breaks the pathway to a Safe Shutdown condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to ~250°F RCS temperature. At that point the LPI/LPSW Systems would be used to achieve the Cold Shutdown Condition. Moreover, the PSW System or the SSF (in combination with the MSIVs) could also be used to achieve and maintain a Safe Shutdown condition, if necessary.

The steam-air environment created inside the Turbine Building from Unit 2 Heater Drain System breaks may potentially result in a loss of the Unit 1 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

5.3.1.6 Heater Vent System

There are no direct interactions between the postulated Unit 2 Heater Vent System HELBs and Unit 1 equipment and structures. Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 2 Heater Vent System would release steam to the interior of the Turbine Building. The steam in the Turbine Building may cause loss of the Unit 1 Main Feeder Buses, in addition to the loss of the EFW and LPSW Pumps. All three (3) ONS Units share a combined Turbine Building, and the Main Feeder Bus, Switchgear, the EFW Pumps, and the LPSW Pumps have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

5.3.1.7 High Pressure Injection System

There are no direct interactions between the postulated Unit 2 HPI HELBs and the Unit 1 equipment and structures. Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Unit 1 & Unit 2 HPI Pumps share the same compartment (room). The arrangement of the Unit 1 & 2 HPI Pumps is shown on Reference 10.2.30. A postulated HELB at the discharge nozzle of either the 2A or 2B HPI Pump would produce a flood that could eventually affect the Unit 1 HPI Pumps. However, the flooding in the Unit 1-2 HPI Pump Room from a Unit 2 HPI Pump discharge nozzle HELB would also affect the remaining Unit 2 HPI Pumps. Moreover, any flooding in the Unit 1-2 Pump Room would not adversely affect the Unit 1 HPI Pumps any sooner than the Unit 2 HPI Pumps. The mitigation scenario for assuring availability of the remaining Unit 2 HPI Pumps has been previously documented in Section 5.2.1.3. This same scenario would assure availability of the Unit 1 HPI Pumps. There are no other indirect interactions between the postulated Unit 2 HPI HELBs and the Unit 1 equipment and structures, and no further evaluations are required.

5.3.1.8 Main Steam System

Some of the postulated HELBs (See Table 5.2-8) on the Unit 2 Main Steam System target cabling that cause a complete loss of all AC power on Unit 1 and the Unit 1 TBVs to fail open. This may result in blow-down of the 1A and 1B SGs. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The complete loss of all AC power results in a loss of Unit 1 systems needed for achieving and maintaining the Safe Shutdown condition. The PSW System will provide the primary means of achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate means of achieving and maintaining a Safe Shutdown condition. Plant cooldown can be accomplished using the PSW System. However, in order to cooldown from ~250°F and establish the Cold Shutdown Condition, power would need to be restored to one LPI pump and one LPSW pump.

Two (2) of the postulated HELBs on the Unit 2 Main Steam System target cabling for the SBB#1 to Unit 1. This interaction renders the SBB#1 to Unit 1 unavailable. If this occurs, auxiliary power for Unit 1 would still be available from SBB#2 through MFB#2 or from the Startup Transformer CT1.

The Postulated HELBs on the Unit 2 Main Steam System would release steam to the interior of the Turbine Building. The steam in the Turbine Building may cause loss of the Unit 1 Main Feeder Buses, in addition to the loss of the EFW and LPSW Pumps due to the postulated Main Steam System HELB. All three (3) ONS Units share a combined Turbine Building, and the Main Feeder Bus, Switchgear, the EFW Pumps, and the LPSW Pumps have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses, switchgear, and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

5.3.1.9 Moisture Separator Reheater Drain System

Some of the postulated HELBs (See Table 5.2-9) on the Unit 2 MSRD System target cabling that cause a complete loss of AC power on Unit 1 and the Unit 1 TBVs to fail open. This may result in blow-down of the 1A and 1B SGs. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report. The complete loss of AC power results in a loss of Unit 1 systems needed for achieving and maintaining the Safe Shutdown condition. The PSW System will provide the primary means of achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate means of achieving and maintaining a Safe Shutdown condition. Plant cooldown can be accomplished using the PSW System. However, in order to cooldown from ~250°F and establish the Cold Shutdown Condition, power would need to be restored to one LPI pump and one LPSW pump.

Several of the postulated HELBs on the Unit 2 MSRD System target cabling for both standby buses to Unit 1. The loss of the standby buses leaves Unit 1 with the startup transformer, CT1, as the only source of emergency power. This configuration is backed up with the PSW System and SSF (in combination with the MSIVs), if the Startup Transformer CT1 is lost. If Startup Transformer CT1 is lost, the Shutdown Sequence to the Cold Shutdown Condition would be the same as that described for the loss of all AC power case. Some of these breaks also cause the TBVs to fail open. This may result in blow-down of the 1A and 1B SGs. The safety consequences on the RCS due to an uncontrolled blow-down of both SGs are addressed in Section 7.1 of the report.

Some of the postulated HELBs on the Unit 2 MSRD System cause the loss of the A & B Chillers. The loss of the A & B Chillers results in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

Several postulated HELBs on the Unit 2 MSRD System cause a loss of either SBB#1 or SBB#2 to feed Unit 1. This condition causes no additional adverse consequences, because emergency power from either transformer CT4 or CT5 would be available from the alternate standby bus not affected by the postulated HELBs, or power from CT1 would be available.

Some of the postulated HELBs on the Unit 2 MSRD System cause a loss of the Unit 1 & 2 CCW Systems. The Shared Units 1 & 2 LPSW System would not be adversely affected as long as the CCW System on another unit is available. The Unit 3 CCW System is not affected by these postulated HELBs. Hence, LPSW is available to support a unit shutdown. For these breaks the pathway to a Safe Shutdown condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to ~250°F RCS temperature. At that point the LPI/LPSW Systems would be used to achieve the Cold Shutdown Condition. Moreover, the PSW System or the SSF (in combination with the MSIVs) could also be used to achieve and maintain a Safe Shutdown condition, if necessary.

The postulated HELBs on the Unit 2 Moisture Separator Reheater Drain System, due to interactions with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 1, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW System or the SSF (in combination with the MSIVs) until such time as the flooding can be stopped, the water drained out of the Turbine Building, and the LPSW System restored. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from Unit 2 Moisture Separator Reheater Drain System breaks may potentially result in a loss of the Unit 1 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW Pump Motors, and the LPSW Pump Motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW System or the SSF (in combination with the MSIVs) can be utilized to a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

5.3.1.10 Plant Heating System

There are no direct interactions between the postulated Unit 2 Plant Heating System HELBs and Unit 1 equipment and structures. Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 2 Plant Heating System would release steam to the interior of the Turbine Building. The steam in the Turbine Building due to a postulated Plant Heating System HELB may cause loss of the Unit 1 Main Feeder Buses, the EFW Pump Motors, and LPSW Pump Motors. All three (3) ONS Units share a combined Turbine Building, and the Unit 1 Main Feeder Buses, Switchgear, the EFW Pump Motors, and the LPSW Pump Motors have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

5.3.1.11 Steam Drain System

There are no direct interactions between the postulated Unit 2 Steam Drain System HELBs and Unit 1 equipment and structures. Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 2 Steam Drain System would release steam to the interior of the Turbine Building. The steam in the Turbine Building due to a postulated Steam Drain System HELB may cause loss of the Unit 1 Main Feeder Buses, the EFW Pump Motors, and LPSW Pump Motors. All three (3) ONS Units share a combined Turbine Building, and the Unit 1 Main Feeder Buses, Switchgear, the EFW Pump Motors, and the LPSW Pump Motors have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

5.3.1.12 Steam Seal Header System

There are no direct interactions between the postulated Unit 2 Steam Seal Header System HELBs and Unit 1 equipment and structures. Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 2 Steam Seal Header System would release steam to the interior of the Turbine Building. The steam in the Turbine Building due to a postulated Steam Seal Header System HELB may cause loss of the Unit 1 Main Feeder Buses, the EFW Pump Motors, and LPSW Pump Motors. All three (3) ONS Units share a combined Turbine Building, and the Unit 1 Main Feeder Buses, Switchgear, the EFW Pump Motors, and the LPSW Pump Motors have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the

LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

5.3.2 Interactions with Unit 3 Equipment and Structures

For each of the twelve (12) HE systems on Unit 2 that have interactions with Unit 3 equipment, the pathway to Safe Shutdown of Unit 3 is described in this section.

5.3.2.1 Auxiliary Steam System

Six (6) of the postulated HELBs on the Unit 2 AS System target cabling that causes a loss of the 230kV Switchyard Red and Yellow buses (see Table 5.2-1). The lockout of the 230kV Yellow bus also causes a loss of the emergency overhead path to the Startup Transformer CT3 from the KHU. Emergency power source would be from the standby buses powered by CT4 or CT5.

Many of the postulated HELBs on the Unit 2 AS System target cabling that causes a complete loss of all AC power on Unit 3. The complete loss of all AC power results in a loss of Unit 3 systems needed for achieving and maintaining the Safe Shutdown condition. The PSW System will provide the primary means of achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate means of achieving and maintaining a Safe Shutdown condition. Plant cooldown can be accomplished using the PSW System. However, in order to cooldown from ~250°F and establish the Cold Shutdown Condition, power would need to be restored to one LPI pump and one LPSW pump.

Several of the postulated HELBs on the Unit 2 AS System target cabling for both standby buses. The loss of the standby buses leaves Unit 3 with the startup transformer, CT3, as the only source of emergency power. This configuration is backed up with the PSW System or the SSF (in combination with the MSIVs), if the Startup Transformer CT3 is lost. If the Startup Transformer CT3 is lost, then the Shutdown Sequence to the Cold Shutdown Condition would be the same as the loss of all AC power case. Some of these breaks also result in the loss of the Unit 3 RCPs and MFB#2. Operation of the RCPs is not required for unit shutdown. Loss of MFB#2 leaves only MFB#1 to power Unit 3. If the SAF is the failure of Breaker E13 to close, the Shutdown Sequence would be the same as described in the loss of all AC power case.

Two (2) of the postulated HELBs on the Unit 2 AS System target cabling that cause the loss of MFB#2. If MFB#2 is lost, Unit 3 can be powered through MFB#1 from CT3 through breaker E13 or from SBB#1 through Breaker S13. For these breaks the pathway to a Safe Shutdown condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to ~250°F RCS temperature. At that point the LPI/LPSW Systems would be used to achieve the Cold Shutdown Condition. Moreover, the PSW System or the SSF (in combination with the MSIVs) could also be used to achieve and maintain a Safe Shutdown condition, if necessary.

Some of the postulated HELBs on the Unit 2 AS System target the Siphon Seal Water (SSW) 4" header. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 3 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 3 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 3. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition, some postulated HELBs on the Unit 2 AS System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

The Postulated HELBs on the Unit 2 Auxiliary Steam System would release steam to the interior of the Turbine Building. The steam in the Turbine Building may cause loss of the Unit 3 Main Feeder Buses, in addition to the loss of the EFW and LPSW Pumps due to the postulated Auxiliary Steam System HELB. All three (3) ONS Units share a combined Turbine Building, and the Main Feeder Bus, Switchgear, the EFW Pumps, and the LPSW Pumps have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

5.3.2.2 Condensate System

Some of the postulated HELBs on the Unit 2 Condensate System target cabling that cause a loss of the 230kV Switchyard Red and Yellow buses (see Table 5.2-2). The lockout of the 230kV Yellow bus also causes a loss of the emergency overhead path to the Startup Transformer CT3 from the KHU. Emergency power source would be from the standby buses powered by CT4 or CT5.

Some of the postulated HELBs on the Unit 2 Condensate System target cabling that cause a complete loss of all AC power on Unit 3. In addition, some of these breaks also cause the loss of the Unit 3 TDEFWP. The complete loss of all AC power results in a loss of Unit 3 systems needed for achieving and maintaining the Safe Shutdown condition. The PSW System will provide the primary means of achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate means of achieving and maintaining a Safe Shutdown condition. Plant cooldown can be accomplished using the PSW System. However, in order to cooldown from ~250°F and establish the Cold Shutdown Condition, power would need to be restored to one LPI pump and one LPSW pump.

Several of the postulated HELBs on the Unit 2 Condensate System target the Siphon Seal Water (SSW) 4" header and cause the loss of Startup Transformer CT3. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 3 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 3 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 3. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 2 Condensate System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1. The loss of Transformer CT3 adds no additional consequences to the Shutdown sequence for these HELBs, because power for Unit 3 would be available from transformers CT4 and CT5 through the standby buses.

Some of the postulated HELBs on the Unit 2 Condensate System cause the loss of both standby buses and Startup Transformer CT3 (due to the loss of the 230kV Switchyard Red and Yellow buses). The only power available for Unit 3 would be through Transformer 3T. If the Unit 3 trips, a loss of all AC power would occur on the unit. The Shutdown Sequence for these postulated HELBS would be the same as for the loss of all AC power case previously described. Breaks 2-C-087-R02-1L, 3 & 3L also cause a loss of MFB#1. This causes no additional consequences, since the alternate bus, MFB#2, could be used if power through Transformer 3T is available.

Some of the postulated HELBs on the Unit 2 Condensate System cause the loss of both standby buses, Unit 3 MFB#2, and the Unit 3 RCPs. The only emergency power source available to Unit 3 would be from Transformer CT3. If the unit is powered from transformer CT3, a normal shutdown can be made. If Startup Transformer CT3 is lost, a loss of all AC power occurs. The Shutdown Sequence for these postulated HELBs would be the same as for loss of all AC power case previously described.

Some of the postulated HELBs on the Unit 2 Condensate System cause a loss of portions of the Unit 3 EFW System. Breaks can cause the loss of the Unit 3 TDEFWP. Breaks can cause a loss of the 3A MDEFWP. For these postulated scenarios the EFW function can be achieved by using the 3B MDEFWP or the cross-tie to one of the other units. One of the breaks that result in the loss of the Unit 3 TDEFWP also causes a loss of Unit 3 MFB#2. For this postulated scenario the unit shutdown equipment is powered through MFB#1 with power provided by transformers CT4 or CT5 through SBB#1 or from Startup Transformer CT3. In addition, the PSW and SSF-ASW Systems would be available to support the EFW function, if needed.

The postulated HELBs on the Unit 2 Condensate System, due to interactions with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 3, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW System or the SSF (in combination with the MSIVs) until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System is achieved. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from Unit 2 Condensate System breaks may potentially result in a loss of the Unit 3 electrical power distribution system. All three

(3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

5.3.2.3 Extraction Steam System

One of the postulated HELBs on the Unit 2 Extraction Steam System target cabling that causes a loss of the 230kV Switchyard Red and Yellow buses (see Table 5.2-3). The lockout of the 230kV Yellow bus also causes a loss of the emergency overhead path to the Startup Transformer CT3 from the KHU. Emergency power source would be from the standby buses powered by CT4 or CT5.

Some of the postulated HELBs on the Unit 2 Extraction Steam System target cabling that cause a loss of the 230kV Switchyard Red and Yellow buses and SBB#2. This causes a loss of off-site power for Unit 3. The lockout of the 230kV Yellow bus also causes a loss of the emergency overhead path to the Startup Transformer CT3 from the KHU. Emergency power source would be from SBB#1 powered by CT4 or CT5. If the SAF is the failure of breaker S13 to close, all AC power to Unit 3 is lost. The complete loss of all AC power results in a loss of Unit 3 systems needed for achieving and maintaining the Safe Shutdown condition. The PSW System will provide the primary means of achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate means of achieving and maintaining a Safe Shutdown condition. Plant cooldown can be accomplished using the PSW System. However, in order to cooldown from ~250°F and establish the Cold Shutdown Condition, power would need to be restored to one LPI pump and one LPSW pump.

Some of the postulated HELBs on the Unit 2 Extraction Steam System cause the loss of both standby buses and Startup Transformer CT3. The only power available for Unit 3 would be through Transformer 3T. If the Unit 3 trips, a loss of all AC power would occur on that unit. The Shutdown Sequence for these postulated HELBS would be the same as for the loss of all AC power event previously described. One of these breaks also causes a loss of MFB#1. This causes no additional consequences, since the alternate bus, MFB#2, could be used if power through Transformer 3T is available.

Several of the postulated HELBs on the Unit 2 Extraction Steam System target the Siphon Seal Water (SSW) 4" header and cause the loss of Transformer CT3. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 3 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 3 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 3. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 2 ES System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1. The loss of Transformer CT3 adds no additional consequences to the Shutdown sequence for these HELBs, because power for Unit 3 would be available from transformers CT4 and CT5 through the Standby Buses.

Numerous postulated HELBs on the Unit 2 Extraction Steam System target cabling that cause loss of Transformer CT3. The loss of CT3 would cause the loss of operation of the RCPs, if the unit trips. However, the loss of Transformer CT3 adds no additional consequences to the Shutdown Sequence for these HELBs, because power for Unit 3 would be available from transformers CT4 and CT5 through the Standby Buses and operation of the RCPs is not required during the Shutdown Sequence.

One of the postulated HELBs on the Unit 2 Extraction Steam System target cabling that causes the loss of operation of the Unit 3 RCPs. This will result in a trip of Unit 3 due to the loss of the RCPs. However, this causes no consequence for the Shutdown Sequence, because RCP operation is not required during the Shutdown Sequence.

The steam-air environment created inside the Turbine Building from Unit 2 Extraction Steam System breaks may potentially result in a loss of the Unit 3 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

5.3.2.4 Feedwater System

Postulated HELBs on the Unit 2 MFDW System can cause a lockout of the 230kV Switchyard Red and Yellow buses (see Table 5.2-4). The lockout of the 230kV Yellow bus also causes a loss of the emergency overhead path to the Startup Transformer CT3 from the KHU. Emergency power source would be from the standby buses powered by CT4 or CT5.

Some of the postulated HELBs on the Unit 2 MFDW System target cabling that cause a complete loss of AC power on Unit 3. The complete loss of AC power results in a loss of Unit 3 systems needed for achieving and maintaining the Safe Shutdown condition. The PSW System would provide the primary means of achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate means of achieving and maintaining a Safe

Shutdown condition. Plant cooldown can be accomplished using the PSW System. However, in order to cooldown from ~250°F and establish the Cold Shutdown Condition, power would need to be restored to one LPI pump and one LPSW pump. Some of these breaks also target the Siphon Seal Water (SSW) 4" header. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. Since all AC power has been lost, this rupture does not alter the Shutdown Sequence, but damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 3. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

Postulated HELBs on the Unit 2 MFDW System, due to interactions with other systems, can result in a loss of off-site power, a loss of Startup Transformer CT3, and the loss of both standby buses. For these events Unit 3 would have power to its auxiliaries, if the unit continued to operate. If the unit is tripped, it would be in a blackout condition. The Shutdown Sequence to the Cold Shutdown Condition would be the same as the loss of all AC power case previously described.

Numerous postulated HELBs on the Unit 2 MFDW System target cabling for both standby buses to Unit 3. The loss of the standby buses leaves Unit 3 with the startup transformer, CT3, as the only source of emergency power. This configuration is backed up with the PSW and SSF Systems, if the Startup Transformer CT3 is lost. If Startup Transformer CT3 is lost, the Shutdown Sequence to the Cold Shutdown Condition would be the same as the loss of all AC power case previously described.

Three (3) of the postulated HELBs on the Unit 2 MFDW System target the Siphon Seal Water (SSW) 4" header and cause the loss of Startup Transformer CT3. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 3 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 3 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 3. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 2 MFDW System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1. The loss of Startup Transformer CT3 adds no additional consequences to the Shutdown sequence for these HELBs, because power for Unit 3 would be available from Transformers CT4 and CT5 through the standby buses.

Two (2) of the postulated HELBs on the Unit 2 MFDW System target cabling that cause the loss of Unit 3 MFB#2. If MFB#2 is lost, Unit 3 can be powered through MFB#1 from Startup Transformer CT3 through Breaker E13 or from SBB#1 through Breaker S13. For these breaks the pathway to a Safe Shutdown condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to ~250°F RCS temperature. At that point the LPI and LPSW Systems would be used to achieve the Cold Shutdown Condition.

Several postulated HELBs on the Unit 2 MFDW System target cabling that cause loss of Startup Transformer CT3. The loss of Startup Transformer CT3 would cause the loss of operation of the RCPs, if the unit trips. However, the loss of Startup Transformer CT3 adds no additional consequences to the Shutdown Sequence for these HELBs, because power for Unit 3 would be available from Transformers CT4 and CT5 through the standby buses. The Shutdown Sequence would be the same as described in the previous paragraph. The operation of the RCPs is not required during the Shutdown Sequence.

Two (2) postulated HELBs on the Unit 2 MFDW System target cabling that cause the loss of Transformer CT5 and the Unit 3 TDEFWP. If Transformer CT5 was lost, power to both standby buses is still available from CT4, and power to both main feeder buses is available from Startup Transformer CT3. If the Unit 3 TDEFWP is lost, the EFW function for Unit 3 can still be accomplished by using either the 3A or 3B MDEFWP or the EFW crosstie from another unit. For these breaks the pathway to a Safe Shutdown condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to ~250°F RCS temperature. At that point the LPI/LPSW Systems would be used to achieve the Cold Shutdown Condition.

The postulated HELBs on Unit 2 MFDW System, due to interactions with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 3, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW System or the SSF (in combination with the MSIVs) until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System is achieved. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from Unit 2 Main Feedwater System breaks may potentially result in a loss of the Unit 3 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

5.3.2.5 Heater Drain System

Three (3) of the postulated HELBs (See Table 5.2-5) on the Unit 2 Heater Drain System target cabling that causes a complete loss of AC power on Unit 3. The complete loss of AC power results in a loss of Unit 3 systems needed for achieving and maintaining the Safe Shutdown condition. The

PSW System will provide the primary means of achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate means of achieving and maintaining a Safe Shutdown condition. Plant cooldown can be accomplished using the PSW System. However, in order to cooldown from ~250°F and establish the Cold Shutdown Condition, power would need to be restored to one LPI pump and one LPSW pump.

Several of the postulated HELBs on the Unit 2 Heater Drain System cause the loss of both standby buses, Unit 3 MFB#2, and the Unit 3 RCPs. The only emergency power source available to Unit 3 would be from Startup Transformer CT3 through Breaker E13 to MFB#1. If the unit is powered from Startup Transformer CT3, a normal shutdown can be made. Operation of the RCPs is not required during the Shutdown Sequence. If MFB#1 cannot be powered from Startup Transformer CT3, a loss of all AC power would occur on Unit 3. The Shutdown Sequence for these postulated HELBs would be the same as for loss of all AC power case described in the previous paragraph.

Some of the postulated HELBs on the Unit 2 Heater Drain System cause the loss of Transformer CT5. With Transformer CT5 lost, power to both standby buses is available from Transformer CT4, and power to both main feeder buses is available from Startup Transformer CT3. Some of these breaks also cause a loss of the Unit 3 TDEFWP. If this pump is lost, the EFW function for Unit 3 can still be accomplished by using either the 3A or 3B MDEFWP or the EFW crosstie from another unit.

The steam-air environment created inside the Turbine Building from Unit 2 Heater Drain System breaks may potentially result in a loss of the Unit 3 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

5.3.2.6 Heater Vent System

There are no direct interactions between the postulated Unit 2 Heater Vent System HELBs and Unit 3 equipment and structures. Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 2 Heater Vent System would release steam to the interior of the Turbine Building. The steam in the Turbine Building may cause loss of the Unit 3 Main Feeder Buses, in addition to the loss of the EFW and LPSW Pumps due to the postulated Heater Vent System HELB. All three (3) ONS Units share a combined Turbine Building, and the Main Feeder Bus, Switchgear, the EFW Pumps, and the LPSW Pumps have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

5.3.2.7 High Pressure Injection System

There are no direct or indirect interactions between the postulated HELBs on the Unit 2 HPI System and the Unit 3 equipment and structures. All Unit 3 equipment and structures are separated from the postulated HELBs on the Unit 2 HPI System by barriers. Thus, Unit 3 operations and Shutdown Equipment would not be affected by any postulated Unit 2 HPI HELBs, and no further evaluation is required.

5.3.2.8 Main Steam System

Some of the postulated HELBs (See Table 5.2-8) on the Unit 2 Main Steam System target cabling that cause a complete loss of all AC power on Unit 3. The complete loss of all AC power results in a loss of Unit 3 systems needed for achieving and maintaining the Safe Shutdown condition. The PSW System will provide the primary means of achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate means of achieving and maintaining a Safe Shutdown condition. Plant cooldown can be accomplished using the PSW System. However, in order to cooldown from ~250°F and establish the Cold Shutdown Condition, power would need to be restored to one LPI pump and one LPSW pump.

Some of the postulated HELBs on the Unit 2 Main Steam System cause the loss of both standby buses and Startup Transformer CT3. The only power available for Unit 3 would be through Transformer 3T. If the unit trips, a loss of all AC power on Unit 3 would occur. The Shutdown Sequence for these postulated HELBS would be the same as for the loss of all AC power case described in the previous paragraph.

Several postulated HELBs on the Unit 3 Main Steam System target cabling that cause loss of Startup Transformer CT3. The loss of CT3 would cause the loss of operation of the RCPs, if the unit trips. However, the loss of Transformer CT3 adds no additional consequences to the Shutdown Sequence for these HELBs, because power for Unit 3 would be available from transformers CT4 and CT5 through the Standby Buses. Operation of the RCPs is not required during the Shutdown Sequence.

Three (3) of the postulated HELBs on the Unit 2 Main Steam System target cabling that causes the loss of operation of the RCPs. This will result in a trip of Unit 3 due to the loss of RCPs. However, this causes no consequence for the Shutdown Sequence, because RCP operation is not required during the Shutdown Sequence.

The Postulated HELBs on the Unit 2 Main Steam System would release steam to the interior of the Turbine Building. The steam in the Turbine Building may cause loss of the Unit 3 Main Feeder Buses, in addition to the loss of the EFW and LPSW Pumps due to the postulated Main Steam System HELB. All three (3) ONS Units share a combined Turbine Building, and the Main Feeder

Bus, Switchgear, the EFW Pumps, and the LPSW Pumps have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

5.3.2.9 Moisture Separator Reheater Drain System

Some of the postulated HELBs (See Table 5.2-9) on the Unit 2 MSRD System target cabling that cause a complete loss of AC power on Unit 3. The complete loss of AC power results in a loss of Unit 3 systems needed for achieving and maintaining the Safe Shutdown condition. The PSW System will provide the primary means of achieving and maintaining a Safe Shutdown condition. The SSF in combination with the MSIVs would provide an alternate means of achieving and maintaining a Safe Shutdown condition. Plant cooldown can be accomplished using the PSW System. However, in order to cooldown from ~250°F and establish the Cold Shutdown Condition, power would need to be restored to one LPI pump and one LPSW pump.

Several of the postulated HELBs on the Unit 2 MSRD System target cabling for both standby buses. The loss of the standby buses leaves Unit 3 with the Startup Transformer, CT3, as the only source of emergency power. This configuration is backed up with the PSW and SSF Systems, if the Startup Transformer CT3 is lost. If the Startup Transformer CT3 is lost, then the Shutdown Sequence to the Cold Shutdown Condition would be the same as the loss of all AC power case described in the preceding paragraph.

Various postulated HELBs on the Unit 2 MSRD System target cabling that cause loss of Startup Transformer CT3. The loss of Startup Transformer CT3 would cause the loss of operation of the RCPs, if the unit trips. However, the loss of Transformer CT3 adds no additional consequences to the Shutdown Sequence for these HELBs, because power for Unit 3 would be available from transformers CT4 and CT5 through the Standby Buses. Operation of the RCPs is not required during the Shutdown Sequence.

Some of the postulated HELBs on the Unit 2 MSRD System target cabling for the SBB#2 to Unit 3. This interaction renders the SBB#2 unavailable to Unit 3. If this occurs, auxiliary power for Unit 3 would still be available from SBB#1 through MFB#1 or from the Startup Transformer CT3.

Five (5) of the postulated HELBs on the Unit 2 MSRD System target cabling that cause the loss of Unit 3 MFB#1. If MFB#1 is lost, Unit 3 can be powered through MFB#2 from Startup Transformer CT3 through breaker E23 or from SBB#2 through Breaker S23. For these breaks the pathway to a Safe Shutdown condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to ~250°F RCS temperature. At that point the LPI/LPSW Systems would be used to achieve the Cold Shutdown Condition. Moreover, the PSW System or the SSF (in combination with the MSIVs) could also be used to achieve and maintain a Safe Shutdown condition, if necessary.

The postulated HELBs on the Unit 2 Moisture Separator Reheater Drain System can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 3, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW System or the SSF (in combination with the MSIVs) until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System is achieved. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from the Unit 2 Moisture Separator Reheater Drain System breaks may potentially result in a loss of the Unit 3 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

5.3.2.10 Plant Heating System

There are no direct interactions between the postulated Unit 2 Plant Heating System HELBs and Unit 3 equipment and structures. Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 2 Plant Heating System would release steam to the interior of the Turbine Building. The steam in the Turbine Building due to a postulated Plant Heating System HELB may cause loss of the Unit 3 Main Feeder Buses, the EFW Pump Motors, and LPSW Pump Motors. All three (3) ONS Units share a combined Turbine Building, and the Unit 3 Main Feeder Buses, Switchgear, the EFW Pump Motors, and the LPSW Pump Motors have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

5.3.2.11 Steam Drain System

There are no direct interactions between the postulated Unit 2 Steam Drain System HELBs and Unit 3 equipment and structures. Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 2 Steam Drain System would release steam to the interior of the Turbine Building. The steam in the Turbine Building due to a postulated Steam Drain System

HELB may cause loss of the Unit 3 Main Feeder Buses, the EFW Pump Motors, and LPSW Pump Motors. All three (3) ONS Units share a combined Turbine Building, and the Unit 3 Main Feeder Buses, Switchgear, the EFW Pump Motors, and the LPSW Pump Motors have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

5.3.2.12 Steam Seal Header System

There are no direct interactions between the postulated Unit 2 Steam Seal Header System HELBs and Unit 3 equipment and structures. Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 2 Steam Seal Header System would release steam to the interior of the Turbine Building. The steam in the Turbine Building due to a postulated Steam Seal Header System HELB may cause loss of the Unit 3 Main Feeder Buses, the EFW Pump Motors, and LPSW Pump Motors. All three (3) ONS Units share a combined Turbine Building, and the Unit 3 Main Feeder Buses, Switchgear, the EFW Pump Motors, and the LPSW Pump Motors have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW System or the SSF (in combination with the MSIVs) can be utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

Table . _-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-AS-001-R	1	None	None	None
2-AS-002-R	1	None	Loss of LC 2X10	None
2-AS-003-R	1,2	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2 and U3 • U1 and U2 TBVs may fail open • Loss of U2 TDEFWP	None
2-AS-004-R	1L,2, 4-7, 9-11, 6L,7L,10L,11L	None	None	None
2-AS-004-R	3	None	• Loss of SBB1 and SBB2 • U1 and U2 TBVs may fail open • Loss of U2 TDEFWP	None
2-AS-005-R	1	None	None	None
2-AS-006-R	4-6,4L-6L	None	• MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-AS-006-R	7	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
2-AS-008-R01	1-3	4" A SSW Line	None	None
2-AS-008-R02	1	None	• Loss of CT5 • Loss of U1 and U2 CCW	None

Table [illegible]-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-AS-008-R02	2-5,2L-5L	6" MS Suppy to AS	• Loss of 230kV Red and Yellow Buses • Loss of SBB2 to Unit 3 • U1 and U2 TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of B Chiller • Loss of AFIS trip signal to FWPTs	None
2-AS-008-R02	6-7,6L-7L	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2, and U3 • U1 and U2 TBVs may fail open • Loss of U2 TDEFWP	None
2-AS-008-R02	9-14,9L,10L	None	• Loss of SBB1 and SBB2 • U1 and U2 TBVs may fail open • MS to SSRHs may fail open • Loss of U1 and U2 CCW • Loss of U2 EFW	None
2-AS-008-R02	11L-14L	None	• Loss of SBB1 and SBB2 • U1 and U2 TBVs may fail open • MS to SSRHs may fail open • Loss of U1 and U2 CCW • Loss of U2 EFW	None
2-AS-008-R02	16-19,17L-20L	None	None	None
2-AS-008-R02	20-23, 21L,22L	None	• Loss of 2MFB2 • Loss of SWGR 2TE • TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None

Table . .2-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-AS-008-R02	24-25, 23L,24L	None	• Loss of 2MFB2 • Loss of SWGR 2TE • TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-AS-008-R02	26,25L,26L	None	• Loss of SWGR 2TC, 2TD, and 2TE • TBVs may fail open • Loss of AFIS Ch 3 MS Pressure Input	None
2-AS-008-R02	27-30, 27L,28L	None	• Loss of 2MFB1 and 2MFB2 • Loss of AFIS Ch 4 MS Pressure Input	None
2-AS-009-R	1-3,2L,3L	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2, and U3 • U1 and U2 TBVs may fail open • Loss of U2 TDEFWP	None
2-AS-015-R	1	6" and 2" MS Supply Piping to AS	• Loss of B Chiller	None
2-AS-016-R	2,2L	6" and 2" MS Supply Piping to AS	• Loss of B Chiller	None
2-AS-017-R	3-4,3L-4L	2" MS Supply Piping to AS	• Loss of B Chiller	None
2-AS-019-R	1	None	None	None
2-AS-022-R	1	None	• Loss of 2MFB1 • Loss of SWGR 2TE • MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of C LPSW Pump	None
2-AS-023-R	2-3	1" LPSW line after 2LPSW-139	None	None

Table . .-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-AS-023-R	4-5,4L-5L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of C LPSW Pump • Loss of AFIS trip signal to FWPTs	None
2-AS-025-R	1,1L	1" LPSW line after 2LPSW-139	• MS to SSRHs may fail open	None
2-AS-026-R	1-4,1L-3L	• 2B MS Supply to ESAE at 2MS-46 • 1" LPSW line after 2LPSW-139	• MS to SSRHs may fail open	None
2-AS-026-R	6, 9-15,8L-15L	MS Supply to U2 TDEFWP at 2MS-92	• Loss of U2 EFW • Loss of AFIS trip signal to FWPTs • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 2TO-145	None
2-AS-026-R	7-8	None	• Loss of SBB1 to U3 • Loss of SBB2 • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-AS-029-R	1	1" LPSW line after 2LPSW-139	None	None
2-AS-031-R01	1	8" UST supply to U1 TDEFWP	None	None
2-AS-031-R01	3	4" A SSW Line	None	None
2-AS-031-R01	4,5	• 10" CCW line • 6" 2B EFW Header	• Loss of U2 TDEFWP • Loss of C LPSW Pump	None
2-AS-031-R01	1L-4L	None	• Loss of C LPSW Pump • Loss of B Chiller	None
2-AS-031-R01	6-8	10" CCW line (A & B Chiller Supply)	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of AFIS Ch 4 MS Pressure Input	None

Table _-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-AS-031-R01	7L-8L	None	• *MS to SSRHs fail open* • Loss of A and B Chillers • Loss of C LPSW Pump	None
2-AS-031-R02	1	10" CCW line (A & B Chiller Supply)	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of AFIS Ch 4 MS Pressure Input	None
2-AS-031-R02	1L-2L	None	None	None
2-AS-031-R02	2-3	None	• Loss of 2MFB1 • Loss of SWGRs 2TD and 2TE • Loss of U2 EFW • Loss of AFIS Ch 4 MS Pressure Input	None
2-AS-031-R02	3L-4L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of AFIS Ch 4 MS Pressure Input	None
2-AS-031-R02	4	None	• Loss of 2MFB1 • Loss of SWGRs 2TD and 2TE • Loss of C LPSW Pump • Loss of U2 EFW • Loss of AFIS Chs 3 and 4 MS Pressure Input • TBVs may fail open • MS to SSRHs may fail open	None
2-AS-031-R02	5,5L-7L,8-11,8L-14L	None	• Loss of 2MFB1 and 2MFB2 • Loss of AFIS Chs 3 and 4 MS Pressure Input • TBVs may fail open	None
2-AS-031-R02	6-7	None	• Loss of 2MFB1 • Loss of SWGRs 2TC, 2TD, and 2TE • Loss of AFIS Chs 3 and 4 MS Pressure Input • TBVs may fail open	None

Table . 2-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-AS-031-R02	12-13	None	• Loss of 2MFB1 • Loss of SWGRs 2TC, 2TD, and 2TE • Loss of AFIS Chs 3 and 4 MS Pressure Input • TBVs may fail open	None
2-AS-031-R02	14	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of U2 EFW • Loss of C LPSW Pump • Loss of AFIS Chs 3 and 4 MS Pressure Input • TBVs may fail open can • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-AS-031-R02	15	None	• Loss of 2MFB2 and 3MFB2 • Loss of SWGR 2TE • Loss of U2 EFW • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-AS-031-R02	15L-16L	None	• Loss of 3MFB2 • Loss of SWGR 2TE	None
2-AS-031-R02	16	None	• Loss of 2MFB2 and 3MFB2 • Loss of SWGRs 2TC, 2TD, and 2TE • Loss of U2 TDEFWP • TBVs may fail open • Loss of AFIS Ch 3 MS Pressure Input	None
2-AS-031-R02	17-25	None	• Loss of SWGRs 2TC, 2TD, and 2TE • Loss of U2 TDEFWP • TBVs may fail open • Loss of AFIS Ch 3 MS Pressure Input	None

Table . .-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-AS-031-R02	19L-22L	None	• Loss of U2 EFW • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-AS-031-R02	17L-18L,23L-26L	None	None	None
2-AS-031-R02	26	None	• Loss of 3MFB2 • Loss of U2 EFW • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-AS-031-R02	27	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2, and U3 • U1 and U2 TBVs may fail open • Loss of U2 TDEFWP	None
2-AS-031-R02	27L-28L	None	• Loss of SBB1 and SBB2 • U1 and U2 TBVs may fail open • Loss U2 TDEFWP	None
2-AS-031-R02	28-29	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2, and U3 • U1 and U2 TBVs may fail open • Loss of U2 TDEFWP	None
2-AS-031-R02	30, 29L-30L	None	None	None
2-AS-032-R	1, 2L-3L	None	None	None
2-AS-032-R	2,4L-5L,5-6,8-9	None	• Loss of SBB1 and SBB2 • U1 and U2 TBVs may fail open • Loss U2 TDEFWP	None

Table . 2-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-AS-032-R	3-4	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2, and U3 • U1 and U2 TBVs may fail open • Loss of U2 TDEFWP	None
2-AS-032-R	6L-8L	None	• Loss of SBB1 and SBB2 • U1 and U2 TBVs may fail open • Loss U2 TDEFWP	None
2-AS-032-R	7	None	• Loss of SBB1 and SBB2 • U1 and U2 TBVs may fail open • Loss U2 TDEFWP	None
2-AS-033-R	1-3	None	• Loss of 2MFB1 and 2MFB2 • Loss of AFIS Ch 4 MS Pressure Input	None
2-AS-037-R01	1	None	None	None
2-AS-037-R01	1L-2L,4	6" WC Line	• Loss of A and B Chillers	None
2-AS-037-R01	2-3,3L4L	None	None	None
2-AS-037-R01	5-7,5L-8L	6" WC Line	• Loss of A and B Chillers • Loss of U2 CCW	None
2-AS-037-R01	8-13,9L-10L,16-17	2 - 6" WC Lines	• Loss of A and B Chillers • Loss of U1 and U2 CCW	None
2-AS-037-R01	11L-14L	None	• Loss of A and B Chillers • Loss of U1 CCW	None
2-AS-037-R01	14-15	6" WC Line	None	None
2-AS-037-R01	15L-16L	None	• Loss of U1 CCW	None
2-AS-037-R01	17L-18L	None	None	None

Table . .2-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-AS-037-R01	18-19,19L-23L	6" WC Line	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of U3 RCPs	None
2-AS-037-R01	20-23	2 - 6" WC Line	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of U3 RCPs • Loss of A and B Chillers	None
2-AS-037-R02	1-2,1L-2L	None	• 2MS-31 (2B TBV) may fail open	None
2-AS-037-R02	3,5,3L-5L	None	None	None
2-AS-037-R02	4	None	None	None
2-AS-037-R02	6-9, 6L-9L	None	None	None
2-AS-037-R02	10	None	None	None
2-AS-037-R02	10L-15L	None	None	None
2-AS-037-R02	11-12	• 8" MS Supply to AS Header • 6" 2A EFW Header	None	None
2-AS-037-R02	13-14	None	• Loss of B Chiller	None
2-AS-037-R02	15	None	None	None

Table ..2-2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-C-001-R	1-2,1L-2L	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-C-001-R	3	4" A SSW Line	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of C LPSW Pump • Loss of U2 TDEFWP • MS to AS may fail open • MS to SSRHs may fail open	G-35a
2-C-001-R	4,5,6	• Loss of Hotwell Supply to EFWPs • Loss of UST Supply to EFWPs • 12" LPSW Line to CCW Return • 4" A SSW Line	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of A and B Chillers • Loss of C LPSW Pump • Loss of U2 TDEFWP • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of AFIS Ch 3 MS Pressure Input	G-32
2-C-002-R	1-2	None	None	None
2-C-003-R	1	None	None	None
2-C-004-R	1,5	None	• Loss of B Chiller	None
2-C-005-R	3-4,3L	None	• Loss of A and B Chillers	None
2-C-006-R	2-4,2L-3L	None	• Loss of B Chiller	None
2-C-007-R	2-4,2L	None	None	None
2-C-008-R01	1	None	None	None

Table ..2-2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-C-011-R	1-3	2" LPSW line to MDEFWPs	None	None
2-C-013-R01	4	None	None	None
2-C-013-R02	1-3,2L	None	None	None
2-C-016-R	1,4,.5,4L-5L	None	None	None
2-C-017-R	2-3	None	None	None
2-C-019-R	1	None	None	None
2-C-020-R	2	None	None	None
2-C-022-R	1,1L	None	None	None
2-C-023-R	4-5	None	None	None
2-C-024-R	1-3,2L	None	• Loss of A and B Chillers • Loss of U2 CCW	None
2-C-025-R01	1-2,2L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump	None
2-C-025-R02	5L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump	None
2-C-026-R01	3	• 36" 2A MSLB • 36" 2B MSLB • 6" 2A EFW Header	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2, and U3 • Loss of U2 TDEFWP • U1 TBVs may fail open	L-40
2-C-026-R01	4,4L	None	• Loss of A and B Chillers • Loss of U2 CCW	None

Table . .-2
Potential Damage to Shutdown Equipment Caused by Condensate System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-C-026-R02	6L	None	• MS to AS may fail open	None
2-C-027-R	1-3,2L	None	None	None
2-C-028-R	1-2	None	• Loss of A and B Chillers • Loss of U2 CCW	None
2-C-029-R	1,1L-2L	None	None	None
2-C-030-R	3L,4	None	None	None
2-C-031-R	1-4,3L	None	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of U3 RCPs	None
2-C-032-R	1-4,3L	None	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of U3 RCPs	None
2-C-033-R01	1,2L	None	None	None
2-C-033-R01	2,3,4	• 36" 2A MS Line • 36" 2B MS Line	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of U3 RCPs	Mezz Floor Beam K41-L41
2-C-033-R01	3L-4L,9	• 8" CCW Line (U3)	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of U3 RCPs	None
2-C-033-R01	5,6	• 36" 2A MS Line • 36" 2B MS Line • 8" U3 CCW Line	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of U3 RCPs • Loss AFIS Ch 3 and 4 MS Pressure Inputs	K-42

Table . _-2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-C-033-R01	5L	None	• Loss of U3 TDEFWP • Loss of 3MFB2	None
2-C-033-R01	7L	None	• Loss of U3 TDEFWP	None
2-C-033-R01	8	• 8" U3 CCW Line	• Loss of U3 TDEFWP • Loss of 3A MDEFWP • Loss of 3A2 and 3B2 RCPs	None
2-C-033-R02	1-3,1L-3L	• 2MS-36 (2B MS Line) • 2MS-79 (2B MS Line) • 8" 2A MS Line after 2MS-35 • 6" MS Line after 2MS-82 and 2MS-84	• Loss of CT2 and CT3 • Loss of SBB1 • Loss of 3MFB1 and 3MFB2 • Loss of U3 TDEFWP	None
2-C-036-R	1,1L	None	None	None
2-C-037-R	2-3,4L	6" EFWP Recirculation Line	None	None
2-C-037-R	5	• UST and HW Supplies to EFWPs • 12" LPSW Line to CCW Discharge • 10" LPSW Line to CCW Discharge • 8" LPSW Line to CCW Discharge • 4" A SSW Line	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of A and B Chillers • Loss of C LPSW Pump • Loss of U2 TDEFWP • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of AFIS Ch 3 MS Pressure input	H-32

Table . -2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-C-037-R	6	• 24" UST Supply to MDEWPs • 8" UST Supply to TDEFWP • 14" LPSW Line (after 2LPSW-139) • 8" CCW Line • 4" A SSW Line	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of A and B Chillers • Loss of C LPSW Pump • Loss of U2 TDEFWP • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of AFIS Ch 3 MS Pressure Input • Loss of AFIS signal to trip FWPTs	H-33a
2-C-037-R	7-8,6L-7L	• 14" LPSW Line (after 2LPSW-139) • 8" CCW Line • WC Lines	• Loss of A and B Chillers	None
2-C-037-R	9-12,9L-10L	None	None	None
2-C-039-R	5-8	None	None	None
2-C-040-R	1-4	None	None	None
2-C-041-R	2-5,3L-5L	None	None	None
2-C-042-R	1-3,2L	None	None	None
2-C-043-R	4-6,5L	None	None	None
2-C-044-R	1-3	None	None	None
2-C-045-R	10,10L	None	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of U3 RCPs	None

Table . .2-2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-C-046-R	6A	None	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of U3 RCPs	None
2-C-047-R	7A	None	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of U3 RCPs	None
2-C-059-R	1	None	None	None
2-C-065-R01	1-2	None	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of U3 RCPs • Loss of 3A MDEFWP • Loss of U3 TDEFWP • Loss of U3 AFIS trip signal to FWPTs	None
2-C-065-R02	6	None	None	None
2-C-066-R	3	None	None	None
2-C-067-R	2L	None	None	None
2-C-068-R	1L	None	• Loss of B Chiller	None
2-C-071-R	6	None	None	None
2-C-074-R	2L-3L,5-6	None	None	None
2-C-076-R	1	None	• Loss of 230kV Red and Yellow Buses • Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None

Table ..2-2
Potential Damage to Shutdown Equipment Caused by Condensate System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-C-077-R	2	None	• Loss of 230kV Red and Yellow Buses • Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-C-079-R	1L	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1 and U2 • Loss of U2 TDEFWP	None
2-C-080-R	1	None	• Loss of 2A MDEFWP	None
2-C-080-R	2	None	• Loss of 230kV Red and Yellow Buses • Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-C-081-R	1-2	None	None	None
2-C-081-R	3	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1 and U2 • Loss of U2 TDEFWP	None
2-C-081-R	4	None	• Loss of 230kV Red and Yellow Buses • Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-C-085-R	3	None	None	None
2-C-087-R01	2	None	• Loss of 230kV Red and Yellow Buses • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
2-C-087-R01	2L	None	• Loss of U2 EFW	None

Table 2-2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-C-087-R01	3-4,3L	None	• Loss of 230kV Red and Yellow Buses • Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-C-087-R01	5,5L	4" 2A MS Supply to FWPT	None	None
2-C-087-R01	6,7	None	None	None
2-C-087-R02	1,2	• 2A MDEFWP Discharge Line • 2B MDEFWP Discharge Line	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1 and U2 • Loss of 3MFB1 • Loss of U2 TDEFWP	Mezz Flr Beam bet B31 & D31
2-C-087-R02	1L,3,3L	2A MS Supply to FWPT	• Loss of CT2 and CT3 • Loss of 3MFB1 • Loss of SBB1 • Loss of SBB2 to U3	None
2-C-088-R01	2A	30" CCW Line	None	None
2-C-088-R01	2-3	12" LPSW Line to CCW Return	None	None
2-C-088-R01	2B,3A,3B	None	None	None
2-C-088-R01	2L-3L	6" EFW Recirc Line	• Loss of SBB1 to U3 • Loss of SBB2 • Loss of U2 EFW • Loss of A and B Chillers • Loss of C LPSW Pump • Loss of AFIS signal to trip FWPTs	None
2-C-088-R01	4,4L	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC power to U1 and U2 • Loss of U1 and U2 TDEFWPs	None

Table . 2-2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-C-088-R01	5,5L	8" 2A MS Supply to FWPT (after 2MS-35)	• Loss of 230kV Red and Yellow Buses • Loss of U2 TDEFWP • MS to SSRHs may fail open	None
2-C-088-R01	6,6L	8" 2A MS Supply to FWPT (after 2MS-35)	None	None
2-C-088-R02	1, 3L	• U2 TDEFWP • 2A MS Supply to FWPT (after 2MS-35)	• MS to SSRHs may fail open	None
2-C-088-R02	2,3	• 2A MDEFWP Discharge Line • 2B MDEFWP Discharge Line • Suction Piping to U2 TDEFWP • MS Supply to U2 TDEFWP • 2A MS Supply to FWPT (after 2MS-35)	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC power to U1 and U2 • Loss of U2 TDEFWP	Mezz Flr Beam bet B31 & D31; Supports for FWPT Exh Duct
2-C-089-R	1	None	• Loss of U2 EFW	None
2-C-090-R	1,1L	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1 and U2 • Loss of U2 TDEFWP	None
2-C-090-R	1A	30" CCW Line	None	None
2-C-091-R	1L,4L	None	• Loss of U2 EFW	None
2-C-091-R	2L-3L	None	• Loss of 230kV Red and Yellow Buses • Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None

Table . .2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-002-R	1-2,1L-2L	None	• MS to SSRHs may fail open	None
2-ES-003-R	6A,6B	None	• MS to SSRHs may fail open	None
2-ES-003-R	9,11	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-003-R	10L-11L	6" 2A EFW Header	None	None
2-ES-003-R	12-13	None	None	None
2-ES-004-R	1-2,1L-2L	None	• MS to SSRHs may fail open	None
2-ES-004-R	3-6,3L-6L	None	None	None
2-ES-004-R	7,7L-8L	None	• MS to SSRHs may fail open	None
2-ES-004-R	8	8" 2A MS Line after 2MS-76	• MS to SSRHs may fail open	None
2-ES-005-R	4	None	None	None
2-ES-007-R	1,3	None	• MS to SSRHs may fail open	None
2-ES-007-R	7,9	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-007-R	8L-9L	6" 2A EFW Header	None	None
2-ES-007-R	10	None	None	None
2-ES-007-R	13	None	None	None

Table 2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-010-R	1-3,3L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-010-R	4-5,4L-5L	None	• MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-ES-010-R	6-7	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB2 to U3 • Loss of U2 TDEFWP • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-ES-010-R	6L-8L,8	None	• MS to SSRHs may fail open	None
2-ES-011-R	1	None	• MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-ES-011-R	2	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-012-R	1	None	None	None

Table 2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-012-R	2	None	• MS to SSRHs may fail open	None
2-ES-012-R	3,3L	None	• TBVs may fail open • MS to SSRHs may fail open	None
2-ES-012-R	4,4L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-012-R	5,5L	8" 2A MS Line with 2MS-35	• MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
2-ES-012-R	6,6L	None	None	None
2-ES-012-R	7	None	• Loss of AFIS Ch 4 MS Pressure Input • Loss of U3 RCPs	None
2-ES-012-R	8,8L	6" 2A EFW Header	• MS to AS may fail open	None
2-ES-012-R	9,9L	None	None	None
2-ES-013-R	1	None	• MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None

Table . .2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-014-R	1-5,2L-5L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-014-R	6-8,6L-8L	None	• Loss of U2 EFW • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-ES-015-R	2-3	None	• Loss of U2 TDEFWP	None
2-ES-015-R	4	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-015-R	4L-5L	6" 2A EFW Header	None	None
2-ES-015-R	5	6" 2A EFW Header	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None

Table 2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-015-R	6	• 24" Condensate Line • 6" 2A EFW Header • 4" A SSW Line	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of A and B Chillers • Loss of C LPSW Pump • Loss of U2 TDEFWP • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	H-38
2-ES-015-R	6L	None	None	None
2-ES-016-R	1-4,3L,4L	None	• MS to SSRHs may fail open	None
2-ES-017-R	1-4	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-017-R	2L-3L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-017-R	5-7,9-10,4L-12L	None	• Loss of U2 EFW • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None

Table . .2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-017-R	8	None	• Loss of U2 EFW • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-ES-018-R	1-4,1L-4L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-019-R	1-4,3L-5L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-ES-019-R	5	6" 2A EFW Header	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of C LPSW Pump • Loss of U2 TDEFWP • TBVs may fail open • MS to SSRHs may fail open • MS to AS may fail open	Fd-38

Table . .2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-019-R	6	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-ES-019-R	6L-7L	None	• Loss of U2 TDEFWP • MS to SSRHs may fail open	None
2-ES-019-R	7	None	• Loss of U2 TDEFWP	None
2-ES-019-R	8-10	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-ES-019-R	8L-12L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-ES-019-R	11-12	None	None	None
2-ES-020-R	1-2,2L-3L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None

Table ..2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-020-R	3	• 24" Condensate Line • 6" 2A EFW Header • 4" A SSW Line	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of A and B Chillers • Loss of C LPSW Pump • Loss of U2 EFW • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	H-39
2-ES-020-R	4	• Condensate Line Breaks • 4" A SSW Line	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • MS to SSRHs may fail open • MS to AS may fail open • Loss of U2 TDEFWP	G-37a
2-ES-020-R	5	• 24" Condensate Line • 6" 2A EFW Header • 4" A SSW Line	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP	G-38
2-ES-020-R	6	• Condensate Line Breaks • Feedwater Line Breaks • 4" A SSW Line	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS Ch 3 MS Pressure Input	G-33a

Table .2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-020-R	7, 6L-7L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-ES-020-R	8,8L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-ES-021-R	1-4,2L-4L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-021-R	5,5L	None	None	None
2-ES-021-R	6	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP	None

Table 2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-021-R	6L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-ES-022-R	1	None	• Loss of CT2 and CT3 • Loss of 3MFB1 • Loss of SBB1 • Loss of SBB2 to U3	None
2-ES-022-R	2L-3L	None	None	None
2-ES-022-R	3	None	• MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-ES-022-R	4-5,4L-5L	6" MS Line to U2 TDEFWP	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-022-R	6-8,6L-7L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-023-R	1-3	None	• Loss of CT2 and CT3 • Loss of 3MFB1 • Loss of SBB1 • Loss of SBB2 to U3	None
2-ES-023-R	2L-3L	None	None	None

Table 2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-023-R	6	None	• Loss of 230kV Red and Yellow Buses • Loss of 2MFB1 • Loss of SWGR 2TE • Loss of SBB2 to U3 • Loss of C LPSW Pump • U1 and U2 TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-024-R	2L-3L	None	• Loss of U2 TDEFWP	None
2-ES-024-R	4	• 8" 2A MS Line to FWPT • 8" 2B MS Line to FWPT • 6" MS Line to U2 TDEFWP	• Loss of CT2 and CT3 • Loss of 3MFB1 • Loss of SBB1 • Loss of SBB2 to U3 • Loss of U2 EFW	None
2-ES-024-R	5	None	• Loss of CT2 and CT3 • Loss of 3MFB1 • Loss of SBB1 • Loss of SBB2 to U3 • Loss of U2 EFW • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-ES-024-R	6	• 6" 2A EFW Header • 6" MS Line to U2 TDEFWP • 8" FDW Line	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1 and U2 • Loss of 3MFB1 • Loss of U2 TDEFWP • TBVs may fail open	C-38
2-ES-024-R	4L-6L	• 2" MS Line with 2MS-87	• Loss of U2 TDEFWP	None

Table ..2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-027-R	1	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of C LPSW Pump • TBVs *may fail open* • MS to SSRHs may fail open • MS to AS may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-027-R	1L	None	• MS to SSRHs may fail open	None
2-ES-027-R	2-3,4L-6L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-028-R	1	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of C LPSW Pump • TBVs may fail open • MS to SSRHs may fail open • MS to AS may fail open • Loss of U2 TDEFWP	None
2-ES-028-R	1L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of C LPSW Pump • TBVs may fail open • MS to SSRHs may fail open • MS to AS may fail open • Loss of U2 TDEFWP	None

Table . .2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-028-R	2-3	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-ES-028-R	2L-3L	None	• MS to SSRHs may fail open	None
2-ES-028-R	4-5	None	• Loss of U2 TDEFWP	None
2-ES-028-R	4L-5L	6" 2A EFW Header	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of C LPSW Pump • Loss of U2 TDEFWP • MS to SSRHs may fail open • MS to AS may fail open	Fd-38
2-ES-028-R	6	None	None	None
2-ES-031-R	1-5,2L-3L,8-9	None	None	None
2-ES-032-R	1-2,4-5	None	None	None
2-ES-045-R	1-7	None	None	None
2-ES-046-R	1-2	14" Condensate Line	None	None
2-ES-046-R	3-4	None	None	None
2-ES-046-R	6-7	None	None	None
2-ES-059-R	1-4	None	None	None
2-ES-059-R	5-7	None	• MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-ES-060-R	1-9	None	None	None

Table 2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-073-R	3-4,4L	None	None	None
2-ES-073-R	5	None	None	None
2-ES-073-R	6-7,6L-7L	None	None	None
2-ES-073-R	8	None	None	None
2-ES-074-R	2-6,2L-5L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
2-ES-077-R	8	None	None	None
2-ES-078-R	1	None	None	None
2-ES-078-R	2	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-ES-079-R	1	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • TBVs may fail open • MS to SSRHs may fail open • MS to AS may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-079-R	2	None	• MS to SSRHs may fail open • Loss of U2 TDEFWP	None

Table 2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-080-R	1	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-ES-080-R	2	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • TBVs may fail open • MS to SSRHs may fail open • MS to AS may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-081-R	1-2	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-081-R	2L-3L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-081-R	3-4	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None

Table . 2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-082-R	1	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-082-R	2-3	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-082-R	4,5L	None	None	None
2-ES-082-R	5	None	None	None
2-ES-082-R	6,9-10,10L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump	None
2-ES-082-R	7-8	6" 2A EFW Header	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump	None
2-ES-083-R	1-3,1L-2L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump	None
2-ES-087-R	1-3,2L	None	• MS to AS may fail open	None
2-ES-094-R	1A,1AL	None	• MS to SSRHs may fail open	None
2-ES-094-R	1B,1BL,2L-4L,4	None	• MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
2-ES-094-R	2-3	None	• MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
2-ES-094-R	5	None	None	None

Table . .2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-094-R	5L-8L,6-8	• 8" 2A MS Line after 2MS-35 • 6" MS Line to U2 TDEFWP	None	None
2-ES-094-R	9,9L	None	None	None
2-ES-094-R	10-11	None	• B MS to SSRHs may fail open	None
2-ES-095-R	3-8,8L-9L,19-22,24-27,25L-28L	None	• TBVs may fail open • MS to SSRHs may fail open	None
2-ES-095-R	6L-7L,9-11,10L-11L	None	• TBVs may fail open • MS to SSRHs may fail open	None
2-ES-095-R	28	None	• TBVs may fail open • MS to SSRHs may fail open	None
2-ES-095-R	29-30,29L-30L	None	• MS to SSRHs may fail open	None
2-ES-098-R	6-8,7L-11L,13L-14L,13-14,19A,19AL,19B,19BL,19C,19CL,20-23,20L-22L	None	None	None
2-ES-098-R	9-12	None	None	None
2-ES-098-R	15-16	6" MS Line to U2 TDEFWP	None	None
2-ES-098-R	15L-17L,17	None	None	None
2-ES-098-R	18	6" MS Line to U2 TDEFWP	None	None
2-ES-099-R	1	None	None	None

Table 2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-211-R	1,2	• 6" 2A EFW Header	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of C LPSW Pump • Loss of U2 EFW • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	Dc-39
2-ES-211-R	5-6,1L-2L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-211-R	3-4,3L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump • Loss of CT3 to 3MFB1 and 3MFB2 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-ES-274-R	2-3	None	None	None
2-ES-274-R	4,4L-5L	None	None	None

Table . 2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-274-R	5,7-8	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
2-ES-274-R	6	None	None	None
2-ES-275-R	1	None	None	None
2-ES-275-R	2-3,5-8	None	None	None
2-ES-275-R	4	None	• TBVs may fail open	None
2-ES-283-R	1-3,1L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump	None
2-ES-287-R	1,1L	None	• MS to AS may fail open	None
2-ES-287-R	2-3	None	• MS to AS may fail open	None
2-ES-501-R	1-4	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs • Loss of B Chiller	None
2-ES-501-R	5-6	6" FDW Line	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs • Loss of B Chiller	None
2-ES-501-R	7,10	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None

Table . .2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-501-R	8-9	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
2-ES-501-R	11-13	None	• Loss of 2MFB1 and 2MFB2	None
2-ES-502-R01	1	• 4" Condensate Line • 8" UST Supply to TDEFWP • 6" 2A MDEFWP Discharge Lilne • 6" 2B MDEFWP Discharge Line	• Loss of AFIS trip signal to FWPTs	None
2-ES-502-R01	2-5	None	• Loss of AFIS trip signal to FWPTs	None
2-ES-502-R01	6	None	• Loss of AFIS trip signal to FWPTs	None
2-ES-502-R01	7	None	• Loss of 230kV Red and Yellow Buses • Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-ES-502-R02	1-3	None	None	None
2-ES-502-R02	5	• 4" Condensate Line • 8" UST Supply to TDEFWP • 6" 2A MDEFWP Discharge Lilne • 6" 2B MDEFWP Discharge Line	• Loss of AFIS trip signal to FWPTs	None
2-ES-503-R01	1	• 4" Condensate Line • 8" UST Supply to TDEFWP • 6" 2A MDEFWP Discharge Lilne • 6" 2B MDEFWP Discharge Line	• Loss of AFIS trip signal to FWPTs	None
2-ES-503-R01	2,3	None	• Loss of AFIS trip signal to FWPTs	None
2-ES-503-R01	4-5	None	None	None
2-ES-503-R01	6-7	• 6" U2 TDEFWP Recirc Line	None	None

Table _.2-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-ES-503-R02	4	• 4" Condensate Line • 8" UST Supply to TDEFWP • 6" 2A MDEFWP Discharge Lilne • 6" 2B MDEFWP Discharge Line	• Loss of AFIS trip signal to FWPTs	None

Table [illegible]2-4
Potential Damage to Shutdown Equipment Caused by Feedwater System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-FDW-004	1	None	None	None
2-FDW-006-R	1-6,2L,6L	None	None	None
2-FDW-006-R	7-11,13,7L-11L,	None	• Loss of A and B Chillers • Loss of 2B MDEFWP • MS to SSRHs may fail open	None
2-FDW-007-R	1-4	2 - 6" WC Lines	None	None
2-FDW-008-R	2-5	None	• Loss of B Chiller	None
2-FDW-008-R	6	• 18" LPSW Line to CCW Return • 12" 2B MS Line (after 2MS-26) • UST's • AS Lines	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2, and U3 • Loss of U2 TDEFWP • U1 and U2 TBVs may fail open	L-35
2-FDW-008-R	7	None	• Loss of A and B Chillers • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs • Loss of 'C' LPSW Pump	None
2-FDW-008-R	7L,9,12-13	None	• Loss of A and B Chillers • Loss of U1 and U2 CCW	None
2-FDW-008-R	8A,8AL,8B,8BL,9L-10L,14	2 - 6" WC Lines	• Loss of A and B Chillers • Loss of C LPSW Pump • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs • Loss of U1 and U2 CCW	None
2-FDW-008-R	10-11	None	• Loss of CT5 • Loss of A Chiller • Loss of U2 and U3 TDEFWPs • Loss of U1 and U2 CCW	None
2-FDW-008-R	11L-13L	2 - 6" WC Lines	• Loss of U1 and U2 CCW	None

Table 2-4
Potential Damage to Shutdown Equipment Caused by Feedwater System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-FDW-008-R	14L-15L,15	2 - 6" WC Lines	• Loss of U2 EFW • Loss of C LPSW Pump • Loss of A and B Chillers • Loss of AFIS trip signal to FWPTs • Loss of U2 CCW	None
2-FDW-009-R01	1L-2L,2-4,4L-5L	None	None	None
2-FDW-009-R01	5-9	None	None	None
2-FDW-009-R01	6L-7L,9L-10L,10-11	None	None	None
2-FDW-009-R01	12-15,15L-16L	None	• Loss of SBB1 to U3 • Loss of SBB2 • Loss of U2 EFW	None
2-FDW-009-R01	16-18	None	None	None
2-FDW-009-R02	1	None	None	None
2-FDW-009-R02	2-5,5L-6L	10" Steam Exhaust piping for U2 TDEFWP (loss of U2 TDEFWP)	None	None
2-FDW-009-R02	6	6" MS Supply to U2 TDEFWP	None	None
2-FDW-009-R02	7-9	• 6" MS Supply to U2 TDEFWP • 10" Steam Exhaust piping for U2 TDEFWP	• Loss of SBB1 to U3 • Loss of SBB2 • Loss of U2 EFW	None
2-FDW-009-R02	7L-8L	None	• Loss of SBB1 to U3 • Loss of SBB2 • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-FDW-009-R02	9L-10L	None	• Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
2-FDW-010-R01	1-3,3L,4L	• 2" U2 TDEFWP Recirc Line	None	None

Table 2-4
Potential Damage to Shutdown Equipment Caused by Feedwater System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-FDW-010-R01	4-5	• 3/4" Vent/drains on 2A MDEFWP • 3/4" Vent/drains on 2B MDEFWP	None	None
2-FDW-010-R01	5L-6L,12L-15L	None	None	None
2-FDW-010-R01	6-10,13	None	None	None
2-FDW-010-R01	14	None	• Loss of SBB1 to U3 • Loss of SBB2 • Loss of U2 EFW	None
2-FDW-010-R01	15-17	None	• Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
2-FDW-010-R02	1	None	• Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
2-FDW-010-R02	2-3	None	• Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
2-FDW-010-R02	4,5L-6L	None	None	None
2-FDW-010-R02	5	None	• Loss of SBB2 to U3	None
2-FDW-010-R02	6-7	6" MS Supply to U2 TDEFWP	None	None
2-FDW-010-R02	8	None	None	None
2-FDW-010-R02	9	6" MS Supply to U2 TDEFWP	None	None
2-FDW-011-R	1	None	• Loss of AFIS trip signal to FWPTs	None
2-FDW-012-R	5,12-13	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1 and U2 • Loss of U2 TDEFWP	None
2-FDW-015-R	1-3,2L-3L	None	None	None

Table 2-4
Potential Damage to Shutdown Equipment Caused by Feedwater System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-FDW-016-R	1-3	None	None	None
2-FDW-020-R	1-3,2L-3L	• 6" 2A MDEFWP Discharge • 6" 2B MDEFWP Discharge • 8" UST Supply to U2 TDEFWP	• Loss of SBB1 to U3 • Loss of SBB2 • Loss of U2 EFW	None
2-FDW-021-R	1-3,2L-3L	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1 and U2 • Loss of U2 TDEFWP	None
2-FDW-022-R01	1,1L	None	• Loss of SBB1 to U3 • Loss of SBB2 • Loss of U2 EFW	None
2-FDW-022-R01	2-3	None	• Loss of 230kV Red and Yellow Buses • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
2-FDW-022-R01	4	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1 and U2 • Loss of U2 TDEFWP	None
2-FDW-022-R01	4L-5L	None	• Loss of AFIS trip signal to FWPTs	None
2-FDW-022-R01	5	None	• Loss of 230kV Red and Yellow Buses • Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None

Table [illegible]2-4
Potential Damage to Shutdown Equipment Caused by Feedwater System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-FDW-022-R01	6-8	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 to U3 • Loss of SBB2 • Loss of C LPSW Pump • Loss of A and B Chiller • Loss of U2 EFW • Loss of U2 CCW • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-FDW-022-R01	6L-8L	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 to U3 • Loss of SBB2 • Loss of U2 TDEFWP	None
2-FDW-022-R01	9-10,9L-10L	None	• Loss of SBB1 to U3 • Loss of SBB2 • Loss of C LPSW Pump • Loss of A and B Chillers • Loss of U2 EFW • MS to SSRHs may fail open • Loss of U2 CCW • Loss of AFIS trip signal to FWPTs	None
2-FDW-022-R01	11	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 to U3 • Loss of SBB2 • Loss of B Chiller • Loss of U2 TDEFWP • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None

Table [illegible].2-4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-FDW-022-R01	11L	None	• Loss of SBB1 to U3 • Loss of SBB2 • Loss of C LPSW Pump • Loss of A and B Chillers • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-FDW-022-R02	1-4,3L-4L	None	• Loss of CT2 • Loss of SBB1 and SBB2 • Loss of all AC power to U2 • Loss of 1MFB2 • TBVs may fail open • Loss of AFIS Ch 4 MS pressure Input • Loss of U2 TDEFWP	None
2-FDW-022-R02	1L-2L	None	• Loss of CT2 • Loss of SBB1 and SBB2 • Loss of all AC power to U2 • Loss of 1MFB2 • Loss of AFIS Ch 4 MS pressure Input • Loss of U2 TDEFWP	None
2-FDW-022-R02	5L-6L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-FDW-023-R01	1-3,1L-3L	6" U2 TDEFWP Recirc Line	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1 and U2 • Loss of U2 TDEFWP	None
2-FDW-023-R02	1,1L-2L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None

Table 5-4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-FDW-023-R02	2	None	• Loss of CT2 • Loss of SBB1 and SBB2 • Loss of all AC power to U2 • Loss of 1MFB2 • TBVs may fail open • Loss of AFIS Ch 4 MS pressure input • Loss of U2 TDEFWP	None
2-FDW-024-R	2	None	None	None
2-FDW-024-R	4-8,6L-7L	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-FDW-025-R	1-4	None	• Loss of U2 EFW • Loss of C LPSW Pump • Loss of A and B Chillers • Loss of AFIS trip signal to FWPTs • Loss of U2 CCW	None
2-FDW-025-R	1L-2L	None	• Loss of A and B Chillers	None
2-FDW-025-R	3L-8L,5-6	2 - 6" WC Lines	None	None
2-FDW-025-R	7-9	None	• Loss of A and B Chillers • Loss of U1 and U2 CCW	None
2-FDW-025-R	9L-10L	WC Lilne	• Loss of C LPSW Pump • Loss of A and B Chillers • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs • Loss of U1 and U2 CCW	none
2-FDW-025-R	10	• 10" LPSW Line • 18" LPSW Line • 16" LPSW Line • 24" LPSW Line	• Loss of A and B Chillers • Loss of U1 and U2 CCW	None

Table 5-4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-FDW-026	1	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None
2-FDW-027	1	None	• Loss of SBB1 and SBB2 • U1 and U2 TBVs may fail open • MS to AS may fail open • Loss of U2 TDEFWP	None
2-FDW-029	1	None	None	None
2-FDW-030	1	None	None	None
2-FDW-031	1	None	• Loss of 2HP-26	None
2-FDW-033-R	1-2,1L-2L	None	None	None
2-FDW-033-R	2,3	• UST and HW Piping to EFW • 6" 2B EFW Header • 8" LPSW Line (after 2LPSW-139) • 8" CCW Line to Chillers • 12" LPSW Line to CCW Return • Numerous WC Lines • AS Lines	• Loss of 2MFB1 and 2MFB2 • Loss of 3MFB2 • Loss of A and B Chillers • Loss of U2 TDEFWP • TBVs may fail open • Loss of AFIS Ch 3 MS Pressure Input	K-32
2-FDW-033-R	4,5	• UST and HW Piping to EFW • 20" LPSW 'B' Line • 8" LPSW Line to Chillers • 8" CCW Line to Chillers • 12" LPSW Return to CCW • 4" A SSW Line • 8" WC Line • AS Lines	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power on U1, U2, and U3 • Loss of U2 TDEFWP • U1 and U2 TBVs may fail open • MS to AS may fail open • Loss of AFIS Ch 3 MS Pressure Input	G-32, L-33

Table [illegible]4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-FDW-033-R	6,5L-6L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of C LPSW Pump • Loss of U2 TDEFWP • TBVs may fail open • MS to SSRHs may fail open • MS to AS may fail open • Loss of AFIS Ch 3 MS Pressure Input	None
2-FDW-033-R	7,9L,10L	• Condensate Lines • 6" 2B EFW Header • UST and HW Supplies to EFWPs • 12" LPSW Line to CCW Return • 4" A SSW Line	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of C LPSW Pump • Loss of A and B Chillers • Loss of U2 EFW • TBVs may fail open • MS to SSRHs may fail open • MS to AS may fail open • Loss of AFIS Ch 3 MS Pressure Input	Ga-31
2-FDW-033-R	8,9,7L-8L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of C LPSW Pump • Loss of U2 TDEFWP • MS to SSRHs may fail open • MS to AS may fail open	None
2-FDW-033-R	10	None	None	None
2-FDW-033-R	13	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U2 EFW • Loss of AFIS trip signal to FWPTs	None

Table 5-4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-FDW-034-R01	2-3	None	None	None
2-FDW-034-R02	1L,2L	• AS Lines	None	K-35
2-FDW-034-R02	1,2	None	None	None
2-FDW-034-R02	3-5	None	• Loss of A and B Chillers • Loss of 2B MDEFWP • MS to SSRHs may fail open	None
2-FDW-035-R01	1	None	None	None
2-FDW-035-R02	1,1L-2L	None	None	None
2-FDW-035-R02	2	2 - 6" WC Lines	• Loss of U2 EFW • Loss of A and B Chillers • Loss of C LPSW Pump • Loss of AFIS trip signal to FWPTs	None
2-FDW-035-R02	3,3L-5L	2 - 6" WC Lines	• Loss of U2 EFW • Loss of A and B Chillers • Loss of C LPSW Pump • Loss of AFIS trip signal to FWPTs • Loss of U1 and U2 CCW	None
2-FDW-035-R02	4,5	• 18" LPSW Line to CCW Return • 12" 2B MS Line (after 2MS-26) • UST's • AS Lines	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2, and U3 • Loss of U2 TDEFWP • U1 and U2 TBVs may fail open	L-35
2-FDW-036-R	1,1L	None	• Loss of SBB1 and SBB2 • U1 and U2 TBVs may fail open • MS to AS may fail open • Loss of U2 TDEFWP	None

Table 5-4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-FDW-037-R	1,1L	None	• Loss of SBB1 and SBB2 • U1 and U2 TBVs may fail open • MS to AS may fail open • Loss of U2 TDEFWP	None
2-FDW-038-R	1-2,1L-2L	None	• Loss of SBB1 and SBB2 • U1 and U2 TBVs may fail open • MS to AS may fail open • Loss of U2 TDEFWP	None
2FDW-040-R	10	• 6" MS Supply to U2 TDEFWP	None	None
2-FDW-050-CR	1	None	• Loss of 2A2, 2B1, 2B2 RCPs • Loss of 2BS-1	None
2-FDW-051-CR	1-3	None	• Loss of U2 TDEFWP • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-FDW-052-CR	1-5	None	• Loss of U2 EFW • TBVs may fail open • MS to SSRHs may fail open	None
2-FDW-053-CR	1-3	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2 and U3 • Loss of U2 TDEFWP • U1 and U2 TBVs may fail open	None
2-FDW-054-CR	1-2	None	• Loss of SBB1 and SBB2 • U1 and U2 TBVs may fail open • MS to AS may fail open • Loss of U2 TDEFWP	None
2-FDW-055-CR	1	None	• Loss of 2HP-26, 2HP-21 and 2HP-5 • Loss of 2LP-17	None

Table 5.[illegible]-4
Potential Damage to Shutdown Equipment Caused by Feedwater System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-FDW-056-CR	1	None	• Loss of 2HP-410 and 2HP-21 • Loss of Pzr Heaters except Bank 2 Gp B • Loss of 2CC-5 and 2CC-6 • Loss of 2A LPI Flow Indication	None
2-FDW-057-CR	1-2	None	• Loss of 2LP-17 • Loss of 2HP-5 and 2HP-21	None
2-FDW-058-CR	1	None	None	None
2-FDW-059-CR	1	None	• Loss of A and B Chillers	None
2-FDW-060-CR	1-3	None	None	None
2-FDW-061-CR	1	None	• Loss of A and B Chillers	None
2-FDW-062-CR	1	None	• Loss of A and B Chillers	None
2-FDW-063-CR	1	None	• Loss of A and B Chillers	None
2-FDW-075-CR	1	None	• Loss of 2HP-26, 2HP-21 and 2HP-5	None

Table [illegible]5
Potential Damage to Shutdown Equipment Caused by Heater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-HD-001-R	1-3,2L-3L	None	None	None
2-HD-002-R	4-5,4L	None	None	None
2-HD-006-R	3-5,4L	None	None	None
2-HD-007-R	1	None	• Loss of A and B Chillers	None
2-HD-008-R	2	None	None	None
2-HD-009-R	1,3L	None	None	None
2-HD-010-R	2L	None	None	None
2-HD-011-R	1-5,2L	None	None	None
2-HD-015-R	5-6	None	• Loss of A and B Chillers	None
2-HD-016-R	1	None	None	None
2-HD-017-R	2L	None	None	None
2-HD-017-R	3-4	None	• Loss of A and B Chillers	None
2-HD-018-R	1-2,3L-4L	None	• Loss of A and B Chillers	None
2-HD-020-R	1-2,2L-4L	None	None	None
2-HD-021-R	1	• Numerous Condensate Lines	• MS to SSRHs may fail open	K-38
2-HD-021-R	2-4,1L-4L	None	None	None
2-HD-022-R	5,6L	None	None	None

Table 5-5
Potential Damage to Shutdown Equipment Caused by Heater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-HD-022-R	7L,8	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-023-R	9	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-025-R	2-3,1L,3L	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-025-R	4,4L	None	None	None
2-HD-025-R	5,5L	None	None	None
2-HD-026-R	1-2	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-028-R	4	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-029-R	3	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-031-R	1-3	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-032-R	5,5L-7L	None	None	None
2-HD-033-R	8-9,8L-9L,8A	• 6" WC Line	None	None
2-HD-034-R	10	None	None	None
2-HD-036-R	1	None	• Loss of CT5 • Loss of U2 and U3 TDEFWPs	None

Table 3.2-5
Potential Damage to Shutdown Equipment Caused by Heater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-HD-036-R	1A,1B,3A,3B	None	None	None
2-HD-036-R	1L-2L	• 6" WC Line	None	None
2-HD-036-R	2	None	• Loss of CT5 • Loss of U2 and U3 TDEFWPs • Loss of U1 and U2 CCW • Loss of A and B Chillers	None
2-HD-036-R	3	None	• Loss of U2 EFW • Loss of 'C' LPSW Pump • Loss of U1 and U2 CCW • Loss of A and B Chillers • Loss of AFIS trip signal to FWPTs	None
2-HD-036-R	3L-4L,4	None	• Loss of U2 EFW • Loss of 'C' LPSW Pump • Loss of U2 CCW • Loss of A and B Chillers • Loss of AFIS trip signal to FWPTs	None
2-HD-036-R	5	None	• Loss of U2 EFW • Loss of 'C' LPSW Pump • Loss of A and B Chillers • Loss of AFIS trip signal to FWPTs	None
2-HD-037-R	1	None	None	None
2-HD-039-R	3,3L	None	• Loss of A and B Chillers • Loss of U1 and U2 CCW • Loss of AFIS trip signal to FWPTs	None
2-HD-040-R	2,2L	None	• Loss of A and B Chillers • Loss of U1 and U2 CCW • Loss of AFIS trip signal to FWPTs	None
2-HD-042-R	1	None	• Loss of A and B Chillers	None

Table [illegible]5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-HD-042-R	2-4	None	None	None
2-HD-045-R	1-2	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of C LPSW Pump	None
2-HD-047-R	1-3,2L-3L	None	• Loss of B Chiller	None
2-HD-049-R	1	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-049-R	9	None	None	None
2-HD-051-R	1-2,2L,2A	None	• Loss of A and B Chillers • Loss of U1 and U2 CCW • Loss of AFIS trip signal to FWPTs	None
2-HD-052-R	3L,3A	None	• Loss of A and B Chillers • Loss of U1 and U2 CCW • Loss of AFIS trip signal to FWPTs	None
2-HD-056-R	4,4L,4A	None	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of A and B Chillers • Loss of U1 and U2 CCW • Loss of U3 RCPs	None
2-HD-056-R	5-6,6L-7L	None	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of U3 RCPs	None

Table [illegible]5
Potential Damage to Shutdown Equipment Caused by Heater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-HD-056-R	7	None	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of A and B Chillers • Loss of U1 and U2 CCW • Loss of U3 RCPs	None
2-HD-056-R	8,8L	None	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of A and B Chillers • Loss of U2 CCW • Loss of U3 RCPs	None
2-HD-056-R	9,9L	None	• Loss of A and B Chillers	None
2-HD-056-R	13,13L	None	• MS to AS may fail open • Loss of U1 and U2 CCW	None
2-HD-057-R	11-12,11L	None	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of A and B Chillers • Loss of U1 and U2 CCW • Loss of U3 RCPs	None
2-HD-057-R	11A,11B	None	None	None
2-HD-058-R	10	None	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of A and B Chillers • Loss of U1 and U2 CCW • Loss of U3 RCPs	None
2-HD-062-R	2	None	None	None

Table 5
Potential Damage to Shutdown Equipment Caused by Heater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-HD-062-R	3-5,4L-5L	None	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of A and B Chillers • Loss of 2B MDEFWP • MS to SSRHs may fail open • Loss of U3 RCPs	None
2-HD-062-R	8	None	None	None
2-HD-063-R	7	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-064-R	6	None	• Loss of 3MFB2 • Loss of SBB1 to U3 • Loss of SBB2 • Loss of U3 RCPs	None
2-HD-065-R	1-2	2 - 6" WC Lines	• Loss of A and B Chillers • Loss of U1 and U2 CCW	None
2-HD-065-R	3-5,4L,4A,6L	None	None	None
2-HD-066-R	1-3,1L-2L	None	None	None
2-HD-067-R	1-4, 2L-3L,2A	• 2 - 6" WC Lines	• Loss of A and B Chillers	None
2-HD-068-R	1L-2L	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-069-R	1,1L,3	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2, and U3 • Loss of U2 TDEFWP • MS to AS may fail open • U1 and U2 TBVs may fail open	None

Table 5-5
Potential Damage to Shutdown Equipment Caused by Heater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-HD-070-R	2-3,3L	None	• Loss of U2 EFW	None
2-HD-075-R01	1-2	None	None	None
2-HD-075-R01	1L	None	• Loss of A Chiller • Loss of U1 and U2 CCW	None
2-HD-075-R01	2L,3-4,9-10	None	None	None
2-HD-075-R01	3L	None	• Loss of A and B Chillers	None
2-HD-075-R01	5,5L-6L	• 2 - 6" WC Lines	• Loss of CT5 • Loss of U2 and U3 TDEFWPs	None
2-HD-075-R01	6	None	None	None
2-HD-075-R01	7-8,8L	None	• Loss of U2 EFW • Loss of 'C' LPSW Pump • Loss of A and B Chillers • Loss of AFIS trip signal to FWPTs	None
2-HD-075-R01	9L-10L	None	• Loss of A and B Chillers • Loss of U1 and U2 CCW	None
2-HD-075-R02	1-4,1L-2L,6	None	• TBVs may fail open	None
2-HD-075-R02	5, 3L-7L	None	None	None
2-HD-075-R02	7	2.5" AS Line	None	None
2-HD-076-R	5-7,5L-7L	None	• Loss of A Chiller • Loss of U1 and U2 CCW	None
2-HD-078-R	1-4,2L-3L	6" WC Line	• Loss of A and B Chillers • Loss of U1 and U2 CCW	None
2-HD-079-R	8L	None	• Loss of U2 EFW • Loss of C LPSW Pump • Loss of A and B Chillers • Loss of AFIS trip signal to FWPTs	None

Table [illegible]5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-HD-080-R01	6-7,6L,8L,9-10,10L,14-15,14L-15L	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-080-R02	1-7,1L-7L	None	None	None
2-HD-081-R	6	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-083-R	1-5,2L-4L	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-085-R	1	None	None	None
2-HD-086-R01	1-2,1L-2L	2 - 6" WC Lines	None	None
2-HD-086-R01	3,3L	None	• Loss of U2 EFW • Loss of C LPSW Pump • Loss of A and B Chillers • Loss of AFIS trip signal to FWPTs	None
2-HD-086-R01	4-6,4L-5L	None	None	None
2-HD-086-R02	1-3,1L-2L	None	None	None
2-HD-089-R	4	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-090-R01	1	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-090-R02	1-3,1L-2L	None	None	None
2-HD-093	1	None	None	None

Table 5.5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-HD-094	1	None	• TBVs may fail open	None
2-HD-095-R	14,7A	None	• MS to AS may fail open	None
2-HD-097-R	2	None	• MS to AS may fail open	None
2-HD-115-R	2,12	None	None	None
2-HD-116-R	13-14	None	None	None
2-HD-117-R	3-4,3L-4L,18	None	• Loss of A Chiller • Loss of U1 and U2 CCW	None
2-HD-119-R	5-11,5L-6L,9L-10L	None	• Loss of A and B Chillers • Loss of U1 and U2 CCW	None
2-HD-120-R	1,15-17,15L-16L	None	• Loss of CT5 • Loss of U2 and U3 TDEFWPs • Loss of A Chiller • Loss of U1 and U2 CCW	None
2-HD-121-R	1-2,2L	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-122-R	1,3,5,8,13,13L-14L	None	None	None
2-HD-122-R	1L-2L,4,9,12	None	• Loss of CT5 • Loss of U2 and U3 TDEFWPs	None
2-HD-122-R	3L-4L,10L-12L	None	None	None
2-HD-122-R	5L-8L	None	• Loss of A and B Chillers	None
2-HD-122-R	6-7,10-11	None	• Loss of CT5 • Loss of U2 and U3 TDEFWPs	None
2-HD-122-R	14-15	None	• Loss of A and B Chillers • Loss of U1 and U2 CCW	None

Table ?5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-HD-123-R	3,3L	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-126-R	4,4L-5L	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-126-R	5,11,11L-12L	None	None	None
2-HD-128-R	1-2,8,3L-7L	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-HD-131-R	1	None	• TBVs may fail open	None
2-HD-132-R	1-10,6L-7L	None	None	None
2-HD-134-R	1	None	• TBVs may fail open	None
2-HD-135-R	1-11,6L-7L,9L-10L	None	None	None
2-HD-136-R	1-4,2L-3L	None	None	None
2-HD-137-R	1-4,2L-4L	None	• TBVs may fail open	None

Table -6
Potential Damage to Shutdown Equipment Caused by Heater Vent System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-HV-001-R	1-2	None	None	None
2-HV-003-R	1-3,2L-3L	None	None	None
2-HV-016-R	1-2	None	None	None

Table 5.2-7
Potential Damage to Shutdown Equipment
Caused by High Pressure Injection System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-HPI-003	1	None	• Loss of 2HP-410 and 2HP-21	None
2-HPI-004	1	None	• Loss of 2BS-2	None
2-HPI-005	1	None	• Loss of 2BS-2	None
2-HPI-006	1	None	• Loss of 2HP-410 and 2HP-21	None
2-HPI-007	1	None	• Loss of 2HP-410	None
2-HPI-008	1	None	• Loss of 2HP-5	None
2-HPI-015-R	6-7	None	None	None
2-HPI-016-R	6-7	None	None	None

Table [illegible]8
Potential Damage to Shutdown Equipment
Caused by Main Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MS-008	1	None	None	None
2-MS-009	1	None	None	None
2-MS-010	1	None	• MS to SSRHs may fail open	None
2-MS-012	1	None	• MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
2-MS-015	1	None	• MS to SSRHs may fail open • Loss of U2 and U3 TDEFWPs • Loss of AFIS trip signal to FWPTs • Loss of U3 RCPs	None
2-MS-016	1	None	• Loss of U2 TDEFWP	None
2-MS-019	1	None	• Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-MS-021	1	None	None	None
2-MS-022	1	None	None	None
2-MS-037-R	1-2	None	None	None
2-MS-037-R	6-7,7L	None	• Loss of U2 EFW	None
2-MS-038	1	None	• Loss of CT2 and CT3 • Loss of SBB1 • Loss of SBB2 to U3	None
2-MS-064	1	None	• RBU PS for RPS Channel B	None

Table [illegible]8
Potential Damage to Shutdown Equipment
Caused by Main Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MS-080-R	3,5,6-10	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of C LPSW Pump • Loss of U2 TDEFWP • MS to AS may fail open • MS to SSRHs may fail open	None
2-MS-080-R	16,16L	None	• Loss of U2 EFW • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-MS-080-R	17,18L	None	None	None
2-MS-094-R	1-11,1L-11L	8" 2A MS Class F Break at 2MS-24	• Possible opening of 2MS-33	None
2-MS-094-R	12-14,13L	None	None	None
2-MS-096-R	15-16,16L	None	• Loss of AFIS Ch 4 MS Pressure input • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 2TO-145 • Loss of B Chiller	None
2-MS-097-R	17,17L	None	None	None
2-MS-101-R	3-4	None	None	None

Table 5[illegible]8
Potential Damage to Shutdown Equipment Caused by Main Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MS-101-R	5,5L	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of C LPSW Pump • Loss of U2 EFW • MS to AS may fail open • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-MS-137-R	8-9,8L-9L	None	None	None
2-MS-200	1	None	None	None
2-MS-201	1,1L	None	• Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-MS-202	1	None	• Loss of AFIS Ch 4 MS Pressure input • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 2TO-145	None
2-MS-204	1	None	• MS to AS may fail open	None
2-MS-205	1	None	• MS to AS may fail open	None
2-MS-207	1	None	• Loss of AFIS Ch 4 MS Pressure input • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 2TO-145	None
2-MS-210	2	None	• Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-MS-222-R	1-2,6L-9L,9	None	None	None

Table 5-8
Potential Damage to Shutdown Equipment
Caused by Main Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MS-231-CR	1-5	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2, and U3 • Loss of U2 TDEFWP • U1 and U2 TBVs may fail open • MS to AS may fail open • Loss of AFIS Ch 4 MS Pressure input • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 2TO-145	None
2-MS-232-CR	1	None	• Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-MS-233-CR	1	None	• Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-MS-235-CR	1-5	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2, and U3 • Loss of U2 TDEFWP • U1 and U2 TBVs may fail open • MS to AS may fail open • Loss of AFIS Ch 4 MS Pressure input • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 2TO-145	None
2-MS-236-CR	1-2	None	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2, and U3 • Loss of U2 TDEFWP • U1 and U2 TBVs may fail open • MS to AS may fail open • Loss of AFIS Ch 4 MS Pressure input • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 2TO-145	None

Table 5-8
Potential Damage to Shutdown Equipment
Caused by Main Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MS-237-CR	3-6	None	• MS to SSRHs may fail open	None
2-MS-238-CR	1	None	• MS to SSRHs may fail open	None
2-MS-239-CR	1	None	• Loss of B Chiller • Loss of AFIS Ch 4 MS Pressure Input • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 2TO-145	None
2-MS-240-CR	1	None	None	None
2-MS-242-CR	1	None	None	None
2-MS-243-CR	1	None	None	None
2-MS-244-CR	1-3	None	• Loss of AFIS Ch 4 MS Pressure Input • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 2TO-145	None
2-MS-245-CR	1	None	• 2MS-28 (2B MS) may fail open	None
2-MS-249-CR	1-3	None	• Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-MS-250-CR	1	None	None	None
2-MS-253-CR	1	None	None	None
2-MS-254-CR	1	None	• Loss of U2 TDEFWP • Loss of AFIS Ch 4 MS Pressure Input • Loss of AFIS trip signal to FWPTs • MS to SSRHs may fail open • Loss of U3 RCPs	None
2-MS-255-CR	1	None	• Loss of AFIS Ch 4 MS Pressure Input • Loss of U3 RCPs	None

Table 5.[illegible]-8
Potential Damage to Shutdown Equipment
Caused by Main Steam System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MS-256-CR	1	None	• MS to SSRHs may fail open	None
2-MS-257-CR	1-2	None	• MS to SSRHs may fail open	None
2-MS-260-CR	1	None	• MS to SSRHs may fail open	None
2-MS-266-CR	1	None	None	None
2-MS-267-CR	1	None	None	None
2-MS-269-CR	1	None	• Loss of AFIS trip signal to FWPT	None
2-MS-270-CR	2	None	None	None
2-MS-271-CR	2	None	None	None
2-MS-272-CR	1	None	• Loss of CT2 and CT3 • Loss of SBB1 • Loss of SBB2 to U3	None

Table 5.2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MSRD-001-R01	1-9,1L-2L,7L-8L	None	None	None
2-MSRD-001-R02	1-3,7,3L-8L	None	None	None
2-MSRD-003-R01	1,2,4,2L-4L	None	None	None
2-MSRD-003-R02	1-5,1L-5L	None	None	None
2-MSRD-004-R01	1-9,3L-8L	None	None	None
2-MSRD-004-R02	1-8	None	None	None
2-MSRD-004-R02	1L-2L	None	None	None
2-MSRD-006-R01	1,4,5,3L-6L	None	None	None
2-MSRD-006-R02	1,3-8,1L-2L,5L-6L	None	None	None
2-MSRD-006-R02	3L-4L	None	None	None
2-MSRD-007-R	2-9,5L-6L	6" 2A EFW Header	None	None
2-MSRD-008-R01	1-3,3L-4L	None	None	None
2-MSRD-008-R01	5-6,5L-6L	None	None	None
2-MSRD-008-R01	7-13	None	• MS to SSRHs may fail open	None
2-MSRD-008-R02	2-3	None	None	None
2-MSRD-008-R02	7-8	None	None	None
2-MSRD-008-R02	11-14,12L-13L	None	None	None
2-MSRD-009-R	10,11,14-15,11L-14L	None	None	None

Table 5-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MSRD-010-R01	10-12	None	None	None
2-MSRD-010-R02	6-8	None	None	None
2-MSRD-012-R01	1-4	None	None	None
2-MSRD-013-R01	10-12	None	None	None
2-MSRD-013-R02	3-6	None	None	None
2-MSRD-016-R	4	None	None	None
2-MSRD-017-R01	1-4	None	• MS to SSRHs may fail open	None
2-MSRD-017-R01	5-7,9-10	None	• MS to SSRHs may fail open	None
2-MSRD-017-R01	8	None	• Loss of SBB1 to U3 • Loss of SBB2 • MS to SSRHs may fail open	None
2-MSRD-017-R02	1-15,18	None	None	None
2-MSRD-018-R	5-8	None	None	None
2-MSRD-019-R	1-2	None	None	None
2-MSRD-020-R01	1-5,1L-5L	6" 2A EFW Header	• MS to SSRHs may fail open	None
2-MSRD-020-R02	1-3,3L-4L	6" 2A EFW Header	• MS to SSRHs may fail open • Loss of U2 TDEFWP	None
2-MSRD-020-R02	4	8" AS Line	• Loss of SBB1 and SBB2 • Loss of U2 EFW • U1 and U2 TBVs may fail open • MS to SSRHs may fail open • MS to AS may fail open • Loss of AFIS trip signal to FWPTs	None

Table 5-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MSRD-020-R02	5-9,5L-10L,10-11,28	6" 2A MS Line to AS	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2, and U3 • U1 and U2 TBVs may fail open • Loss of U2 TDEFWP	None
2-MSRD-020-R02	12,13	• 36" 2A MSLB • 12" 2B MSLB (with 2MS-26) • 2A UST • 24" Condensate Piping	• Loss of 230kV Red and Yellow Buses • Loss of SBB1 and SBB2 • Loss of all AC Power to U1, U2, and U3 • Loss of U2 TDEFWP • U1 and U2 TBVs may fail open	L-37
2-MSRD-020-R02	14-15	12" 2A MS Line at 2MS-17	• Loss of SBB1 and SBB2 • Loss of U2 EFW • U1 and U2 TBVs may fail open • MS to SSRHs may fail open • MS to AS may fail open • Loss of U1 and U2 CCW	None
2-MSRD-020-R02	16-20	8" AS Line	• Loss of 3MFB1 • TBVs may fail open	None
2-MSRD-020-R02	17L-20L	None	• Loss of SBB1 and SBB2 • Loss of U2 TDEFWP • U1 and U2 TBVs may fail open • MS to AS may fail open	None
2-MSRD-020-R02	21,21L	None	None	None
2-MSRD-020-R02	22,22L	None	• Loss of U2 TDEFWP • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-MSRD-020-R02	23-26	None	• Loss of SBB1 and SBB2 • Loss of U2 TDEFWP • U1 and U2 TBVs may fail open • MS to AS may fail open	None

Table [illegible]9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MSRD-020-R02	27,27L	None	None	None
2-MSRD-021-R01	1-2,3L-4L	None	• MS to SSRHs may fail open	None
2-MSRD-021-R02	1-2	None	• TBVs may fail open • MS to SSRHs may fail open	None
2-MSRD-021-R02	3-4	None	• MS to SSRHs may fail open	None
2-MSRD-021-R02	5L	None	None	None
2-MSRD-023-R01	1	None	None	None
2-MSRD-023-R02	2-8,1L-6L	None	None	None
2-MSRD-025-R	3	None	None	None
2-MSRD-026-R01	1-3	None	None	None
2-MSRD-026-R02	3-10,9L-10L	None	None	None
2-MSRD-028-R	1-8	None	None	None
2-MSRD-029-R	5-8,11,13,5L-8L	6" 2A EFW Header	None	None
2-MSRD-030-R02	3	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of C LPSW Pump • Loss of U2 TDEFWP • MS to AS may fail open • MS to SSRHs may fail open	None
2-MSRD-030-R02	4-5,5L-8L	None	None	None

Table 9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MSRD-030-R02	16-17	None	• Loss of U2 EFW • TBVs may fail open • MS to SSRHs may fail open • Loss of AFIS signal to FWPT trip	None
2-MSRD-030-R01	2-6,5L-6L	None	None	None
2-MSRD-031-R	4,12	None	None	None
2-MSRD-031-R	5-6	None	None	None
2-MSRD-031-R	6L-10L,12L-15L,8,13-16	None	None	None
2-MSRD-031-R	9-10	None	None	None
2-MSRD-031-R	17-18	None	None	None
2-MSRD-032-R01	1-5	None	None	None
2-MSRD-032-R02	1-3,8-11	None	None	None
2-MSRD-035-R01	1-5	None	None	None
2-MSRD-035-R02	1-5,8-13	None	None	None
2-MSRD-037-R	4-5	None	None	None
2-MSRD-038-R	6-13	6" 2A EFW Header	None	None
2-MSRD-039-R	1-5	None	None	None
2-MSRD-040-R	1	None	None	None

Table 5.2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MSRD-040-R	4,7-8	None	None	None
2-MSRD-040-R	9-12,12L-13L,17L-20L,16-25	None	None	None
2-MSRD-040-R	13-15,26	None	None	None
2-MSRD-041-R02	1	None	• TBVs may fail open • MS to SSRHs may fail open	None
2-MSRD-043-R01	1-2,2L	None	• Loss of SBB2 to U3	None
2-MSRD-044-R01	1-3,2L	None	• Loss of SBB2 to U3	None
2-MSRD-044-R02	1	None	• MS to SSRHs may fail open	None
2-MSRD-045-R	1-2,1L-2L	None	• MS to SSRHs may fail open	None
2-MSRD-046-R	1-4	None	None	None
2-MSRD-047-R	1-3,4L-5L	None	None	None
2-MSRD-049-R	1-2	None	• TBVs may fail open • MS to SSRHs may fail open	None
2-MSRD-068-R	7-9,11	None	• Loss of A and B Chillers • Loss of U1 and U2 CCW	None
2-MSRD-068-R	10,12-15	None	• Loss of A Chiller • Loss of U1 and U2 CCW	None
2-MSRD-068-R	16	None	• Loss of A and B Chillers	None
2-MSRD-068-R	17-20	None	• Loss of A and B Chillers	None
2-MSRD-069-R01	1-5	None	• MS to SSRHs may fail open	None
2-MSRD-069-R01	3L-4L	None	• MS to SSRHs may fail open	None

Table 5.2-9
Potential Damage to Shutdown Equipment Caused by Moisture Separator Reheater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MSRD-069-R02	1-3	None	• Loss of 2MFB1 • Loss of SWGR 2TE • Loss of CT3 to 3MFB1 and 3MFB2 • Loss of C LPSW Pump • Loss of U2 EFW • TBVs may fail open • MS to AS may fail open • MS to SSRH may fail open • Loss of AFIS trip signal to FWPTs	None
2-MSRD-070-R01	1	None	• Loss of SBB2 to U3	None
2-MSRD-070-R02	2-4,2L	None	• Loss of SBB2 to U3	None
2-MSRD-070-R02	5	None	• MS to SSRH may fail open	None
2-MSRD-071-R	2,2L-3L	None	• MS to SSRH may fail open	None
2-MSRD-073-R	2-5,2L-4L	None	• MS to SSRH may fail open	None
2-MSRD-074-R 01	1	None	• MS to SSRH may fail open	None
2-MSRD-074-R 02	2-3	None	• MS to SSRH may fail open	None
2-MSRD-074-R 02	2L-3L	None	• MS to SSRH may fail open • Loss of SBB2 to U3	None
2-MSRD-075-R	1	None	• MS to SSRH may fail open	None
2-MSRD-077-R01	1	None	None	None
2-MSRD-077-R02	2,4-5	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-MSRD-085-R01	1,1L	None	• Loss of SBB2 to U3	None

Table 5.2-9
Potential Damage to Shutdown Equipment Caused by Moisture Separator Reheater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MSRD-085-R02	2-4,2L	None	• Loss of SBB2 to U3	None
2-MSRD-085-R02	6	None	• MS to SSRHs may fail open	None
2-MSRD-086-R	1	None	• MS to SSRHs may fail open	None
2-MSRD-087-R02	2-3,1L-2L	None	• Loss of SBB1 to U3 • Loss of SBB2 • MS to SSRHs may fail open	None
2-MSRD-088-R	1	None	• MS to SSRHs may fail open	None
2-MSRD-089-R02	1	None	• MS to SSRHs may fail open	None
2-MSRD-092-R02	1	None	• MS to SSRHs may fail open	None
2-MSRD-095-R	1-2,2L,4L-5L,6	None	None	None
2-MSRD-095-R	3-4	None	• MS to SSRHs may fail open	None
2-MSRD-095-R	7-8	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-MSRD-095-R	9-10	None	None	None
2-MSRD-096-R	1-3	None	None	None
2-MSRD-097-R	1	None	None	None
2-MSRD-100-R	2-6,1L-2L,5L-6L	None	• Loss of 2B MDEFWP • Loss of A and B Chillers • MS to SSRHs may fail open	None
2-MSRD-101-R	1	None	None	None

Table 5-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MSRD-102-R	1-5,2L-3L,5L-6L,7-8	None	• MS to SSRHs may fail open	None
2-MSRD-103-R	1,1L	None	None	None
2-MSRD-104-R	4-6,4L-8L,10-11	None	None	None
2-MSRD-119-R	1-3	LPSW Line after 2LPSW-139	None	None
2-MSRD-120-R	1-2	None	None	None
2-MSRD-121-R	1-3,6-7,9L-11L	None	None	None
2-MSRD-123-R	1-2,1L-2L	None	None	None
2-MSRD-124-R	4	None	None	None
2-MSRD-125-R	1-2	None	None	None
2-MSRD-127-R	1-2	None	None	None
2-MSRD-128-R	1-2,1L-2L	None	None	None
2-MSRD-128-R	3,9-10	None	None	None
2-MSRD-128-R	4-6	None	None	None
2-MSRD-128-R	5L-11L	None	None	None
2-MSRD-128-R	7-8,11-14	None	None	None
2-MSRD-131-R	1	None	• MS to SSRHs may fail open	None
2-MSRD-132-R	1-5,7-8,10-18	None	None	None

Table 5.2-9
Potential Damage to Shutdown Equipment Caused by Moisture Separator Reheater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MSRD-132-R	6,9	None	None	None
2-MSRD-133-R	1-2	None	None	None
2-MSRD-134-R	1-2,5,8,16-17,19-20,26,30-31	None	None	None
2-MSRD-134-R	3-4	None	None	None
2-MSRD-134-R	7,9-10,12-15	None	None	None
2-MSRD-134-R	11	None	None	None
2-MSRD-134-R	21-22,24	6" 2A EFW Header	• Loss of B Chiller	None
2-MSRD-134-R	23,25	None	• Loss of B Chiller	None
2-MSRD-134-R	28-29	None	None	None
2-MSRD-135-R	1	None	None	None
2-MSRD-136-R	1	None	None	None
2-MSRD-138-R	9,15-18,21-24	None	None	None
2-MSRD-138-R	13-14,19-20	None	None	None
2-MSRD-139-R	1	None	None	None
2-MSRD-141-R	1-2	None	None	None
2-MSRD-143-R	2	LPSW Line after 2LPSW-139	None	None
2-MSRD-144-R	2	LPSW Line after 2LPSW-139	None	None

Table 5.2-9
Potential Damage to Shutdown Equipment Caused by Moisture Separator Reheater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MSRD-145-R	1-4,3L-4L	None	None	None
2-MSRD-148-R	1-2	None	None	None
2-MSRD-149-R	1-2	None	None	None
2-MSRD-149-R	3-4,6-7	None	None	None
2-MSRD-149-R	8-9	None	None	None
2-MSRD-149-R	9L-10L,10-11	None	None	None
2-MSRD-150-R	1	None	None	None
2-MSRD-151-R	1	None	None	None
2-MSRD-152-R	1	None	None	None
2-MSRD-153-R	1,1L-2L	None	None	None
2-MSRD-153-R	2-7,3L-6L	None	• MS to SSRHs may fail open	None
2-MSRD-154-R	1-2,2L	6" 2A EFW Header	• MS to SSRHs may fail open	None
2-MSRD-155-R	1-2	None	None	None
2-MSRD-159-R	1-2	None	None	None
2-MSRD-160-R	1-4	None	None	None
2-MSRD-201-R	1-4,2L-6L,6	None	None	None
2-MSRD-202-R	1-2	None	None	None
2-MSRD-202-R	3-6,8-9,9L,14-15	None	None	None

Table [illegible]-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-MSRD-202-R	12-13	None	None	None
2-MSRD-204-R01	6-8	None	• MS to SSRHs may fail open	None
2-MSRD-204-R02	1-7,13-14	None	None	None

Table 11
Potential Damage to Shutdown Equipment Caused by Steam Drain System HELBs (Unit 2)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
2-SD-001	1	None	• Loss of U2 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
2-SD-006	1	None	None	None
2-SD-028-R	1	None	None	None
2-SD-029-R	1	None	None	None
2-SD-030-R	1	None	None	None
2-SD-034-R	1	None	• MS to SSRHs may fail open	None
2-SD-036-R	2	None	• MS to SSRHs may fail open	None
2-SD-037-R	3	None	• MS to SSRHs may fail open	None

6.0 UNIT 3 – ANALYSIS

For Unit 3 a total of twelve (12) systems have been identified as having high energy lines and postulated break locations outside of the Containment. These systems are as follows:

- Auxiliary Steam System
- Condensate System
- Extraction Steam System
- Feedwater System
- Heater Drain System
- Heater Vent System
- High Pressure Injection System
- Main Steam System
- Moisture Separator Reheater Drain System
- Plant Heating System
- Steam Drain System
- Steam Seal Header System

These systems were identified and their break locations and break types were generated based upon the criteria provided in Section 2. The Unit 3 HE Systems, the HE Lines on these systems, and the HE boundaries for each HE piping run are identified and documented in Calculation OSC-8385 (Reference 10.2.1). The break locations, and break types for each HE piping run are compiled and documented in Calculation OSC–7518.01 (Reference 10.2.52). Additional break location details are provided in Calculation OSC-7518.02 (Reference 10.2.53), and additional information on excluded piping sections and/or break locations is provided in Calculations OSC-8385 & OSC–7518.04 (References 10.2.1 & 10.2.55, respectively). The analysis of each system follows.

6.1 High Energy Systems (HE Lines, Boundaries & Break Locations)

For each HE System the following parameters are provided:

- HE Lines
- The HE Line boundaries
- HELB locations

6.1.1 Auxiliary Steam System

The purpose of the Auxiliary Steam (AS) System is to supply steam as necessary to various plant components and systems. The AS System supplies steam for startup of the unit, when the Main Steam System is not available. In particular, the AS System provides a backup steam supply to the Turbine-Driven Emergency Feedwater Pump, and the AS System provides steam to the Condensate Steam Air Ejectors, the Main Feedwater Pump Turbines, the Steam Seal Header, the Low-Pressure Feedwater "E" Heaters and various station heating & radwaste system loads. The AS System is shared by all three ONS Units. Steam for the AS System is supplied from the Main Steam System of any Unit or an Auxiliary Boiler, which is shared with all three (3) units. A simplified functional configuration of the Unit 3 AS System is shown on Figure 6.1-1.

The high energy portions of the AS System include essentially all Unit 3 AS piping that exceeds 1" nominal pipe size. All Unit 3 AS High Energy piping is located in the Turbine Building. The major HE piping boundaries of the AS System include:

- Branch connection to the Unit 3 Main Steam System
- Valve 2AS-5, which separates the Unit 2 and Unit 3 AS Systems
- The 12" AS header between Columns 42 and 43, which separates the Unit 2 and Unit 3 AS Systems
- Branch connection to the Unit 3 Main Feedwater Pump Turbine piping

Other component boundaries for the Unit 3 AS System include valves 3AS-10, 3AS-22, 3AS-34, 3AS-26, 3AS-38, 3AS-40, 3AS-44, 3AS-45, and 3AS-315. There are also boundaries at safety valves 3AS-23 and 3AS-101. These boundaries are described in References 10.2.1 & 10.2.52, and these boundaries are shown graphically on Figure 6.1-1.

On the Unit 3 AS System there are 51 Running Breaks and one Intermediate Break that were considered for analysis. One non-excluded Intermediate Break and 42 non-excluded Running Breaks were identified (References 10.2.1, 10.2.52, 10.2.53 & 10.2.55). A compilation of the non-excluded Intermediate Break and the Running Breaks (42) and their physical parameters are provided in Table 6.1-1. The AS System has no seismically analyzed lines, and most of the individual breaks are located in the Unit 3 section of the Turbine Building. A small portion of Running Break 3-AS-041-R02 is located outside of the Turbine Building in the Yard. The majority of these individual breaks are located on the basement level (775'-0" Elev.) of the Turbine Building with most of the other individual breaks located on the Turbine Building mezzanine level (796'-6" Elev.). Several individual breaks are also located in the Yard at the south end of the Turbine Building. Three (3) of the Running Breaks, 3-AS-012-R, 3-AS-013-R, & 3-AS-014-R, were excluded based upon the normally closed position of valve 3AS-34 (Reference 10.2.55). Running Break 3-AS-027 was excluded based upon the normally closed position of valve 3AS-40 (Reference 10.2.1), and Running Break 3-AS-029-R was excluded based upon the normally closed position of valve 3AS-364 (Reference 10.2.55). Running Breaks 3-AS-030-R to 033-R have been excluded because they are downstream of steam traps in the Turbine Building and the Interim Radwaste Building. The location of each of the non-excluded, Running Breaks is shown on Figure 6.1-1. There are no postulated critical crack locations on the Unit 3 AS System (Reference 10.2.52).

6.1.2 Condensate System

The purpose of the Condensate System is to deliver condensate water from the Condenser Hotwells to the suction of the Main Feedwater (MFDW) Pumps. The Hotwell and Condensate Booster Pumps raise the condensate water pressure to the net positive suction head (NPSH) of the MFDW Pumps. The Polishing Demineralizers purify the condensate water to meet the chemistry specifications of the Steam Generators, and the condensate water is heated in the Low Pressure Heaters between the Condensate Booster Pumps and the MFDW Pumps. A simplified functional configuration of the Unit 3 Condensate System is shown on Figure 6.1-2.

The high energy portions of the Condensate System include most of the Unit 3 piping that exceeds 1" nominal pipe size. All of the Unit 3 Condensate System HE piping is located in the Turbine Building. The major boundaries of the Condensate System HE piping are the discharge nozzles of the Condensate Booster pumps, the inlet and outlet nozzles of the Low Pressure heaters, and the suction nozzles on the MFDW Pumps. The other HE piping boundaries on the Condensate System include Control Valves 3C-425, 3C-426, & 3C-427; valves 3C-98 & 3C-99; valve 3C-124; and safety/relief valves 3FDW-50 & 3FDW-62. The MFDW Pump Seal Injection piping has boundaries at the seal inlet nozzles to the MFDW Pumps; valves 3C-320 & 3C-321; and MFDW Seal Injection Pump valves 3C-311, 3C-313, 3C-314 & 3C-316. The HE lines and their boundaries for the Condensate System are described in References 10.2.1 & 10.2.52 and are shown graphically on Figure 6.1-2.

For the Unit 3 Condensate System 107 Running Breaks and one Terminal End (TE) Break were considered for the analysis, and 91 Running Breaks and one Terminal End Break were identified as non-excluded (References 10.2.1, 10.2.52, 10.2.53, & 10.2.55). A compilation of the non-excluded, Terminal End Break, the Running Breaks (91), and the location and physical parameters of each of these breaks are provided in Table 6.1–2. The Condensate System has no seismically analyzed piping lines, and all of the individual breaks are located in the Unit 3 portion of the Turbine Building. Twelve (12) of the Running Breaks are located on the mezzanine level (796'-6" Elev.) and the balance of the Running Breaks are located on the basement level (775'-0" Elev.) of the Turbine Building. Sixteen (16) of the Running Breaks (3-C-034-R01, 3-C-034-R02, 3-C-035-R, 3-C-048-R to 3-C-051-R, 3-C-054-R to 3-C-057-R, 3-C-060-R to 3-C-064-R) were excluded based upon either being isolated by a closed valve or not meeting the definition of a HE Line during Normal Plant Conditions. The location of each of the non-excluded, Running Breaks is shown on Figure 6.1-2. There are no postulated critical crack locations on the Unit 3 Condensate System (Reference 10.2.52).

6.1.3 Extraction Steam System

The Extraction Steam System includes:

- 'A' Extraction - supplies steam to 'A' FDW Heaters and FSRHs
- 'B' Extraction - supplies steam to 'B' FDW Heaters
- 'C' Extraction - supplies steam to 'C' FDW Heaters
- HP Turbine Exhaust (Cold Reheat - Inlet to MSRH)
- LP Turbine Inlet (Hot Reheat - Outlet from MSRH)
- 'D' Extraction - supplies steam to 'D' Feedwater Heaters
- 'E' Extraction - supplies steam to 'E' Feedwater Heaters

The purpose of the Extraction Steam (ES) System is to provide heating steam for the Condensate and Feedwater Systems, in order to heat the water being supplied to the shell side of the Steam Generators. Steam is removed from various points on the Turbine Cycle for the steam. The system can also supply steam to the Plant Heating System, if desired. A simplified functional configuration of the Unit 3 Extraction Steam System is shown on Figure 6.1-3.

The high energy portions of the ES System include most of the Unit 3 piping that operates at elevated pressures and exceeds 1" nominal pipe size. All of the Unit 3 ES System HE piping is located in the Turbine Building. The major HE piping boundaries of the ES System include connections to steam supply piping line at the (Main) Feedwater Pumps and the connection points to HP & LP Heaters. The ES System also shares boundaries with the AS System, MS System, MSRD System, PH System, and the SD System. The other HE Boundaries on the ES System include valves 3HPE-20, 3MS-117, 3MS-118, 3MS-114, 3MS-121, 3MS-113, 3MS-122, & 3HPE-35. The HE lines and their boundaries for the ES System are described in References 10.2.1 & 10.2.52, and are shown graphically on Figure 6.1-3.

For the Unit 3 ES System 113 Running Breaks and 11 Terminal End Breaks were considered for analysis. The 11 Terminal End Breaks and 83 of the Running Breaks were identified as non-excluded (References 10.2.1, 10.2.52, 10.2.53 & 10.2.55). A compilation of these non-excluded, Terminal End and Running Breaks, their locations, and their physical parameters are provided in Table 6.1-3. The ES System has no seismically analyzed piping lines, and all of the individual breaks on the ES System are located in the Unit 3 portion of the Turbine Building. All but two (2) of the Running Breaks and two (2) of the Terminal End Breaks are located on the mezzanine level (796'-6" Elevation), and the remaining two (2) Running Breaks and two (2) Terminal End Breaks are located on the basement level (775'-0" Elevation) of the Turbine Building. Thirty (30) of the Running Breaks (3-ES-035-040, 049-054, 067-072, 088-093, 101-102, 189, 289, 292, & 293-R) were excluded based upon the lack of pressure in these piping sections. These piping sections have a normal operating pressure below atmospheric pressure (≤ 0 psig). The location and break number of each of the non-excluded Running Breaks are shown on Figure 6.1-3. There are no postulated critical crack locations on the Unit 3 ES System (Reference 10.2.52).

6.1.4 Feedwater System

The purpose of the Feedwater System (also identified as the "Main Feedwater System" or MFDW) is to increase the temperature and pressure of the water received from the Condensate System, so that the water can be used on the shell side of the Steam Generators. The MFDW System also controls the flow rate of the water, which is supplied to the shell side of the Steam Generators. A simplified functional configuration of the Unit 3 Feedwater System is provided in Figure 6.1- 4.

The high energy portions of the MFDW System include essentially all of the Unit 3 MFDW System piping that exceeds 1" nominal pipe size. Most of the MFDW System HE piping is located in the Turbine Building. The two (2) Main Feedwater piping lines are routed out of the Turbine Building into the Auxiliary Building, and these piping lines are routed to Containment Penetrations #25 & #27 in the EPR. The major boundaries of the high energy sections of the MFDW System include the discharge nozzles of the Main Feedwater Pumps "3A" & "3B," the connections to the "A" & "B" HP Heaters, and the Containment Penetrations #25 & #27. The other HE boundaries on the MFDW System include valves 3FDW-53, 3FDW-65, 3FDW- 262, 3FDW-263, 3FDW-279, 3FDW-280, 3FDW-283, 3FDW-74, 3FDW-76, 3FDW-200, 3FDW-38, and 3FDW-47. The HE piping lines and their boundaries for the MFDW System are described in References 10.2.1 & 10.2.52 and are shown graphically on Figure 6.1-4.

For the Unit 3 MFDW System twelve (12) Terminal End Breaks, three (3) Intermediate Breaks (IB), fourteen (14) Critical Cracks (CR), and 31 Running Breaks were considered in the analysis. The non-excluded breaks on the MFDW System include twelve (12) Terminal End Breaks, three (3)

Intermediate Breaks, fourteen (14) Critical Cracks, and 31 Running Breaks (References 10.2.1, 10.2.52, 10.2.53 & 10.2.55). A compilation of these non-excluded breaks, their locations, and their physical parameters are provided in Table 6.1-4. The MFDW System piping is seismically analyzed from valves 3FDW-26 & 3FDW-21 to the Containment Penetrations, #25 & #27, respectively. This accounts for the Terminal End & Critical Crack breaks and the number of Running Breaks on the system. The postulated break locations on the MFDW System are located in both the Turbine Building and the Auxiliary Building. Within the Auxiliary Building the MFDW System is seismically analyzed. There are two (2) postulated break locations in the Auxiliary Building, 3-FDW-027 and 3-FDW-028 at Penetrations #27 and #25, respectively, at Elevation 828'-6". There are also three (3) Critical Cracks in the Auxiliary Building on the MFDW piping lines. These three (3) critical cracks, 3-FDW-055-CR, 3-FDW-056-R, and 3-FDW-062-CR, are located on the Main Feedwater piping line to Penetration #25. All of the non-analyzed piping, and hence, the Running Breaks are located in the Turbine Building on the basement level (775'-0" Elevation) and the mezzanine level (796'-6" Elevation). The MFDW System TE breaks and the CRs in the Turbine Building are also located on the basement and mezzanine levels. The location and break number of each of the non-excluded HELBs on the MFDW System are shown on Figure 6.1-4. No Critical Crack locations are postulated on the non-analyzed portions of the Unit 3 MFDW System (References 10.2.52 & 10.3.17).

6.1.5 Heater Drain System

The purpose of the Heater Drain (HD) System is to collect the condensed extraction steam from the Feedwater Heaters and to transport the condensate to the Condensate System. A simplified functional configuration of the portions of the HD System that contain HE piping is shown of Figure 6.1-5.

The High Energy portions of the HD System consist of most of the piping on the HD System that exceeds 1" nominal pipe size. The major portions of the HD System that are not HE piping include the "E" Heater Drain Pumps suction piping (from the "E" LP Heaters to the drain pumps) and the HD Piping from the "F" LP Heaters to the Condenser. The major HE piping boundaries of the HD System are the two (2) connections to the Condensate System; the outlet nozzles on the Heaters, Flash Tanks and Drain Coolers; the connections with the discharge piping for the Moisture separator Drain Tank Pumps; and the outlet nozzles of the Heater Drain Pumps. The other HE piping boundaries of the HD System are the numerous closed valves. The HE Lines and their boundaries for the HD System are described in References 10.2.1 & 10.2.52 and are shown graphically on Figure 6.1- 5.

Ten (10) Terminal End Breaks, nine (9) Intermediate Breaks, and 130 Running Breaks were considered for the analysis. Of these ten (10) Terminal End Breaks, nine (9) Intermediate Breaks, and 130 Running Breaks were identified as non-excluded breaks on the HD System (References 10.2.1, 10.2.52, 10.2.53 & 10.2.55). A compilation of the non-excluded Terminal, Intermediate, & Running Breaks, their location, and physical parameters associated with each break is provided in Table 6.1-5. The HD System has no seismically analyzed piping lines, and all of the postulated breaks are located in the Unit 3 portion of the Turbine Building. The majority of the postulated breaks on the HD System are located on the basement level of the Turbine Building (775'-0" Elevation). The remaining postulated breaks are located on the Mezzanine level of the Turbine

Building (796'-6" Elevation). The location of each of the Terminal End Breaks, Intermediate Breaks, and Running Breaks are shown on Figure 6.1-5. There are no postulated critical crack locations on the Unit 3 HD System (Reference 10.2.52).

6.1.6 Heater Vent System

The purpose of the Heater Vent (HV) System is to remove non-condensable gases from the shell side of the "A", "B", "C", & "D" Heaters, the Heater Drain Coolers, and the Heater Drain lines and to transport these non-condensable gases to the Main Condenser. A simplified functional configuration of the portions of the HV System that contain HE piping is shown of Figure 6.1-6.

The high energy portions of the HV System include most of the Unit 3 piping on the HV System, whose normal operating pressure is greater than atmospheric and greater than 1" nominal pipe size. All of the Unit 3 Heater Vent System piping is in the Turbine Building. The major boundaries of the HV System HE piping are the vent piping lines from the "A", "B", "C", & "D" heaters to the first closed valve, relief valve, or pressure reducing orifice. There are also two boundaries from the "C" Heater Drain Cooler drain lines to relief valves 3HV-76 & 3HV-79. Some parts of the piping on the HV System normally operates at atmospheric or sub-atmospheric pressure, and therefore, these sections of pipe are incapable of generating pipe whips, jet impingement, flooding, or compartmental pressurization effects. The HV System HE piping line sections and their boundaries are described in References 10.2.1 & 10.2.52 and shown graphically on Figure 6.1-6.

For the Unit 3 Heater Vent System 44 Running Breaks were considered (Reference 10.2.52 & 10.2.53), and there are a total of 28 non-excluded, Running Breaks on the system (References 10.2.1, 10.2.52, 10.2.53 & 10.2.55). A compilation of the non-excluded, Running Breaks, their locations, and their physical parameters are provided in Table 6.1-6. The Heater Vent System has no seismically analyzed piping lines, and all of the individual breaks on the HV System are located in the Unit 3 portion of the Turbine Building. Most of the Running Breaks are located on the mezzanine level (796'-6" Elevation) and the remaining postulated breaks are located on the basement level (775' – 0" Elevation) of the Turbine Building. Sixteen (16) of the Running Breaks (3-HV-023-R to 030-R; 3-HV-031-R01 & R02; 3-HV-032-R; 3-HV-033-R01 & R02; 3-HV-034-R to 3-HV-036-R) were excluded based upon the lack of pressure in these piping sections. These Running Breaks had a normal operating pressure of less than or equal to atmospheric pressure (≤ 0 psig) (Reference 10.2.1). The location and break number of each of the non-excluded, Running Breaks are shown on Figure 6.1-6. There are no postulated critical crack locations on the Unit 3 HV System (Reference 10.2.52).

6.1.7 High Pressure Injection System

The purpose of the High Pressure Injection (HPI) System is to maintain the RCS coolant inventory (i.e. maintain RCS level), regulate the boric acid concentration in the RCS water, and maintain the RCP seal integrity. The HPI System adds RCS inventory as necessary through both the normal HPI Injection Line and through the RCP seals via the individual seal injection lines. The RCS inventory is removed through the Letdown Line. Each ONS Unit has its own HPI System. Each ONS Unit has three (3) HPI pumps, two (2) injection flow headers outside of the Containment, and the RCP Seal Injection flow paths. The Unit 3 HPI System does not functionally or physically interface with any portion of the Unit 1 or 2 HPI System. A simplified functional configuration of the Unit 3 HPI System is shown on Figure 6.1-7.

With the exception of the HPI Pump mini-flow lines all of the Unit 3 HPI System piping is seismically analyzed. The high energy portions of the HPI System include:

- The HPI Pump discharge piping from the HPI Pumps 3A & 3B to Containment Penetration #9 for the HPI Injection Lines & to Containment Penetrations #10A, 10B, 23A, & 23B (RCP Seal Injection Lines)
- The Letdown Line from the Containment Penetration #6 to the pressure reducing device or a closed valve
- The HPI Pump mini-flow lines for HPI Pumps 3A & 3B from the branch connection on the HPI Pump discharge line to beyond the block orifices

The RCP Seal Return Piping and the HPI Pump Suction Piping have been excluded as HE piping, because under Normal Plant Conditions the piping does not exceed the HE piping temperature or pressure limits (See Section 2.2.1). The HPI Pump 3C discharge piping from the pump to Containment Penetration #52 and its mini-flow line are excluded as HE piping with postulated HELBs, because this piping is not pressurized more than 1% of the total operating time of the unit. Also, all HPI Piping with a nominal pipe size of 1" and smaller is excluded (Reference 10.1.1).

The primary boundaries for the HE HPI Pump discharge piping are the discharge nozzles for HPI Pumps 3A & 3B, Containment Penetration #9, and the four (4) RCP Seal Injection Lines Containment Penetrations 10A &10B (WPR) and 23A & 23B (EPR). The primary boundaries on the Letdown Line are Containment Penetration #6, closed valve 3HP-42 (Letdown Block Orifice Manual Bypass Valve), the Block Orifice (3HPIFE0040), and the isolation valve 3HP-41 (Letdown Flow Control Outlet Block Valve). The other HPI System HE pipe boundaries are valve 3HP-62 (LDST and HPI Pump Bypass Valve), valve 3HP-116 (HPI Pumps 3B/3C Discharge Header Separation Valve), and the HPI Pumps 3A & 3B mini-flow line stop check valves 3HP-248 & 3HP-250, respectively. The High Energy Piping and the boundaries of the Unit 3 HPI System are described in References 10.2.1 & 10.2.52 and are shown on Figure 6.1-7.

The Unit 3 HPI System has fourteen (14) Terminal End Break locations and three (3) Running Breaks that were considered during the analysis. There are a total of 8 non-excluded, Terminal End Breaks and two (2) non-excluded Running Breaks on the system (References 10.2.1, 10.2.52, 10.2.53 & 10.2.55). A compilation of the non-excluded breaks, their locations, and their physical parameters are provided in Table 6.1-6. No other HELBs or Critical Cracks have been postulated, because no other locations on the HE piping on the Unit 3 HPI System exceeded the stress limits (References 10.2.1 & 10.2.52). All of the listed break locations are located on the HPI Pump Discharge Piping, except for break location 3-HPI-008, which is located on the Letdown Line at Containment Penetration #6. The three (3) postulated Running Breaks, 3-HPI-015-R, 3-HPI-016-R, & 3-HPI-017-R, are on the HPI Pump mini-flow lines. Because the piping on the RCP Seal Return Line did not meet the temperature or pressure criteria for a HE Line, Terminal End break, 3-HPI-011 on the RCP Seal Return Line was excluded from further analysis. The HPI Pump 3C Discharge Piping did not meet the criteria for operation in excess of 1% of the total operating time of the plant. Hence, the postulated HELBs on these lines, locations 3-HPI-009 & 3-HPI-010, were excluded as break locations. The postulated Running Break, 3-HPI-017-R on the HPI Pump 3C Mini-Flow Line, is also excluded for the same reason. Postulated break locations on the HPI Pumps Suction Piping, 3-HPI-012, 3-HPI-013, and 3-HPI-014, were excluded because the normal operating fluid conditions in this piping did not meet the definition for HE Piping (References 10.2.1 & 10.2.55). The remaining individual break locations (TEs) and Running Breaks are listed in Table 6.1-7.

6.1.8 Main Steam System

The purpose of the Main Steam System is to provide steam at specified thermodynamic conditions and at specified flow rates to the Main Turbine. The MS System is also used to remove heat from the RCS and to supply steam to the Main Feedwater and TDEFW Pumps, Condenser Air Ejectors, SSH, the 2nd Stage of the MSRH, and miscellaneous auxiliary equipment. A simplified functional configuration of the Unit 3 Main Steam System is shown on Figure 6.1-8.

The high energy portions of the MS System include essentially all of the Unit 3 MS System piping that exceeds 1" nominal pipe size. Most of the MS System HE piping is located in the Turbine Building. A section of the MS piping line from Containment Penetration #28 is routed through the Yard outside of any building before entering the Turbine Building. The other MS piping line exits the containment from Containment Penetration #26 into the EPR in the Auxiliary Building. It is then routed out of the Auxiliary Building through the Yard and into the Turbine Building. The major boundaries to the MS System include Containment Penetrations #26 & #28 and the connections to the Main Turbine, the TDEFWP, the Main Feedwater Pump Turbines, the 2nd Stage Reheaters, the steam separators, steam drains, the Auxiliary Steam System and safety valves for the Condenser Steam Air Ejectors. The MS System HE piping also has boundaries at the MSRVs, TBVs, ADVs, & valves 3MS-37, 3MS-38, 3AS-38, 3MS-138, 3MS-92, 3SSH-1, 3SSH-3, 3AS-468, and 3AS-469. The HE piping lines and their boundaries for the Unit 3 MS System are described in References 10.2.1 & 10.2.52 and are shown graphically on Figure 6.1-8.

For the Unit 3 Main Steam System twenty-one (21) Terminal End Breaks, eight (8) Intermediate Breaks, fifty-one (51) Critical Cracks, and fifty-five (55) Running Breaks were considered for analysis. The non-excluded HELBs on the MS System include twenty-one (21) Terminal End Breaks, eight (8) Intermediate Breaks, fifty-one (51) Critical Cracks, and thirty-three (33) Running Breaks (References 10.2.1, 10.2.52, 10.2.53 & 10.2.55). A compilation of these non-excluded breaks, their locations, and their physical parameters are provided in Table 6.1-8. The MS System HE piping is, for the most part, seismically analyzed. The Main Steam Lines and the branch lines of the Main Steam Lines to the first isolation valve are seismically analyzed. The only non-seismically analyzed sections are the piping to the Emergency Steam Air Ejector, the piping to the Steam Separators for the Condenser Steam Air Ejectors, the piping to the Start-up Steam Header (AS System), the piping between the Turbine Bypass Inlet Block Valves & the TBVs, the piping on the MFDW Pump Turbine steam supply lines downstream of valves 3MS-35 & 3MS-36, and the piping to the Steam Seal Header System. Since most of the MS piping is seismically analyzed, this accounts for numerous TE, IB, and CRs on the system. The MS System is seismically analyzed for the HE piping in the Yard and in the Auxiliary Building. The only HELB on the MS System in the Auxiliary Building is the Terminal end Break 3-MS-064 (835'-0" Elevation) at Containment Penetration #26 in the EPR. The HELBs in the Yard are the TE Break, 3-MS-063 (853'-9" Elevation) at Containment Penetration #28, IB 3-MS-204 (827'-2"), and Critical Crack 3-MS-238-

CR (827'-4" Elevation). The remaining MS System HE piping break locations are in the Turbine Building. The Running Breaks are located almost exclusively on the mezzanine level (796'-6" Elevation), and the TE, IB, and CRs in the Turbine Building are found on the basement, mezzanine, turbine operating floor levels. Twenty-two (22) Running Break have been excluded because they are located downstream of the TBVs. These sections of the MS piping lines downstream of the TBVs are not HE piping because they are not pressurized during Normal Plant Conditions more than 2% of the operating time of the MS System. The location and break number of each of the non-excluded HELBs on the Unit 3 MS System are shown on Figure 6.1-8. There are no critical crack locations on the non-analyzed portions of the Unit 3 Main Steam System (References 10.2.52 & 10.3.17).

6.1.9 Moisture Separator Reheater Drain (MSRD) System

The MSRD System consists of the following three sub-systems:

- Moisture Separator Reheater (MSRH) Drains
- First Stage Reheater (FSRH) Drains
- Second Stage Reheater (SSRH) Drains

Steam from the HP turbine exhaust passes through the moisture separator portion of the MSRHs, where condensate is removed from the wet steam. The condensate is routed to the MSRH Drain System. The dry steam is then heated by the FSRH tube bundle. The "A" extraction steam inside the FSRH tubes condenses as it transmits heat to the HP turbine exhaust steam. The condensate from the FSRH tubes is routed to the FSRH drain system. The steam from the HP turbine exhaust is then heated by the SSRH tube bundle before it leaves the MSRH to the LP turbine inlet. The main steam inside the SSRH tubes condenses as it transmits heat to the HP turbine exhaust steam. The condensate from the SSRH tubes is routed to the SSRH drain system.

The purpose of the MSRD System is to collect the condensate from the moisture separators and reheater tube bundles and transport the condensate back to the feedwater heaters for heat recovery. A simplified functional configuration of the Unit 3 MSRD System is shown on Figure 6.1-9.

The high energy portions of the MSRD System include most of the Unit 3 piping that exceeds 1" nominal pipe size. All of the Unit 3 MSRD System HE piping is located in the Turbine Building. The major boundaries of the MSRD System HE piping are the connections to the Moisture Separator Reheaters, Reheater Drain Tanks, Moisture Separator Drain Tank Pumps, "A" HP heaters, and the Heater Drain piping lines. The other HE boundaries include valves 3HD-29, 3HD-30, 3HD-26, 3HD-25, 3HD-601, 3HD-102, 3HD-103, 3HD-27, 3HD-28, 3HD-56, 3HD-58, 3HD-41, 3HD-43, 3HD-70, 3HD-72, 3HD-85, 3HD-87, 3HD-453, 3HD-454, 3HD-541, and 3HD-548. The HE piping lines and their boundaries for the MSRD System are described in References 10.2.1, 10.2.52, & 10.2.53 and are shown graphically on Figure 6.1-9.

For the Unit 3 MSRD System thirty (30) Terminal End Breaks, four (4) Intermediate Breaks, and 174 Running Breaks were considered for analysis, and all of these postulated breaks, except for four (4) Running Breaks, were identified as non-excluded. The non-excluded breaks include thirty (30) Terminal End Breaks, four (4) Intermediate Breaks, and 170 non-excluded, Running Breaks

(References 10.2.1, 10.2.52, 10.2.53 & 10.2.55). A compilation of these non-excluded postulated breaks on the MSRD System, their locations, and physical parameters is provided in Table 6.1-9. The MSRD System has no seismically analyzed piping lines, and all of the postulated break locations are located in the Turbine Building. These postulated MSRD System breaks are located on the basement and mezzanine floors of the Turbine Building. Four (4) Running Breaks were excluded from evaluation (3-MSRD-064-R, 3-MSRD-065-R, 3-MSRD-396-R, & 3-MSRD-397-R) because these Running Breaks are located downstream of closed valves 3HD-25, 3HD-26, 3HD-29, and 3HD-30. The locations of each of the postulated MSRD System break locations are shown on Figure 6.1-9. There are no postulated critical crack locations on the Unit 3 MSRD System (Reference 10.2.52)

6.1.10 Plant Heating System

The purpose of the Plant Heating System is to distribute low pressure steam (~27 psig) to space heaters, Air Handling Units (AHUs), Reactor Building Purge Heaters, Condensate Storage Tanks, and the Auxiliary Boiler. A simplified function configuration of the Unit 3 Plant Heating System is shown on Figure 6.1-10.

The high energy sections of the PH System include essentially all of the PH System Piping greater than 1" in nominal pipe size on the supply side (inlet side) of the equipment supplied with steam. The PH System HE piping is located in the Turbine Building and the Auxiliary Building. The major boundaries of the PH System HE piping include the connections of the Units 3 PH System piping with the Unit 2 PH System piping, and the connections to the equipment supplied by the PH System. Other boundaries include valves 3HPE-35, 3AS-44, 3AS-45, 3AS-56, 3AS-70, 3AS-73, 3AS-75, 3AS-78, 3AS-483, and PH-630. The HE piping line sections and their boundaries are described in References 10.2.1 & 10.2.52 and are shown graphically on Figure 6.1-10.

On the Unit 3 Plant Heating System there are 78 Running Breaks that were considered for the analysis and 78 non-excluded, Running Breaks were identified (References 10.2.1, 10.2.52, 10.2.53 & 10.2.55). A compilation of these non-excluded, Running Breaks, their locations, and their physical parameters are provided in Table 6.1-10. The PH System has no seismically analyzed lines, and majority of the individual breaks are located in the Unit 3 section of the Turbine Building. The remaining HELBs on the PH System are located in the Auxiliary Building. In the Auxiliary Building three separate PH System HE piping lines are run. The physical routing of each piping line is as follows:

- From the Turbine Building directly into the Ventilation Equipment Room – 565 (Supply Line for AHU 3-7 & AHU 3-8)
- From the Turbine Building through the Unit 3 East and West Penetration Rooms (Reactor Building Purge Heater steam supply line)
- From the Auxiliary Building Ventilation Equipment Room 565, through the EPR, and up to the Ventilation Equipment Room 651 (Supply Line for AHU 3-9 & AHU 3-10)

The location of each of the non-excluded, Running Breaks and their designated identification numbers are shown on Figure 6.1-10. There are no postulated critical crack locations on the Unit 3 PH System (Reference 10.2.52).

6.1.11 Steam Drain System

The purpose of the Steam Drain (SD) System is to remove condensate from the Main Steam System, Extraction Steam system, and the Steam Seal Header (SSH) System. A simplified functional configuration of the SD System is shown of Figure 6.1-11. Since the SD System is directly connected to the MS, ES, & SSH Systems, the SD piping is shown on the diagrams for these other systems.

The high energy portions of the Steam Drain System are, in general, those sections, directly connected to the HE sections of the MS, ES, & SSH Systems. The HE piping line identified sections of the SD System extend to a closed valve, steam trap, or an excluded section of piping that is 1" in nominal pipe size or smaller. The connections to the other steam systems and their terminations at a closed valve, steam trap, or an excluded section of piping that is less than 1" in nominal pipe size constitute the HE piping boundaries of the SD System. The extent of the HE piping lines and their boundaries are described in References 10.2.1 & 10.2.52 and are shown graphically on Figure 6.1-11.

On the Unit 3 SD System ten (10) Terminal End Breaks and 75 Running Breaks were considered for analysis. Of these nine (9) Terminal End Breaks and forty-one (41) Running Breaks were identified as non-excluded (References 10.2.1, 10.2.52, 10.2.53, & 10.2.55). A compilation of these non-excluded postulated HELBs, their physical location, and their physical parameters are provided in Table 6.1-11. All of the individual breaks are located in the Unit 3 portion of the Turbine Building. Two (2) of the Running Breaks and one of the Terminal End Breaks are located on the basement level (775'-0" Elevation), and the balance of the postulated breaks are located on the mezzanine level (796'-6" Elevation). One of the Terminal End Breaks (3-SD-008) has been excluded because the pipe size, on which this break is located, was physically changed to ¾" nominal pipe size. Hence, a break location was no longer required to be postulated at this location. Thirty-four (34) postulated Running Breaks on the SD System have been excluded as HE line break locations. Some of these Running Breaks have been excluded because each of these is connected to a piping line that has an internal pressure at atmospheric pressure (~0 psig). The remaining excluded Running Breaks (3-SD-097-R & 3-SD-098-R) on the SD System are excluded because they are connected to a section of the MS System that had been excluded as HE piping. The locations of the SD System postulated HELBs and their break numbers are shown on Figure 6.1-11. There are no critical crack locations on the non-analyzed portions of the Unit 3 Steam Drain System (References 10.2.52 & 10.3.17).

6.1.12 Steam Seal Header System

The purpose of the Steam Seal Header System is to provide steam to the Low Pressure Turbine (Main Turbine) seals and the (Main) Feedwater Pump Turbine seals to prevent in leakage of air into the turbines. A simplified functional configuration of the Unit 3 SSH System is shown on Figure 6.1.-12.

The high energy sections of the SSH System include all of the inlet piping to the Main Feedwater Pump Turbines, the inlets to the Low Pressure Turbines, the connection to the Main Steam System, and the connection to the Auxiliary Steam System at valve 3AS-10. The other HE piping boundaries on the SSH System include valves 3SSH-8, 3SSH-9, 3SSH-14, 3SSH-15, 3SSH-19, 3SSH-22, 3SSH-1 and 3SSH-3. The HE piping lines and their boundaries are described in References 10.2.1 & 10.2.52 and are shown graphically on Figure 6.1-12.

The analysis considered fifty-three (53) Running Breaks on the SSH System, and there are a total of twenty-nine (29) non-excluded, Running Breaks on the Unit 3 SSH System (References 10.2.1, 10.2.52, 10.2.53 & 10.2.54). There are no other types of HELBs on the SSH System, because the SSH System has no seismically analyzed piping lines. A compilation of the non-excluded, Running Breaks, their location, and their physical parameters are provided in Table 6.1-12. All of the individual breaks are located in the Unit 3 section of the Turbine Building. All but three (3) of the Running Breaks are located on the Mezzanine Level (796'-6" Elevation) of the Turbine Building, and the other three (3) Running Breaks are located on the Basement Level (775'-0" Elevation) of the Turbine Building. Twenty-four (24) postulated Running Breaks (3-SSH-001, 009-013, 033-049, & 052-R) were excluded as having postulated HELBs on them. These Running Breaks were excluded because during Normal Plant Conditions these sections of piping are operating below atmospheric pressure (~0 psig) (Reference 10.2.1). There are no postulated critical crack locations on the Unit 3 SSH System (Reference 10.2.52).

6.2 Interaction Analysis

For each of the systems listed in the previous section the interactions with the Shutdown Equipment and the defined pathway, for achieving and maintaining a Safe Shutdown condition and then proceeding to the Cold Shutdown Condition, are provided. Because of the large number of individual break locations an analysis for each break is not provided. Instead the individual breaks are grouped according to their effects on the Shutdown Equipment and a pathway to achieving a Safe Shutdown condition and then proceeding to the Cold Shutdown Condition is described for each group. A comprehensive evaluation of each individual non-excluded break location on each of the HE Systems in Unit 3 is provided in Calculations OSC-7518.04, OSC-7518.08, & OSC-7518.10 (References 10.2.55, 10.2.58, & 10.2.60). Input for these evaluations was generated in Calculations OSC-7518.01, OSC-7518.02, OSC-7518.06, OSC-7518.07, & OSC-7518.09 (References 10.2.52, 10.2.53, 10.2.56, 10.2.57, & 10.2.59).

Unit 3 has six (6) areas, where HELBs are postulated. These areas are as follows:

- East Penetration Room (Auxiliary Building)
- West Penetration Room (Auxiliary Building)
- HPI Pump Room (Auxiliary Building)
- Miscellaneous Rooms in the Auxiliary Building (including Ventilation Equipment Rooms 565 & 651)
- Station Yard

- Turbine Building

It should be noted that Section 6.2 provides the interaction analysis of only the Unit 3 postulated HELBs and their effects on the ONS. A description of the HELB interactions for each system in each area follows. Each postulated HELB with identified targets is listed in the Shutdown Interaction Tables, 6.2-1 to 6.2-11. These tables identify all of the Shutdown Equipment damaged by individual HELBs. The direct effects from pipe whip and jet impingement, as well as the collateral damage created by the structural component failure, have been included in these tables. The HPI System has postulated HELBs in three (3) different areas of the Auxiliary Building, and its interaction Table is 6.2-7. The Feedwater System, Main Steam System, and the Plant Heating System have postulated HELBs both in the Turbine Building and the Auxiliary Building. The Main Steam System and the Auxiliary Steam System are the only HE Systems in the Yard. The interaction tables for the Main Feedwater and the Main Steam Systems are Tables 6.2-4 and 6.2-8 respectively. The Steam Seal Header System has no table, because the SSH System has no direct interactions with any Shutdown Equipment.

6.2.1 HELB Interactions in the Auxiliary Building & Station Yard

6.2.1.1 HELB Interactions in the East Penetration Room

The information in this section describes the HELBs that affect the Shutdown Equipment in the East Penetration Room (EPR) and the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these HELBs. The information is separated by HE System with a write up for each system. The only HE Systems in the East Penetration Room are the Main Steam System, the (Main) Feedwater System, Plant Heating System, and the High Pressure Injection System. A detailed discussion of the postulated HELBs for these systems and their interactions are provided.

6.2.1.1.1 High Pressure Injection System

There are four (4) postulated HPI HELBs in the EPR. These breaks are the TE break on the HPI Charging Line at Containment Penetration #9 (3-HPI-007), the TE breaks on the RCP Seal Injection Lines at Containment Penetrations # 23A & #23B (3-HPI-003 &3-HPI-006, respectively), and the TE break on the Letdown Line at Containment Penetration #6 (3-HPI-008). For any of these postulated break locations a pathway to the Safe Shutdown/Cold Shutdown Conditions exists.

For the Seal Injection Line breaks once either of the breaks occurs, the detection of the break would be made by the alarm of high seal flow in one of the lines and low flow in the other three lines. The break would be isolated by taking manual control of valve 3HP-31 and closing this valve from the Control Room[5]. If valve 3HP-31 (RCP Seal Flow Control Valve) fails to close from the Control Room, operators can isolate the break by closing manually operated valves, which are located outside of the break area (Reference 10.3.20). Since the Component Cooling System is available, RCP seal cooling is not lost. Moreover, any flooding in the EPR would remain in the EPR for a significant period of time. The flood level in the EPR would not exceed the top of the curb around

[5] In Section 6.0 of this report references to "Control Room" and the variations thereof refer to the Unit 3 Control Room.

the Flood Outlet Device (FOD) for 1 hour and 40 minutes (References 10.2.20 & 10.2.24). Hence, sufficient time exists to get the seal injection line isolated

Because the Seal Injection flow is normally from the Letdown Storage Tank (LDST) or possibly from the BWST, the temperature of the water would have a maximum temperature of approximately 100-105°F. This temperature water flowing out of the break would not flash to steam and cause compartmental pressurization in the EPR. Without the compartmental pressurization, the water and any radioactive materials in the water would remain in the EPR.

Upon isolation of the break, the EPR can be drained to the Low Activity Waste Tank, and the ruptured RCP Seal Injection line can be isolated from the rest of the HPI System. Seal injection flow could then be restored to the other three seal injection lines. Unit shutdown would be conducted with all of the identified Shutdown Systems available. Shutdown from the Initial Plant Conditions to the Cold Shutdown Condition can be achieved.

For the HPI Charging Line Break at Containment Penetration #9, the HELB (3-HPI-007) would be detected by the loss of inventory from the LDST and the low pressure in the HPI Discharge. The postulated HELB is isolated by taking remote manual control of valve 3HP-120 (RC Volume Control Valve) and closing this valve.

If valve 3HP-120 cannot be closed from the Control Room, operators are directed to isolate the break by closing 3HP-115 (HPI Pumps 3A & 3B Discharge Header Cross Connection Isolation Valve) and stopping the HPI Pumps. These actions can be performed from the Control Room. These actions will significantly reduce the break flow rate. However, flow will continue through the break until the break is isolated by closing a manually operated valve on the discharge of the HPI pump. This manually operated valve is located outside of the break area. With the break isolated, the HPI charging flow could be restored through the alternate charging line with, at least, two (2) HPI Pumps available and two throttling valves (3HP-27 & 3HP-409) available. This postulated HELB may affect valve 3HP-410 (bypass valve for valve 3HP-26) and prevent 3HP-410 from opening. However, valve 3HP-410 would not be used to re-establish charging flow and loss of function of this valve is of no consequence.

As a result of this HELB on the Charging Line at Penetration #9, the EPR would flood to above the FOD curb in approximately 10.6 minutes (Reference 10.2.24), if the break had not been isolated. At this time water from the LDST and possibly the BWST would begin to flow out of the Auxiliary Building. The radiological consequences of the flooding would be bounded by the Letdown Line Break, because of the much smaller source term.

Following the isolation of the charging line break by using valve 3HP-120 or a manually operated valve on the HPI discharge piping outside of the break area, unit shutdown would be conducted. Any flooding in the EPR could then be drained to the Low Activity Waste Tank, and RCP Seal Injection can be reestablished. All of the identified Shutdown Systems would be available to support the unit shutdown. Shutdown from the Initial Plant Conditions to the Cold Shutdown Condition can be achieved.

There is one other postulated HPI HELB in the EPR. There is a postulated TE break at the Letdown Line Containment Penetration #6. This break does not interact with any other SSD equipment, but the detection and isolation of the Letdown Line is important, since the isolation of the Letdown Line would eliminate the loss of RCS inventory.

Upon rupture of the Letdown Line, the flow from the break will enter the EPR. The Letdown Line break flow will flash to steam. The EPR blowout panels were postulated to fail, so that a conservative offsite dose would be calculated (Reference 10.2.26). The Letdown Line break results in a relatively fast depressurization of the RCS as primary inventory is lost through the break (See Section 7.3 of this report). With the RCS pressure decreasing, a reactor trip is initiated on either the low RCS pressure or on variable low pressure trip function. The continued RCS pressure reduction results in the RCS pressure dropping to the Engineered Safeguards actuation point. The Engineered Safeguards System actuation isolates the break by closing valves 3HP-3 (3A Letdown Cooler Outlet & Containment Isolation Valve) and 3HP-4 (3B Letdown Cooler Outlet & Containment Isolation Valve). If the Single Active Failure is either a 3HP-3 or 3HP-4 failure to close, procedures are provided to have valves 3HP-1 (3A Letdown Cooler Inlet Isolation Valve) and 3HP-2 (3B Letdown Cooler Inlet Isolation Valve) closed to isolate the break. The procedures are updated to assure that if an SAF of either 3HP-3 or 3HP-4 occurs, isolation by closing 3HP-1 and 3HP-2 is conducted prior to exceeding offsite or Control Room dose limits (References 10.2.25 & 10.2.26). Following the isolation of the Letdown Line, unit shutdown would be conducted with the normal Shutdown Systems available. Shutdown from the Initial Plant Conditions to the Cold Shutdown Condition can be achieved (See Section 7.3 of this report).

6.2.1.1.2 Feedwater System

Both the 3A and the 3B Main Feedwater lines pass through the EPR. Each Main Feedwater line contains an isolation check valve. The purpose of the check valve is to provide SG pressure boundary integrity for breaks upstream of the isolation check valve. Should a break occur downstream of the feedwater isolation check valve (i.e., between the check valve and the SG), the plant response would be similar to a loss of Main Feedwater event (Reference 10.2.27) except one SG will not have an intact pressure boundary. Should a break occur upstream of the feedwater isolation check valve, the check valve will close to prevent the blowdown of the SG. Both SGs will have intact pressure boundaries. The plant response would be comparable to a loss of Main Feedwater event.

The only postulated break in the Main Feedwater piping inside the EPR is at the terminal end of each Main Feedwater pipe (identified as 3-FDW-027 and 3-FDW-028). A break at this location is downstream of the feedwater isolation check valve. The analysis of this break is similar to that of a loss of Main Feedwater event. The analysis for a feedwater line break at this location is described in OSC-7726 (Reference 10.2.27). The RPS would trip the reactor on high RCS pressure. The main turbine would trip causing the main turbine stop valves to close, separating the Main Steam lines such that only one SG would continue to blowdown. Main and Emergency Feedwater would be automatically terminated to the faulted SG by AFIS. RCS pressure will not decrease to the point where Engineered Safeguards System Digital Channels 1 and 2 would actuate the HPI System. However, the HPI System is credited for normal makeup and RCP seal injection. The HPI System may also be needed for core decay heat removal following a single active failure to the EFW flow control valve to the intact SG. A single active failure on the EFW flow control valve to the intact SG would result in a loss of secondary side decay heat removal. Operator actions would need to be taken to restore a source of feedwater to the intact SG. Either the PSW or the SSF Systems could be used as a source to provide secondary side cooling to the intact Steam Generator.

There is no damage from the direct effects (pipe whip and jet impingement) to systems, structures or components needed to mitigate the consequences of these breaks. Whip restraints have been installed at these postulated break locations to prevent pipe whip. Guard pipes have been installed around the break location to limit and direct break flow away from critical equipment inside the EPR (Reference 10.2.34). Blowout panels have been installed in exterior walls of the EPR that are designed to relieve steam from the Main Feedwater line breaks to outside. The blowout panels are designed to limit the pressure inside the penetration rooms to prevent structural failure due to compartmental pressurization. However, a number of unreinforced block walls are assumed to fail. Their failure would result in unacceptable flooding consequences for other areas in the Auxiliary Building. This adverse consequence has been addressed by plant modifications. A Flood Outlet Device has been installed inside the EPR to release water to outside to prevent flooding of critical electrical equipment inside the EPR. Flood barriers have been installed inside the EPR to address the failure of the unreinforced block walls. The flood barriers act to contain water inside the room so that it can be directed to the FOD and to limit the amount of water that could be released to other areas of the Auxiliary Building.

Adverse environmental conditions will be created inside the penetration room. The environmental profiles have been determined. The electrical equipment required during the Shutdown Sequence and located inside the penetration rooms, have been evaluated (Reference 10.2.17) to the calculated environmental conditions and have been found to be acceptable. In addition, the non-safety control systems that could be affected by the harsh environment inside the EPR have been evaluated and determined to have no significant impact to the safety analysis. The environmental effects created by either the Main Feedwater line breaks in Main Feedwater piping may lead to a loss of all pressurizer heaters with the exception of Bank 2 Groups B and C heaters. Bank 2 Group B heaters can be controlled from the plant Control Room. Both groups (B and C) can be controlled from the SSF Control Room (if control has been transferred to the SSF). If the heat loss from the pressurizer exceeds the capacity of the remaining group B heaters, a plant cooldown would be initiated from the plant Control Room.

"Critical Cracks" have been postulated on the "3B" Main Feedwater piping line inside of the EPR. These cracks are postulated both downstream and upstream of the Main Feedwater isolation check valves on the "3B" line. These cracks include:

- 3-FDW-055-CR ("3B" Line Upstream of the Isolation Check Valve)
- 3-FDW-056-CR ("3B" Line Upstream of the Isolation Check Valve)
- 3-FDW-062-CR ("3B" Line Downstream of the Isolation Check Valve)

Unlike the postulated Main Feedwater line breaks, guard pipes are not installed at these locations. Therefore, the effects of jet impingement require analysis.

The postulated crack 3-FDW-055-CR causes the loss of the Pressurizer heaters (except groups B and C). The crack interacts with valve 3BS-1. It is assumed that 3BS-1 may open resulting in the loss of BWST inventory through the open valve. The loss of BWST inventory can be mitigated by closing 3BS-3 or manually closing 3BS-1. This crack also interacts with 3CC-5 and 3HP-21. Closure of valves 3CC-5 results in loss of CC system cooling for the RCP seals, but seal cooling is still maintained with HPI Seal injection. The failure of 3HP-21 is of no consequence since it is not required for the shutdown sequence for this postulated Critical Crack. This crack also impacts the 3A LPI Flow transmitter as well as the 3A LPI cooler outlet temperature. The LPI system is not adversely affected by the loss of the Train "3A" flow indication or the cooler outlet temperature.

The postulated crack 3-FDW-056-CR causes a loss of the Reactor Coolant Pumps. The crack also impacts cabling to the "A" RPS Channel and the "A" ESG Analog Channel. The RPS channel trips which is its required state for this event. The ESG analog channel is assumed to be incapable of tripping. This results in a loss of redundancy to the ESG system. However, the system remains functional in a 2-out-of-2 logic. It should be noted that the ESG system is not required to mitigate the consequences of the break. Therefore, the loss of redundancy is considered to be acceptable. The crack also causes the following valves to fail – 3HP-5, 3HP-21, & 3LP-17. The failure of these HPI valves is of no consequence, since these valves are not required for the shutdown sequence for these postulated Critical Cracks. If valve 3LP-17 fails closed, due to an adverse cable interaction, this valve can be manually opened. With valve 3LP-17 open LPI train "A" is used for unit cooldown. If valve 3LP-17 cannot be manually opened or another SAF occurs on LPI Train "A," Train "B" is used for unit cooldown. This crack also impacts the "3B" LPI Cooler outlet temperature instrument. The LPI System is not adversely affected by the loss of the Train "3B" LPI Cooler outlet temperature instrument.

The postulated crack 3-FDW-062-CR causes a loss of the Reactor Coolant Pumps. In addition, the following valves are assumed to fail – 3HP-5 and 3HP-21. The failure of these valves is of no consequence, since these valves are not required for HPI operation during the Shutdown Sequence.

The environmental effects created by the postulated critical cracks are bounded by the postulated Main Feedwater line breaks.

6.2.1.1.3 Main Steam System

Only the 3A Main Steam Line passes through the EPR. The only postulated break in the Main Steam piping inside the EPR is at the terminal end of the 3A Main Steam pipe (identified as 3-MS-064). The analysis for a MSLB is described in UFSAR Section 15.13. The RPS would trip the reactor on low or variable low RCS pressure. The main turbine would trip causing the main turbine stop valves to close, separating the Main Steam lines such that only one SG would continue to blowdown. Main and Emergency Feedwater should be automatically terminated to the faulted SG by AFIS. However, if Feedwater flow continued to the faulted SG, the faulted SG would continue to depressurize the RCS to the point where Engineered Safeguards System Digital Channels 1 and 2 would actuate the HPI System. RCS pressure continues to decrease to the point where the CF tanks automatically inject borated water into the RCS. RCS pressure may decrease to the point where Engineered Safeguards System Digital Channels 3 and 4 actuate the LPI System. However, the LPI System is not credited in the mitigation of a MSLB.

There is no damage from the direct effects (pipe whip and jet impingement) to systems, structures or components needed to mitigate the consequences of these breaks. Blowout panels have been installed in exterior walls of the EPR that are designed to relieve steam from a Main Steam line break to outside. The blowout panels are designed to limit the pressure inside the EPR & WPR to prevent structural failure.

Adverse environmental conditions will be created inside the EPR. The environmental profiles have been determined. The electrical equipment required during the Shutdown Sequence, located inside the penetration rooms have been evaluated (Calculation OSC-8505, Reference 10.2.17) to the calculated environmental conditions and have been found to be acceptable. In addition, the non-safety control systems that could be affected by the harsh environment inside the penetration room have been evaluated and determined to have no significant impact to the safety analysis.

The environmental effects created by the Main Steam line break may lead to a loss of all pressurizer heaters with the exception of Bank 2 Groups B and C heaters. Bank 2 Group B heaters can be controlled from the plant Control Room. Both groups (B and C) can be controlled from the SSF Control Room (if control has been transferred to the SSF). If the heat loss from the pressurizer exceeds the capacity of the remaining group B heaters, a plant cooldown would be initiated from the Unit 3 Control Room

6.2.1.1.4 Plant Heating System

There are two (2) Plant Heating (PH) System lines in the Unit 3 EPR. These include:

- The 4" piping line to the Unit 3 Reactor Building Purge Heater Unit
- The 3" piping line to Air Handling Units AHU 3-9 & AHU 3-10

The piping line to the Unit 3 Reactor Building Purge Heater unit does not require HELB interaction analysis. This section of piping is isolated in the Turbine Building at valve 3AS-182 during Normal Plant Conditions. Hence, HELBs are not required to be postulated on this PH System piping line in the EPR. The other PH System line (Running Break 3-PH-066-R) has no direct interactions with the Shutdown Equipment in the EPR (References 10.2.53 & 10.2.55), and any indirect interactions are enveloped by the physical conditions created by the postulated MS and MFDW System HELBs in the EPR.

6.2.1.2 HELB Interactions in the West Penetration Room

The information in this section describes the HELBs that affect the Shutdown Equipment in the West Penetration Room and the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these HELBs. The information is separated by HE System with a write up for each system. The only HE Systems in the West Penetration Room are the HPI System and the Plant Heating System.

6.2.1.2.1 High Pressure Injection System

There are two (2) postulated HELBs in the West Penetration Room. These two (2) breaks are the TE breaks on the RCP Seal Injection Lines at Containment Penetrations # 10A & #10B (3-HPI-004 & 3-HPI-005, respectively). The detection, isolation, and Unit shutdown for an RCP Seal Injection line break in the WPR would be the same as that for a RCP Seal Injection line break in the EPR with one difference. Because of the smaller size of the WPR, the flooding of the WPR would not have the same scenario. The WPR has an emergency exit door and stairwell, which leads to the outside of the Auxiliary Building. Immediately in front of the door is a 5.75 inch flood barrier that would retain any flood water in the WPR as long as the level did not exceed 5.75 inches. Based upon the postulated HELBs in the WPR the flooding would start to enter the stairwell approximately 1 hour and 4 minutes after the initiation of the HELB (Reference 10.2.24). This is sufficient time to isolate the HELB.

Upon isolation of the break, the WPR could be drained to the LPI Room 82 Sump Pumps A & B and then pumped to the Unit 3 High Activity Waste Tank. The ruptured RCP Seal Injection line would be isolated from the rest of the HPI System. Seal injection flow could then be restored to the other three seal injection lines. Unit shutdown would be conducted with all the identified Shutdown Systems available without impact to these Shutdown Systems. Shutdown from the Initial Plant Conditions to the Cold Shutdown Condition can be achieved.

6.2.1.2.2 Plant Heating System

The 4" Plant Heating System HE piping in the WPR is excluded from analysis. The section of piping is isolated in the Turbine Building at valve 3AS-182 during Normal Plant Conditions. Hence, HELBs are not required to be postulated on the Plant Heating System piping lines in the WPR.

6.2.1.3 HELB Interactions in the HPI Pump Room

The information in this section describes the postulated HELBs that affect the Shutdown Equipment in the HPI Pump Room and the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these HELBs. The only HE System in the HPI Pump Room is HPI System itself, and only HPI System High Energy Lines are in the HPI Pump Room. No discussion is required for any other system.

There are four (4) postulated HPI HELBs in the HPI Pump Room. These HELBs include the Terminal end breaks on the HPI Pump discharge Nozzles (3-HPI-001 & 3-HPI-002) and the breaks on the mini-flow recirculation line for HPI Pumps 3A & 3B (3-HPI-015-R & 3-HPI-016-R). For these four (4) postulated HELBs the other HPI Pumps and their throttling valves are not impacted by pipe whips or jet impingements. As such, the redundancy in the HPI System is not lost. Hence, there is no loss in the capability to achieve a Safe Shutdown condition or to have Unit 3 achieve the Cold Shutdown Condition. The only adverse interaction from these breaks is the flooding in the HPI Pump Room. A discussion of this interaction follows.

For a postulated HELB at the discharge nozzle of the HPI Pump, the immediate response is the loss of charging flow and the auto-start of a second HPI Pump. Upon the start of the second HPI Pump, the charging flow would be restored to the RCS. The HPI Pump, on which the HELB is postulated, would immediately increase flow to its full run out flow at the cavitation condition. At this flow rate the minimum time to flood the HPI Pump Room to an unacceptable level is 39 minutes (Reference 10.2.21). However, there is sufficient time to identify the HPI Pump that is operating at run out conditions and trip that HPI Pump. At these run out conditions the flow is approximately 650 gpm, and once tripped, the flooding rate is reduced to approximately 35 gpm (Reference 10.2.21). This reduction would give plant personnel sufficient time to isolate the break.

The postulated HELB at the discharge nozzle of an operating HPI Pump can be quickly detected and diagnosed. There would be alarms related to low HPI header pressure, low flow in the RCP Seal Injection Lines, a low level alarm for the LDST (Reference 10.3.20), and an alarm when HPI suction is automatically transferred to the BWST. Moreover, the Control Room indication would show two (2) HPI Pumps operating. The HPI Pump, on which the HELB occurred, would be the pump in the "ON" position, and this pump would be manually tripped. The HPI Pump that automatically started on loss of charging flow would have its control switch in the "AUTO" position. Thus, the operator would know which pump to trip (Reference 10.3.32).

Once the break location has been identified, the affected HPI Pump would be tripped by the operator. If the HPI Pump 3A had the postulated HELB, the HELB would be isolated by closing valve 3HP-103 (3A HPI Pump Suction Valve). If the break is postulated on the 3B HPI Pump, the break would be isolated by closing valve 3HP-107 (3B HPI Pump Suction Valve). Closure of the suction valve on the affected HPI Pump suction piping line is necessary to allow the LDST to stay aligned to the HPI Pump suction piping, and thus, prevents an overflow of the LDST inventory. If the SAF is either 3HP-103 or 3HP-107, a second valve is provided in series with these valves on the HPI Pump suction line. With this planned modification, described in Section 9.0 of this report, the operators can isolate the break with redundant isolation valves that do not require entry into the HPI Pump Room. By isolating the postulated HELB with the HPI Pump suction valve, both of the remaining HPI Pumps are available to supply charging flow and RCP Seal injection flow. In addition, any SAF of an HPI MOV on the HPI Pump suction piping would not adversely affect the isolation of the postulated HELB or the ability to provide borated water from either the LDST or the BWST to either of the remaining HPI Pumps.

Once the postulated HPI Pump discharge nozzle break is isolated, the other two (2) HPI Pumps and either charging line would be available to support the achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition. Likewise, RCP Seal injection could be accomplished from either of the available HPI Pumps. With no other Shutdown Systems or Components targeted, the shutdown of the unit could proceed to a Safe Shutdown condition and to the Cold Shutdown Condition.

The postulated HELBs on the HPI Pump mini-flow lines are Running Breaks with multiple break locations postulated on both mini-flow lines. Each mini-flow piping line has a pair of in-series, restricting orifices that reduce the internal pressure in the mini-flow line to the fluid pressure in the RCP Seal Return piping lines. Any postulated individual HELBs downstream of both of the restricting orifices are excluded because this section of piping does not meet the HE piping definition during Normal Plant Conditions. The remaining postulated HELBs on the mini-flow lines do not target any SSD equipment, but these postulated HELBs would be a potential flooding hazard in the HPI Pump Room.

For a (non-excluded) postulated HELB on either of the HPI Pump mini-flow lines, the detection of this postulated HELB would be very similar to a postulated break at the HPI Pump discharge nozzle. These postulated mini-flow line breaks would cause low HPI header pressure, low RCP Seal Injection flow, and the auto-start of a second HPI Pump. Isolation would be the same as for the HPI Pump discharge nozzle break, and the previously postulated SAFs would be mitigated in the same way. With no other Shutdown Systems or Components targeted, the unit can achieve and maintain the Safe Shutdown condition and could, subsequently, proceed to the Cold Shutdown Condition.

6.2.1.4 HELB Interactions in Miscellaneous Rooms in the Auxiliary Building

Within the Unit 3 Auxiliary Building there are some additional rooms, which contain HE piping lines. These rooms include:

- Room 565 – Ventilation Equipment Room
- Room 651 – Control Room A/C Units Room
- Room 453 – Lobby
- Room 454A – Stairs
- Room 455 – Ventilation Equipment Room
- Room 455B – Vestibule
- Room 666 – Purge exhaust Equipment Room
- Rooms 655 (Lobby), 657 (Clean Locker Room), 658 (Closet), 659 (Drying Room), & 660 (Contaminated Shower Room)
- Room 669 – (Reactor Building) Purge Heater Room

An evaluation of each room follows.

Room 565 – Ventilation equipment Room

The PH System HE pipe is routed directly from the Turbine Building into Room 565. The HE piping in this room consists of the 6" Plant Heating system pipe that supplies steam to the Air Handling Units 3-7 & 3-8 (AHU 3-7 & AHU 3-8). There is also a 3" PH System piping line that tees from this 6" line and is routed into the EPR. There are no direct interactions with the Safe Shutdown pipe (Emergency Feedwater) in the room (References 10.2.52 & 10.2.53). The indirect effects of any postulated PH System HELB in this room cannot adversely affect this pipe because it is a passive component. Flooding, compartmental pressurization, or environmental effects could not damage this pipe.

The compartmental pressurization of Room 565 would not cause an adverse condition. The floor and ceiling of the room are reinforced concrete slabs. The walls to this room are unreinforced block or brick walls. The only wall, whose failure could adversely impact any Shutdown Equipment, is the west wall (along Column P). However, transient analysis performed for Room 565 shows that the peak pressure created by a postulated PH System HELB will not cause the west wall to fail (References 10.2.50 & 10.2.51). The failure of any other wall and the associated indirect HELB effects do not prevent achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition (Reference 10.2.50).

Hence, it can be concluded that for any postulated HELB on the PH System pipe in Room 565 a pathway for achieving and maintaining a Safe Shutdown condition and the subsequent cooldown to the Cold Shutdown Condition exists.

Room 651 – Control Room A/C Units Room

Room 651 shares a compartment in the Auxiliary Building with Room 650 & Room 653. Hence, any postulated HELB in Room 651 also could affect equipment in the other rooms within the compartment.

The only HE piping in Room 651 is a 3" Plant Heating System piping line. The postulated PH System HELBs in the room do not cause any direct HELB interactions (References 10.2.53 & 10.2.55). There would be no flooding in the compartment due to the large volume and numerous doors and exits to the room. No appreciable compartmental pressurization effects are expected due to the relatively low pressure in the PH System and the small line size. In addition, this compartment is not an air-tight structure. There are numerous pathways for the steam to be released from the room.

The electrical equipment located inside of the compartment has not been qualified for operation in a steam – air environment. It is assumed that the electrical equipment located in this room would be lost due to environmental effects. The air handling units serving the Unit 3 control room are located in this compartment. As a result, all ventilation for Unit 3 Control Room is assumed to be lost. The loss of the Control Room Ventilation System does not result in a loss of the habitability of the Control Room. However, damage repair procedures would need to be implemented to restore cooling to the Control Room for long term habitability (See section 3.8.1 of this report).

Rooms 453 (Lobby), 454A (Stairs), & 455 (Ventilation Equipment Room)

The 24" Main Feedwater pipe to Steam Generator 3B passes through Rooms 453 & 454A. There are no postulated HELBs or Critical Crack locations on the Main Feedwater pipes in these rooms and hence no direct or indirect HELB interactions (References 10.2.52 & 10.2.53).

Room 455 & Room 455B

The 24" Main Feedwater pipe to Steam Generator 3A passes through the Ventilation Equipment Room 455. There are no postulated HELBs or Critical Crack locations on the Main Feedwater pipes in these rooms and hence no direct or indirect HELB interactions (References 10.2.52 & 10.2.53), resulting from the Main Feedwater pipe.

There is, however, an indirect HELB that affects both of these rooms. Postulated HELBs, 3-MS-066-R-1 and 3-MS-067-R-1, in the Turbine Building may cause the loss of the block wall along

Row N, which is also the wall between the Turbine and Auxiliary Buildings. These postulated HELBs and the failure of the wall do not result in any direct impacts on Shutdown Equipment in the Auxiliary Building (References 10.2.53 & 10.2.59) and do not create a flood or compartmental pressurization in the rooms. The failure of the wall will assure that either room cannot pressurize or allow water to build up in the room. Any steam entering adjacent Room 458 would not adversely affect the batteries for the Unit 3 125 VDC Vital Instrumentation and Control Power System. An analogous condition exists for Room 408B, and the evaluation for Room 408B would also apply to these rooms (See section 5.2.14 of this report). Hence, it may be concluded that these postulated HELBs do not adversely affect Shutdown Equipment in the Auxiliary Building.

Room 666 – Purge Exhaust Equipment Room

The only HE piping in the Purge Exhaust Equipment Room 666 is the 3" Plant Heating System pipe to air handling units AHU 3-9 & AHU 3-10. However, there is no Shutdown Equipment in this Room, and hence, no direct or indirect HELB interactions (References 10.2.4, 10.2.53 & 10.2.55).

Rooms 655 (Lobby), 657 (Clean Locker Room), 658 (Closet), 659 (Drying Room), & 660 (Contaminated Shower Room)

The only HE piping in these rooms is the 3" Plant Heating System pipe to air handling units AHU 3-9 & AHU 3-10. However, there is no Shutdown Equipment in this Room, and hence, no direct or indirect HELB interactions (References 10.2.4, 10.2.53 & 10.2.55).

Room 669 – (Reactor Building) Purge Heater Room

The only HE piping in room 669 is the 4" Plant Heating System HE piping. This section of piping is isolated in the Turbine building at valve 3AS-182 during Normal Plant Conditions. Hence, HELBs are not required to be postulated on the PH System piping in room 669.

6.2.1.5 HELB Interactions in the Station Yard

The only HE piping in the Unit 3 section of the Station Yard is the Unit 3 Main Steam Lines and a portion of the 12" Auxiliary Steam System header. There are no Shutdown Systems or Components in the Station Yard. A postulated MS line break at this location would result in an unisolable break in one of the MS lines. Because there is no Shutdown Equipment in the station yard, there are no direct or indirect HELB interactions. The sequence used to shutdown the unit would be the same as that provided in UFSAR Section 15.13 for a single MSLB. The sequence used to shutdown the unit for a postulated HELB on the Auxiliary Steam System would be the same as that provided in Section 6.2.2.1 for an AS System postulated HELB that does not target any Shutdown Equipment.

6.2.2 HELB Interactions in the Turbine Building

Most of the postulated HELBs at the ONS would occur in the Turbine Building. As such, a detailed discussion of the interactions and pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition is provided for all of the HE

Systems, except the HPI System. The HE piping associated with the HPI System is not located in the Turbine Building, and no further discussion is required.

6.2.2.1 Auxiliary Steam System

Some of the break locations on the Unit 3 AS System in the Turbine Building were identified as targeting no Shutdown Equipment. For these breaks the pathway to a Safe Shutdown condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to ~250°F RCS temperature. Moreover, the SSF-ASW and PSW Systems could also be used to support the cool down the Unit to ~250°F RCS temperature condition and maintain ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

Table 6.2-1 lists the Unit 3 individual breaks and the damage to the station SSD equipment and/or station structures. Some of the individual break locations with identified damage will target some Shutdown Equipment. However, these interactions do not prevent the Unit from proceeding to the Cold Shutdown Condition because only a small number of Shutdown Components were adversely affected by the postulated HELB. The pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these breaks would be similar to the methodology described for the non-interacting HELBs above.

Some of the breaks in the AS system target cabling associated with the emergency power distribution system. The bounding postulated interactions could result in the loss of the Startup Transformer CT3 and both Unit 3 Main Feeder Buses. The result would be a loss of all AC power on Unit 3. The Unit 3 TDEFWP is postulated to fail due to other cable interactions. The loss of all AC power results in a loss of HPI, EFW, LPI, and LPSW functions. Safe shutdown can be established and maintained using the PSW and HPI (powered from PSW) systems. An alternate means of safe shutdown is the SSF. The PSW and HPI systems would be utilized to cool down to LPI entry conditions. Damage repair procedures are utilized to restore power to one LPI pump and one LPSW pump for Unit 3. If PSW/HPI is unavailable and the SSF is being used to maintain safe shutdown, damage repair procedures are utilized to restore power to one HPI pump in addition to the LPSW and LPI pumps prior to initiating a cooldown. As previously discussed, the LPI and LPSW Systems are credited for achieving the Cold Shutdown Condition.

Some breaks in the AS System can create small steam line breaks inside the Turbine Building, due to pipe whips. In addition, direct effects to non-safety control systems that impact the TBVs and the MS to SSRHs could lead to blowdown of both SGs. The postulated small steam line breaks, as well as, the failures in the non-safety control systems for the TBVs and SSRHs would normally be isolated by a single MS branch line isolation valve. However, the power supply and/or controls to these valves may be impacted by the same break. The MSIV in each MS line could be closed to isolate both MS lines from the affected branch lines. The functions performed by HPI, EFW, LPI, and LPSW are not impacted by the direct interactions from these postulated breaks in the AS system and are assumed to remain available.

Some breaks in the AS System can result in a loss of Unit 3 EFW. EFW function would normally be met by manual valve alignment to cross-connect EFW between units. However, certain postulated breaks in the AS system may result in a rupture of the 3A EFW header, rendering the cross-connection between units unavailable. The PSW or SSF-ASW systems would be credited to perform the EFW function for Unit 3.

Some breaks in the AS System can result in a rupture of a SSW header. A rupture in a SSW header may result in a loss of cooling to all three units CCW pumps requiring the pumps to be stopped. In addition, the loss of SSW would result in a loss of essential siphon vacuum (ESV) system. Emergency CCW siphon flow cannot be assured without the ESV system. The LPSW System is assumed to be unavailable should forced CCW flow and emergency siphon flow be lost. The loss of LPSW is assumed to result in the loss of HPI function. The loss of LPSW also results in a loss of the Unit 3 MDEFWPs. EFW function is met by the operation of the TDEFWPs on each unit. The PSW System is credited to provide cooling water to the HPI pumps and to provide a backup to the TDEFWP. If the PSW System is not available, the SSF would be credited to maintain a Safe Shutdown condition. Damage repair procedures are credited to provide an alternate means of cooling to a CCW pump to allow its restart and thus restoration of LPSW function for plant cooldown and the establishment of the Cold Shutdown Condition.

A potential indirect HELB interaction caused by the Unit 3 Auxiliary Steam System postulated HELBs is the loss of the Unit 3 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated AS System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF System is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

The postulated AS System HELBs in the Turbine Building would not affect the Shutdown Equipment in the Auxiliary Building or Control Room Habitability. None of the postulated AS System HELBs could cause a Turbine Building flood, and no HELBs on the AS System cause any collateral damage.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated Auxiliary Steam System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1. The potential flooding in the Turbine Building from postulated Auxiliary Steam System HELBs has been previously discussed.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated AS System HELBs. However, as previously discussed (Refer to Section 3.8.1) alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost.

The Containment Boundary is unaffected by the postulated AS System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

6.2.2.2 Condensate System

All of the non-excluded individual break locations on the Unit 3 Condensate System are located in the Turbine Building. Most of these postulated breaks were identified as targeting no Shutdown Equipment. However, it should be noted that these breaks do result in a "Loss of Main Feedwater" event. The RPS is expected to trip the reactor on high RCS pressure and trip the main turbine which closes the main turbine stop valves to prevent overcooling. The pressurizer code safety valves will lift to relieve excess RCS pressure until a source of feedwater can be reestablished to the SG. The EFW System is expected to automatically start following the loss of Main Feedwater, but its operation is impacted by the breaks. The Condensate System line breaks also deplete the condensate inventory stored in the Hotwell. The only condensate inventory credited for the affected unit's EFW is the minimum inventory stored in the UST (30,000 gallons), without any additional interactions being considered. Some interactions resulting from these postulated HELBs will result in the complete loss of Unit 3 EFW. Feedwater to the SGs would rely upon EFW from an alternate unit (if the cross-connect is available), the new PSW System, or the SSF-ASW System. For these postulated breaks the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition would be to use the PSW & SSF Systems. The PSW System would be the primary means for achieving a Safe Shutdown condition and cooling down the Unit to ~250 °F. The SSF System would serve as a back-up to achieving and maintaining a Safe Shutdown condition. The SSF System alone cannot accommodate a plant cooldown. Other equipment would need to be restored using damage repair procedures to accommodate a plant cooldown to ~250 °F. This condition would have to be maintained for an extended period of time until the LPSW and LPI Systems are restored to an operational status (References 10.3.21 – 10.3.25) and the Unit could proceed to the Cold Shutdown Condition.

Any postulated HELB on the Unit 3 Condensate System with an interaction with Shutdown Equipment is listed in Table 6.2-2. Some of the postulated break locations in the table identify no damage to Shutdown Equipment. The pathway to a Safe Shutdown condition for these breaks would be the same as for the breaks with no targets. The remaining break locations target Shutdown Equipment. However, these interactions do not prevent the unit from proceeding to the Cold Shutdown Condition because only a small number of Shutdown Components were adversely affected by the postulated HELBs. The pathway to a Safe Shutdown condition for these breaks would be similar to the methodology described for breaks with no targets.

Some of the breaks in the Condensate System target cabling associated with the emergency power distribution system. The bounding postulated interactions could result in the loss of the Startup Transformer CT3 as well as the loss of both Unit 3 Main Feeder Buses. The result would be a loss of all AC power to Unit 3. The Unit 3 TDEFWP is postulated to fail due to other cable interactions. In addition, a pipe rupture may occur in an 8-inch 3A MS line. The closure of the MSIV on the affected MS line would be credited to isolate the MS line break. Safe shutdown can be established and maintained using the PSW and HPI (powered from PSW) systems. An alternate means of safe shutdown is the SSF. The safety consequences on the RCS due to an uncontrolled blowdown of a SG are addressed in Section 7.1 of this report. The PSW and HPI systems would be utilized to cool the unit(s) down to LPI entry conditions. Damage repair procedures are utilized to restore power to one LPI pump and one LPSW pump for Unit 3. If PSW/HPI is unavailable and the SSF is being used to maintain safe shutdown, damage repair procedures are utilized to restore power to one HPI pump in addition to the LPSW and LPI pumps prior to initiating a cooldown. As previously discussed, the LPI and LPSW Systems are credited for achieving the Cold Shutdown Condition.

Some breaks in the Condensate System can create small steam line breaks on both main steam headers inside the Turbine Building, due to pipe whips. This could lead to blowdown of both SGs. The postulated small steam line breaks would normally be isolated by a single MS branch line isolation valve. However, the power supply and/or controls to these valves may be impacted by the same break. The MSIV in each MS line could be closed to isolate both MS lines from the affected branch lines. The functions performed by HPI, LPI, and LPSW are not impacted by the direct interactions from these postulated breaks in the Condensate system and are assumed to remain available. The EFW system remains available for initial event mitigation with inventory available from the UST.

Several interactions from condensate line breaks were identified with the SSW header. A rupture in the SSW header may result in a loss of cooling to all three units CCW pumps requiring the pumps to be stopped. In addition, the loss of SSW would result in a loss of essential siphon vacuum (ESV) system. Emergency CCW siphon flow cannot be assured without the ESV system. The LPSW System is assumed to be unavailable should forced CCW flow and emergency siphon flow be lost. The loss of LPSW is assumed to result in the loss of HPI function. The loss of LPSW also results in a loss of the Unit 3 MDEFWPs. EFW function is met by the operation of the TDEFWPs. The Unit 3 TDEFWP is postulated to fail due to other cable interactions; however, EFW is available via the unit cross-connects. In addition, direct effects to non-safety control systems that impact the TBVs and the MS to SSRHs could lead to blowdown of both SGs. The failures in the non-safety control systems for the TBVs and SSRHs would normally be isolated by a single MS branch line isolation valve. However, the power supply and/or controls to these valves may be impacted by the same break. The MSIV in each MS line could be closed to isolate both MS lines from the affected branch lines. The PSW System is credited to provide cooling water to the HPI pumps and to provide a backup to the EFW system. If the PSW System is not available, the SSF would be credited to maintain safe shutdown. Damage repair procedures are credited to provide an alternate means of cooling to a CCW pump to allow its restart and thus restoration of LPSW function for plant cooldown and the establishment of the Cold Shutdown Condition.

Postulated HELBs on the Unit 3 Condensate System can result in Turbine Building flooding. The Condensate System postulated HELBs are, in and of themselves, not the source of Turbine Building flooding due to the limited condensate inventory. However, interactions with CCW and LPSW piping can create a source for Turbine Building flooding. Flood protection measures have been incorporated into the design of the Turbine Building. These measures protect equipment located inside the Auxiliary Building from Turbine Building flooding because these postulated HELBs, causing flooding inside the Turbine Building, can be mitigated with equipment located inside the Auxiliary Building. None of the postulated Condensate System HELBs could cause a Turbine

Building flood that could exceed the Auxiliary Building flood barrier height limit of 20 feet (References 10.2.22 & 10.2.33). The PSW System would be credited for achieving and maintaining a Safe Shutdown condition. The SSF System would be credited as the backup method for achieving and maintaining a Safe Shutdown condition. The PSW System would be required for plant cooldown.

To achieve the Cold Shutdown Condition the source of the TB flooding would need to be isolated. The CCW Inlet Piping can be isolated by closure of the CCW Pump discharge valves (xCCW-10, xCCW-11,xCCW-12, & xCCW-13) in each unit. A single active failure of any of these valves to close would not result in an unacceptable flood height in the Turbine Building. This is because the flow rate out of the Turbine Building through the Turbine Building Drain will exceed the flooding rate prior to the flood height reaching the 20 foot in the Turbine Building Basement (References 10.2.22 & 10.2.33). If it is not possible to close the failed valve locally, the lake level needs to be lowered to below the 796' Elevation to isolate the inlet flow (References 10.2.36 & 10.2.37). The reverse flow from the CCW discharge piping would be isolated by dropping the CCW Discharge Gates or lowering the lake level below ~ 791' Elevation. Damage repair procedures (References 10.3.21 – 10.3.25) would be utilized to restore CCW and LPSW to an operational status once the TB basement has been drained.

A potential indirect HELB interaction caused by the Condensate System is the loss of the Unit 3 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF System is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated Condensate System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1. The potential flooding in the Turbine Building from postulated Condensate System HELBs has been previously discussed.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated Condensate System HELBs. However, as previously discussed (Refer to Section 3.8.1) alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost.

The Containment Boundary is unaffected by the postulated Condensate System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

6.2.2.3 Extraction Steam System

All of the non-excluded individual break locations on the Unit 3 ES System are located in the Turbine Building. Many of these individual breaks were identified as targeting no Shutdown Equipment. For these postulated HELBs, the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to approximately the 250°F RCS temperature. Moreover, the SSF-ASW and PSW Systems could also be used to support the cool down of the Unit to approximately the 250°F RCS temperature condition and maintain the ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

Any postulated HELB on the Unit 3 ES System with an interaction with Shutdown Equipment is listed in Table 6.2-3. Some of the break locations in the table identify no damage. The pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these breaks would be the same as for the breaks with no targets described in the previous paragraph.

Some of the breaks in the Extraction Steam System target cabling associated with the emergency power distribution system. The bounding postulated interactions could result in the loss of both Unit 3 Main Feeder Buses. The result would be a loss of 4160VAC power to Unit 3. Safe shutdown can be established and maintained using the PSW and HPI systems. An alternate means of safe shutdown is the SSF. Main Steam pressure boundary control is established by the closure of the MSIVs should the MS branch lines open or remain open (TBVs, MS to SSRHs, and MS to AS) following the loss of AC power. The PSW and HPI systems would be utilized to cool the unit(s) down to LPI entry conditions. If PSW/HPI is unavailable and the SSF is being used to maintain safe shutdown, damage repair procedures are utilized to restore power to one HPI pump, one LPI pump, one LPSW pump for Unit 3 prior to initiating a cooldown. As previously discussed, the LPI and LPSW Systems are credited for achieving the Cold Shutdown Condition.

Some breaks in the Extraction Steam System can create small steam line breaks on the class F and class G portions of the MS system inside the Turbine Building, due to pipe whips. In addition, direct effects to non-safety control systems that impact the TBVs and the MS to SSRHs could lead to blowdown of both SGs. Some of the small steam line breaks occur on or before the MS branch line isolation valves. Other postulated small steam line breaks, as well as, the failures in the non-safety control systems for the TBVs and SSRHs would normally be isolated by a single MS branch line isolation valve. However, the power supply and/or controls to these valves may be impacted by the same break. The MSIV in each MS line could be closed to isolate both MS lines from the affected branch lines. The functions performed by HPI, LPI, and LPSW are not impacted by the direct interactions from these postulated breaks in the Extraction system and are assumed to remain available. The Unit 3 EFW system, as well as the ability to cross-connect EFW from an alternate unit, may be lost. The PSW or the SSF-ASW systems would be credited to perform the EFW function.

Several interactions from Extraction Steam line breaks were identified with the SSW headers. A rupture in the SSW headers will result in a loss of cooling to all three units CCW pumps requiring the pumps to be stopped. In addition, the loss of SSW would result in a loss of essential siphon vacuum (ESV) system. Emergency CCW siphon flow cannot be assured without the ESV system. The LPSW System is assumed to be unavailable should forced CCW flow and emergency siphon flow be lost. The loss of LPSW is assumed to result in the loss of HPI function and loss of the Unit 3 MDEFWs. The Unit 3 EFW System will also be lost due to cable interactions with the TDEFWP and the loss of the cross-connect capability to an alternate unit's TDEFWP. The PSW System is credited to provide cooling water to the HPI pumps and to provide the EFW function for Unit 3. If the PSW System is not available, the SSF would be credited to maintain a Safe Shutdown condition. Damage repair procedures are credited to provide an alternate means of cooling to a CCW pump to allow its restart and thus restoration of LPSW function for plant cooldown and the establishment of the Cold Shutdown Condition.

Postulated HELBs on the Unit 3 Extraction Steam System can result in Turbine Building flooding. Interactions with CCW and LPSW piping can create a source for Turbine Building flooding. Flood protection measures have been incorporated into the design to protect equipment located inside the Auxiliary Building from flooding inside the Turbine Building, because these postulated HELBs causing flooding inside the Turbine Building can be mitigated with equipment located inside the Auxiliary Building. None of the postulated Extraction Steam System HELBs could cause a Turbine Building flood that could exceed the Auxiliary Building flood barrier height limit of 20 feet (References 10.2.22 & 10.2.33). The PSW System would be credited for achieving and maintaining a Safe Shutdown condition. The SSF System would be credited as the backup method for achieving and maintaining a Safe Shutdown condition. The PSW System would be required for plant cooldown.

To achieve the Cold Shutdown Condition the source of the TB flooding would need to be isolated. The CCW Inlet Piping can be isolated by closure of the CCW Pump discharge valves (xCCW-10, xCCW-11, xCCW-12, & xCCW-13) in each unit. A single active failure of any of these valves to close would not result in an unacceptable flood height in the Turbine Building. This is because the flow rate out of the Turbine Building through the Turbine Building Drain will exceed the flooding rate prior to the flood height reaching the 20 foot in the Turbine Building Basement (References 10.2.22 & 10.2.33). If it is not possible to close the failed valve locally, the lake level needs to be lowered to below the 796' Elevation to isolate the inlet flow (References 10.2.36 & 10.2.37). The reverse flow from the CCW discharge piping would be isolated by dropping the CCW Discharge Gates or lowering the lake level below ~ 791' Elevation. Damage repair procedures (References 10.3.21 – 10.3.25) would be utilized to restore CCW and LPSW to an operational status once the TB basement has been drained.

A potential indirect HELB interaction caused by the ES System is the loss of the Unit 3 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF System is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

The postulated ES System HELBs in the Turbine Building would not affect the Shutdown Equipment in the Auxiliary Building or Control Room Habitability. The potential flooding in the Turbine Building from postulated ES System HELBs has been previously discussed.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated Extraction Steam System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1. The potential flooding in the Turbine Building from postulated Extraction Steam System HELBs has been previously discussed.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated ES System HELBs. However, as previously discussed alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost (Refer to Section 3.8.1).

The Containment Boundary is unaffected by the postulated ES System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

6.2.2.4 Feedwater System

This section describes the consequences of postulated breaks of Main Feedwater piping located in the Turbine Building. Any postulated HELB on the Unit 3 MFDW System in the Turbine Building with an interaction with Shutdown Equipment is listed in Table 6.2-4. A number of breaks were excluded based on normal operating configuration. In addition, a number of Main Feedwater line breaks were found to have no Shutdown Equipment targets within the break zone of influence from pipe whip or jet impingement. However, it should be noted that these breaks result in a loss of Main Feedwater event. The RPS is expected to trip the reactor on high RCS pressure and trip the main turbine which closes the main turbine stop valves to prevent overcooling. The pressurizer code safety valves are credited to relieve excess RCS pressure until a source of feedwater can be reestablished to the SG (Reference 10.2.32). The EFW System is expected to automatically start following the loss of Main Feedwater, but its operation may be impacted by the breaks. The Main Feedwater line breaks also deplete the condensate inventory stored in the Hotwell. The only condensate inventory credited for the affected unit's EFW is the minimum inventory stored in the UST (30,000 gallons), without any additional interactions being considered. Some interactions resulting from FWLBs will result in the complete loss of Unit 3 EFW, as well as the EFW cross-connect piping to other units. If the HPI system is available, HPI forced cooling could be utilized to provide decay heat removal until a source of feedwater can be established to the SG(s). Feedwater to the SGs relies upon EFW from an alternate unit (if the cross-connect is available), the new PSW System, or the SSF-ASW System.

For these postulated breaks the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition would be to use the PSW & SSF Systems. The PSW System would be the primary means for achieving a Safe Shutdown condition and cooling down the Unit to ~250°F. The SSF System would serve as a back-up to achieving and maintaining a Safe Shutdown condition. The SSF System alone cannot accommodate a plant cooldown. Other equipment would need to be restored using damage repair procedures to accommodate a plant cooldown to ~250°F. This condition would have to be maintained for an extended period of time until the LPSW and LPI Systems are restored to an operational status (References 10.3.21 – 10.3.25) and the Unit could proceed to the Cold Shutdown Condition.

Some of the breaks in the Main MFDW System target cabling associated with the emergency power distribution system. The bounding postulated interactions could result in the loss of the Startup Transformer CT3 as well as the loss of both Unit 3 Main Feeder Buses. The result would be a loss of all AC power to Unit 3. The Unit 3 TDEFWP is postulated to fail due to other cable interactions. Ruptures may occur in LPSW and CCW piping resulting in flooding of the Turbine Building. The loss of all AC power results in a loss of HPI, EFW, LPI, and LPSW functions. Safe shutdown can be established and maintained using the PSW and HPI systems. An alternate means of safe shutdown is the SSF. The PSW and HPI systems would be utilized to cool the unit(s) down to LPI entry conditions. Damage repair procedures are utilized to restore power to one LPI pump, one LPSW pump for Unit 3. LPSW motor replacement may also be necessary due to the consequences of turbine building flooding. CCW/LPSW pipe breaks would need to be isolated or repaired prior to returning those systems to service. If PSW/HPI is unavailable and the SSF is being used to maintain safe shutdown, damage repair procedures are utilized to restore power to one HPI pump in addition to the LPSW and LPI pumps prior to initiating a cooldown. As previously discussed, the LPI and LPSW Systems are credited for achieving the Cold Shutdown Condition.

Some breaks in the Main MFDW System can create small steam line breaks inside the Turbine Building, due to pipe whips. In addition, direct effects to non-safety control systems that impact the TBVs and the MS to SSRHs could lead to blowdown of both SGs. The postulated small steam line breaks, as well as, the failures in the non-safety control systems for the TBVs and SSRHs would normally be isolated by a single MS branch line isolation valve. However, the power supply and/or controls to these valves may be impacted by the same break. The MSIV in each MS line could be closed to isolate both MS lines from the affected branch lines. The functions performed by HPI, LPI, and LPSW are not impacted by the direct interactions from these postulated breaks in the MFDW system and are assumed to remain available. EFW may be lost on Unit 3. However, the EFW cross-connects from another unit remains available. In addition, the PSW or SSF-ASW systems could be used to provide the EFW function.

Several interactions from MFDW line breaks were identified with the SSW header. A rupture in the SSW header may result in a loss of cooling to all three units CCW pumps requiring the pumps to be stopped. In addition, the loss of SSW would result in a loss of essential siphon vacuum (ESV) system. Emergency CCW siphon flow cannot be assured without the ESV system. The LPSW

System is assumed to be unavailable should forced CCW flow and emergency siphon flow be lost. The loss of LPSW is assumed to result in the loss of HPI function. The loss of the LPSW System also results in the loss of the Unit 3 MDEFWPs. EFW function is met by the operation of the TDEFWPs on each unit. The PSW System is credited to provide cooling water to the HPI pumps and to provide a backup to the TDEFWP. If the PSW System is not available, the SSF would be credited to maintain safe shutdown. Damage repair procedures are credited to provide an alternate means of cooling to a CCW pump to allow its restart and thus restoration of LPSW function for plant cooldown and the establishment of the Cold Shutdown Condition.

FWLBs can result in Turbine Building flooding. The FWLBs, in and of themselves, are not the source of Turbine Building flooding due to the limited condensate inventory. However, interactions with CCW and LPSW piping can create a source for Turbine Building flooding. Flood protection measures have been incorporated into the design to protect equipment located inside the Auxiliary Building from flooding inside the Turbine Building, because these postulated HELBs causing flooding inside the Turbine Building can be mitigated with equipment located inside the Auxiliary Building. None of the postulated Main Feedwater System HELBs could cause a Turbine Building flood that could exceed the Auxiliary Building flood barrier height limit of 20 feet (References 10.2.22 & 10.2.33). The PSW System would be credited for achieving and maintaining a Safe Shutdown condition. The SSF System would be credited as the backup method for achieving and maintaining a Safe Shutdown condition. The PSW System would be required for plant cooldown.

To achieve the Cold Shutdown Condition the source of the TB flooding would need to be isolated. The CCW Inlet Piping can be isolated by closure of the CCW Pump discharge valves (xCCW-10, xCCW-11, xCCW-12, & xCCW-13) in each unit. A single active failure of any of these valves to close would not result in an unacceptable flood height in the Turbine Building. This is because the flow rate out of the Turbine Building through the Turbine Building Drain will exceed the flooding rate prior to the flood height reaching the 20 foot in the Turbine Building Basement (References 10.2.22 & 10.2.33). If it is not possible to close the failed valve locally, the lake level needs to be lowered to below the 796' Elevation to isolate the inlet flow (References 10.2.36 & 10.2.37). The reverse flow from the CCW discharge piping would be isolated by dropping the CCW Discharge Gates or lowering the lake level below ~ 791' Elevation. Damage repair procedures (References 10.3.21 – 10.3.25) would be utilized to restore CCW and LPSW to an operational status once the TB basement has been drained.

A potential indirect HELB interaction caused by the MFDW System is the loss of the Unit 3 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF System is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

The postulated MFDW System HELBs in the Turbine Building would not affect the Shutdown Equipment in the Auxiliary Building or Control Room Habitability. The potential flooding in the Turbine Building from postulated MFDW System HELBs has been previously discussed.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated Main Feedwater System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1. The potential flooding in the Turbine Building from postulated Main Feedwater System HELBs has been previously discussed.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated MFDW System HELBs. However, as previously discussed (Refer to Section 3.8.1) alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost.

The Containment Boundary is unaffected by the postulated MFDW System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

6.2.2.5 Heater Drain System

All of the non-excluded individual break locations on the Unit 3 Heater Drain System are located in the Turbine Building. Most of these postulated HELBs were identified as targeting no Shutdown Equipment. For these postulated HELBs the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to approximately the 250°F RCS temperature. Moreover, the SSF-ASW and PSW Systems could also be used to support the cool down of the Unit to approximately the 250°F RCS temperature condition and maintain the ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

However, it should be noted that postulated HELBs on the discharge of the 3E or 3D HD Pumps are similar to Condensate System line breaks in that they result in a "Loss of Main Feedwater" event and a loss of condensate inventory stored in the hotwell as described in Section 6.2.2.2. The only condensate inventory credited for the affected unit's EFW is the minimum inventory stored in the UST (30,000 gallons). This limited inventory would not be sufficient for EFW to support a plant cooldown to ~250°F. Feedwater to the SGs relies upon EFW from an alternate unit (if the cross-connect is available), the new PSW System, or the SSF-ASW System (Ref. UFSAR Section 10.4.7). For these postulated breaks the EFW function for enabling a plant cooldown to LPI entry conditions is satisfied by the PSW System or the SSF-ASW System. The PSW System would be the primary means for maintaining a Safe Shutdown condition and cooling down the Unit to ~250°F. The SSF-ASW System would serve as a back-up to PSW System.

Any postulated HELB on the HD System with an interaction with Shutdown Equipment is listed in Table 6.2-5. Several of the postulated break locations on the table identify no damage to Shutdown Equipment. The pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these breaks would be the same as for the breaks with no targets.

One of the breaks in the HD System target cabling associated with the emergency power distribution system. The postulated interactions could result in the loss of the Startup Transformer CT3. The Unit 3 Main Feeder Buses will receive power from the Standby Buses. However, 6900VAC power will be lost when the unit trips. This results in a loss of the RCPs. The Unit 3 TDEFWP is postulated to fail due to other cable interactions. In addition, the TBVs and the MS to the SSRHs are postulated to fail open creating an open flowpath for both Unit 2 MS lines to the condenser. The closure of the MSIV on each MS line would be credited to isolate the MS supply to the SSRHs and the failed open TBVs. The HPI, LPI, and LPSW functions are not affected. The EFW function is met by either of the two MDEFWPs. Safe shutdown can be established and maintained using the EFW and HPI systems. Systems needed for plant cooldown remain available. As previously discussed, the LPI and LPSW Systems are credited for achieving the Cold Shutdown Condition.

Some breaks in the HD System can create small steam line breaks inside the Turbine Building, due to pipe whips. In addition, direct effects to non-safety control systems that impact the TBVs and the MS to SSRHs could lead to blowdown of both SGs. The MSIV in each MS line could be closed to isolate both MS lines from the affected branch lines. The functions performed by HPI, LPI, and LPSW are not impacted by the direct interactions from these postulated breaks in the HD system and are assumed to remain available.

Some breaks in the HD System can create breaks in the Unit 3 EFW system, as well as the cross-connect piping from the other units. This results in a loss of EFW on Unit 3. The PSW or SSF-ASW systems would be credited to provide the EFW function.

Other interactions from HD line breaks were identified with the SSW header. A rupture in the SSW header may result in a loss of cooling to all three units CCW pumps requiring the pumps to be stopped. In addition, the loss of SSW would result in a loss of essential siphon vacuum (ESV) system. Emergency CCW siphon flow cannot be assured without the ESV system. The LPSW System is assumed to be unavailable should forced CCW flow and emergency siphon flow be lost. The loss of LPSW is assumed to result in the loss of HPI function. The loss of LPSW also results in a loss of the Unit 3 MDEFWPs. EFW function is met by the operation of the TDEFWPs on each unit. The PSW System is credited to provide cooling water to the HPI pumps and to provide a backup to the TDEFWP. If the PSW System is not available, the SSF would be credited to maintain safe shutdown. Damage repair procedures are credited to provide an alternate means of cooling to a CCW pump to allow its restart and thus restoration of LPSW function for plant cooldown and the establishment of the Cold Shutdown Condition.

HDLBs can result in Turbine Building flooding. The HDLBs, in and of themselves, are not the source of Turbine Building flooding due to the limited inventory. However, interactions with CCW and LPSW piping can create a source for Turbine Building flooding. Flood protection measures have been incorporated into the design to protect equipment located inside the Auxiliary Building from flooding inside the Turbine Building, because these postulated HELBs causing flooding inside the Turbine Building can be mitigated with equipment located inside the Auxiliary Building. None of the postulated Main Feedwater System HELBs could cause a Turbine Building flood that could exceed the Auxiliary Building flood barrier height limit of 20 feet (References 10.2.22 & 10.2.33). The PSW System would be credited for achieving and maintaining a Safe Shutdown condition. The SSF System would be credited as the backup method for achieving and maintaining a Safe Shutdown condition. The PSW System would be required for plant cooldown.

To achieve the Cold Shutdown Condition the source of the TB flooding would need to be isolated. The CCW Inlet Piping can be isolated by closure of the CCW Pump discharge valves (xCCW-10, xCCW-11, xCCW-12, & xCCW-13) in each unit. A single active failure of any of these valves to close would not result in an unacceptable flood height in the Turbine Building. This is because the flow rate out of the Turbine Building through the Turbine Building Drain will exceed the flooding rate prior to the flood height reaching the 20 foot in the Turbine Building Basement (References 10.2.22 & 10.2.33). If it is not possible to close the failed valve locally, the lake level needs to be lowered to below the 796' Elevation to isolate the inlet flow (References 10.2.36 & 10.2.37). The reverse flow from the CCW discharge piping would be isolated by dropping the CCW Discharge Gates or lowering the lake level below ~ 791' Elevation. Damage repair procedures (References 10.3.21 – 10.3.25) would be utilized to restore CCW and LPSW to an operational status once the TB basement has been drained.

A potential indirect HELB interaction caused by the Heater Drain System is the loss of the Unit 3 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF System is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated Heater Drain System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1. The potential flooding in the Turbine Building from postulated Heater Drain System HELBs has been previously discussed.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated HD System HELBs. However, as previously discussed alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost (Refer to Section 3.8.1).

The Containment Boundary is unaffected by the postulated HD System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

6.2.2.6 Heater Vent System

All of the non-excluded Individual Break locations on the Heater Vent System are located in the Turbine Building. All of the postulated HELBs (See Table 6.2-6) were identified as targeting no Shutdown Equipment. For these postulated HELBs the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to approximately the 250°F RCS temperature. Moreover, the SSF-ASW and PSW Systems could also be used to support the cool down of the Unit to approximately the 250°F RCS temperature condition and maintain the ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

A potential indirect HELB interaction caused by the Heater Vent System is the loss of the Unit 3 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF System is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

The postulated HV System HELBs in the Turbine Building would not affect the Shutdown Equipment in the Auxiliary Building or Control Room Habitability. None of the postulated HV System HELBs could cause a Turbine Building flood. No postulated HELBs on the HV System target any CCW/LPSW System piping, and no HELBs on the HV System cause any collateral damage.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated Heater Vent System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1. The potential flooding in the Turbine Building from postulated Heater Vent System HELBs has been previously discussed.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the

Auxiliary Building is protected from the postulated HV System HELBs. However, as previously discussed alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost (Refer to Section 3.8.1).

The Containment Boundary is unaffected by the postulated HV System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

6.2.2.7 High Pressure Injection System

There is no High Pressure Injection System HE piping in the Turbine Building.

6.2.2.8 Main Steam System

This section addresses the consequences of postulated ruptures of Main Steam System piping located inside the Turbine Building. Any postulated HELB on the Unit 3 MS System in the Turbine Building with an interaction with Shutdown Equipment is listed in Table 6.2-8. The Main Steam piping inside the Turbine Building consists of Duke Class F and Class G piping. Ruptures in the Class F piping (except the piping to the TDEFWP) result in breaks that can only be isolated by the MSIVs. Ruptures in the Class G piping for Main Steam (and MS piping to the TDEFWP), are normally isolated by the associated Main Steam branch line isolation valve. If the capability to close the MS branch line isolation valve from the Control Room is lost, the MSIVs can be closed from the control room to isolate any MSLB inside the turbine building.

Typically, only one Main Steam line is affected by a single postulated break in the Main Steam System. A large break in the Main Steam piping will result in an automatic trip of the reactor from RPS due to low or variable low RCS pressure. Large Main Steam line breaks are described in UFSAR Section 15.13. Small breaks in the Main Steam piping may not result in an automatic trip of the reactor. However, operator action is credited to trip the reactor. Small Main Steam line breaks are described in UFSAR Section 15.17. Once the reactor and main turbine are tripped, the Main Steam lines are separated by the main turbine stop valves.

There is the potential for a single postulated break in the Main Steam System to affect both Main Steam headers even with the closure of the Main Turbine Stop Valves. Normally, both the 3A and 3B MS lines are cross connected through the steam supply to the TDEFW Pump. Breaks in the TDEFW Pump supply lines or postulated breaks that could affect the supply lines could result in a blowdown of both Main Steam lines. However, branch line isolation valves are provided on the MS supply lines to the TDEFW Pump to isolate ruptures in this piping.

The vast majority of the breaks in the MS System do not target equipment or cabling associated with the emergency power distribution system. However, postulated breaks in a section of 2-inch MS piping from the 3B MS header could result in the loss of the Startup Transformer CT3 and both Unit 3 Main Feeder Buses. Another postulated break in a section of 3-inch MS piping from the 3B MS header could result in a loss of the Startup Transformer CT3, but the Unit 3 Main Feeder Buses would remain available to provide power to safe shutdown equipment. The loss of CT3 and both Unit 3 MFBs would result in a loss of all AC power to Unit 3. Safe shutdown can be established and maintained using the PSW and HPI systems. An alternate means of safe shutdown is the SSF. Main

Steam pressure boundary control is established by the closure of the MSIVs to isolate the 2-inch MSLB affecting the 3B MS Line. The PSW and HPI systems would be utilized to cool the unit(s) down to LPI entry conditions. Damage repair procedures are utilized to restore power to one LPI pump and one LPSW pump for Unit 3. If PSW/HPI is unavailable and the SSF is being used to maintain safe shutdown, damage repair procedures are utilized to restore power to one HPI pump per unit in addition to the LPSW and LPI pumps prior to initiating a cooldown. As previously discussed, the LPI and LPSW Systems are credited for achieving the Cold Shutdown Condition.

Some breaks in the MS System can create small steam line breaks inside the Turbine Building, due to pipe whips. In addition, direct effects to non-safety control systems that impact the TBVs and the MS to SSRHs could lead to blowdown of both SGs. The postulated small steam line breaks, as well as, the failures in the non-safety control systems for the TBVs and SSRHs would normally be isolated by a single MS branch line isolation valve. However, the power supply and/or controls to these valves may be impacted by the same break. The MSIV in each MS line could be closed to isolate both MS lines from the affected branch lines. The functions performed by HPI, LPI, and LPSW are not impacted by the direct interactions from these postulated breaks in the MS system and are assumed to remain available. EFW may be lost on Unit 3. However, the EFW cross-connects from another unit remains available. In addition, the PSW or SSF-ASW systems could be used to provide the EFW function.

Some breaks in the MS System can result in Turbine Building flooding due to interactions with CCW piping. The postulated breaks in the MS System are located downstream of the Main Turbine Stop Valves and are automatically isolated when the Main Turbine trips. Flood protection measures have been incorporated into the design to protect equipment located inside the Auxiliary Building from flooding inside the Turbine Building, because these postulated HELBs causing flooding inside the Turbine Building can be mitigated with equipment located inside the Auxiliary Building. None of the postulated Main Feedwater System HELBs could cause a Turbine Building flood that could exceed the Auxiliary Building flood barrier height limit of 20 feet (References 10.2.22 & 10.2.33). The PSW System would be credited for achieving and maintaining a Safe Shutdown condition. The SSF System would be credited as the backup method for achieving and maintaining a Safe Shutdown condition. The PSW System would be required for plant cooldown.

To achieve the Cold Shutdown Condition the source of the TB flooding would need to be isolated. The CCW Inlet Piping can be isolated by closure of the CCW Pump discharge valves (xCCW-10, xCCW-11, xCCW-12, & xCCW-13) in each unit. A single active failure of any of these valves to close would not result in an unacceptable flood height in the Turbine Building. This is because the flow rate out of the Turbine Building through the Turbine Building Drain will exceed the flooding rate prior to the flood height reaching the 20 foot in the Turbine Building Basement (References 10.2.22 & 10.2.33). If it is not possible to close the failed valve locally, the lake level needs to be lowered to below the 796' Elevation to isolate the inlet flow (References 10.2.36 & 10.2.37). The reverse flow from the CCW discharge piping would be isolated by dropping the CCW Discharge Gates or lowering the lake level below ~ 791' Elevation. Damage repair procedures (References 10.3.21 – 10.3.25) would be utilized to restore CCW and LPSW to an operational status once the TB basement has been drained.

A potential indirect interaction caused by a MS System HELB is the loss of the Unit 3 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, the PSW System, backed up by the SSF System, is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

The postulated MS System HELBs in the Turbine Building would not affect the Shutdown Equipment in the Auxiliary Building or Control Room Habitability. None of the postulated MS System HELBs could cause a Turbine Building flood. No postulated HELBs on the MS System target any CCW/LPSW System piping.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated Main Steam System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1. The potential flooding in the Turbine Building from postulated Main Steam System HELBs has been previously discussed.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated MS System HELBs. However, as previously discussed (Refer to Section 3.8.1) alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost.

The Containment Boundary is unaffected by the postulated MS System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

6.2.2.9 Moisture Separator Reheater Drain System

All of the non-excluded, Running Breaks on the MSRD System are located in the Turbine Building. Most of these postulated HELBs were identified as targeting no Shutdown Equipment. For these postulated HELBs the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down of the Unit to approximately the 250°F RCS temperature. Moreover, the PSW and SSF-ASW Systems could also be used to support the cool down the Unit to approximately the 250°F RCS temperature condition and maintain the ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

Any postulated HELB on the MSRD System with an interaction with Shutdown Equipment is listed in Table 6.2-9. Several of the break locations in the table identify no damage. The pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these breaks would be the same as for the breaks with no targets.

Some of the breaks in the MSRD System target cabling associated with the emergency power distribution system. The bounding postulated interactions could result in the loss of the Startup Transformer CT3. The Unit 3 Main Feeder Buses will receive power from the Standby Buses. However, 6900VAC power will be lost when the unit trips. This results in a loss of the RCPs. The Unit 3 EFW System is assumed to be lost due to the failure of the UST and a pipe rupture in the EFW unit cross-connect piping. The Unit 3 LPSW System is assumed to be lost due to a pipe rupture in one of the 24-inch essential LPSW headers. In addition, pipe ruptures may occur in a 12-inch 3A MS branch line and a 12-inch 3B MS branch line to the TBVs. The closure of the MSIV on each MS line would be credited to isolate the MS line breaks. The loss of LPSW results in a loss of the HPI and LPI functions. Safe shutdown can be established and maintained using the PSW and HPI (motor cooling from PSW) systems. An alternate means of safe shutdown is the SSF. The safety consequences on the RCS due to an uncontrolled blowdown of both SGs are addressed in Section 7.1 of this report. The PSW and HPI systems would be utilized to cool the unit(s) down to LPI entry conditions. Damage repair procedures are utilized to restore LPSW for Unit 3. If PSW is unavailable and the SSF is being used to maintain safe shutdown, damage repair procedures are utilized to restore LPSW to supply cooling water to the HPI pump(s) prior to initiating a cooldown. As previously discussed, the LPI and LPSW Systems are credited for achieving the Cold Shutdown Condition.

Other interactions from MSRD line breaks were identified with the SSW header. A rupture in the SSW header may result in a loss of cooling to all three units CCW pumps requiring the pumps to be stopped. In addition, the loss of SSW would result in a loss of Essential Siphon Vacuum (ESV) system. Emergency CCW siphon flow cannot be assured without the ESV System. The LPSW System is assumed to be unavailable should forced CCW flow and emergency siphon flow be lost. The loss of LPSW is assumed to result in the loss of HPI function. The loss of LPSW also results in a loss of the Unit 3 MDEFWPs. EFW function is met by the operation of the TDEFWPs on each unit. The PSW System is credited to provide cooling water to the HPI pumps and to provide a backup to the TDEFWP. If the PSW System is not available, the SSF would be credited to maintain safe shutdown. Damage repair procedures are credited to provide an alternate means of cooling to a CCW pump to allow its restart and thus restoration of LPSW function for plant cooldown and the establishment of the Cold Shutdown Condition.

MSRD System HELBs can result in Turbine Building flooding. These postulated HELBs in and of themselves, are not the source of Turbine Building flooding due to the limited condensate inventory. However, interactions with CCW and LPSW piping can create a source for Turbine Building flooding. Flood protection measures have been incorporated into the design to protect equipment located inside the Auxiliary Building from flooding inside the Turbine Building, because these postulated HELBs causing flooding inside the Turbine Building can be mitigated with equipment located inside the Auxiliary Building. The maximum flood height inside the Turbine Building is not expected to exceed the protected 20 foot height limit for these breaks (References

10.2.22 & 10.2.33). The PSW System would be credited for achieving and maintaining a Safe Shutdown condition. The SSF System would be credited as the backup method for achieving and maintaining a Safe Shutdown condition. The PSW System would be required for plant cooldown.

To achieve the Cold Shutdown Condition the source of the TB flooding would need to be isolated. The CCW Inlet Piping can be isolated by closure of the CCW Pump discharge valves (xCCW-10, xCCW-11, xCCW-12, & x3CCW-13) in each unit. A single active failure of any of these valves to close would not result in an unacceptable flood height in the Turbine Building. This is because the flow rate out of the Turbine Building through the Turbine Building Drain will exceed the flooding rate prior to the flood height reaching the 20 foot in the Turbine Building Basement (References 10.2.22 & 10.2.33). If it is not possible to close the failed valve locally, the lake level needs to be lowered to below the 796' Elevation to isolate the inlet flow (References 10.2.36 & 10.2.37). The reverse flow from the CCW discharge piping would be isolated by dropping the CCW Discharge Gates or lowering the lake level below ~ 791' Elevation. Damage repair procedures (References 10.3.21 – 10.3.25) would be utilized to restore CCW and LPSW to an operational status once the TB basement has been drained.

A potential indirect HELB interaction caused by the MSRD System is the loss of the Unit 3 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated MSRD HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF System is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

The postulated MSRD System HELBs in the Turbine Building would not affect the Shutdown Equipment in the Auxiliary Building or Control Room Habitability. The potential flooding in the Turbine Building from postulated MSRD System HELBs has been previously discussed.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated MSRD System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1. The potential flooding in the Turbine Building from postulated MSRD System HELBs has been previously discussed.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated MSRD System HELBs. However, as previously discussed alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost (Refer to Section 3.8.1).

The Containment Boundary is unaffected by the postulated MSRD System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

6.2.2.10 Plant Heating System

Most of the PH System HE piping is in the Turbine Building. Most of these postulated HELBs were identified as targeting no Shutdown Equipment. For these postulated HELBs the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down of the Unit to approximately the 250°F RCS temperature. Moreover, the PSW and SSF-ASW Systems could also be used to support the cool down the Unit to approximately the 250°F RCS temperature condition and maintain the ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

Any postulated HELB on the PH System with an interaction with Shutdown Equipment is listed in Table 6.2-10. The direct effects from some breaks in the PH System may affect the control of MS to SSRHs which could lead to blowdown of both SGs. The MSIV in each MS line could be closed to isolate both MS lines from the affected branch lines. The functions performed by HPI, LPI, and LPSW are not impacted by the direct interactions from these postulated breaks in the PH system and are assumed to remain available. The Unit 3 TDEFWP may also be lost due to cable interactions. The EFW function is met by the MDEFWPs.

A potential indirect HELB interaction caused by the Plant Heating System is the loss of the Unit 3 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated PH System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF System is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

The postulated PH System HELBs in the Turbine Building would not affect the Shutdown Equipment in the Auxiliary Building or Control Room Habitability. None of the postulated PH System HELBs could cause a Turbine Building flood. No postulated HELBs on the PH System target any CCW/LPSW System piping, and no HELBs on the PH System cause any collateral damage.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated PH System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1. The potential flooding in the Turbine Building from postulated PH System HELBs has been previously discussed.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated PH System HELBs. However, as previously discussed alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost (Refer to Section 3.8.1).

The Containment Boundary is unaffected by the postulated PH System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

6.2.2.11 Steam Drain System

All of the postulated HELB locations on the Steam Drain System are located in the Turbine Building. The postulated SD System HELBs are on piping connections to the MS System pressure boundary piping or the ES System pressure boundary piping. Most of the postulated HELBs do not interact with any Shutdown Equipment. For the postulated SD System HELBs connected to the MS pressure boundary, the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition is provided in Section 6.2.2.8 (MS System). For the postulated SD System HELBs connected to the ES pressure boundary, the pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe Shutdown condition and cool down the Unit to approximately the 250°F RCS temperature. Moreover, the SSF-ASW and PSW Systems could also be used to support the cool down of the Unit to approximately the 250°F RCS temperature condition and maintain the ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

Any postulated HELB on the Steam Drain System with a possible interaction with Shutdown Equipment is provided in Table 6.2-11. None of these breaks target the CCW/ LPSW Systems, which would result in Turbine Building flooding, and none of these postulated breaks directly target the Unit 3 4160 VAC Power Distribution System, which would cause an immediate loss of the system. The most adverse break results in the possible loss of the Unit 3 TDEFWP and the loss of isolation capacity for the MS to SSRH. Although the Unit 3 TDEFWP is not available both of the Unit 3 MDEFWPs are available as well as the cross connections to the EFW Systems in the other units. Should circumstances prevent the use of the Unit 3 MDEFW Pumps and prevent the alignment of the Unit 3 EFW System to an alternate unit, the PSW and SSF-ASW systems provide a redundant means of establishing a source of feedwater to the SG(s). In addition, direct effects to the non-safety control system for the MS to SSRHs could result in a loss of isolation capability for these pathways from the control room. The safety consequences on the RCS due to an uncontrolled blowdown of either or both SGs are addressed in Section 7.1 of this report. All other SD System

Unit 3 HELBS, which affect Shutdown Equipment, affect only the MS to SSRH isolation capacity and is discussed in Section 7.1 of this report.

A potential indirect HELB interaction caused by the Steam Drain System is the loss of the Unit 3 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated SD System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF System is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

The postulated SD System HELBs in the Turbine Building would not affect the Shutdown Equipment in the Auxiliary Building or Control Room Habitability. None of the postulated SD System HELBs could cause a Turbine Building flood. No postulated HELBs on the SD System target any CCW/LPSW System piping, and no HELBs on the SD System cause any collateral damage.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated SD System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1. The potential flooding in the Turbine Building from postulated SD System HELBs has been previously discussed.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated SD System HELBs. However, as previously discussed alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost (Refer to Section 3.8.1).

The Containment Boundary is unaffected by the postulated SD System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

6.2.2.12 Steam Seal Header System

All of the non-excluded individual break locations on the Unit 3 Steam Seal Header System are located in the Turbine Building. None of the non-excluded individual breaks cause adverse interactions with any Shutdown Equipment. The pathway for achieving and maintaining a Safe Shutdown condition and subsequent cooldown to the Cold Shutdown Condition for these postulated HELBs would be the normal shutdown sequence using the EFW and HPI Systems to achieve a Safe

Shutdown condition and cool down the Unit to approximately the 250°F RCS temperature. Moreover, the PSW and SSF-ASW Systems could also be used to support the cool down of the Unit to approximately the 250°F RCS temperature condition and maintain the ~250°F RCS temperature. The LPI/LPSW Systems would then be used to achieve the Cold Shutdown Condition.

A potential indirect HELB interaction caused by the Steam Seal Header System is the loss of the Unit 3 Main Feeder Buses and the loss of the EFW and LPSW Pumps, as a result of the steam environment created in the Turbine Building from the postulated HELB. The Main Feeder Bus Switchgear and the EFW and LPSW Pump motors have not been analyzed as being qualified for an elevated temperature, steam-air environment created by a postulated SSH System HELB. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this postulated HELB scenario, either the PSW System or the SSF System is credited for achieving and maintaining a Safe Shutdown condition until the Main Feeder Buses, switchgear, and the LPSW System are restored to an operational status. Once the LPSW and LPI Systems are restored to an operational status, the ONS Units could proceed to the Cold Shutdown Condition.

The postulated SSH System HELBs in the Turbine Building would not affect the Shutdown Equipment in the Auxiliary Building or Control Room Habitability. None of the postulated SSH System HELBs could cause a Turbine Building flood. No postulated HELBs on the SSH System target any CCW/LPSW System piping, and no HELBs on the SSH System cause any collateral damage.

Shutdown Equipment located outside the Turbine Building is protected from the effects of postulated Steam Seal Header System HELBs in the Turbine Building. However, if the equipment receives power from electrical sources inside the Turbine Building, the potential exists to lose that power source. The loss of Control Room Ventilation and its effect on Control Room Habitability is addressed in Section 3.8.1. The potential flooding in the Turbine Building from postulated Steam Seal Header System HELBs has been previously discussed.

The Turbine Building is a very large and vented volume. Due to its size and openings in the building, there would be no compartmental pressurization in the Turbine Building that would affect the Auxiliary Building. Moreover, the Turbine Building is atmospherically isolated from the Auxiliary Building and the Control Complex. Thus, the environment in the Control Room and the Auxiliary Building is protected from the postulated SSH System HELBs. However, as previously discussed alternate means of cooling the Control Room may be required for long term occupancy, in the event that the Control Room HVAC System is lost (Refer to Section 3.8.1).

The Containment Boundary is unaffected by the postulated SSH System HELBs due to the barriers between the postulated HELBs and the Containment Boundary.

6.3 Unit 3 HELB Interactions with Other Units

The effects of postulated HELBS from the Unit 3 HE lines on the Units 1 & 2 equipment and structures are identified in this section. The information on this section is based upon field inspections of the area of influence of each postulated HELB, and these interactions with Unit 1 and/or Unit 2 equipment are documented in Calculation OSC-7518.02 and evaluated in Calculations OSC-7518.04, OSC-7518.08, and OSC-7518.10 (References 10.2.53, 10.2.55, 10.2.58, & 10.2.60, respectively).

6.3.1 Interactions with Unit 1 Equipment and Structures

For each of the twelve (12) HE systems on Unit 3 the interactions with Unit 1 equipment and the pathway to Safe Shutdown in Unit 1 are described in this section.

6.3.1.1 Auxiliary Steam System

Some of the postulated HELBs on the Unit 3 AS System target cabling for Standby Bus 1 (See Table 6.2-1). Unit 1 can be powered from the Startup Transformer CT1 or from Standby Bus 2 if needed.

Some of the postulated HELBs on the Unit 3 AS System target the Siphon Seal Water (SSW) 4" header. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 1 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 1 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 1. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 3 AS System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

Some of the postulated HELBs on the Unit 3 AS System cause the loss of the chilled water system, which is used to cool the Unit 1 & 2 Control Complex. Analysis has shown that the Control Complex temperatures remain within acceptable limits for an extended period of time (approximately 16 hours) without the HVAC System (Reference 10.2.23). However, for long term occupancy damage repair measures would need to be taken to restore alternate means of area cooling to extend Control Room habitability during the remainder of the HELB mitigation and unit shutdown. For additional information, see Section 3.8.1 of this report.

Postulated HELBs on the Unit 3 Auxiliary Steam System would release steam to the interior of the Turbine Building. The steam in the Turbine Building may cause loss of the Unit 1 Main Feeder Buses, in addition to the loss of the EFW and LPSW Pumps due to the postulated Auxiliary Steam System HELB. All three (3) ONS Units share a combined Turbine Building, and the Main Feeder Bus, Switchgear, the EFW Pumps, and the LPSW Pumps have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW and/or the SSF Systems are utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

6.3.1.2 Condensate System

Some of the postulated HELBs on the Unit 3 Condensate System target cabling for Standby Bus 2 (See Table 6.2-2). Unit 1 can be powered from the Startup Transformer CT1 or from Standby Bus 1 if needed.

Some of the postulated HELBs on the Unit 3 Condensate System target one or both of the 4" SSW headers. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 1 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 1 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 1. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 3 Condensate System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

The postulated HELBs on the Unit 3 Condensate System, due to interactions with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 1, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW and/or SSF Systems until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from Unit 3 Condensate System breaks may potentially result in a loss of the Unit 1 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW and/or SSF Systems are utilized to achieve and maintain a Safe Shutdown condition. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

6.3.1.3 Extraction Steam System

Some of the postulated HELBs on the Unit 3 Extraction Steam System target one or both of the 4" SSW headers (See Table 6.2-3). The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 1 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 1 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 1. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 3 AS System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

The postulated HELBs on the Unit 3 Extraction Steam System, due to interactions with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 1, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW and/or SSF Systems until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from Unit 3 Extraction Steam System breaks may potentially result in a loss of the Unit 1 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW and/or SSF Systems are utilized to achieve and maintain a Safe Shutdown condition. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

6.3.1.4 Feedwater System

Some of the postulated HELBs on the Unit 3 MFDW System target cabling for the Standby Bus 1 (See Table 6.2-4). Unit 1 can be powered from the Startup Transformer CT1 or from Standby Bus 2 if needed.

Some of the postulated HELBs on the Unit 3 MFDW System target the 4" SSW header. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 1 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 1 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 1. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 3 MFDW System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

The postulated HELBs on the Unit 3 Main Feedwater System, due to interaction with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 1, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW and/or SSF Systems until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from Unit 3 Main Feedwater System breaks may potentially result in a loss of the Unit 1 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW and/or SSF Systems are utilized to achieve and maintain a Safe Shutdown condition. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

6.3.1.5 Heater Drain System

Some of the postulated HELBs on the Unit 3 HD System target the 4" SSW header (See Table 6.2-5). The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 1 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 1 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 1. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 3 HD System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

The postulated HELBs on the Unit 3 Heater Drain System, due to interaction with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 1, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW and/or SSF Systems until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from Unit 3 Heater Drain System breaks may potentially result in a loss of the Unit 1 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW and/or SSF Systems are utilized to achieve and maintain a Safe Shutdown condition. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

6.3.1.6 Heater Vent System

There are no direct interactions between the postulated Unit 3 Heater Vent System HELBs and Unit 1 equipment and structures. Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 3 Heater Vent System would release steam to the interior of the Turbine Building. The steam in the Turbine Building may cause loss of the Unit 1 Main Feeder Buses and the 4160 VAC switchgear, in addition to the loss of the EFW and LPSW Pumps. All three (3) ONS Units share a combined Turbine Building, and the Main Feeder Bus, Switchgear, the EFW Pumps, and the LPSW Pumps have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW and/or the SSF Systems are utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

6.3.1.7 High Pressure Injection System

There are no direct or indirect interactions between the postulated HELBs on the Unit 3 HPI System and the Unit 1 equipment and structures. All Unit 1 equipment and structures are separated from the postulated HELBs on the Unit 3 HPI System by barriers. Thus, Unit 1 operations and Shutdown Equipment would not be affected by any postulated Unit 3 HPI HELB, and no further evaluation is required.

6.3.1.8 Main Steam System

Some of the postulated HELBs on the Unit 3 Main Steam System target cabling for the Standby Bus 1 (See Table 6.2-8). Unit 1 can be powered from the Startup Transformer CT1 or from Standby Bus 2 if needed.

The postulated HELBs on the Unit 3 Main Steam System, due to interaction with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 1, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW and/or SSF Systems until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The Postulated HELBs on the Unit 3 Main Steam System would release steam to the interior of the Turbine Building. The steam in the Turbine Building may cause loss of the Unit 1 Main Feeder Buses, in addition to the loss of the EFW and LPSW Pumps due to the postulated Main Steam System HELB. All three (3) ONS Units share a combined Turbine Building, and the Main Feeder Bus, Switchgear, the EFW Pumps, and the LPSW Pumps have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW and/or the SSF Systems are utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

6.3.1.9 Moisture Separator Reheater Drain System

Some of the postulated HELBs on the Unit 3 MSRD System target the 4" SSW header (See Table 6.2-9). The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 1 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 1 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 1. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 3 MSRD System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

The postulated HELBs on the Unit 3 Moisture Separator Reheater Drain System, due to interactions with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 1, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW and/or SSF Systems until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from Unit 3 Moisture Separator Reheater Drain System breaks may potentially result in a loss of the Unit 1 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW Pump Motors, and the LPSW Pump Motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW and/or SSF Systems are utilized to achieve and maintain a Safe Shutdown condition. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

6.3.1.10 Plant Heating System

There are no direct interactions between the postulated Unit 3 Plant Heating System HELBs and Unit 1 equipment and structures (See Table 6.2-10). Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 3 Plant Heating System would release steam to the interior of the Turbine Building. The steam in the Turbine Building due to a postulated Plant Heating System HELB may cause loss of the Unit 1 Main Feeder Buses, the EFW Pump Motors, and LPSW Pump Motors. All three (3) ONS Units share a combined Turbine Building, and the Unit 1 Main Feeder Buses, Switchgear, the EFW Pump Motors, and the LPSW Pump Motors have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW and/or the SSF Systems are utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

6.3.1.11 Steam Drain System

There are no direct interactions between the postulated Unit 3 Steam Drain System HELBs and Unit 1 equipment and structures (See Table 6.2-11). Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 3 Steam Drain System would release steam to the interior of the Turbine Building. The steam in the Turbine Building due to a postulated Steam Drain System HELB may cause loss of the Unit 1 Main Feeder Buses, the EFW Pump Motors, and LPSW Pump Motors. All three (3) ONS Units share a combined Turbine Building, and the Unit 1 Main Feeder Buses, Switchgear, the EFW Pump Motors, and the LPSW Pump Motors have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW and/or the SSF Systems are utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

6.3.1.12 Steam Seal Header System

There are no direct interactions between the postulated Unit 3 Steam Seal Header System HELBs and Unit 1 equipment and structures. Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 3 Steam Seal Header System would release steam to the interior of the Turbine Building. The steam in the Turbine Building due to a postulated Steam Seal Header System HELB may cause loss of the Unit 1 Main Feeder Buses, the EFW Pump Motors, and LPSW Pump Motors. All three (3) ONS Units share a combined Turbine Building, and the Unit 1 Main Feeder Buses, Switchgear, the EFW Pump Motors, and the LPSW Pump Motors have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW and/or the SSF Systems are utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

6.3.2 Interactions with Unit 2 Equipment and Structures

For each of the twelve (12) HE systems on Unit 3 that have interactions with Unit 2 equipment, the pathway to Safe Shutdown of Unit 2 is described in this section.

6.3.2.1 Auxiliary Steam System

Some of the postulated HELBs on the Unit 3 AS System target cabling for the Standby Bus 1 and Startup Transformer CT2 (See Table 6.2-1). The loss of CT2 and Standby Bus 1 leaves Unit 2 with Standby Bus 2 as the only means of emergency power to the main feeder buses. If the Standby Bus 2 breaker fails to close to energize the Unit 2 Main Feeder Bus 2, the PSW Systems would be credited to establish and maintain safe shutdown. The PSW System could be utilized to cool the unit down to ~250°F RCS temperature. Power would need to be restored one LPI pump to enable plant cooldown to cold shutdown. At least one LPSW pump should remain available due to it being powered from Unit 1.

Some of the postulated HELBs on the Unit 3 AS System target cabling for Unit 2 TDEFWP, MS to SSRH controls, and the AFIS signal to Unit 2 Main Feedwater pumps. EFW function can still be met using the Unit 2 MDEFWPs. HPI, LPI and LPSW functions are not affected.

Some of the postulated HELBs on the Unit 3 AS System cause the loss of the chilled water system, which is used to cool the Unit 1 & 2 Control Complex. Analysis has shown that the Control Complex temperatures remain within acceptable limits for an extended period of time (approximately 16 hours) without the HVAC System (Reference 10.2.23). However, for long term occupancy damage repair measures would need to be taken to restore alternate means of area cooling to extend Control Room habitability during the remainder of the HELB mitigation and unit shutdown. For additional information, see Section 3.8.1 of this report.

Some of the postulated HELBs on the Unit 3 AS System target the 4" SSW header. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 2 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 2 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 2. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 3 AS System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

The Postulated HELBs on the Unit 3 Auxiliary Steam System would release steam to the interior of the Turbine Building. The steam in the Turbine Building may cause loss of the Unit 2 Main Feeder Buses, in addition to the loss of the EFW and LPSW Pumps due to the postulated Auxiliary Steam System HELB. All three (3) ONS Units share a combined Turbine Building, and the Main Feeder Bus, Switchgear, the EFW Pumps, and the LPSW Pumps have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW and/or the SSF Systems are utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

6.3.2.2 Condensate System

Some of the postulated HELBs on the Unit 3 Condensate System target cabling for Standby Bus 2 (See Table 6.2-2). Unit 2 can be powered from the Startup Transformer CT2 or from Standby Bus 1 if needed.

Some of the postulated HELBs on the Unit 3 Condensate System target cabling for one channel of Main Steam pressure for Unit 2 AFIS. The system remains available for actuation, if needed.

Some of the postulated HELBs on the Unit 3 Condensate System target one or both of the 4" SSW headers. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 2 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 2 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 2. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 3

Condensate System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

The postulated HELBs on the Unit 3 Condensate System, due to interactions with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 2, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW and/or SSF Systems until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from Unit 3 Condensate System breaks may potentially result in a loss of the Unit 2 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW and/or SSF Systems are utilized to achieve and maintain a condition. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

6.3.2.3 Extraction Steam System

Some of the postulated HELBs on the Unit 3 Extraction Steam System target cabling for one channel of Main Steam pressure for Unit 2 AFIS (see Table 6.2-3). The system remains available for actuation, if needed.

Some of the postulated HELBs on the Unit 3 AS System target cabling for Unit 2 TDEFWP, MS to SSRH controls, and the AFIS signal to Unit 2 Main Feedwater pumps. EFW function can still be met using the Unit 2 MDEFWPs. The HPI, LPI and LPSW functions are not affected.

Some of the postulated HELBs on the Unit 3 Extraction Steam System target one or both of the 4" SSW headers. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 2 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 2 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 2. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 3 ES System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

The postulated HELBs on the Unit 3 Condensate System, due to interactions with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 2, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW and/or SSF Systems until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from Unit 3 Extraction Steam System breaks may potentially result in a loss of the Unit 2 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW and/or SSF Systems are utilized to achieve and maintain a Safe Shutdown condition. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

6.3:2.4 Feedwater System

Some of the postulated HELBs on the Unit 3 Feedwater System target cabling for the Standby Bus 1 and Startup Transformer CT2 (See Table 6.2-4). The loss of CT2 and Standby Bus 1 leaves Unit 2 with Standby Bus 2 as the only means of emergency power to the main feeder buses. If the Standby Bus 2 breaker fails to close to energize the Unit 2 Main Feeder Bus 2, the PSW Systems would be credited to establish and maintain safe shutdown. The PSW System could be utilized to cool the unit down to ~250°F RCS temperature. Power would need to be restored one LPI pump to enable plant cooldown to cold shutdown. At least one LPSW pump should remain available due to it being powered from Unit 1.

Some of the postulated HELBs on the Unit 3 Feedwater System target cabling for two channels of Main Steam pressure for Unit 2 AFIS. This interaction may result in an actuation of AFIS on Unit 2 resulting in a loss of main and emergency feedwater if both channels fail low. This interaction may also result in a loss of redundancy for the Unit 2 AFIS. The system is designed as a two-out-of-four logic. Since two channels are needed for actuation, the system will no longer meet the single active failure should both channels fail high.

Some of the postulated HELBs on the Unit 3 Feedwater System target the 4" SSW header. The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 2 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 2 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the

Cold Shutdown Condition for Unit 2. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 3 MFDW System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.
The postulated HELBs on Unit 3 Main Feedwater System, due to interactions with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 2, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW and/or SSF Systems until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from Unit 3 Main Feedwater System breaks may potentially result in a loss of the Unit 2 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW and/or SSF Systems are utilized to achieve and maintain a Safe Shutdown condition. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

6.3.2.5 Heater Drain System

Some of the postulated HELBs on the Unit 3 HD System target the 4" SSW header (See Table 6.2-5). The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 2 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 2 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 2. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 3 HD System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

The postulated HELBs on Unit 3 Heater Drain System, due to interactions with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 2, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW and/or SSF Systems until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from Unit 3 Heater Drain System breaks may potentially result in a loss of the Unit 2 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW and/or SSF Systems are utilized to achieve and maintain a Safe Shutdown condition. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

6.3.2.6 Heater Vent System

There are no direct interactions between the postulated Unit 3 Heater Vent System HELBs and Unit 2 equipment and structures (See Table 6.2.6). Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 3 Heater Vent System would release steam to the interior of the Turbine Building. The steam in the Turbine Building may cause loss of the Unit 2 Main Feeder Buses, in addition to the loss of the EFW and LPSW Pumps due to the postulated Heater Vent System HELB. All three (3) ONS Units share a combined Turbine Building, and the Main Feeder Bus, Switchgear, the EFW Pumps, and the LPSW Pumps have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW and/or the SSF Systems are utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

6.3.2.7 High Pressure Injection System

There are no direct or indirect interactions between the postulated HELBs on the Unit 3 HPI System and the Unit 2 equipment and structures. All Unit 2 equipment and structures are separated from the postulated HELBs on the Unit 3 HPI System by barriers. Thus, Unit 2 operations and Shutdown Equipment would not be affected by any postulated Unit 3 HPI HELB, and no further evaluation is required.

6.3.2.8 Main Steam System

Some of the postulated HELBs on the Unit 3 MS System target cabling for the Standby Bus 1 and Startup Transformer CT2 (See Table 6.2-8). The loss of CT2 and Standby Bus 1 leaves Unit 2 with Standby Bus 2 as the only means of emergency power to the main feeder buses. If the Standby Bus 2 breaker fails to close to energize the Unit 2 Main Feeder Bus 2, the PSW Systems would be credited to establish and maintain safe shutdown. The PSW System could be utilized to cool the unit down to ~250°F RCS temperature. Power would need to be restored one LPI pump to enable plant cooldown to cold shutdown. At least one LPSW pump should remain available due to it being powered from Unit 1.

The postulated HELBs on Unit 3 Main Steam System, due to interactions with other systems, can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 2, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW and/or SSF Systems until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The Postulated HELBs on the Unit 3 Main Steam System would release steam to the interior of the Turbine Building. The steam in the Turbine Building may cause loss of the Unit 2 Main Feeder Buses, in addition to the loss of the EFW and LPSW Pumps due to the postulated Main Steam System HELB. All three (3) ONS Units share a combined Turbine Building, and the Main Feeder Bus, Switchgear, the EFW Pumps, and the LPSW Pumps have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW and/or the SSF Systems are utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

6.3.2.9 Moisture Separator Reheater Drain System

Some of the postulated HELBs on the Unit 3 MSRD System target the 4" SSW header (See Table 6.2-9). The rupture of the SSW System may result in a loss of all CCW (forced flow and siphon flow) on all three units causing the loss of LPSW on all three units. The loss of the LPSW results in a loss of cooling to the Unit 2 MDEFWPs. The EFW function is met by the operation of the TDEFWP. The loss of the LPSW also results in the loss of cooling to the Unit 2 HPI pumps. The PSW System would be utilized to supply cooling to the HPI pumps. In addition, the PSW System would provide a backup to the TDEFWP to meet the EFW function. The SSF in combination with the MSIVs would provide an alternate means of safe shutdown. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition for Unit 2. The loss of CCW and LPSW would result in a loss of cooling for the Control Room. In addition some postulated HELBs on the Unit 3 MSRD System can cause the loss of the A & B Chillers, which also result in a loss of cooling for the Control Room. The loss of control room cooling and its effect on safe shutdown is discussed in Section 3.8.1.

The postulated HELBs on the Unit 3 Moisture Separator Reheater Drain System can cause significant flooding in the Turbine Building. The flooding can cause a loss of the EFW and LPSW Systems in Unit 2, due to submergence of the EFW and LPSW pumps. Safe Shutdown, following Turbine Building flooding, can be achieved and maintained using the PSW and/or SSF Systems until such time as the flooding can be stopped, the water drained out of the Turbine Building, and restoration of the LPSW System. Once LPSW has been restored, the plant can be cooled to the Cold Shutdown Condition.

The steam-air environment created inside the Turbine Building from the Unit 3 Moisture Separator Reheater Drain System breaks may potentially result in a loss of the Unit 2 electrical power distribution system. All three (3) ONS units share a combined Turbine Building. The main feeder buses, the 4160VAC switchgear, the EFW pump motors, and the LPSW pump motors are located inside the Turbine Building. This electrical equipment has not been qualified for a steam-air environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. The PSW and/or SSF Systems are utilized to achieve and maintain a Safe Shutdown condition. Once power can be restored to the LPI and LPSW Systems, the plant can be cooled to the Cold Shutdown Condition.

6.3.2.10 Plant Heating System

There are no direct interactions between the postulated Unit 3 Plant Heating System HELBs and Unit 2 equipment and structures. Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 3 Plant Heating System would release steam to the interior of the Turbine Building. The steam in the Turbine Building due to a postulated Plant Heating System HELB may cause loss of the Unit 2 Main Feeder Buses, the EFW Pump Motors, and LPSW Pump Motors. All three (3) ONS Units share a combined Turbine Building, and the Unit 2 Main Feeder Buses, Switchgear, the EFW Pump Motors, and the LPSW Pump Motors have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW and/or the SSF Systems are utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

6.3.2.11 Steam Drain System

There are no direct interactions between the postulated Unit 3 Steam Drain System HELBs and Unit 2 equipment and structures (See Table 6.2-10). Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 3 Steam Drain System would release steam to the interior of the Turbine Building. The steam in the Turbine Building due to a postulated Steam Drain System HELB may cause loss of the Unit 2 Main Feeder Buses, the EFW Pump Motors, and LPSW Pump Motors. All three (3) ONS Units share a combined Turbine Building, and the Unit 2 Main Feeder Buses, Switchgear, the EFW Pump Motors, and the LPSW Pump Motors have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW and/or the SSF Systems are utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

6.3.2.12 Steam Seal Header System

There are no direct interactions between the postulated Unit 3 Steam Seal Header System HELBs and Unit 2 equipment and structures. Because of the lack of direct interactions no further evaluation of direct interactions is required.

The Postulated HELBs on the Unit 3 Steam Seal Header System would release steam to the interior of the Turbine Building. The steam in the Turbine Building due to a postulated Steam Seal Header System HELB may cause loss of the Unit 2 Main Feeder Buses, the EFW Pump Motors, and LPSW Pump Motors. All three (3) ONS Units share a combined Turbine Building, and the Unit 2 Main Feeder Buses, Switchgear, the EFW Pump Motors, and the LPSW Pump Motors have not been analyzed as qualified for a steam environment. As such, it is possible that this steam-air environment may eventually, at some time after the initiation of the HELB, cause the failure of this equipment to function. For this interaction the PSW and/or the SSF Systems are utilized to achieve a Safe Shutdown condition and maintain that condition until the Main Feeder Buses and the LPSW System could be restored to an operational status. Once the LPSW and LPI Systems are restored to operability, the ONS Units can proceed to the Cold Shutdown Condition.

Table 6.2-1
Potential Damage to Shutdown Equipment Caused by Auxiliary Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-AS-004-R	1	None	• Loss of CT3 • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	None
3-AS-005-R	1	None	• Loss of 3MFB1 and 3MFB2	None
3-AS-006-R	1L,2L 3	None	None	None
3-AS-007-R	5-7,5L-6L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-AS-009-R	4	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-AS-018-R	1-4	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-AS-018-R	1L	None	• Loss of U3 TDEFWP	None
3-AS-020-R	1	None	• Loss of U3 TDEFWP	None
3-AS-027-R	1,2	None	• Loss of U3 RCPs	None
3-AS-027-R	1L,3	None	• Loss of CT3 • Loss of 3MFB1 and 3MFB2 • Loss of SBB1 • Loss of U3 TDEFWP • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	None
3-AS-034-R	1	None	None	None

Table 6.. .1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-AS-035-R01	1-3	None	• Loss of U3 TDEFWP • Loss of 3B MDEFWP • Loss of AFIS trip signal to FWPTs	None
3-AS-035-R02	1,2L-3L	None	• Loss of CT3 and CT2 • Loss of 3MFB1 and 3MFB2 • Loss of SBB1 • Loss of U3 TDEFWP	None
3-AS-035-R02	2-4	None	• U2 MS to SSRHs may fail open • Loss of U2 and U3 TDEFWPs • Loss of AFIS trip signal to U2 and U3 FWPTs	None
3-AS-035-R02	4L	None	• Loss of CT3 • Loss of SBB1 • Loss of 3MFB1 and 3MFB2 • Loss of U3 TDEFWP • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	None
3-AS-035-R02	5L,6,7L	None	• Loss of CT3 • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	None
3-AS-035-R02	8,9	None	• Loss of 3MFB1 and 3MFB2	None
3-AS-035-R02	10L,11,11L,13	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-AS-035-R02	12,12AL	None	• 3MS-31 may fail open	None
3-AS-035-R02	14,15	• 6" 3A EFW Header	• Loss of U3 TDEFWP • MS to SSRHs may fail open	None
3-AS-035-R02	14L,15L	None	• Loss of U3 TDEFWP	None

Table C...1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-AS-041-R01	1-2,1L-4L, 4-10,10L-11L, 17,17L	WC Supply/Return lines for U3	None	None
3-AS-041-R01	3	None	• Loss of U3 TDEFWP • Loss of 3A MDEFWP • Loss of U3 RCPs • Loss of AFIS trip signal to FWPT	None
3-AS-041-R01	5L-6L, 12L-13L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of 3A MDEFWP	None
3-AS-041-R01	7L-9L,11-13	WC Supply/Return lines for U3	• MS to SSRHs may fail open	None
3-AS-041-R01	14-16, 14L-16L	None	• Loss of CT3 • MS to SSRHs may fail open	None
3-AS-041-R02	1,3,5,10,16L, 20-24,33-35, 34L,35L,38	None	• 3MS-31 may fail open	None
3-AS-041-R02	4,17,20L-24L	• 6" 3A MS line after 3MS-24 • 3A MS line with 3MS-19 • 3A MS line with 3MS-22	None	None
3-AS-041-R02	4L,5L	• 3A MS line with 3MS-18 & 3MS-21 • 3B MS line with 3MS-28 & 3MS-31	None	None
3-AS-041-R02	6,9,6L-15L, 14-16, 17L-19L,18, 19,32	• 6" 3A EFW Header	None	None
3-AS-041-R02	7,8	• 3B MS line with 3MS-28 & 3MS-31	• MS to SSRHs may fail open	None
3-AS-041-R02	11-13,25-30, 25L-30L	• 6" 3A EFW Header	• Loss of U3 TDEFWP • MS to SSRHs may fail open	None

Table [illegible]-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-AS-042-R	1-4,6-13, 2L-3L,7L-10L, 12L,13L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-AS-043-R	1L-5L,3-5	None	None	None
3-AS-043-R	2	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-AS-045-R	39	None	None	None
3-AS-046-R	11-13	None	• Loss of U3 TDEFWP	None
3-AS-047-R01	11,12,12L,13L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-AS-047-R02	1-5,2L-5L	None	None	None
3-AS-048-R	4-6	None	None	None
3-AS-049-R	1-3,1L-2L	None	None	None
3-AS-052-R	1,3-5,7, 4L-7L	None	• Loss of U3 TDEFWP	None
3-AS-052-R	6,6A,8	None	None	None
3-AS-060-R01	1,3,5	None	None	None
3-AS-060-R01	2,11,3L-5L, 7L,8L,9L,12L,13L	None	None	None
3-AS-060-R01	8,10	None	None	None
3-AS-060-R01	13,14	4" A SSW Header	None	None

Table [illegible]-1
Potential Damage to Shutdown Equipment
Caused by Auxiliary Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-AS-060-R02	1-4, 1L,2L	6" 3A MS Line after 3MS-24	• Loss of U3 TDEFWP	None
3-AS-060-R02	5-6, 8-10	6" 3A MS Line after 3MS-24	None	None
3-AS-061-R	1	4" A SSW Header	None	None
3-AS-061-R	2,3,2L-4L, 11-14,14L,15L	None	None	None
3-AS-061-R	9-10	None	None	None
3-AS-061-R	15	2" CCW Return from TDEFWP Oil Cooler	None	None
3-AS-061-R	16-19,16L-19L	2" CCW Return from TDEFWP Oil Cooler	• Loss of 3A MDEFWP	None
3-AS-061-R	20-24,20L-25L	None	• Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs • Loss of AFIS signal to FWCVs	None

Table 6.2-2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-C-001-R	1L	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-C-001-R	2	• 14" CCW Inlet Line • 14" CCW Return Line • 4" A SSW Line • 4" B SSW Line	• Loss of CT3 • TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT • Loss of U2 AFIS Ch 4 MS Press	H-50
3-C-001-R	3	None	• Loss of 3B MDEFWP • Loss of AFIS trip signal to FWPT	None
3-C-001-R	4,5	• 4" A SSW Line • 78" CCW Inlet Line • 24" UST Supply to EFW • 42" Hotwell Outlet to HWPs • 6" EFW Recirc to UST	• Loss of 3B MDEFWP • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	G-46
3-C-001-R	6	• 4" A SSW Line • 4" B SSW Line • 14" CCW Inlet Line • 14" CCW Return Line • 26" Hotwell Outlet • 4" Hotwell Drain Line	• Loss of CT3 • TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT • Loss of U2 AFIS Ch 4 MS Press	H-50, G49a
3-C-002-R	1	None	None	None
3-C-003-R	1	None	• Loss of AFIS trip signal to FWPT	None
3-C-004-R	1, 1L	None	• Loss of AFIS trip signal to FWPT	None
3-C-005-R	1,1L,2	None	• Loss of AFIS trip signal to FWPT	None

Table 6.2-2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-C-005-R	3	• 4" A SSW Line • 24" UST Supply to EFW • 42" Hotwell Outlet to HWPs • 6" EFW Recirc to UST	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of 3B MDEFWP • Loss of AFIS trip signal to FWPT • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145 • Loss of U2 AFIS Ch 4 MS Press	H-46
3-C-006-R	1,2	None	• Loss of AFIS trip signal to FWPT	None
3-C-006-R	3,4	• 4" A SSW Line • 24" UST Supply to EFW • 6" EFW Recirc to UST	• Loss of CT3 • TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT • Loss of U2 AFIS Ch 4 MS Press	H-47a
3-C-007-R	1,2	None	None	None
3-C-007-R	3	• 4" A SSW Line • 4" B SSW Line	• Loss of CT3 • TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT • Loss of U2 AFIS Ch 4 MS Press	H-48
3-C-008-R01	1,2	None	None	None
3-C-009-R01	1,2	None	None	None
3-C-010-R01	1,2	None	None	None
3-C-011-R	1,2,3L,4	2" LPSW Supply/Return lines to MDEFWPs	• Loss of U3 EFW	None
3-C-011-R	5L,6L	None	None	None

Table 6.2-2
Potential Damage to Shutdown Equipment Caused by Condensate System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-C-013-R01	1,1L	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-C-013-R02	2	None	• Loss of U3 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-C-014-R01	1	None	None	None
3-C-014-R02	2	None	• Loss of U3 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-C-015-R02	1	None	• Loss of AFIS trip signal to FWPT	None
3-C-016-R	1,2	None	None	None
3-C-017-R	1-3	None	• Loss of CT3 • MS to SSRHs may fail open	None
3-C-019-R	1,2	None	None	None
3-C-020-R	1,1L,2	None	None	None
3-C-023-R	1	None	None	None
3-C-024-R	1	None	None	None
3-C-025-R01	1,2,3L	None	None	None
3-C-025-R02	4,4L	None	• MS to SSRHs may fail open	None
3-C-026-R01	2,2L	None	• MS to SSRHs may fail open	None
3-C-026-R02	1,1L	None	• MS to AS may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-C-027-R	1,2	None	None	None

Table C-2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-C-027-R	2L,3L,3	None	None	None
3-C-028-R	1L,2,2L	None	• MS to SSRHs may fail open	None
3-C-029-R	1,1L	None	None	None
3-C-030-R	1L-3L,3,4	None	None	None
3-C-031-R	1-3,1L,2L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-C-032-R	1,2,1L-3L	None	• MS to SSRHs may fail open	None
3-C-033-R01	2-6,1L,2L 4L-8L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-C-033-R01	9L,10L,10	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-C-033-R02	1,2L	• 6" MS Line before 3MS-87 • 8" 3B MS Line after 3MS-36 • 8" 3A MS Line after 3MS-35 • 12" 3B MS Line with 3MS-79	• MS to SSRHs may fail open	None
3-C-033-R02	2	• 8" 3B MS Line after 3MS-36	• MS to SSRHs may fail open	B-55
3-C-033-R02	1L,3,3L	None	• Loss of U3 TDEFWP	None
3-C-037-R	1L,2L, 5L-7L,6,8,9	None	None	None

Table [illegible]-2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-C-037-R	3	• 4" A SSW Line • 24" UST Supply to EFW • 42" Hotwell Outlet to HWPs • 6" EFW Recirc to UST	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of 3B MDEFWP • Loss of AFIS trip signal to FWPT • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145 • Loss of U2 AFIS Ch 4 MS Press	H-46
3-C-037-R	4	• 4" A SSW Line • 24" UST Supply to EFW • 6" EFW Recirc to UST	• Loss of CT3 • TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT • Loss of U2 AFIS Ch 4 MS Press	H-47a
3-C-037-R	5,4L	• 14" LPSW Line after 3LPSW-139 • 30" CCW Supply to 3A LPSW Pump	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-C-039-R	1-3,2L	None	None	None
3-C-040-R	1-3,1L,2L	None	None	None
3-C-041-R	1L,2,3, 4L-7L,6	None	None	None
3-C-042-R	1	None	None	None
3-C-043-R	1,2,1L	None	None	None
3-C-044-R	1-3,1L,2L	None	None	None
3-C-045-R	1,2,2L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-C-046-R	1	None	None	None
3-C-047-R	1	None	None	None

Table [illegible]-2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-C-065-R01	1-4,2L,4L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-C-065-R02	1,1L	None	None	None
3-C-066-R	1-3	3C2 Waterbox Inlet Expansion Joint	None	None
3-C-067-R	1-3	3C1 Waterbox Inlet Expansion Joint	None	None
3-C-068-R	1,3,4	None	None	None
3-C-072-R	5	None	None	None
3-C-073-R	9	None	• Loss of AFIS trip signal to FWPT	None
3-C-074-R	21	None	None	None
3-C-075-R	22	None	None	None
3-C-076-R	1-3	None	• Loss of CT3 • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-C-076-R	4,7	None	None	None
3-C-077-R	1,2,10,11	None	• Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-C-079-R	2	None	• Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-C-080-R	1	None	None	None
3-C-081-R	2, 8A,8B	None	• Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-C-081-R	12	None	None	None

Table 6.2-2
Potential Damage to Shutdown Equipment Caused by Condensate System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-C-082-R	9	None	None	None
3-C-082-R	8	None	• Loss of CT3 • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-C-083-R	6	None	• Loss of CT3 • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-C-083-R	7	None	None	None
3-C-084-R	3,6	None	• Loss of CT3 • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-C-087-R01	1L,2L	None	None	None
3-C-087-R01	2-4,3L-4L, 7-10, 9L-10L	None	• Loss of CT3 • Loss of U3 EFW • Loss of AFIS trip signal to FWPTs • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	None
3-C-087-R01	5,6,5L-8L	None	• Loss of CT3 • Loss of U3 EFW • Loss of AFIS trip signal to FWPTs • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	None
3-C-087-R02	2L-4L,6,6L	None	None	None
3-C-087-R02	5	None	• Loss of AFIS trip signal to FWPTs	None
3-C-088-R01	1-5 6A,6B,6BL, 7-9,11, 3L-5L,7L	• 8" 3A MS Line after 3MS-35	• Loss of CT3 • Loss of 3MFB1 and 3MFB2 • Loss of SBB1 to Unit 3 • Loss of SBB2 • Loss of U3 TDEFWP	None

Table [illegible]-2
Potential Damage to Shutdown Equipment
Caused by Condensate System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-C-088-R01	1L,2L,10	None	• Loss of U3 TDEFWP • Loss of 3B MDEFWP • Loss of AFIS trip signal to FWPTs	None
3-C-088-R01	8L-11L	• 6" EFW Recirc Line	• Loss of U3 TDEFWP • Loss of 3B MDEFWP • Loss of AFIS trip signal to FWPTs	None
3-C-088-R02	1,3,4	None	• Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-C-088-R02	5	• 8" 3A MS Line after 3MS-35	• Loss of CT3 • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-C-089-R	12L,13,13L	None	• Loss of U3 EFW	None
3-C-090-R	13-15, 13L,14L	None	• Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-C-091-R	21,22	None	None	None
3-C-093-R	18	None	• Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-C-094-R	15	None	None	None
3-C-096-R	1L,2L	None	None	None

Table ‹. 3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-ES-002-R	1,1L	None	• MS to SSRHs may fail open	None
3-ES-004-R	2,2L	None	• MS to SSRHs may fail open	None
3-ES-004-R	3L,8L,9L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-005-R	1	None	• MS to SSRHs may fail open	None
3-ES-010-R	1,2,2L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-010-R	3,3L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-010-R	4,4L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-010-R	5	None	None	None
3-ES-011-R	1,2	None	• MS to SSRHs may fail open	None
3-ES-011-R	3	None	None	None
3-ES-012-R	1-3,1L-3L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-012-R	6	None	None	None
3-ES-012-R	4,4L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-012-R	5	• 8" 3A MS Line with 3MS-35 • 12" 3A MS Line with 3MS-76	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None

Table 6. 3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-ES-012-R	5L	14" LPSW Line after 3LPSW-139	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-012-R	6L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-012-R	7,7L	6" 3A MS Line after 3MS-24	None	None
3-ES-012-R	8,8L	None	• MS to SSRHs may fail open	None
3-ES-012-R	9,9L	6" 3A MS Line after 3MS-24	• MS to SSRHs may fail open	None
3-ES-013-R	1,2	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-014-R	1-2,2L,3L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-014-R	3,4,4L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-014-R	5,6	None	• Loss of U3 TDEFWP	None
3-ES-015-R	1,2	6" 3A EFW Header	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-015-R	1L,2L	None	None	None

Table C.-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-ES-015-R	3	• 6" 3A EFW Header • 14" CCW Inlet/Return Line • 4" A SSW Line • 4" B SSW Line	• Loss of CT3 • TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT • Loss of U2 AFIS Ch4 MS PTs	H-52
3-ES-016-R	3,4,4L	None	• MS to SSRHs may fail open	None
3-ES-017-R	1,1L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-017-R	2-5,2L-6L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-018-R	1,1L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-019-R	1,2,4,1L-4L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-019-R	3	• 6" 3A EFW Header • 14" CCW Line (Inlet/Return)	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	Fd-52
3-ES-019-R	5,5L	None	• MS to SSRHs may fail open	None
3-ES-020-R	1,1L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None

Table C.3

Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-ES-020-R	2	• 6" 3A EFW Header • 4" A SSW Header • 14" CCW Line (Inlet/Return) • Condensate Piping	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	G-52, G-51a
3-ES-020-R	3	• 4" A SSW Header • Condensate/Feedwater Piping	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	G-47a
3-ES-020-R	4,2L,3L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-021-R	2-4,2L,4L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-021-R	3L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-022-R	1,2,1L,3L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-022-R	3	None	• Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	B-49, B-50
3-ES-022-R	4	None	None	B-49, B-50
3-ES-022-R	2L	6" MS Line after 3MS-87	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-023-R	1	None	None	None
3-ES-023-R	2,2L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None

Table C.-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-ES-024-R	1,2,2L,4L	None	• Loss of U3 TDEFWP	None
3-ES-024-R	3,3L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-024-R	4	• 6" MS Line after 3MS-87 • 8" 3A MS Line after 3MS-35 • 8" 3B MS Line after 3MS-36	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-024-R	5	• 6" MS Line after 3MS-87 • 8" 3A MS Line after 3MS-35 • 8" 3B MS Line after 3MS-36	• MS to SSRHs may fail open	C-52
3-ES-027-R	5,6L,7L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-028-R	5,5L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-028-R	6	None	• Loss of U3 TDEFWP	None
3-ES-031-R	1,2,4,5,7L,8L	None	None	None
3-ES-031-R	3	None	None	None
3-ES-031-R	5L,6L,9	None	None	None
3-ES-031-R	6	None	None	None
3-ES-031-R	7	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-031-R	8	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-032-R	1-6	None	None	None

Table [illegible]-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-ES-032-R	2L-4L	None	None	None
3-ES-032-R	7	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-045-R	1-3,6,3L,4L	None	None	None
3-ES-045-R	4	None	None	None
3-ES-045-R	5	None	None	None
3-ES-045-R	7	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-046-R	1-5	None	None	None
3-ES-046-R	2L-4L	None	None	None
3-ES-046-R	7	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-059-R	1-4	None	None	None
3-ES-059-R	2L-4L	None	None	None
3-ES-059-R	7	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-060-R	1-6,8,9, 5L-8L	None	None	None
3-ES-060-R	2L-4L	None	None	None
3-ES-060-R	7	None	• Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None

Table 6.[illegible]-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-ES-078-R	1,2	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-079-R	1,2	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-080-R	1-4,2L,3L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-081-R	1,2,2L,3L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-081-R	3,4	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-082-R	1,2	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-082-R	2L,3L,3	• 6" 3A EFW Header • 24" MS Line after the TBVs	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-082-R	4,7,8	• 6" 3A EFW Header	None	None
3-ES-082-R	5,6,9,4L,5L, 8L-10L	None	• MS to SSRHs may fail open	None
3-ES-082-R	6L,7L,10	None	• MS to AS may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-083-R	1,1L,2L	None	• MS to SSRHs may fail open	None

Table C._-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-ES-083-R	2,3	None	None	None
3-ES-086-R	1,2,4,5,1L-3L	None	• MS to SSRHs may fail open	None
3-ES-087-R	1	8" 3A MS Line after 3MS-24	None	None
3-ES-087-R	1L,3	None	• MS to SSRHs may fail open	None
3-ES-087-R	2	8" 3A MS Line after 3MS-24	• MS to SSRHs may fail open	None
3-ES-087-R	3L,4	None	• MS to AS may fail open	None
3-ES-094-R	4-7,4L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-094-R	5L-7L	• 6" MS Line before 3MS-87 • 8" 3A MS Line after 3MS-35	• MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-095-R	1-5,1L-3L, 7-9,7L,8L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-095-R	6	None	• MS to SSRHs may fail open	None
3-ES-098-R	1-4,1L,2L,5L, 8-11,8L-10L	None	• MS to SSRHs may fail open	None
3-ES-098-R	6L,7	None	None	None
3-ES-099-R	12	None	None	None
3-ES-211-R	1,2L,3,3L	None	• MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None

Table C.-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-ES-211-R	2	None	• MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-211-R	4,4L	None	• MS to SSRHs may fail open • Loss of U2 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-283-R	1	None	• MS to AS may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-283-R	1L,2L	None	• MS to SSRHs may fail open	None
3-ES-283-R	2,3	None	None	None
3-ES-287-R	1,2	8" 3A MS Line after 3MS-24	• MS to SSRHs may fail open	None
3-ES-287-R	1L,4	None	• MS to AS may fail open • MS to SSRHs may fail open	None
3-ES-287-R	3	8" 3A MS Line after 3MS-24	• MS to SSRHs may fail open	None
3-ES-287-R	4L	None	• MS to AS may fail open	None
3-ES-301-R	1-3,1L-4L 6-9,6L,7L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-301-R	4,5	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-301-R	5L,8L,9L	None	None	None
3-ES-302-R	2,3,3L,4L	None	• Loss of 3MFB1 and 3MFB2	None
3-ES-302-R	4	None	• Loss of 3MFB1 and 3MFB2 • TBVs may fail open	None

Table 6.[illegible]-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-ES-302-R	5	None	• TBVs may fail open • MS to SSRHs may fail open	None
3-ES-302-R	6-9	None	None	None
3-ES-303-R01	1	• 6" 3B EFW Header • 8" UST Supply to TDEFWP • 4" Condensate Line	• Loss of 3A MDEFWP Motor Cooling • Loss of AFIS trip signal to FWPT	None
3-ES-303-R01	1L-6L	None	• Loss of 3A MDEFWP Motor Cooling	None
3-ES-303-R01	2,3	• 6" UST Supply to Aux Boiler Feed Pump (affects MDEFWP suction) • 2 – 4" Condensate Lines	• Loss of 3A MDEFWP Motor Cooling • Loss of AFIS trip signal to FWPT	None
3-ES-303-R01	4-6	• 6" UST Supply to Aux Boiler Feed Pump (affects MDEFWP suction) • 6" EFW Recirc Line • 16" CCW Discharge Line	None	None
3-ES-303-R02	4	• 6" 3B EFW Header • 8" UST Supply to U3 TDEFWP • 4" Condensate Line	• Loss of AFIS trip signal to FWPT	None
3-ES-304-R01	1	• 6" 3B EFW Header • 8" UST Supply to U3 TDEFWP • 4" Condensate Line	• Loss of 3A MDEFWP Motor Cooling • Loss of AFIS trip signal to FWPT	None
3-ES-304-R01	2-5,1L-5L	None	• Loss of 3A MDEFWP Motor Cooling	None
3-ES-304-R02	1-3	None	None	None
3-ES-304-R02	5	• 6" 3B EFW Header • 8" UST Supply to U3 TDEFWP • 4" Condensate Line	• Loss of AFIS trip signal to FWPT	None
3-ES-310-R	1-4,1L-3L, 7,8	None	None	None
3-ES-310-R	5,6	None	None	None

Table … -3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-ES-311-R	1	None	None	None
3-ES-311-R	2,3	None	None	None
3-ES-312-R	1,1L,2L,5,8, 7L-12L,17L-20L,23L,24L	None	None	None
3-ES-312-R	2,6,7,12,16-24	None	None	None
3-ES-312-R	2A	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-312-R	2AL,3L,4L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-312-R	3,4	None	• MS to SSRHs may fail open	None
3-ES-312-R	5L,6L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-ES-312-R	9-11	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-312-R	13-15	None	• MS to SSRHs may fail open	None
3-ES-313-R	2-5,1L-5L	None	None	None
3-ES-314-R	1,2,7,6L,7L	None	None	None
3-ES-314-R	3,4	None	• TBVs may fail open	None

Table C[illegible]-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-ES-320-R	1	None	None	None
3-ES-320-R	1L,2L,2-7, 2L,5L,6L	None	None	None
3-ES-320-R	3L,4L	None	• Loss of U3 TDEFWP	None
3-ES-321-R	1	None	None	None
3-ES-322-R	1,2,1L-4L,14L, 15L,20L	None	None	None
3-ES-322-R	6,7	None	None	None
3-ES-322-R	8,9,13-16,19, 20,22	None	• MS to SSRHs may fail open	None
3-ES-322-R	9L-11L,17,18	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-ES-322-R	10,11,21,21L, 22L	None	• MS to SSRHs may fail open	None
3-ES-323-R	1,2	None	None	None
3-ES-323-R	2L-7L,3-6,10, 10L,11L	None	None	None
3-ES-323-R	7,8	None	None	None
3-ES-324-R	1-5,4L,5L	None	• MS to SSRHs may fail open • TBVs may fail open • Loss of U3 TDEFWP	None
3-ES-324-R	2L,3L	None	None	None
3-ES-325-R	1,2,2L-5L	None	None	None

Table 6-3
Potential Damage to Shutdown Equipment
Caused by Extraction Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-ES-325-R	3-5	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 EFW	None
3-ES-325-R	6,7,6L,7L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-501	1	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-502	1	None	• Loss of AFIS trip signal to FWPT	None
3-ES-503	1	• 6" UST Supply to Aux Boiler Feed Pump (affects MDEFWP suction) • 6" EFW Recirc Line • 16" CCW Discharge Line	• Loss of AFIS trip signal to FWPT	None
3-ES-506	1	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-507	1	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-ES-511	1	None	None	None

Table 6.[illegible]-4
Potential Damage to Shutdown Equipment Caused by Feedwater System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-FDW-001	1	None	None	None
3-FDW-003	1	None	None	None
3-FDW-004	1	None	• Loss of CT3 • MS to SSRHs may fail open	None
3-FDW-004	1L	None	None	None
3-FDW-005-R	1,2,2L,3L	None	None	None
3-FDW-005-R	3,4	• 10" CCW Line	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-FDW-006-R	1-5,8,4L-8L	None	None	None
3-FDW-006-R	6,7	None	None	K-49
3-FDW-006-R	9-11,14,15,17, 18,12L,13L	None	• Loss of CT3 • Loss of 3A LPSW Pump • Loss of AFIS trip signal to FWPT	None
3-FDW-006-R	12,16	• 4" B SSW Header	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-FDW-006-R	19	None	• Loss of 3A LPSW Pump	None
3-FDW-007-R	3,4	None	• Loss of CT3 • MS to SSRHs may fail open	None
3-FDW-008-R	1-5,4L-7L, 9-13,14L-16L	None	None	None
3-FDW-008-R	6,7	• Loss of UST • 12" 3B MS Line after 3MS-26	• Loss of CT3 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	L-49
3-FDW-008-R	8	None	• MS to SSRHs may fail open	None

Table 6._-4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-FDW-008-R	9L,10L,17L,18L	None	• Loss of CT3 • MS to SSRHs may fail open	None
3-FDW-008-R	14,17,18	• 24" 3A LPSW Header • 24" 3B LPSW Header	• Loss of CT3 • MS to SSRHs may fail open	None
3-FDW-008-R	15,16	None	None	None
3-FDW-010	1	None	None	None
3-FDW-011-R	1,2	None	• Loss of AFIS trip signal to FWPTs	None
3-FDW-011-R	3,4,5A,5B,6-9	None	• Loss of U3 TDEFWP • Loss of 3B MDEFWP • Loss of AFIS trip signal to FWPT	None
3-FDW-017	1	None	• Loss of U3 TDEFWP • MS to AS may fail open	None
3-FDW-017	3	None	• Loss of 3TE SWGR • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U3 EFW • 3FDW-41 and 3 FDW-44	None
3-FDW-021-R	1-3	None	• Loss of U3 EFW	None
3-FDW-022-R	1-3,2L,3L	None	• Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-FDW-024	1	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 EFW	None
3-FDW-026	2	None	• MS to AS may fail open • Loss of U3 TDEFWP	None
3-FDW-027	1	None	None	None
3-FDW-028	1	None	• 3LPSW-6	None

Table 6.-4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-FDW-029-R01	1	None	• Loss of U3 EFW	None
3-FDW-029-R01	2-5,2L-5L,9	None	• Loss of CT3 • Loss of U3 EFW • Loss of AFIS trip signal to FWPTs	None
3-FDW-029-R01	6-8,6L-9L	None	• Loss of CT3 • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-FDW-029-R01	10-12	None	• Loss of AFIS trip signal to FWPT	None
3-FDW-029-R02	2-3,2L,3L,5	None	• Loss of CT2 and CT3 • Loss of SBB1 • Loss of 3MFB1 and 3MFB2 • Loss of U3 TDEFWP	None
3-FDW-029-R02	4,4L,5L	• 2" 3B MS Line after 3MS-36	• Loss of CT2 and CT3 • Loss of SBB1 • Loss of 3MFB1 and 3MFB2 • Loss of U3 TDEFWP • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	None
3-FDW-029-R02	6,7	None	• Loss of U3 TDEFWP	None
3-FDW-030-R01	1,1L	• 6" U3 TDEFWP Recirc Line	• Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-FDW-030-R01	2	None	• Loss of U3 TDEFWP • Loss of 3B MDEFWP • Loss of AFIS trip signal to FWPTs	None
3-FDW-030-R01	2L,3L	None	• Loss of U3 EFW • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	None
3-FDW-030-R01	3	• 6" U3 TDEFWP Recirc Line	• Loss of U3 TDEFWP • Loss of 3B MDEFWP • Loss of AFIS trip signal to FWPTs	None

Table 6.4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-FDW-030-R02	2,2L,3L,4	None	• Loss of U3 TDEFWP	None
3-FDW-030-R02	3	None	• Loss of CT2 and CT3 • Loss of SBB1 • Loss of 3MFB1 and 3MFB2 • Loss of U3 TDEFWP	None
3-FDW-031-R	1-3,1L-3L,11,12	None	None	None
3-FDW-031-R	4	• 24" UST Supply to EFW • 6" 3B EFW Header • 30" 3B LPSW Pump Suction • 24" LPSW B Line • 12" CCW Line	• Loss of CT3 • Loss of SBB1 • Loss of 3MFB1 and 3MFB2 • Loss of U2 AFIS MS PTs (Ch 3 and Ch 4)	K-46
3-FDW-031-R	5	• 24" UST Supply to EFW • 42"/30" HW Outlet • 78" CCW Inlet Line • 4" A SSW Header	• Loss of 3TE SWGR • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	G-46
3-FDW-031-R	4L,5L	None	None	None
3-FDW-031-R	6	• 24" UST Supply to EFW • 42"/30" HW Outlet • 78" CCW Inlet Line • 4" A SSW Header	• Loss of 3B MDEFWP • Loss of U3 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	G-46
3-FDW-031-R	7,6L,7L	None	• Loss of U3 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	None

Table 6. 4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-FDW-031-R	8	• 42"/30" Hotwell Outlet • 24" UST Supply to EFW • 6" 3B EFW Header • 78" CCW Inlet Line • 4" A SSW Header	• Loss of all U3 EFW • Loss of AFIS trip signal to FWPT • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	Ga-45, G-46
3-FDW-031-R	9,10,8L,9L	None	• Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	None
3-FDW-031-R	11	None	None	None
3-FDW-031-R	13,13L,14	None	• Loss of U3 TDEFWP	None
3-FDW-032-R	1,2	None	None	None
3-FDW-032-R	3,4	• 10" CCW line	None	None
3-FDW-032-R	5-8	• 14" CCW Line	• Loss of CT3 • Loss of AFIS signal to trip FWPT	None
3-FDW-032-R	8L,9L,9,10	None	• Loss of CT3 • Loss of AFIS signal to trip FWPT	None
3-FDW-034-R	1	• Loss of UST • 12" 3B MS Line after 3MS-26	• Loss of CT3 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	L-49
3-FDW-034-R	1L,2,2L,8	None	• Loss of CT3 • MS to SSRHs may fail open	None
3-FDW-034-R	3,3L,4,4L,5L	None	None	None
3-FDW-034-R	5-7	None	• Loss of CT3 • MS to SSRHS may fail open	None
3-FDW-035-R01	1	• 10" CCW Line	None	None

Table 6.4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-FDW-035-R01	2,4	None	None	None
3-FDW-035-R01	5	• 12" CCW Line	None	None
3-FDW-035-R02	1,2,1L-3L	None	None	None
3-FDW-035-R02	3	• 12" CCW Line	None	None
3-FDW-036-R01	2,4	• Loss of UST • 12" 3B MS Line after 3MS-26	• Loss of CT3 • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	L-49
3-FDW-036-R01	3	None	• Loss of CT3 • MS to SSRHs may fail open	None
3-FDW-036-R02	1,2	None	None	None
3-FDW-037-R	1-4	None	• Cable to 3FDW-42	None
3-FDW-041-R01	1,2,1L,2L, 9L,10L,10	None	None	None
3-FDW-041-R01	4,5,5L,6L,6,7, 7L,8L,8,9	None	• Loss of U3 EFW	None
3-FDW-041-R02	1-3,3L-6L,10,11	None	None	None
3-FDW-041-R02	1L,2L,4,5	None	• Loss of U3 EFW	None
3-FDW-041-R02	6-9,12,13	None	None	None
3-FDW-042-R01	1,1L,2L	None	None	None
3-FDW-042-R02	1-3,3L-8L,10,11, 11L,12L,15L,16L	None	None	None
3-FDW-042-R02	1L,2L,4,5, 13L,14L	None	• Loss of U3 EFW	None

Table 6... 4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-FDW-042-R02	6-9	None	None	None
3-FDW-042-R02	12-14	• 6" MS Line after 3MS-87	• Loss of U3 TDEFWP • Loss of 3A MDEFWP	None
3-FDW-042-R02	15,16	None	• Loss of U3 TDEFWP • Loss of 3A MDEFWP	None
3-FDW-043-R	1	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-FDW-043-R	1L,2L,2	None	None	None
3-FDW-044-R	1,1L,2L,2	None	None	None
3-FDW-045-CR		None	None	None
3-FDW-046	1	None	None	None
3-FDW-049	1	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 EFW	None
3-FDW-050-CR		None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TD EFWP	None
3-FDW-051-CR		None	None	None
3-FDW-052-CR	1,2	None	• Loss of U3 EFW • TBVs may fail open • MS to SSRHs may fail open	None
3-FDW-053-CR		None	• Loss of 3MFB2 • Loss of SWGR 3TE • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U3 EFW	None

Table 6.4
Potential Damage to Shutdown Equipment
Caused by Feedwater System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-FDW-054-CR		None	• Loss of SWGR 3TE • TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U3 EFW • 3FDW-41	None
3-FDW-055-CR		None	• Loss of MCCs 3XH, 3XI, 3XJ, 3XK • Loss of all Pzr Heaters (except Gp B & C) • Loss of 3A LPI Flow Indication • Loss of 3A LPI Cooler Outlet Temp • 3BS-1, 3CC-5, 3HP-21	None
3-FDW-056-CR		None	• Loss of RPS Channel A Inputs • Loss of ES Channel A Inputs • Loss of RCPs • Loss of 3B LPI Cooler Outlet Temperature • 3HP-5, 3HP-21 and 3LP-17	None
3-FDW-057-CR		None	None	None
3-FDW-062-CR		None	• Loss of U3 RCPs • 3HP-5 and 3HP-21	None

Table 6... 5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-HD-001-R	1	None	None	None
3-HD-002-R	2,2L	None	None	None
3-HD-006-R	1,2	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-007-R	3,4	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-008-R	3,3L-5L	None	None	None
3-HD-008-R	7	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-009-R	1,2L,3L	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-010-R	2L	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-011-R	1-5,2L	None	None	None
3-HD-013-R	6L	None	• MS to SSRHs may fail open	None
3-HD-015-R	1,3,4	None	• MS to SSRHs may fail open	None
3-HD-015-R	2,2L	None	• Loss of CT3 • MS to SSRHs may fail open	None
3-HD-016-R	7,8	None	None	None
3-HD-016-R	9	None	None	None
3-HD-017-R	2,2L	None	• Loss of CT3 • MS to SSRHs may fail open	None
3-HD-017-R	5	None	• Loss of CT3 • MS to SSRHs may fail open	None
3-HD-017-R	6,7	None	• Loss of CT3 • MS to SSRHs may fail open	None

Table 6... 5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-HD-017-R	7L,8L	None	None	None
3-HD-018-R	1,2L,3L	None	• MS to SSRHs may fail open	None
3-HD-020-R	1,2,2L	None	None	None
3-HD-020-R	3,3L	None	None	None
3-HD-021-R	1	None	• MS to SSRHs may fail open	K-52
3-HD-021-R	2,3,2L-4L	None	None	None
3-HD-022-R	6	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-023-R	5	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-025-R	1L,2,2L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-025-R	3	• 14" LPSW Line after 3LPSW-139 • 14" CCW Inlet Line	None	None
3-HD-025-R	4	None	None	None
3-HD-025-R	5,5L	None	• Loss of CT3	None
3-HD-026-R	2,3	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-026-R	5-7	1.5" LPSW line after 3LPSW-139	None	None

Table 6.5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-HD-028-R	4	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-029-R	1	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-030-R	1,2,5	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-031-R	3	• 14" LPSW Line after 3LPSW-139 • 14" CCW Inlet Line	None	None
3-HD-031-R	3L	None	None	None
3-HD-032-R	4,4L,5L	None	None	None
3-HD-032-R	6	None	• MS to SSRHs may fail open	None
3-HD-032-R	6L	None	None	None
3-HD-033-R	7,8	None	None	None
3-HD-034-R	9,10	None	None	None
3-HD-036-R	1L,3L,5AL	None	• MS to SSRHs may fail open	None
3-HD-036-R	2-4,4L,5A,5BL	None	• Loss of CT3 • MS to SSRHs may fail open	None
3-HD-037-R	1-3	None	• Loss of CT3 • MS to SSRHs may fail open	None
3-HD-037-R	6	None	None	None
3-HD-039-R	4	None	None	None

Table 6.5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-HD-040-R	5	None	None	None
3-HD-041-R	1,2	None	• MS to SSRHs may fail open	None
3-HD-041-R	3,4,4L	None	None	None
3-HD-042-R	5,5L	None	None	None
3-HD-045-R	1-3,4L	None	None	None
3-HD-045-R	4	None	• MS to SSRHs may fail open	None
3-HD-047-R	1,2L,4L	None	• MS to AS may fail open • Loss of U3 TDEFWP	None
3-HD-047-R	1L2,3	None	• MS to AS may fail open	None
3-HD-048-R01	5	None	• MS to SSRHs may fail open	None
3-HD-049-R	2	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-050-R	1	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-051-R	1-2,2L	None	• MS to SSRHs may fail open	None
3-HD-052-R	3,3L	6" 3A EFW Header	• MS to SSRHs may fail open	None
3-HD-056-R01	2-6,1L,3L-7L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-HD-056-R01	10,10L	None	• MS to SSRHs may fail open	None
3-HD-056-R02	11,11L	None	• MS to AS may fail open • Loss of U3 TDEFWP	None

Table 6.__5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-HD-057-R	8,9,9L	None	• MS to SSRHs may fail open	None
3-HD-062-R01	1L-3L,2,6L,7, 7L,10,10L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-HD-062-R01	4,5,5L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-HD-062-R02	12,12L	None	None	None
3-HD-063-R	8-9,8L-9L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-HD-065-R	1-3	None	None	None
3-HD-065-R	4,5	None	• MS to SSRHs may fail open	None
3-HD-066-R	1	None	None	None
3-HD-066-R	3,3L,4	None	None	None
3-HD-067-R	1-3,1L-3L	None	• MS to SSRHs may fail open	None
3-HD-068-R	1L-3L	None	• MS to SSRHs may fail open	None
3-HD-068-R	4L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-069-R	1,1L,2L	• 12" 3B MS Line before 3MS-26 • 8" 3B MS Line with 3MS-33 • 8" 3A MS Line after 3MS-24	None	None

Table 6.5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-HD-069-R	2-5,3L	• 12" 3B MS Line before 3MS-26 • 8" 3A MS Line after 3MS-24	• MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-HD-070-R	1,2,1L,2L	None	• TBVs may fail open • MS to SSRHs may fail open	None
3-HD-070-R	4	None	• MS to SSRHs may fail open	None
3-HD-075-R01	1-4,4L,5L,7,11, 12	None	• MS to SSRHs may fail open	None
3-HD-075-R01	1L,3L,6	None	• MS to SSRHs may fail open	None
3-HD-075-R01	5	• 6" 3A EFW Header • 6" EFW Unit Cross-connect Header	None	None
3-HD-075-R02	8-10,8L-10L	None	None	None
3-HD-076-R	4,5	None	None	None
3-HD-078-R	1-3,2L-3L	None	• MS to SSRHs may fail open	None
3-HD-080-R01	1,1L,2,4,4L, 4A,5,5L	• 14" CCW Line on U3	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-080-R01	3L,6,7,7L, 10,11	None	None	None
3-HD-080-R02	8,8L,9	None	None	None
3-HD-081-R	7,8	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-083-R	1-3,5,2L-4L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-083-R	6	None	None	None

Table 6._-5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-HD-086-R	1	None	None	None
3-HD-086-R	1A,2,2L	None	None	None
3-HD-089-R01	5	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-090-R	1,1L,2	None	None	None
3-HD-096-R	11	None	None	None
3-HD-105-R	1-4,1L-3L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS signal to FWPT	None
3-HD-105-R	5L	None	• MS to SSRHs may fail open	None
3-HD-106		None	None	None
3-HD-107		None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-115		None	None	None
3-HD-116		None	• MS to SSRHs may fail open	None
3-HD-117		None	None	None
3-HD-118		None	None	None
3-HD-119		None	• MS to SSRHs may fail open	None
3-HD-121		None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-122	4, 4L	None	• MS to SSRHs may fail open	None

Table [illegible]-5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-HD-123		None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-124		None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-125		None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-126		None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-130-R	1	None	• Loss of CT3	None
3-HD-132-R	6-8,7L,8L	None	• Loss of CT3	None
3-HD-133-R	16	None	None	None
3-HD-134-R	9.10	None	None	None
3-HD-134-R	10L,11L	None	None	None
3-HD-134-R	11-15	None	• Loss of CT3	None
3-HD-134-R	13L,14L	None	• Loss of CT3	None
3-HD-135-R	1-5	None	None	None
3-HD-136-R	5	None	None	None
3-HD-137-R	1	None	None	None
3-HD-137-R	1L-4L,4	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-137-R	2,3	4" B SSW Header	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None

Table 6.5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-HD-138-R	5	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-139-R	9-12,11L,12L	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-140-R	1	None	• Loss of CT3	None
3-HD-140-R	1L,2L,2,3	None	None	None
3-HD-141-R	4	None	None	None
3-HD-142-R	6-8,7L,8L	None	None	None
3-HD-143-R	15	None	• TBVs may fail open • MS to SSRHs may fail open	None
3-HD-144-R	9,9L-11L	None	• TBVs may fail open	None
3-HD-144-R	10-12	None	• Loss of CT3 • TBVs may fail open	None
3-HD-144-R	12L,13L	None	• Loss of CT3	None
3-HD-144-R	13,14	None	• Loss of CT3 • TBVs may fail open	None
3-HD-145-R	1-3	None	None	None
3-HD-146-R	5	None	None	None
3-HD-147-R	1,2	None	None	None
3-HD-148-R	3	None	None	None
3-HD-149-R	4	None	None	None
3-HD-150-R	5L, 7L, 8L	None	• MS to SSRHs may fail open	None

Table 6.__-5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-HD-150-R	6-8	None	None	None
3-HD-150-R	6L	None	• MS to SSRHs may fail open	None
3-HD-151-R	9	None	None	None
3-HD-152-R	6,7	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-154-R	8	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-155-R	5	None	None	None
3-HD-156-R	1,3L,4L,9L,10L	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-156-R	4-7	None	None	None
3-HD-156-R	5L-8L	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-HD-156-R	8,9,12,13	None	None	None
3-HD-156-R	11L,12L,14	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-157-R	1,2,2L,3L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-157-R	3	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-HD-158-R	1,1L-4L,4 9L-14L,9, 11-13	None	None	None
3-HD-158-R	5-8,5L-8L,14	None	• MS to SSRHs may fail open	None

Table 6.__-5
Potential Damage to Shutdown Equipment
Caused by Heater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-HD-159-R	1-5,7-8,1L,2L, 8L,9L	None	• MS to SSRHs may fail open	None
3-HD-159-R	9-12,10L,11L	None	• MS to SSRHs may fail open	None

Table 6.–-6
Potential Damage to Shutdown Equipment Caused by Heater Vent System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-HV-013-R	1	None	None	None
3-HV-014-R01	2	None	None	None
3-HV-014-R02	2	None	None	None

Table 3.2-7
Potential Damage to Shutdown Equipment Caused by High Pressure Injection System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-HPI-007	1	None	• Loss of 3HP-410	None
3-HPI-008	1	None	None	None
3-HPI-015-R	All	None	None	None
3-HPI-016-R	All	None	None	None

Table _.2-8
Potential Damage to Shutdown Equipment
Caused by Main Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MS-002	1	• 14" CCW Line	None	None
3-MS-004	1	• 14" CCW Line	None	None
3-MS-008	1	None	None	None
3-MS-009	1	None	None	None
3-MS-012	1	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-MS-015	1	None	• MS to SSRHs may fail open • Loss of AFIS trip signal to FWPTs	None
3-MS-016	1	None	• Loss of U3 TDEFWP	None
3-MS-019	1	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-MS-020	1	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-MS-023	1	None	None	None
3-MS-024	1	None	None	None
3-MS-037-R	1,2,2L	None	• Loss of CT2 and CT3 • Loss of SBB1 • Loss of 3MFB1 and 3MFB2 • Loss of U3 TDEFWP	None
3-MS-037-R	1L,3	None	• Loss of U3 TDEFWP	None
3-MS-038-R	1L	None	• Loss of U3 RCPs • Loss of U3 TDEFWP	None

Table ..2-8
Potential Damage to Shutdown Equipment
Caused by Main Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MS-038-R	2,2L,3	None	None	None
3-MS-056-R01	3,4	None	None	None
3-MS-056-R01	5,6,14, 12L-15L	• 6" MS Line before 3MS-87	None	None
3-MS-056-R02	1,2,2L	None	None	None
3-MS-057-R01	2,3,3A,4	• 6" MS Line after 3MS-87	• Loss of U3 TDEFWP • MS to SSRHs may fail open	None
3-MS-057-R02	1	None	• Loss of U3 EFW • Loss of AFIS trip signal to FWPTs • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	None
3-MS-063	1	None	None	None
3-MS-064	1	None	• Loss of Pzr Heater Bank 1 Groups 3A & 3K	None
3-MS-066-R	1	None	• Loss of U3 TDEFWP • MS to AS may fail open	Block Wall
3-MS-067-R	1	None	• Loss of U3 TDEFWP • MS to AS may fail open	Block Wall
3-MS-069-R	3	None	None	None
3-MS-076-R	1-5	None	• MS to AS may fail open	None
3-MS-080-R	1L	None	• Loss of 3B1 and 3B2 RCPs	None
3-MS-080-R	2	None	• Loss of CT3 • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	None

Table …2-8
Potential Damage to Shutdown Equipment
Caused by Main Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MS-201	1	None	None	None
3-MS-202	1,1L	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-MS-203	1,1L	None	None	None
3-MS-205	1	None	None	None
3-MS-206	1	None	None	None
3-MS-207	1	None	None	None
3-MS-208-R	1-8,10,14	None	None	None
3-MS-210	3	None	None	None
3-MS-231-CR	1,2	None	None	None
3-MS-232-CR	2,3	None	• MS to AS may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-MS-233-CR	1	None	• MS to AS may fail open • Loss of U3 TDEFWP • AFIS Ch 3 and 4 MS Press Transmitters • TBVs may be affected by MS PTs	None
3-MS-234-CR	1,2	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-MS-235-CR	1	None	None	None
3-MS-236-CR	1	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None

Table _.2-8
Potential Damage to Shutdown Equipment
Caused by Main Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MS-239-CR	1,2	None	None	None
3-MS-240-CR	2,3	None	• MS to SSRHs may fail open • MS to AS may fail open • Loss of U3 TDEFWP	None
3-MS-241-CR	1	None	• MS to SSRHs may fail open • MS to AS may fail open • Loss of U3 TDEFWP	None
3-MS-242-CR	1	None	• MS to AS may fail open • Loss of U3 TDEFWP • AFIS Ch 3 and Ch 4 MS Press Transmitters • TBVs may be affected by MS PTs	None
3-MS-243-CR	1,3	None	None	None
3-MS-244-CR	1	None	• MS to SSRHs may fail open	None
3-MS-245-CR	1	None	None	None
3-MS-246-CR	1	None	None	None
3-MS-247-CR	2,3	None	• TBVs may fail open • Loss of AFIS signal to FWCVs • Loss of AFIS signal to 3TO-145	None
3-MS-248-CR	1	None	• 3MS-31 may fail open	None
3-MS-250-CR	1,2	None	• MS to AS may fail open	None
3-MS-251-CR	4	None	None	None
3-MS-254-CR	2,3,5,6	None	• MS to AS may fail open	None
3-MS-255-CR	1	None	• MS to AS may fail open • Loss of U3 TDEFWP	None

Tabl… 2-8
Potential Damage to Shutdown Equipment
Caused by Main Steam System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MS-256-CR	2,3	None	None	None
3-MS-262-CR	2	None	None	None
3-MS-269-CR	1,2	None	None	None
3-MS-271-CR	1,2	None	• MS to SSRHs may fail open	None
3-MS-274-CR	1,2	None	• MS to SSRHs may fail open	None

Table _.2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-008	1	None	• MS to SSRHs may fail open	None
3-MSRD-019-R	1-2	None	None	None
3-MSRD-020-R	2	None	• 3MS-31 may fail open	None
3-MSRD-020-R	3,3L,4,4L,5	None	• MS to SSRHs may fail open • 3MS-22 may fail open • 3FDW-35 may fail	None
3-MSRD-020-R	5L,6,6L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-MSRD-021-R01	1,2,2L,3,4	None	• MS to SSRHs may fail open	None
3-MSRD-021-R02	1	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-021-R02	2	None	• MS to SSRHs may fail open	None
3-MSRD-021-R02	3	None	• MS to SSRHs may fail open	None
3-MSRD-021-R02	4,5	None	• MS to SSRHs may fail open • TBVs may fail open • Loss of U3 TDEFWP	None
3-MSRD-022-R	1	None	• MS to SSRHs may fail open • 3MS-22 may fail open	None
3-MSRD-030	1	None	• MS to SSRHs may fail open	None
3-MSRD-036-R01	1,2,3L	None	• Loss of U3 TDEFWP	None
3-MSRD-045	1	None	None	None
3-MSRD-046-R	1,2,2L,3	None	None	None

Table ...2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-047-R	1L,2L	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-MSRD-047-R	3,4	None	None	None
3-MSRD-049-R	1,2	None	• TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-MSRD-069-R01	1-3	None	• MS to SSRHs may fail open	None
3-MSRD-069-R02	1-3	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-MSRD-070-R01	1	• 14" CCW Line	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-070-R01	1L,3	None	None	None
3-MSRD-070-R01	4	• 14" CCW Line	None	None
3-MSRD-070-R02	3	None	None	None
3-MSRD-071-R	2,2L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-073-R	3,3L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None

Table .2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-074-R01	2	• 14" CCW Line	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-074-R01	2L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-074-R01	5	• 14" CCW Line	None	None
3-MSRD-074-R02	1	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-075-R	4	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-077-R01	2	None	None	None
3-MSRD-077-R01	3	• 4" B SSW Header	None	None
3-MSRD-077-R01	3L	None	None	None
3-MSRD-078-R	4,4L	None	• MS to SSRHs may fail open	None
3-MSRD-079-R	5	None	None	None
3-MSRD-079-R	5L,6,6L,7,7L	• 4" A SSW Header • 4" LPSW Line after 3LPSW-139	None	None
3-MSRD-080-R01	1	• 14" LPSW Line after 3LPSW-139 • 4" B SSW Header	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None

Table ...2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-080-R01	1L	None	None	None
3-MSRD-080-R02	1	• 14" LPSW Line after 3LPSW-139 • 4" B SSW Header	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-MSRD-080-R02	1L	None	None	None
3-MSRD-081-R	2,2L	• 4" A SSW Header	None	None
3-MSRD-082-R	3	None	None	None
3-MSRD-082-R	3L,4L	• 4" LPSW Line after 3LPSW-139	None	None
3-MSRD-085-R01	1,2L	None	• Loss of CT3 • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-087-R01	1	None	• Loss of CT3 • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-092-R01	1L,2L	None	None	None
3-MSRD-095-R	1,1L	None	None	None
3-MSRD-095-R	2,3	None	None	None
3-MSRD-095-R	4,5	• 4" A SSW Header	None	None
3-MSRD-095-R	6	None	None	None
3-MSRD-095-R	7-9,7L,8L	• 4" B SSW Header	None	None
3-MSRD-095-R	9L,10	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None

Table ..2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-096-R	1	None	None	None
3-MSRD-099-R	1L,2L,5	• 4" A SSW Header	None	None
3-MSRD-099-R	3	• 4" B SSW Header	None	None
3-MSRD-099-R	4	None	None	None
3-MSRD-099-R	6	None	• Loss of CT3 • Loss of AFIS trip signal to FWPT	None
3-MSRD-101-R	1,2	• 4" A SSW Header	None	None
3-MSRD-102-R	1	None	None	None
3-MSRD-103-R	1	None	None	None
3-MSRD-204	1	None	• MS to SSRHs may fail open	None
3-MSRD-304-R	1-7	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-MSRD-304-R	1L,2L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-MSRD-305-R	6,7	None	None	None
3-MSRD-305-R	8,9,12, 9L-12L	None	None	None
3-MSRD-305-R	10,11	None	• MS to SSRHs may fail open	None
3-MSRD-306-R01	2	None	None	None

Table ..2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-306-R01	4	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-MSRD-306-R01	5-8,5L-7L	None	None	None
3-MSRD-306-R02	2L,3L,3-5, 8,9	None	None	None
3-MSRD-306-R02	4L-7L	None	None	None
3-MSRD-307-R01	1	None	None	None
3-MSRD-307-R01	2	None	None	None
3-MSRD-307-R01	2L-4L	None	None	None
3-MSRD-307-R01	4-7	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-MSRD-307-R01	8,7L,8L	None	None	None
3-MSRD-307-R02	2,2L,3L,7-9	None	None	None
3-MSRD-307-R02	3,4	None	None	None
3-MSRD-307-R02	8L,9L	None	None	None
3-MSRD-308-R01	1-3,2L,3L	None	None	None
3-MSRD-308-R02	4-6,11,5L, 10L,11L	None	None	None
3-MSRD-308-R02	6L-9L	None	None	None

Table ..2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-308-R02	7,8	None	None	None
3-MSRD-308-R02	9,10	None	None	None
3-MSRD-309-R01	1-3,2L,3L	None	None	None
3-MSRD-309-R02	2,2L,3,3L, 6,9,8L,9L	None	None	None
3-MSRD-309-R02	7,8	None	None	None
3-MSRD-310-R01	1,2,2L,3L	None	None	None
3-MSRD-310-R01	3	None	None	None
3-MSRD-310-R02	2,8L,9L,9	None	None	None
3-MSRD-310-R02	2L,3L,3,4,7,8	None	None	None
3-MSRD-311-R01	1,2,2L,3L	None	None	None
3-MSRD-311-R01	3	None	None	None
3-MSRD-311-R02	2L-9L,3,4, 7,8	None	None	None
3-MSRD-311-R02	9	None	None	None
3-MSRD-312-R01	1-4	None	None	None
3-MSRD-312-R01	2L-5L,5	None	None	None
3-MSRD-312-R02	2,3,5,10, 2L-8L	None	None	None
3-MSRD-312-R02	8,9	None	None	None
3-MSRD-313-R01	1,2	None	None	None

Table ...2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-313-R01	2L,2AL,2A, 3-5,3L-5L	None	None	None
3-MSRD-313-R02	2,4L-11L, 5,6,8,11	None	None	None
3-MSRD-313-R02	10	None	None	None
3-MSRD-314-R01	1-4,1L-4L	None	None	None
3-MSRD-314-R02	4,5	None	None	None
3-MSRD-314-R02	7-11,7L,8L	None	None	None
3-MSRD-315-R01	2-4,2L,3L	None	None	None
3-MSRD-315-R02	3-6	None	None	None
3-MSRD-316-R01	1,7,8	None	None	None
3-MSRD-316-R01	3,5,6,3L-6L	None	None	None
3-MSRD-316-R02	1-4	None	None	None
3-MSRD-317-R01	1,5-8	None	• Loss of U3 TDEFWP	None
3-MSRD-317-R01	2,4	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-317-R01	6L,7L,9,10	None	None	None
3-MSRD-317-R02	9-11	None	None	None
3-MSRD-318-R01	3	None	None	None

Tabl... .2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-318-R01	4,5	• 4" B SSW Header	None	None
3-MSRD-318-R01	7,9-10,11L, 12L	None	None	None
3-MSRD-318-R01	11,12	None	None	None
3-MSRD-318-R02	1,11-14	None	None	None
3-MSRD-318-R02	2-4,7,8,13L, 14L	None	None	None
3-MSRD-318-R02	9,10,11L,12L	None	None	None
3-MSRD-319-R01	1,1L,2L	None	• MS to SSRHs may fail open	None
3-MSRD-319-R01	2,3	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-319-R01	3L,4L	None	None	None
3-MSRD-319-R01	4-7,5L,6L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-319-R01	7L,8L	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-319-R01	8,9	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-319-R01	9L,10,10L	None	None	None

Tabl.. .2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-319-R02	1,2,2L,3L, 13L,14L, 14,15	None	None	None
3-MSRD-319-R02	3,7-13,16,17	None	• MS to SSRHs may fail open	None
3-MSRD-320-R01	4-6	None	• MS to SSRHs may fail open	None
3-MSRD-320-R02	1	None	• MS to SSRHs may fail open	None
3-MSRD-320-R02	1L,2,2L,5L, 6L,16	None	None	None
3-MSRD-320-R02	4-10,12-14, 18	None	None	None
3-MSRD-320-R02	22,23	None	None	None
3-MSRD-320-R02	24,25	None	None	None
3-MSRD-320-R02	26	None	• MS to SSRHs may fail open • TBVs may fail open • Loss of U3 TDEFWP	None
3-MSRD-320-R02	27	None	• MS to SSRHs may fail open • TBVs may fail open • Loss of U3 TDEFWP	None
3-MSRD-321-R01	1L,2L,3-5	None	• MS to SSRHs may fail open	None
3-MSRD-321-R01	2,6-8	None	• Loss of CT3 • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-MSRD-321-R01	5L,6L	None	None	None
3-MSRD-321-R02	1,2,8L-11L,9	None	None	None
3-MSRD-321-R02	2L,3L,3,4,7,8	None	None	None

Table _.2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-321-R02	5,6	None	• MS to SSRHs may fail open	None
3-MSRD-321-R02	15-22,25	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-MSRD-321-R02	23,24	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPTs	None
3-MSRD-325-R	2,4	None	None	None
3-MSRD-325-R	3	• 4" B SSW Header	None	None
3-MSRD-326-R	2,4	None	None	None
3-MSRD-326-R	3	• 4" B SSW Header	None	None
3-MSRD-327-R	2,4,2L-4L	None	None	None
3-MSRD-327-R	3	• 4" B SSW Header	None	None
3-MSRD-328-R	2,4	None	None	None
3-MSRD-328-R	3	• 4" B SSW Header	None	None
3-MSRD-329-R	1	None	• Loss of U3 TDEFWP	None
3-MSRD-330-R	1	None	• Loss of U3 TDEFWP	None
3-MSRD-331-R	1	None	None	None
3-MSRD-332-R	1	None	None	None
3-MSRD-333-R	2,4,5,9,10	• 6" 3A EFW Header	None	None

Table ..2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-333-R	6,7	None	None	None
3-MSRD-333-R	7L,8,8L	None	None	None
3-MSRD-334-R	4,5,8,9	None	None	None
3-MSRD-335-R	1,3,5,6,9,10	None	None	None
3-MSRD-335-R	6L,7L,7,8	None	None	None
3-MSRD-335-R	8L,9L	• 6" 3A EFW Header	None	None
3-MSRD-336-R	8L,9L,9,10, 11L,12L	None	None	None
3-MSRD-340-R	2,3,5-8,14, 15	None	None	None
3-MSRD-340-R	9,10,12	• 6" 3A EFW Header	None	None
3-MSRD-341-R	1,2,2L,2AL	• 6" 3A EFW Header	None	None
3-MSRD-342-R	1-4	None	None	None
3-MSRD-343-R	1,8,9,12	None	None	None
3-MSRD-343-R	10,11	None	None	None
3-MSRD-344-R	3,6	None	None	None
3-MSRD-345-R	3,3L,4L,6	None	None	None
3-MSRD-345-R	4,5,6L,7L, 7-10	None	None	None
3-MSRD-346-R	1,2,4,4L,5L	None	• MS to SSRHs may fail open	None
3-MSRD-346-R	3,5,10	None	• MS to SSRHs may fail open	None

Tabl... 2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-350-R	3L,4L,4	None	None	None
3-MSRD-351-R	5,6,5L,6L,7	None	None	None
3-MSRD-352-R	1	None	None	None
3-MSRD-353-R	1,2,5	None	None	None
3-MSRD-353-R	3,4,6-8	None	None	None
3-MSRD-354-R	4,27	None	None	None
3-MSRD-354-R	6,7,10-16, 28,29	None	None	None
3-MSRD-354-R	7L,8L,8	None	None	None
3-MSRD-356-R	11,12	None	None	None
3-MSRD-357-R	1,8	None	None	None
3-MSRD-357-R	2,3,5,6,9-13, 9L-12L	None	• MS to SSRHs may fail open	None
3-MSRD-360-R	1,5,7,6L-8L, 14,15,19-21, 27	None	None	None
3-MSRD-360-R	3,4,4L,5L,6, 8,9,13	None	None	None
3-MSRD-361-R	1,1L-4L,3,5	None	• MS to SSRHs may fail open	None
3-MSRD-361-R	2,5L	None	• MS to SSRHs may fail open	None
3-MSRD-361-R	4	None	• MS to SSRHs may fail open	None
3-MSRD-362-R01	1,2	None	• MS to SSRHs may fail open	None

Table ..2-9
Potential Damage to Shutdown Equipment
Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-362-R01	3,5,6	• 12" CCW Line • 14" CCW Line	• MS to SSRHs may fail open	None
3-MSRD-362-R01	4	• 6" 3A EFW Header	• MS to SSRHs may fail open	None
3-MSRD-362-R02	1	• 14" CCW Line (Inlet/Return) • 4" B SSW Header • 6" 3A EFW Header • Condensate Piping	• Loss of CT3 • TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	Floor beam West of H-52
3-MSRD-362-R02	1L,2L	• 6" 3A EFW Header	None	None
3-MSRD-362-R02	3L,4L	• 14" CCW Line (Inlet/Return) • 4" B SSW Header • 6" 3A EFW Header • Condensate Piping	• Loss of CT3 • TBVs may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	Floor beam West of H-52
3-MSRD-362-R02	2,3,7L,8L, 14-18,20	• 2 - 12" MS Lines after TBVs	• MS to AS may fail open • TBVs may fail open	None
3-MSRD-362-R02	12	• U3 UST • 12" 3A MS Line with 3MS-17 • 12" 3B MS Line after 3MS-26 • Condensate Piping • EFW Unit Cross Connect Piping • 24" LPSW 3A Line	• Loss of CT3 • MS to AS may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	L-51
3-MSRD-362-R02	4-11,9L,10L	• 6" 3A EFW Header • 12" 3B MS Line after 3MS-26	• TBVs may fail open • MS to AS may fail open • MS to SSRHs may fail open • Loss of U3 TDEFWP	None
3-MSRD-370-R	3,4,4L,5L, 8-10,9L,10L	None	None	None
3-MSRD-370-R	5,6,19-24	None	None	None

Tabl_ _.2-9
Potential Damage to Shutdown Equipment Caused by Moisture Separator Reheater Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-MSRD-372-R	7	None	• MS to SSRHs may fail open	None
3-MSRD-380-R	1,2	None	None	None
3-MSRD-380-R	3,6L,7L	None	• MS to SSRHs may fail open	None
3-MSRD-380-R	4L,5L	• 6" 3A EFW Header	None	None
3-MSRD-381-R	10-15, 9L-12L	None	• MS to SSRHs may fail open	None
3-MSRD-390-R	1-4	None	None	None
3-MSRD-391-R	9,10	None	None	None

Table ...2-10
Potential Damage to Shutdown Equipment Caused by Plant Heating System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-PH-003-R	1	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None
3-PH-064-R	2-4	None	• MS to SSRHs may fail open • Loss of U3 TDEFWP • Loss of AFIS trip signal to FWPT	None

Table ..2-11
Potential Damage to Shutdown Equipment Caused by Steam Drain System HELBs (Unit 3)

Break ID	Sub-break	Mechanical Damage	Electrical Damage	Structural Damage
3-SD-001	1	None	• Loss of U3 TDEFWP • MS to SSRHs may fail open • Loss of AFIS trip signal to FWPT	None
3-SD-006	1	None	None	None
3-SD-035-R	1	None	• MS to SSRHs may fail open	None
3-SD-036-R	2	None	• MS to SSRHs may fail open	None
3-SD-037-R	3	None	• MS to SSRHs may fail open	None
3-SD-111-R	2,3	None	None	None

7.0 ANALYSIS OF MAIN STEAM LINE, MAIN FEEDWATER LINE, & LETDOWN LINE BREAKS

This section of the report describes the results of the transient analysis performed for specified station conditions, resulting from various HELBs. The three (3) events addressed are:

- Main Steam Line Breaks
- Main Feedwater Line Breaks
- Letdown Line Break

These events have been analyzed since they would generate the most extreme transient conditions in the station.

7.1 Main Steam Line Breaks (MSLB)

MSLBs have been postulated in a number of locations as shown in Tables 4.1-8, 5.1-8, and 6.1-8. In addition other Non-MS HELBs may result in a loss of MS pressure boundary either by causing breaks on MS piping or by causing malfunctions in TBV controls, MS to AS controls, or MS to SSRH controls which may lead to an uncontrolled blowdown of either or both Main Steam lines. It should be noted that the analyses contained in this section models the planned modifications for the new PSW System and the Main Steam Isolation Valves. As such, the analyses utilize assumptions regarding the preliminary design of these systems.

Direct effects from some HELBs inside the Turbine Building can impact the electrical distribution system that provides power to both safety related and non-safety related equipment. In addition, some HELBs can result in the loss of the secondary systems needed for continued plant operation. The effects can result in any combination of the following:

- Loss of the 230kV Red and Yellow Buses (similar to a LOOP)
- Loss of the Standby Buses
- Loss of the 4160VAC Main Feeder Buses
- Loss of the 6900VAC Buses
- Loss of Condensate/Main Feedwater System

Any interaction on the above equipment due to direct effects from postulated HELBs is assumed to result in its immediate loss at the time of the break. If there are no direct interactions on the above equipment, the equipment is assumed to remain in operation during the transient analyses (approximately 10 minutes).

Small MS line breaks are analyzed in Section 15.17 of the UFSAR. A limiting break size was determined in the analysis that resulted in a maximum power excursion, which occurs by avoiding a RPS trip function. The analysis assumed that the electrical distribution system as well as the secondary systems remained in operation such that the reactor did not automatically trip. Should the 230kV Red and Yellow buses, both main feeder buses, or the 6900VAC buses be lost, the reactor will automatically trip. A loss of the condensate and main feedwater systems would also result in an automatic trip of the reactor. Any of these direct effects on plant equipment would result in less limiting consequences than that already analyzed in UFSAR Section 15.17.

Other MS line breaks are analyzed in Section 15.13 of the UFSAR (Reference 10.3.8). For steam line breaks resulting in a reactor trip, the limiting break size is the double-ended guillotine break of a 36-inch line. The analysis assumes a break in one of the two main steam lines. The single MS line break is analyzed both with and without offsite power. HELB interactions may result in more than one MS line being affected. In addition, HELB interactions may impact the electrical distribution system that is not discussed in Section 15.13 of the UFSAR.

The various HELB interactions with the MS System have been divided into two categories. The first category is MS break locations outside the Turbine Building (inside the EPR and in the yard). These breaks result in an unisolatable break in one Main Steam line.

The second category is break locations inside the Turbine Building on the Duke Class F and Class G MS pressure boundary. Break sizes vary from 2" to 36" nominal pipe size. Interactions can result in one or both Main Steam lines being affected. In addition, failures in non-safety controls for the TBVs, MS to AS control valves, and MS to SSRH isolation may affect both MS lines. These breaks, and non-safety control malfunctions, are isolated by the closure of the MSIVs (to be installed).

The first category of MSLBs have previously been analyzed and documented in UFSAR Section 15.13 (Reference 10.3.8). However, the second category of MSLBs required additional analyses to evaluate the possible safety consequences on the reactor core (Potential for return-to-criticality and unacceptable DNBR). The core must remain within its thermal bounds and the reactor damage criteria. The acceptance criterion for the transient analysis is that the minimum DNBR be maintained above previously established limits.

The thermal-hydraulic analysis for a double MSLB was analyzed using the RETRAN-3D code. The thermal-hydraulic analysis performed for the double MSLB is consistent with the methodology utilized for the UFSAR Chapter 15 Large Steam Line Break with the exception that a double MSLB is simulated. A full circumferential break in both the "A" and "B" 36-inch (nominal pipe size) Main Steam lines is postulated based on the potential damage scenarios described in Sections 4, 5, and 6. The rupture of both Main Steam lines initiates a simultaneous blowdown of both steam generators. A rapid increase in the heat removal from the primary system results from this event, which causes a depressurization and rapid cooldown of the RCS. An immediate reactor trip is conservatively assumed. This will result in a rapid reduction of heat load on the RCS and maximizes the overcooling aspect of the event. The secondary side depressurization will result in automatic closure of the MSIVs and actuate the Automatic Feedwater Isolation System (AFIS) on low steam generator pressure.

The magnitude of the RCS overcooling and depressurization is impacted by the availability of plant equipment during the event. Therefore, three scenarios were selected to represent the various combinations of available plant equipment and to determine the effects on the core response (References 10.2.31 & 10.2.35). The scenarios are:

- Double MSLB With Loss of 4160VAC Essential Power System
- Double MSLB With the 4160VAC Essential Power System Available

- Double MSLB With a Loss of Off-site Power

The following major assumptions were used in the analyses:

a. The reactor is operating at rated full power (2568 MWth) at the time of the HELB.
b. Core decay heat is modeled consistent with the analysis contained in UFSAR Section 15.13 for the single large MSLB.
c. The most negative moderator feedback is modeled.
d. The maximum worth control rod is assumed to be stuck out.
e. An upper bound value on the differential boron worth over the range of temperatures expected during the transient is used. The boron worth is assumed to remain constant with decreasing temperatures, which is conservative.
f. Both CFTs are credited in the analyses with a conservatively low initial inventory in each CFT assumed.
g. The CFT initial pressure is assumed to be conservatively low.
h. The CFT boron concentration is assumed to be conservatively low.
i. The BWST boron concentration is assumed to be conservatively low.
j. The LPI System is assumed to not provide injection flow to the RCS.
k. No credit is taken for the Integrated Control System for repositioning of the Main Feedwater Control valves following a reactor trip.

7.1.1 Double MSLB with Loss of 4160VAC Essential Power System

In this scenario, 6900VAC power to the Reactor Coolant Pumps is assumed to remain available. However, it is assumed that the 4160VAC Essential Power System is immediately lost due to the effects of HELB. The loss of the 4160VAC power results in a loss of systems needed to maintain the affected unit in a safe shutdown condition. The loss of 4160VAC power results in a loss of the HPI, LPI, Condensate, and Main Feedwater Systems. In addition, both motor-driven EFW pumps would be lost. The turbine-driven EFW pump is assumed to operate from an available steam source (i.e., auxiliary steam supplied by another unit) since it does not require 4160VAC power to operate. In addition, its continued operation would worsen the overcooling of the RCS. The magnitude of the resulting RCS overcooling depends on the functioning of the MSIVs. Analyses have been performed to consider automatic closure of the MSIVs and failure of the MSIVs to close. The Automatic Feedwater Isolation System is not credited to isolate main and emergency feedwater in either analysis. The results of the analyses are provided below.

7.1.1.1 Double MSLB with Automatic Closure of the MSIVs

The analysis assumes that the reactor is operating at 100% of full power (2568 MWth) at the time of the event. For analysis purposes, a reactor power level of 102% full power is assumed to account for instrument uncertainty. Since the 4160VAC Essential Power System is assumed to be immediately lost, the PSW and the SSF Systems are the credited means of achieving and maintaining safe shutdown. The failure of the PSW System is assumed for this case in which both MSIVs close. The SSF systems are used in the transient analysis. A failure of the PSW System was selected since the SSF RCMU system provides the bounding case for minimum RCS makeup. No additional single active failures are considered. Since 6900VAC power is assumed to be available, the RCPs will continue to operate until stopped by the operator. Three cases were analyzed to evaluate the effects of continued operation of the RCPs. One case assumed the RCPs were tripped at three minutes based on activation of the SSF due to the loss of 4160VAC power. Another case assumed the operators stopped the RCPs at 2 minutes following a loss of subcooled margin. A third case assumed the RCPs were tripped off at the same time as the reactor trip. In each case, the EFW flow from the TDEFWP is assumed to be controlling SG level at setpoint. The MSIVs are assumed to close at a setpoint of 550 psig. A value of 520 psig is used in the analysis to account for instrument uncertainty. The maximum closure time for the MSIVs is specified to be 5 seconds. The analysis uses a 6 second closure time for additional conservatism (Reference 10.2.63).

In all three cases, the automatic closure of the MSIVs limits the resultant RCS overcooling such that the RCS can be maintained in Mode 3, with Tave ≥ 525 °F and without interruption of single-phase natural circulation. The minimum RCS cold leg temperature reached was approximately 525°F. The RCS pressure rapidly drops below the ESG setpoint for HPI actuation. However, no HPI flow is immediately available due to the loss of 4160VAC power. The minimum RCS pressure remains above the point where CFTs would inject borated water into the RCS. However, adequate shutdown margin is maintained throughout the event due to the inserted control rod worth, and the limited nature of the RCS cooldown.

Pressurizer level initially drops off scale low due to the rapid contraction of the RCS inventory. However, Pressurizer level is eventually restored after the overcooling has been terminated and the SSF RCMU flow adds RCS inventory.

The DNBR was not specifically analyzed for the SSF cases. However, the DNBR is bounded by the double MSLB without offsite power case described in Section 7.1.3.

7.1.1.2 Double MSLB without Automatic Closure of the MSIVs

Again, for analysis purposes, a reactor power level of 102% full power is assumed to account for instrument uncertainty. Since the 4160VAC Essential Power System is assumed to be immediately lost, the ESG Systems are assumed to be lost and an alternate means of safe shutdown would be credited. If the MSIVs automatically close, the RCS overcooling is terminated such that the SSF can be relied upon for maintaining safe shutdown (as shown in Section 7.1.1.1). If a postulated single active failure of one MSIV to close is assumed, one SG would continue to blowdown resulting in a cooldown of the RCS below the point at which the SSF is currently licensed. The PSW System would provide a means of safe shutdown. In this scenario, no credit is taken for either MSIV to automatically close in order to maximize the RCS overcooling for conservatism in determining the effects on the reactor core.

Since 6900VAC power is assumed to remain available, two cases were analyzed to evaluate the effects of continued operation of the RCPs. The first case assumed the RCPs were left on throughout the transient analysis. The second case assumed the operators stopped the RCPs following a loss of subcooled margin. For the case where RCPs continue to operate, the TDEFW pump would be controlling SG water levels at a setpoint of approximately 30 inches. An additional conservatism is applied by assuming one of the EFW flow control valves fails fully open to increase the severity of the overcooling. For the case where the RCPs are stopped by the operator, the TDEFWP would be raising SG water levels to a setpoint of approximately 240 inches. Since both

EFW flow control valves are assumed to be fully open in attempting to raise the SG water levels, no additional conservatisms are taken. However, it is assumed that the operators isolate EFW at 10 minutes.

In both cases, it has been determined that there is no return-to-criticality (References 10.2.31 & 10.2.35). The negative reactivity insertion by the control rods and the borated water from the CFTs are sufficient to maintain the reactor in a sub-critical condition throughout the transient. The transient was analyzed out in time to approximately 3500 seconds. The core response for both cases is similar. The results of these cases are provided below.

The double MSLB occurs with an initial power level of 102% FP. The reactor trips at 0.1 seconds. Power decreases rapidly after reactor trip with no return-to-criticality predicted for either case. The RCS pressure rapidly decreases causing HPI to actuate. However, since 4160VAC power has been lost, no HPI flow is initiated. RCS pressure continues to rapidly decrease until the CFTs begin injecting at approximately 55 seconds. The majority of the water injected for the entire transient occurs during the first minute of injection. After this time, the RCS depressurization rate has dropped off. Some additional mass is injected up until the time the overcooling is terminated. Following this time, RCS pressure continues to decrease to approximately 130 psig for the first case where RCPs remain running and approximately 220 psig for the second case where RCPs are stopped by the operators.

Pressurizer level drops off scale low due to the rapid contraction of the RCS inventory. Pressurizer level is not recovered throughout the transient. The RCS rapidly cools down to approximately 350°F during the first two minutes of the transient. The RCS average temperature continues to decrease to approximately 220°F for the first case where RCPs remain running and approximately 260°F for the second case where RCPs are stopped by the operator. A loss of subcooling margin occurs within the first few seconds of the transient in both cases.

In both cases the reactor is maintained subcritical due to the injection of borated water from the CFTs. Based on the reactor remaining subcritical post-trip, no return-to-criticality occurs. Secondly, the RCPs continue to operate for at least two minutes for each of the cases analyzed. Therefore, the DNBR is bounded by the double MSLB without offsite power case, where RCPs are immediately lost.

Since the 4160VAC Essential Power System is not available, the unit cannot be brought to the Cold Shutdown Condition immediately following the event due to the loss of power to the LPI and LPSW Systems. Actions would be taken by the operator to maintain a stable RCS temperature and pressure via the PSW System until power could be restored to an LPI pump, LPSW pump, and the decay heat drop line isolation valves.

The PSW mechanical and electrical systems can maintain the unit in a Safe Shutdown condition until power can be restored to the LPI components to enable cooldown to the Cold Shutdown Condition. Power can be supplied to a single HPI pump and associated HPI valves from the PSW electrical system. Restoration of HPI provides for reactivity control, RCP seal cooling, and RCS inventory recovery (restore pressurizer water level to normal conditions). Suction for the HPI pump is aligned to the BWST. Power can also be supplied to the pressurizer heaters from the PSW electrical system to maintain RCS pressure once water level is restored in the pressurizer. This provides RCS pressure control. Power can be supplied to the RV Head Vent and RCS Loop High Point vent valves from the PSW electrical system. This provides for reactivity control and RCS inventory control in conjunction with the restoration of the HPI system once pressurizer water level is restored to the desired control point. The HPI makeup in combination with the letdown through one of the RCS Loop High Point vent pathways is sufficient to provide the boration necessary to offset the decay of Xenon-135 below the equilibrium value used in the core reactivity analysis. The PSW pump and its associated valves can be used to supply water to the SGs as necessary to control RCS temperature.

7.1.2 Double MSLB with the 4160VAC Essential Power System Available

In this scenario, both 4160VAC and 6900VAC power remain available. The 4160VAC Essential Power remains available to power safety systems as well as non-safety systems. Both MSIVs should automatically close. A postulated single active failure of one MSIV to close would result in one SG to continue to blowdown, The RCS overcooling would be similar to the MSLB with offsite power available case analyzed in UFSAR Section 15.13. However, in this scenario, no credit is taken for either MSIV to automatically close in order to maximize the RCS overcooling for conservatism in determining the effects on the reactor core. Although both Main Steam lines are assumed to be lost, the turbine-driven EFW pump is assumed to operate from an available steam source (i.e., auxiliary steam supplied by another unit).

The double MSLB with 4160VAC power available results in the HPI pumps and LPI pumps remaining available for event mitigation and maintaining the unit in a Safe Shutdown condition. Borated water injection is available from the CF tanks. In addition, the condensate and feedwater pumps remain available to feed the steam generators. This event is identical to the UFSAR Section 15.13 MSLB analysis with respect to the initial conditions and boundary conditions for the "with offsite power available" case. The primary difference is that both steam generators experience an uncontrolled depressurization. Cases were analyzed to evaluate the effects of various additional failures, operation of the ICS, and operation of the RCPs. The cases considered the following:

- Uncontrolled Main Feedwater addition with a loss of one 4160VAC Switchgear (RCPs on and off)
- Uncontrolled Main Feedwater addition with a failed open EFW flow control valve (RCPs on and off)
- Main Feedwater controlling SG water levels at various setpoints

A reactor power level of 102% full power is assumed to account for instrument uncertainty. An immediate reactor trip is conservatively assumed to maximize the overcooling effects for this event. Although LPI pumps remain available for this event, no credit is taken for boron injection from the LPI System. No credit is taken for automatic isolation of main or emergency feedwater during this event. The Condensate and Feedwater Systems are assumed to continue feeding the steam generators until the condensate inventory is depleted.

In all cases, it has been determined that there is no return-to-criticality (References 10.2.31 & 10.2.35). The limiting overcooling case for its affect on reactivity was a double MSLB with the

4kV equipment available and the RCPs left on (similar to the UFSAR Section 15.13 analysis). The case also assumed uncontrolled main feedwater addition with the additional failure to the 4kV system resulting in a loss of the HPI Train A. The results of this limiting case are provided below.

The double MSLB occurs with an initial power level of 102% FP. The reactor trips at 0.1 seconds. Power decreases rapidly after reactor trip with no return-to-criticality predicted for this case. The RCS pressure rapidly decreases causing HPI to actuate at approximately 21 seconds. Flow from a single HPI pump begins entering the RCS through the B train. Flow rapidly reaches its near maximum rate within the first two minutes. Following this, flow remains relatively constant for the remainder of the transient analysis. RCS pressure continues to rapidly decrease until the CFTs begin injecting at approximately 55 seconds. The majority of the water injected for the entire transient occurs during the first minute of injection. After this time, the RCS depressurization rate has dropped off. Some additional mass is injected up until the time the overcooling is terminated. RCS pressure gradually decreases to approximately 100 psig at 410 seconds. At this time, the Hotwell inventory has become depleted, resulting in the MFW pumps tripping off and terminating the overcooling event. RCS pressure gradually increases after this for the remainder of the transient run due to HPI injection and a gradual increase in RCS temperatures.

Pressurizer level drops off scale low within the first 15 seconds due to the rapid contraction of the RCS inventory. The RCS rapidly cools down to approximately 350°F during the first two minutes of the transient. The RCS average temperature continues to decrease to approximately 190°F until main feedwater is eventually lost. Pressurizer level returns on scale at approximately 530 seconds.

A large negative reactivity insertion occurs at the beginning of the transient due to the insertion of control rods following reactor trip. The cooldown causes positive reactivity insertion due to the negative moderator and Doppler coefficients. The uncontrolled MFW addition causes this positive reactivity insertion to increase during the transient. The injection of borated HPI water and CFT water causes the increase in total reactivity to subside; the reactor remains subcritical with a shutdown margin greater than 1% Δk/k throughout the transient.

Based on the reactor remaining subcritical post-trip, no return-to-criticality occurs. Secondly, the RCPs continue to operate in this case. Therefore, the DNBR is bounded by the double MSLB without offsite power case where RCPs are lost immediately.

Since the 4160VAC Essential Power System is available, the unit can be brought to the Cold Shutdown Condition immediately following the event. Operator actions are necessary to realign the LPI system from the emergency injection mode to the normal decay heat removal mode of operation. The SGs would be relied upon for decay heat removal until the change in LPI alignment has been completed. A number of water sources could be utilized for feeding the SGs. The affected unit's EFW source is from the UST (only) since the condensate in the hotwell has been depleted. EFW can be supplied from an alternate unit should the inventory in the UST on the affected unit be lost. PSW or SSF-ASW could also be utilized to supply water to the SGs until normal decay heat removal via the LPI system is achieved.

7.1.3 Double MSLB with a Loss of Offsite Power

This event assumes that the loss of offsite power is coincident with the double MSLB. Both MSIVs should automatically close. A postulated single active failure of one MSIV to close would result in one SG to continue to blowdown similar to the single MSLB analyzed in the UFSAR. However, in this scenario, no credit is taken for either MSIV to automatically close in order to maximize the RCS overcooling for conservatism in determining the effects on the reactor core. This event is similar to the event described in UFSAR Section 15.13.3 MSLB analysis with respect to the initial conditions and boundary conditions for the "without offsite power available" case. The differences are both steam generators experience an uncontrolled depressurization and the assumed initial reactor power level. The initial assumed reactor power is 100% full power. The transient RCS conditions for the MSLB without offsite power are within the ranges covered by the statistical core design (SCD) approach. Therefore the SCD methodology is utilized in the analysis for evaluating the DNBR. The SCD limit accounts for most of the uncertainties in key parameters. As a result no additional conservatism for initial reactor power is included in the double MSLB with a loss of offsite power event. The minimum DNBR for this event occurs during the first few seconds of the event. This event is considered to be bounded by the earlier cases discussed for effects on core reactivity and a potential return-to-criticality condition. Therefore, the analysis was only run out in time to determine the minimum DNBR, immediately following the reactor trip. The analysis shows that the minimum DNBR is within acceptable limits (Reference 10.2.31).

The previous discussions regarding subsequent plant cooldown and the establishment of Cold Shutdown Conditions contained in Sections 7.1.1 and 7.1.2 are applicable to this section. The methodology utilized for plant cooldown to Cold Shutdown Conditions is dictated by the availability or recovery of the 4160VAC Essential Power System.

7.2 Main Feedwater Line Breaks

Main Feedwater line breaks have been postulated in a number of locations as shown in Table 4.1-4, 5.1-4, and 6.1-4. In addition other HELBs may result in ruptures to Main Feedwater piping.

The various pipe breaks in the Main Feedwater System have been divided into three categories. These categories are:

- Main Feedwater Line Breaks in the Turbine Building
- Main Feedwater Line Breaks in the EPR upstream of the isolation check valves
- Main Feedwater Line Breaks in the EPR downstream of the isolation check valves

7.2.1 Main Feedwater Line Breaks Inside the Turbine Building:

The majority of the postulated Main Feedwater line breaks are located inside the Turbine Building. Certain Main Feedwater line breaks inside the Turbine Building can result in a complete loss of electrical power to the affected unit. This essentially creates a blackout condition on the affected unit. These breaks also result in a loss of the TDEFW pump on the affected unit. These breaks can result in ruptures to the CCW and LPSW piping. Ruptures in the CCW and LPSW piping can lead to Turbine Building flooding events which can fail all EFW pumps and LPSW pumps. The effect is that the unit experiences a complete loss of secondary system decay heat removal. The event leads to an overheating condition for the RCS. The RPS will trip the reactor on the loss of Main Feedwater pumps or on high RCS pressure. The pressurizer code safety valves are credited to relieve pressure to maintain RCS pressure below the safety limit (Reference 10.2.32). The Main Steam lines are assumed to remain intact with only the MSRVs lifting when the high Main Steam pressure setpoint is reached to maximize the RCS heatup.

Operator actions are needed to restore secondary side decay heat removal and RCP seal cooling to establish a Safe Shutdown Condition. The PSW System is designed to be placed into service and begin feeding the SGs within 15 minutes. The SSF-ASW System is designed to be placed into service and begin feeding the SGs within 15 minutes. Each system is capable of delivering sufficient flow to either SG with MS pressure being maintained at the MSRV setpoint. RCS makeup and RCP seal cooling is reestablished by re-powering an HPI pump and its associated valves needed for RCS makeup and seal cooling from the PSW electrical system. The SSF RCMU System can be placed into service to establish RCS makeup and RCP seal cooling. Each system is capable of being placed into service within 20 minutes to protect the RCP seals.

A Safe Shutdown condition can be maintained for an extended period of time from either the Control Room using the PSW and HPI Systems or from the SSF Control Room using the SSF-ASW and SSF RCMU Systems.

Plant cooldown requires the HPI System for sufficient makeup capability. Either the PSW System or the SSF-ASW System could be used to feed the steam generators for plant cooldown. Damage repair procedures are credited to restore power to an LPI pump, the decay heat drop line isolation valves (xLP-1 and xLP-2), and the CFT outlet valves (xCF-1 and xCF-2). In addition, damage repair procedures are credited to restore the LPSW System to provide cooling water to the LPI coolers. The LPI and LPSW Systems are needed to cool the plant to cold shutdown.

7.2.2 Feedwater Line Breaks Inside the EPR (Upstream of the FDW Isolation Check Valve):

The only breaks postulated on this section of feedwater piping are critical cracks. The effects of these breaks would be similar to the loss of Main Feedwater transient described in UFSAR section 10.4.7. The RPS will trip the reactor on high RCS pressure. Since the critical cracks are upstream of the Main Feedwater isolation check valves, there is no loss of SG pressure boundary. The EFW System is available to feed both SGs. The HPI System is available for normal makeup and RCP seal cooling. The RPS, EFW, and HPI are sufficient to achieve and maintain a Safe Shutdown condition. The pressurizer heater capacity is limited to one group of heaters. Should the available heater capacity be insufficient to accommodate heat losses from the pressurizer, a plant cooldown would be initiated. The atmospheric dump valves, in addition to HPI and EFW, are credited to cool the plant down to LPI entry conditions. The LPI and LPSW Systems are available to cool the plant down to the Cold Shutdown Condition.

7.2.3 Feedwater Line Breaks Inside the EPR (Downstream of the FDW Isolation Check Valve):

A break at this location results in a breach of the pressure boundary of one SG. However, unlike a MSLB, the analysis of this break (Reference 10.2.27) is initially similar to that of a loss of Main

Feedwater event. The RPS will trip the reactor on high RCS pressure in approximately 14 seconds. The main turbine would trip causing the main turbine stop valves to close, separating the Main Steam lines. However, unlike the loss of main feedwater event, one SG would blowdown. AFIS will automatically trip both Main Feedwater Pumps on low MS pressure in approximately 71 seconds. In addition, AFIS automatically closes the main and startup feedwater control valves on the affected SG. Emergency Feedwater is automatically terminated to the affected SG by the tripping of the motor-driven EFW pump aligned to the affected SG and stopping the turbine-driven EFW pump. A single active failure to the EFW flow control valve or motor-driven EFW pump aligned to the intact SG would result in a loss of secondary decay heat removal. The pressurizer code safety valves would be credited to limit RCS pressure within acceptable limits. Decay heat removal would need to be restored from one of the following:

- Reestablish EFW flow to the affected SG until the intact SG can be fed
- Bypass the failed EFW flow control valve to the intact SG using the non-safety startup feedwater control valve.
- Initiate forced HPI cooling until EFW flow can be restored to the intact SG
- Feed the intact SG from the new PSW or SSF System

RCS pressure does not decrease to the point where Engineered Safeguards System Digital Channels 1 and 2 would actuate the HPI System. A Safe Shutdown condition can be maintained with HPI normal makeup/seal injection and EFW flow to the unaffected SG. These systems remain available for plant cooldown. The atmospheric dump valve on the intact SG would be utilized to cool the plant down to LPI entry conditions. The LPI and LPSW Systems are available to cool the plant down to the Cold Shutdown Condition.

7.3 Letdown Line Break

The letdown line break is postulated to occur in the HPI system piping between the Reactor Building and the outside containment isolation valve (xHP-5). The analysis for this postulated break location is divided into two parts. The first part is the thermal-hydraulic transient analysis for the RCS and the determination of the resultant break flow. The second part of the analysis is the dose consequences resulting from the calculated break flow in the thermal-hydraulic analysis.

The thermal-hydraulic analysis for the postulated letdown line break is documented in reference 10.2.25. The RETRAN-3D computer code is used to determine the plant response resulting from a letdown line break. The analysis assumes a double-ended guillotine break of the 2 1/2" inch letdown line. The following major assumptions were used in the analyses:

a. Plant is assumed to be operating with an initial power of 102% rated thermal power.
b. Offsite power is assumed to remain available during the event which allows continued operation of the RCPs.
c. The ICS is assumed to be operating in automatic. This delays protection system actuation and maximizes break flow.
d. Pressurizer heater controls are assumed to remain operable. Operation of the pressurizer heaters will help to reduce the depressurization of the RCS further delaying protection system actuation and maximizing break flow.

e. Maximum flow from three pumps and two trains of HPI is assumed for injection into the RCS following an engineered safeguards signal. This maximizes the calculated break flow.
f. A single active failure to close xHP-3 upon an engineered safeguards signal is assumed.

The results of the thermal-hydraulic transient analysis show that the RPS trips the reactor on low or variable low RCS pressure at 193 seconds. Post-trip shrinkage and the inventory lost out the break continue to depressurize the RCS until Engineered Safeguards System Digital channels 1 and 2 actuate on low RCS pressure at 343 seconds. The Engineered Safeguards System signal automatically starts all available HPI pumps and opens the HPI injection valves. The Engineered Safeguards System signal also closes xHP-3 and xHP-4 to isolate the letdown line break. However, the assumed failure of xHP-3 to close, results in continued break flow. The injection flow from the HPI system exceeds the break flow and the RCS is eventually restored to normal post-trip conditions. After 1190 seconds, HPI is assumed to be throttled by the operator to control pressurizer level constant. The RCS pressure is restored to approximately 2185 psig and assumed to be maintained at that setpoint. The RCS temperature is being maintained at approximately 560°F. However break flow continues until operator action is taken to close xHP-1 to isolate the letdown break.

Operator action to close xHP-1 is considered to be a simple operation that can be performed from the Control Room. Once Engineered Safeguards System has actuated at approximately 6 minutes, the operator verifies that Engineered Safeguards System equipment has gone to their required position in accordance with the EOP. The verification step would identify the failure of xHP-3. The EOP provides guidance to close either xHP-1 or xHP-2 should xHP-3 or xHP-4 fail to close. A required operator response time to isolate the letdown line within 20 minutes following actuation of engineered safeguards digital channels 1 and 2 signal is established to mitigate the single active failure of xHP-3 or xHP-4 to close following a postulated pipe rupture in the letdown line.

The dose consequence of the postulated letdown line break is documented in reference 10.2.26. The radiological analysis utilizes computer code LOCADOSE. The calculated mass flow rate out of the break is used as an input to the dose analysis. In addition, the operator action to isolate the break within 20 minutes following actuation of engineered safeguards (or 26 minutes after the break initiation) to terminate the break flow is used as input to the dose analysis. The following major assumptions/considerations were used in the radiological analysis:

a. Guidance from Regulatory Guide 1.183 was used for alternate source term.
b. Standard Review Plan 15.6.2 was used for small line breaks outside containment.
c. Control room pressurization was assumed to be initiated within 30 minutes after engineered safeguards actuation (or 36 minutes after break occurs).
d. No fuel failures were assumed to occur as a result of the letdown line break.
e. No radioactivity enters the control room from areas in the plant other than the control room air intakes.
f. The release of radioactivity was assumed to occur out the blowout panels located on the exterior wall of the east penetration room.
g. A limit of 2.5 Rem (10% of the 25 Rem limit) total effective dose equivalent (TEDE) was applied to offsite doses.
h. A limit of 5 Rem TEDE was applied to the control room for the duration of the event.

The radiological analysis was performed using an iodine spike factor of 500 in accordance with SRP 15.6.2 and the break being isolated within 26 minutes following the break. The dose at the Exclusion Area Boundary (EAB) was calculated to be 1.3 Rem. The dose in the Low Population Zone (LPZ) was calculated to be 0.14 Rem. The control room dose was calculated to be 4.79 Rem. All of the calculated doses remain within the limits from 10 CFR 50.67 (Reference 10.1.8).

Normal plant systems remain available for this event. Plant cooldown and the establishment of the Cold Shutdown Condition can be achieved using the normal plant systems. The new PSW System and the SSF Systems are not credited for letdown line breaks.

8.0 EVALUATION OF THE ONS PLANT TO THE HELB REGULATORY REQUIREMENTS

The regulatory requirements for HELBs outside containment at ONS is based on the requirements contained in a request from the AEC dated 12/15/1972 (Giambusso Letter) and the errata sheet contained in a letter from the AEC dated 1/17/1973 (Schwencer Letter – References 10.1.1 and 10.1.2).

The HELB requirements can be summarized as follows:

1. The reactor can be shutdown and maintained in a Safe Shutdown condition and subsequently cooled to the Cold Shutdown Condition in the event of a postulated rupture, outside containment, of a pipe containing a high energy fluid, including the double ended rupture of the largest pipe in the Main Steam and Feedwater Systems.
2. Plant structures, systems, and components required to safely shutdown the reactor and maintain it in a Safe Shutdown condition should be protected or designed to withstand the effects of such a postulated pipe failure.
   The commission requested the following information from the licensee to assist them in their review to verify that the above HELB requirements could be met.

Item 1 in the Giambusso letter requested that pipe whip protection be provided to those systems that normally operate at temperatures greater than or equal to 200°F or have design pressures greater than or equal to 275 psig. Pipe whip protection would not be required if certain conditions could be met.

Duke has excluded some systems from consideration based on later guidance obtained from BTP MEB 3-1 (Reference 10.1.4). No HELB protection will be provided if the operating time of a system at high energy conditions is less than 1% of the total unit operating time (e.g. Emergency Feedwater, Reactor Building Spray), or if the operating time of a system at high energy conditions is less than 2% of the total system operating time (e.g. Low Pressure Injection). For systems meeting these limitations, no breaks or cracks are postulated. This is justified based on the very low probability of a HELB occurring during the limited operating time of these systems at high energy conditions. In addition, gas systems (e.g. Nitrogen) and oil systems (e.g. EHC) have been excluded, since these systems possess limited energy (Reference 10.3.17).

Items 2 and 3 in the Giambusso letter, as modified by the Schwencer letter, provided guidance on the selection of break locations based on a set of criteria. In addition a single critical crack was required to be postulated at the most adverse location(s) with regard to those essential structures and systems. The critical crack size area was taken to be 1/2 the pipe diameter in length and 1/2 the wall thickness in width.

Duke has modified the break selection criteria using GL 87-11 (Reference 10.1.5) and portions of BTP MEB 3-1 (Reference 10.1.4). Duke has postulated circumferential and longitudinal break locations as follows:

A. For piping that is seismically analyzed, i.e. stress analysis information is available and the analysis includes seismic loading, intermediate breaks are postulated in Class 2 or 3 piping at axial locations where the calculated longitudinal stress for the applicable load cases exceed $0.8(S_A + S_h)$. Applicable load cases include internal pressure, dead weight (gravity), thermal, and seismic (defined as operational basis earthquake, OBE). Intermediate breaks are not postulated at locations where the only stress is the expansion stress and this stress exceeds $0.8S_A$. Thermal stress is a secondary stress, and taken in absence of other stresses, does not cause ruptures in pipe.

B. For piping that is not rigorously analyzed or does not include seismic loadings, intermediate breaks are postulated in accordance with BTP MEB 3-1 (Section B.1.c(2)(b)(i)) (References 10.1.5, 10.1.6 & 10.1.7).

C. Terminal ends are vessel/pump nozzles, building penetrations, in-line anchors, and branch to run connections that act as essentially rigid constraints to piping thermal expansion. A branch appropriately modeled in a rigorous stress analysis with the run flexibility and applied branch line movements included and where the branch connection stress is accurately known, the stress criteria noted above is used for postulating breaks locations. For unanalyzed branch connections or where the stress at the branch connection is not accurately known, break locations are postulated in accordance with BTP MEB 3-1 (Section B.1.c(2)(b)(i)) (References 10.1.5, 10.1.6 & 10.1.7).

D. The Giambusso letter provided criteria to determine pipe break orientation at break locations and specifies that longitudinal breaks in piping runs and branch runs be postulated for nominal pipe sizes greater than or equal to 4 inches. Circumferential breaks are postulated at all terminal ends. The design of existing and potentially new rupture restraints may be used to mitigate the results from such breaks, including prevention of pipe whip and alteration of the break flow. Longitudinal breaks are not postulated at terminal ends, unless the piping at the terminal end contains longitudinal seam welds. This is consistent with the requirements of BTP MEB 3-1.

For the postulation of critical cracks, the following applies:

E. For piping that is seismically analyzed (i.e. stress analysis information is available and the analysis includes seismic loading), critical cracks are postulated in Class 2 or 3 piping at axial locations where the calculated longitudinal stress for the applicable load cases exceed $0.4(S_A + S_h)$. Applicable load cases include internal pressure, dead weight (gravity), thermal and seismic (defined as operational basis earthquake, OBE).

F. For non-seismically analyzed piping, critical cracks are not postulated, since the effects of postulated circumferential and longitudinal breaks at these locations will bound the effects from critical cracks (See Item B above).

Actual stresses used for comparison to the break and crack thresholds noted above are calculated in accordance with the Oconee piping code of record, USAS B31.1.0 (1967 Edition). Allowable stress values S_A and S_h are determined in accordance with the USAS B31.1.0 code or the USAS B31.7 (February 1968 Draft Edition with Errata) code as appropriate. Detailed criteria for HELB break locations and types are provided in Sections 2.2 of this report.

Item 4 in the Giambusso Letter requested that a summary be provided for the dynamic analysis applicable to the design of Category 1 piping and associated supports which determine the resulting loadings, including:

a. the locations and number of design basis breaks on which the dynamic analyses are based
b. the postulated rupture orientation for each design basis break location
c. a description of the forcing functions used for the pipe whip dynamic analyses including the direction, rise time, magnitude, duration and initial conditions that adequately represent the jet stream dynamics and the system pressure difference.
d. diagrams of mathematical models used for the dynamic analysis
e. a summary of the analyses which demonstrates that unrestrained motion of ruptured lines will not damage to an unacceptable degree, structure, systems, or components important to safety, such as the Control Room.

Dynamic analyses were performed for postulated pipe ruptures in the East Penetration Room to determine the internal pressurization of the room. A description of that analysis is given in the responses to Items 9 & 20 in this section of this report. Dynamic analysis of High Energy Category 1 piping postulated break locations and the effect on associated supports was not accomplished at Oconee. With the exception of two MFDW rupture restraints, located in the EPR, evaluations of the effects of whip and jet impingement associated with postulated break locations of Category 1 piping assumed unrestrained lines. The design of the MFDW rupture restraints are described in the response to Item 5 below.

Item 5 in the Giambusso Letter requested that a description be provided for the measures, as applicable, to protect against pipe whip, blowdown jet and reactive forces including:

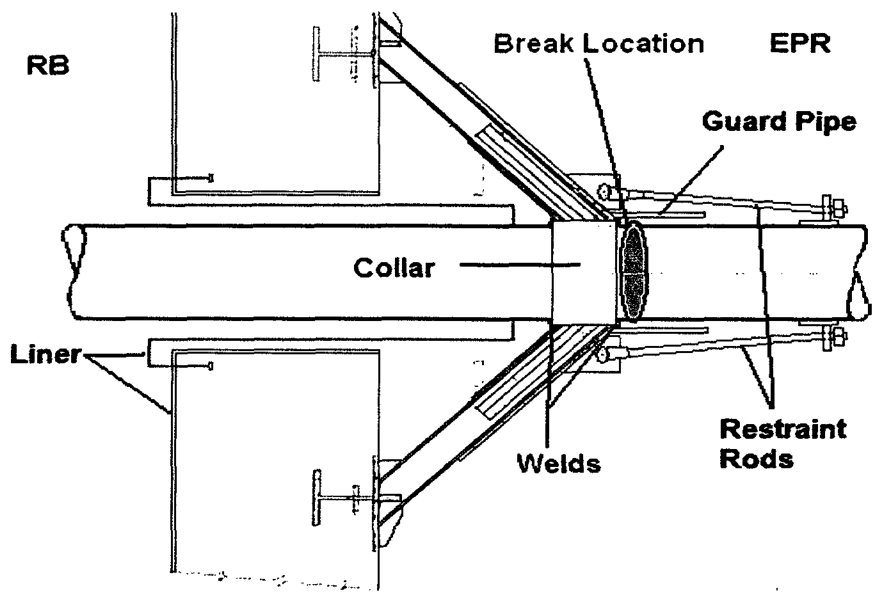
a. pipe restraint design to prevent pipe whip impact
b. protective provisions for structures, systems, and components required for safety against pipe whip, blowdown jet and reactive forces
c. separation of redundant features
d. provisions to physically separate piping and other components of redundant features
e. a description of the typical pipe whip restraints and a summary of number and locations of all restraints in each system.

Each MFDW train contains a rupture restraint, located in the EPR, adjacent to the respective RBU penetration. The rupture restraint consists of eight threaded rods that are attached at one end via clevises to vain plates that are in turn attached to the structure of the MFDW structural anchor. This anchor is attached directly to the exterior of the RBU wall. The structural anchor is considered a terminal end. The other end(s) of the threaded rods are attached to the MFDW pipe by welded attachments. At the welded attachments, the rods penetrated through holes in the welded attachments. Heavy hex nuts are threaded onto the rods. Gaps are provided between the heavy hex nuts and the welded attachments to allow thermal growth. A sketch of a MFDW rupture restraint is given below.

The MFDW rupture restraints are designed to prevent pipe whip of the lines into the EPR following a postulated double ended guillotine break just upstream of the structural anchor. No breaks are postulated immediately downstream of the structural anchor. The design limits the break gap to 0 inches insofar as possible based on the thermal expansion tolerances, and the physical properties of the restraint rods. A guard pipe is provided as part of the rupture restraint. The guard pipe limits jet impingement resulting from the postulated break. The guard pipe also directs flow of the leakage away from vulnerable mechanical and electrical equipment located in the EPR.

The guard pipe is designed for full system design pressure and temperature, 1275 psig, and 475°F. All load bearing members are designed to an allowable of .9 F_y for primary stresses, where F_y is the yield stress of the applicable material. A dynamic load factor of 3.0 is used for applicable load bearing members of the restraint.

Main Feedwater Rupture Restraint



There are no additional rupture restraints outside of containment, other than those described above.

The updated HELB mitigation strategy addresses the measures to be taken to minimize postulated pipe failures that could affect structures, systems, and components (SSC) necessary to achieve and maintain a Safe Shutdown condition. SSCs located in the TB are protected from postulated breaks and cracks that could occur in the AB due to separation. In addition, SSCs located in the AB are protected from postulated breaks and cracks that could occur in the TB. SSC's located in the Standby Shutdown Facility (SSF) are protected from breaks that could occur in the TB. SSF related systems and components located in the WPR have been evaluated for pipe ruptures postulated to occur in the WPR.

Item 6 in the Giambusso Letter requested procedures be provided that will be used to evaluate the structural adequacy of Category 1 structures and to design new seismic Category 1 structures, including:

a. the method of evaluating stresses, e.g., the working stress method and/or the ultimate strength method that will be used.
b. the allowable design stresses and/or strains
c. the load factors and the load combinations

Auxiliary Building (OSC-8602 – Reference 10.2.19):

Un-reinforced Block and Brick Walls

Method of Evaluating Stresses: Arch Method

Allowable Design Stress:

Flexure:		
	Brick:	.85 f_m = 935 psi
	Block:	.85 f_m = 850 psi
Shear:		
	Brick:	48.5 psi
	Block:	48.5 psi
Strain:		ε_c = .00085

Where: f'_m is the compressive strength of the brick or block, as appropriate.

Loading Combination:

Dead Load + Internal Pressure Load

Reinforced Concrete:

Method of Evaluating Stresses: Ultimate Strength and Yield Line/Plastic Hinge

Allowable Design Stress:

Compression:	f'_c = 5,400 psi
Flexure:	0.85 f'_c = 4,590 psi
Shear:	1.33 x 1.1 $(f'_c)^{1/2}$ = 107.5 psi
Bond:	1.33 x 3.4 $(f'_c)^{1/2}$ / D (for top bars)
Bond:	1.33 x 4.8 $(f'_c)^{1/2}$ / D (for other bars, not top bars)
Steel reinforcement:	f_y = 40,000 psi

Where: f'_c is the compressive strength of the concrete.
D is the diameter of the reinforcing bars (in.)

In cases where the components could not be qualified by the ultimate strength methodology, a yield line/plastic hinge methodology was used. This method used a yield line collapse mechanism approach to obtain the ultimate load of the component. Ductility and hinge rotation were then checked to ensure that the component could withstand the deformation(s). The following ductility limits were imposed:

Flexure (concrete beams):	$0.10 / \rho - \rho' \leq 10$
Flexure (slabs):	$0.10 / \rho - \rho' \leq 30$
Compression (walls and Columns):	1.3
Shear (beams and slabs)	
carried by concrete only	1.0
carried by concrete & stirrups	1.3
carried completely by stirrups	3.0

Where: ρ is the tension reinforcement ratio
ρ' is the compression reinforcement ratio

In addition, the following concrete plastic rotational limits must be satisfied:

$r_\theta \leq 0.0065$ d/c
and
$r_\theta \leq 0.07$

Where: r_θ is the actual rotational of plastic hinge, radians.
d is the effective depth of the section (distance from extreme compressive fiber to centroid of tensile reinforcement), in.
c is the distance from the extreme compressive fiber to neutral axis at ultimate strength, in.

Loading Combination:

Dead Load + Internal Pressure Load

$$Y = (1/\Phi)[1.05D + P]$$

Dead Load + Internal Flooding Load

$$Y = (1/\Phi)[1.05D + F]$$

Where: Y = Required strength of structure
D = Dead loads of the structure and equipment, plus any other permanent loads.
P = Design Accident Pressure
F = Design Flood Pressure
ϕ = Concrete capacity reduction factor
= .9 for concrete flexure
= .85 for tension, shear, bond, and anchorage in concrete

Steel Reinforced Masonry Walls

Flexure (Steel members):	$F_b = F_y = 36{,}000$ psi
Shear (Steel members):	$F_v = .6\ F_y = 21{,}600$ psi
Shear (7/8" Anchor Bolts):	V = 18,800 psi, factor of safety = 2.0

Dynamic Increase Factor (DIF): 1.2

Turbine Building (OSC- 7516.03, OSC-7517.03, & OSC-7518.03 – References 10.2.7, 10.2.41, & 10.2.54, respectively):

Steel Beams and Columns

Method of Evaluating Stresses: Linear Elastic

Allowable Design Stress:

Bending:	$F_y = 36{,}000$ psi
Shear:	$.6\ F_y = 21{,}600$ psi
Web Crippling:	$F_y = 36{,}000$ psi

Loading Combination:

1.0 D + 1.0 T

Where D = the dead load of the structure and equipment
T = the HELB thrust load

Item 7 in the Giambusso letter, as modified by the Schwencer letter, requested information regarding the structural design loads, including the pressure and temperature transients, the dead, live and equipment loads; and the pipe and equipment static, thermal and dynamic reactions.

The design loads utilized in the analysis for the Auxiliary Building are as follows:

1. Concrete	150 lbs. per cu. ft.
2. Block Walls	125 lbs. per cu. ft.
3. Structural Steel	490 lbs. per cu. ft.
4. Pressure and Temperature Transients	See Reference 10.2.3, Appendix A

The design loads utilized in the analysis for the Turbine Building are as follows:

1. Roof	25 lbs. per sq. ft. (psf)
2. Operating Floor (Total)	370 psf
Dead Load (Concrete Slab):	145 psf
Dead Load (Steel)	25 psf

Equipment Load	200 psf
3. Mezzanine Floor (Total)	240 psf
Dead Load (Concrete Slab):	100 psf
Dead Load (Steel)	15 psf
Equipment Load	125 psf
4. Pressure and Temperature Transients	Negligible

Item 8 in the Giambusso letter requested that Seismic Category 1 structural elements such as floors, interior walls, exterior walls, building penetrations and the buildings as a whole for eventual reversal of loads due to the postulated accident be analyzed.

The only areas of the plant outside containment subjected to reversal of load are the EPR and WPR ceilings at Elevation 838'+6. The ceiling structures are normally loaded with equipment and dead loads. Pressurization of the EPR and WPR due to postulated MFDW and MS HELBs located in the EPR will exert an upward load on the ceiling structure followed by a reestablishment of the equipment and dead loads.

Item 9 in the Giambusso letter requested that if new openings are to be provided in existing structures, demonstrate the capabilities of the modified structures to carry the design loads.

The north and west facing exterior block walls were removed from the Unit 1 EPR and replaced by lightweight panels in 1974. These panels were designed to relieve the internal pressure in the EPR, following either a MFDW or MS break. Analysis (See reference 10.2.14), to determine the pressure blowout capability of each panel, has been completed, considering their as-built configuration.

The computer code GOTHIC 4.0/DUKE (Reference 10.3.16) was used to model the EPR and West Penetration Room (WPR), and determine the resulting pressurization following either a MFDW break or a MS break. The model consists of four volumes, 36 junctions, and 27 "quick open" valves to represent the blowout panels. The pressure blowout capability (failure pressure) of each of the panels was then assigned to the appropriate "quick open" valves in the GOTHIC model to represent the failure of the panels following the pipe rupture. Pressure time histories were obtained for each junction. The structural components that comprise the EPR and WPR were then evaluated for the appropriate pressure time history.

Item 10 in the Giambusso letter requested that failure of any structure, including non-seismic Category 1 structures, caused by the accident, will not cause failure of any other structure in a manner to adversely affect:

a. mitigation of the consequences of the accident
b. capability to bring the unit(s) to a Cold Shutdown Condition

There is no damage postulated to the Auxiliary Building structure. Postulated ruptures in the Main Feedwater piping are limited to the terminal ends at the RBU wall. Whip restraints were installed to protect against the resultant pipe whips from the feedwater line breaks. There were no interactions with the Auxiliary Building structure due to pipe whips or jet impingement from the postulated Main Steam line break inside the penetration room. A postulated pipe rupture in the MS line or either of the Main Feedwater lines could result in pressurization of the penetration room. Blowout panels were installed in the exterior walls of the EPR to relieve the steam to outside to prevent excessive pressurization of the room. The peak pressure inside the penetration room was determined to be between 3.6 and 4.3 psig, and occurs between 0.1 and 0.2 seconds (Reference 10.2.3). The peak pressure was based on the double-ended MSLB. The pressure response for the MSLB bounds the other postulated HELBs inside the penetration room. The resulting pressure spike does not result in a failure of the penetration room structure. However, several unreinforced masonry walls are expected to crack and potentially fail (Reference 10.2.19). The Control Room and cable spreading room are protected by a structural reinforced wall between it and the penetration room. In addition the control battery room is protected by a reinforced wall between it and the penetration room.

Localized structural damage is postulated inside the Turbine Building. Although postulated pipe ruptures inside the TB will not result in any significant pressurization effect, pipe whip and jet impingement may result in interactions with structural components. The results of the structural interactions are provided below.

Unit 1 HELB Structural Interactions:

Structural components that are postulated to fail are contained in Tables 4.2-1 through 4.2-11. No structural damage was caused by the following Unit 1 systems inside the Turbine Building:

- Auxiliary Steam System
- Heater Vent System
- Plant Heating System
- Steam Seal System
- Steam Drain System

However, some localized structural damage to the Turbine Building was caused by specific breaks on the Condensate, Extraction Steam, Main Feedwater, Heater Drain, Main Steam, and Moisture Separator Reheater Drain Systems. These interactions are discussed in the subsequent paragraphs.

Unit 1 Condensate System

Running break 1-C-020-R is on the 24-inch condensate line bypassing 'E' Feedwater Heaters. Sub-break 6 interacts with floor beams Kb-17 and Kb-18 (two north-south intermediate floor beams spanning between column lines 17 and 18, between column lines K & L). The collateral damage resulting from this break does not interact with any Shutdown Equipment. However, the failure of this floor beam may result in collateral damage to both MS lines. Sub-breaks 1-C-019-R-3, 4, & 5 and 1-C-042-R-2 & 3 also impact structural members, but the collateral damage caused by these HELBs does include any Shutdown Equipment. The structural damage described herein does not prevent achieving and maintaining a Safe Shutdown condition and the subsequent cooldown to the Cold Shutdown Condition.

Unit 1 Extraction Steam System

Running break 1-ES-015-R is on the 42-inch '1C' Extraction line. Sub-break 1 interacts with Column H-17 and may result in its failure. The direct effects on plant equipment will not prevent the unit from achieving and maintaining a Safe Shutdown condition or plant cooldown to the Cold Shutdown Condition. The failure of the Column may result in debris blocking the pathway used to replace the LPSW pump motors following major plant damage. However, the break does not result in the loss of LPSW. Therefore, this structural failure does not prevent the establishment of the Cold Shutdown Condition.

Running break 1-ES-020-R is on the 36-inch Hot Reheat Line from the '1B1' SSRH to the '1C' Low Pressure Turbine. Sub-break 5 interacts with Column G-17 and may result in its failure. The direct effects on plant equipment will not prevent the unit from achieving a Safe Shutdown condition. However, collateral damage from the Column failure may result in a rupture to CCW piping. Ruptures in CCW piping can lead to Turbine Building flooding which can result in a complete loss of the EFW and LPSW Systems on all three units. In addition, the chilled water system that is used to provide cooling for all three units Control Rooms would be lost. Safe Shutdown can be maintained from the unit Control Rooms for an extended period of time using the PSW and HPI Systems with no credit being taken for control area cooling systems. Safe Shutdown can also be maintained from the SSF Control Room using SSF Systems. Plant cooldown to Cold Shutdown Conditions requires the use of the LPI and LPSW Systems. Following Turbine Building flooding events where LPSW pumps are lost, damage repair measures are credited for replacement of motors on one LPSW pump shared by Units 1 and 2 and one LPSW pump for Unit 3. There is a pre-defined pathway for LPSW motor replacement activities. The failure of Column G-17 should not result in structural damage that would block this pre-defined pathway. Therefore, damage repairs to restore LPSW remain available.

Floor beam Db-23, spanning north south between Column Db-23 and the connecting beam between columns Dd-24 and D-24 may fail from interactions by sub-breaks 3 & 4 on 1-ES-503-R02 and sub-breaks 2 & 3 on 1-ES-504-R02. These breaks are on the 18-inch Extraction Steam lines that supply the main FWPTs. The direct effects on plant equipment will not prevent the unit from achieving and maintaining a Safe Shutdown or plant cooldown to the Cold Shutdown Condition. The failure of the Column does not result in a loss of LPSW nor does it result in debris blocking the pathway used to replace the LPSW pump motors following major plant damage. Therefore, this structural failure does not prevent the establishment of the Cold Shutdown Condition.

Unit 1 Main Feedwater System

Column L-20 may fail from interactions created by Sub-breaks 3, 5, and 6 on 1-FDW-036-R. Running break 1-FDW-036-R is on the 24-inch inlet line to the '1B2' Feedwater Heater. The direct effects on plant equipment from these breaks will not prevent the unit from achieving a Safe Shutdown condition or plant cooldown to the Cold Shutdown Condition. The failure of the Column does not result in a loss of LPSW nor does it result in debris blocking the pathway used to replace the LPSW pump motors following major plant damage. Therefore, this structural failure does not prevent the establishment of the Cold Shutdown Condition.

Running break 1-FDW-030-R is on the 24-inch discharge line from the '1B' Main Feedwater Pump. Sub-breaks 12 and 13 interact with Column D-26 and may result in its failure. The direct effects from these breaks may result in the loss of 4160VAC power to Unit 1 and Unit 2 Shutdown Equipment. The loss of 4160VAC power on both Units 1 and 2 will result in the loss of LPSW for Units 1 and 2 as well as the loss of control area cooling for Units 1 and 2. The failure of Column D-26 may also result in collateral damage to CCW piping which will result in Turbine Building flooding. The pathway to achieving and maintaining a Safe Shutdown Condition can be made from the unit Control Rooms for an extended period of time using the PSW and HPI Systems with no credit being taken for control area cooling systems. A Safe Shutdown condition can also be maintained from the SSF Control Room using SSF Systems. Plant cooldown to Cold Shutdown Conditions requires the use of the LPI and LPSW Systems. The combined damage to the electrical systems and flooding of the Turbine Building basement requires damage repair measures to pull cables to one LPI pump motor for each unit, one LPSW pump motor shared by Units 1 and 2, and one LPSW pump motor for Unit 3. Since flooding of the Turbine Building has occurred, the LPSW motors will need to be replaced as well. The failure of Column D-26 may prevent damage repair measure from routing the LPI and LPSW pump motor cabling in the pre-defined pathway. Structural damage created by the Column D-26 failure may prevent the establishment of the Cold Shutdown Condition. A modification is planned to protect Column D-26 against failure (See Section 9.0).

Running break 1-FDW-031-R is on the 30-inch common discharge line from the Main Feedwater pumps. A number of sub-breaks interact with various Turbine Building structural components. Sub-break 7 interacts with Column Ga-24 and may result in its failure. The direct effects from this break does not impact equipment needed for achieving and maintaining a Safe Shutdown condition. However, collateral damage from the failure of Column Ga-24 may result in a rupture to the CCW piping leading to Turbine Building flooding. Safe Shutdown and plant cooldown to the Cold Shutdown Condition following Turbine Building flooding has been previously discussed (See Section 4.2.2.4). The failure of Column Ga-24 may result in debris blocking the pre-defined pathway to replacement of the 'A' LPSW pump motor. The pathway to the 'C' LPSW pump remains available. Plant damage repair procedures will need to be revised to include the option of replacing and re-powering the 'C' LPSW pump motor. Sub-break 8 interacts with a floor beam that spans between Column Ga-24 and the floor beam along Column Line 23 and may result in its failure. The direct effects of the break and the collateral damage created by the beam failure will not prevent achieving and maintaining a Safe Shutdown condition or plant cooldown to the Cold Shutdown Condition. Sub-break 9 interacts with Column G-23 and may result in its failure. The direct effects from this break does not impact equipment needed for achieving and maintaining a Safe Shutdown condition. However, collateral damage from the failure of Column G-23 may result in a rupture to the CCW piping leading to Turbine Building flooding. A Safe Shutdown condition can be achieved and maintained. However, plant cooldown from approximately the 250°F RCS condition to the Cold Shutdown Condition can be accomplished upon restoration of LPSW and LPI to an operable status. The failure of Column G-23 is not expected to block the pre-defined pathway to replace the LPSW pump motors. Sub-break 10 interacts with Column L-22 and may result in its failure. The direct effects of the break and the collateral damage created by the Column failure will not prevent achieving and maintaining a Safe Shutdown condition or plant cooldown to the Cold Shutdown Condition. Sub-break 11 interacts with Column K-23 and may result in its failure. The direct effects may lead to a loss of 4160VAC power on Unit 1. The collateral damage created by the failure of Column K-23 may result in a rupture in the CCW piping leading to Turbine Building flooding. Achieving and maintaining a Safe Shutdown condition and plant cooldown to the Cold Shutdown Condition following a loss of 4160VAC power and Turbine Building flooding has been previously discussed (See Section 4.2.2.4). The failure of Column K-23 is not expected to block the pre-defined pathways for LPSW pump motor replacement or the pre-defined pathway for cable routing to the LPI and LPSW pump motors. Therefore, the structural failures created by the various sub-breaks associated with running break 1-FDW-031-R do not prevent the establishment of Safe Shutdown or Cold Shutdown Conditions.

Running break 1-FDW-035-R is on the 24-inch inlet to the '1B1' Feedwater Heater. Sub-break 5 interacts with Column K-20 and may result in its failure. The direct effects of the break and the collateral damage created by the Column failure will not prevent achieving and maintaining a Safe Shutdown condition or plant cooldown to the Cold Shutdown Condition.

Unit 1 Heater Drain System

Column L-17 may fail from interactions created by Sub-break 5 on 1-HD-020-R, and Column L-18 may fail from interactions created by Sub-break 4 on 1-HD-075-R. Running break 1-HD-020-R is on the 24-inch common discharge from the '1D' HD pumps. Running Break 1-HD-075-R is on the 16-inch bypass around HP Heater 1B2. The direct effects from these breaks do not prevent the unit from reaching a Safe Shutdown condition or being cooled down to Cold Shutdown Conditions. The failure of either column may result in collateral damage to both MS lines. However, plant emergency systems remain available for achieving a Safe Shutdown condition and plant cooldown to the Cold Shutdown Condition.

Unit 1 Main Steam System

Break 1-MS-012 is on the 12-inch '1A' MS branch line to the SSRHs. The break interacts with a north-south floor beam spanning between Column Lines 13 & 14 (5'-6'' west of Column Line F) and may cause its failure. There were no other interactions identified for this break. The collateral damage created by the Column failure may result in damage to both MS lines. However, plant emergency systems remain available for achieving and maintaining a Safe Shutdown condition and plant cooldown to the Cold Shutdown Condition.

Unit 1 Moisture Separator Reheater Drain System

Column L-21 may fail due to interactions from sub-breaks 2 and 3 on 1-MSRD-020-R, 1-MSRD-045 and sub-break 25 on 1-MSRD-151-R02. All of these breaks are on the 18-inch SSRH drain tank line to the '1A' Feedwater Heaters. The direct effects from these breaks do not interact with any shutdown Equipment. Failure of the Column may also result in collateral damage to the condensate and feedwater piping. The damage does not prevent the unit from achieving and maintaining a Safe Shutdown condition. Systems remain available for unit cooldown to the Cold Shutdown Condition.

Running break 1-MSRD-134-R01 is on the 8-inch '1A2' SSRH drain line to the '1A' SSRH Drain Tank. Sub-breaks 12 and 13 interact with a floor beam spanning Columns C-14 and C-15. The direct effects from these breaks do not interact with any Shutdown Equipment. The collateral damage created by failure of the floor beam does not impact any Shutdown Equipment. Therefore, systems remain available for achieving and maintaining a Safe Shutdown condition and plant cooldown to the Cold Shutdown Condition.

Unit 2 HELB Structural Interactions:

Structural components that are postulated to fail are contained in Tables 5.2-1 through 5.2-9 & 5.2-11. No structural damage was caused by the following systems inside the Turbine Building:

- Auxiliary Steam System
- Heater Vent System
- Plant Heating System
- Main Steam System
- Steam Seal System
- Steam Drain System

However, some localized structural damage to the Turbine Building was caused by specific breaks on the Condensate, Extraction Steam, Main Feedwater, Heater Drain, and Moisture Separator Reheater Drain Systems. These interactions are discussed in the subsequent paragraphs.

Unit 2 Condensate System

Running break 2-C-001-R is on the 24-inch discharge piping of the Condensate Booster pumps.

- Sub-break 3 interacts with Column G-35a and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure degrade the EFW, HPI and LPSW Systems. EFW is reduced to one MDEFWP to the 2A SG. PSW or SSF-ASW may be utilized to feed the SGs to mitigate a failure to the single available MDEFWP. Power is lost to one HPI pump, but two trains of HPI remain available for event mitigation as well as plant cooldown. LPSW could be lost due to a rupture in the SSW line. The PSW System would be utilized to supply cooling water to the HPI pumps to mitigate the loss of LPSW to support the HPI function. If the PSW System is not available, the HPI function may be lost. The SSF in combination with the MSIVs would be available to mitigate the loss of HPI function. Damage repair procedures would be utilized to restore cooling water to a CCW pump to allow restart of the CCW and LPSW Systems to enable a plant cooldown to the Cold Shutdown Condition. The failure of the column does not impact any of the pre-defined pathways utilized in the damage repair procedures to establish the Cold Shutdown Condition.
- Sub-breaks 4, 5, and 6 interact with G-32 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure may result in the flooding of the Turbine Building causing the loss of EFW and LPSW. In addition, a pipe rupture may occur on the SSW System supplied from Unit 1 & 2 LPSW. The PSW System is credited for performing the EFW function as well as supporting the HPI function due to the loss of LPSW. The SSF in combination with the MSIVs would be available to mitigate the loss of EFW and HPI functions, should the PSW System be lost. Damage repair procedures would be credited to replace the A LPSW Pump and 3A LPSW

Pump motors and to provide an alternate source of cooling water to the CCW pumps to restore LPSW function. These actions are necessary to enable a plant cooldown to the Cold Shutdown Condition. The failure of the column may impact the pre-defined cable routing pathway utilized in the damage repair procedures for providing DC power to the Emergency 4160V Switchgear. The switchgear is not needed for event mitigation or the establishment of the Cold Shutdown Condition. However, an alternate pathway for the cable routing remains available.

Running break 2-C-026-R01 is on the 24-inch inlet piping to the 2C2 Drain Cooler. Sub-break 3 interacts with Column L-40 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure may result in ruptures to both 2A and 2B 36-inch MS lines with a loss of all AC power to each unit. The PSW and HPI Systems would be credited for event mitigation. The SSF in combination with the MSIVs would be credited as an alternate means of event mitigation should the PSW/HPI Systems be lost. Damage repair procedures would be credited to restore power to one HPI pump (if PSW is not available) and one LPI pump on each unit. Power would also need to be restored to one CCW pump, the A LPSW Pump, and the 3A LPSW Pump to enable a plant cooldown to the Cold Shutdown Condition. The failure of the column does not impact any of the pre-defined pathways utilized in the damage repair procedures to establish the Cold Shutdown Condition.

Running break 2-C-033-R01 is on the 30-inch outlet piping from the 2C Heaters.

- Sub-breaks 2, 3, and 4 interact with a mezzanine floor beam spanning columns K-41 and L-41 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the beam failure may result in ruptures to both 2A and 2B 36-inch MS lines. However, AC power remains available for Unit 2 systems needed for event mitigation and for plant cooldown to the Cold Shutdown Condition. The failure of this beam does not impact any of the pre-defined pathways utilized in the damage repair procedures to establish the Cold Shutdown Condition should they be needed.
- Sub-breaks 5 and 6 interact with Column K-42 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure are similar to those of sub-breaks 2 through 4 except the failure of this column may impact the pre-defined power cable routing pathway utilized in the damage repair procedures for providing power to the 3A LPSW Pump. However, an alternate pathway for cable routing remains available, if needed.

Running break 2-C-037-R is on the 24-inch outlet piping from the 2F Heaters.

- Sub-break 5 interacts with Column H-32 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure may result in loss of Unit 2 EFW, a pipe rupture in the SSW System, Turbine Building flooding, and TBVs failing open. The PSW System would be credited for performing the EFW function as well as supporting the HPI function due to the loss of LPSW. The SSF in combination with the MSIVs would provide an alternate means for event mitigation if the PSW System is lost. Damage repair procedures would be credited to replace the A LPSW Pump Motor, the 3A LPSW Pump Motor, and to provide an alternate means of cooling for a

CCW pump to restore LPSW function and enable a plant cooldown to the Cold Shutdown Condition.

- Sub-break 6 interacts with Column H-33a and may result in its failure. The combined effects from this break are similar to that of sub-break 5 except there is no Turbine Building flooding. However, LPSW could be lost due to the rupture on the SSW line. The event mitigation is identical to that of sub-break 5. However, the damage repair procedures would be limited to restoring cooling water to a CCW pump to allow restart of the CCW and LPSW Systems to enable a plant cooldown to the Cold Shutdown Condition.
- The failure of the either column (H-32 or H-33a) may impact the pre-defined cable routing pathway utilized in the damage repair procedures for providing DC power to the Emergency 4160V Switchgear. However, an alternate pathway for the cable routing remains available. The failure of the column may also impact the pre-defined pathway for motor replacement and power cable routing for the 3A LPSW pump. An alternative pathway must be established.

Running break 2-C-087-R02 is on the 24-inch suction piping to the 2A Main Feedwater Pump. Sub-breaks 1 and 2 interact with a mezzanine floor beam spanning columns B-31 and D-31 and may result in its failure. The combined effects from direct interactions and the collateral damage created by the beam failure may result in a loss of all AC power to Units 1 and 2 with a loss of the Unit 2 TDEFWP. The PSW and HPI would be credited for event mitigation. The SSF in combination with the MSIVs would provide an alternate means of event mitigation. Damage repair procedures would be credited to restore power to one HPI pump (if PSW is not available) and LPI pump on Units 1 and 2 as well as the A LPSW Pump to enable a plant cooldown to the Cold Shutdown Condition. The failure of the beam may impact the pre-defined cable routing pathway utilized in the damage repair procedures for providing DC power to the Emergency 4160V Switchgear. However, an alternate pathway for the cable routing remains available.

Running break 2-C-088-R02 is on the 24-inch suction piping to the 2B Main Feedwater Pump. Sub-breaks 2 and 3 interact with a mezzanine floor beam spanning columns B-31 and D-31 and supports for the FWPT exhaust duct resulting in their failure. The combined effects from direct interactions and the collateral damage created by the beam and support failures may result in a loss of all AC power to Units 1 and 2 with a loss of the Unit 2 TDEFWP. In addition, pipe ruptures in the 2A MS supply to the FWPT and the MS supply to the Unit 2 TDEFWP may result in the blow-down of both the 2A and 2B MS lines. The PSW and HPI systems would be credited for event mitigation. The SSF in combination with the MSIVs would provide an alternate means of event mitigation. Damage repair procedures would be credited to restore power to one HPI pump (if PSW is not available) and an LPI pump on Units 1 and 2. Power would also need to be restored to the A LPSW Pump to enable a plant cooldown to the Cold Shutdown Condition. The failure of the beam may impact the pre-defined cable routing pathway utilized in the damage repair procedures for providing DC power to the Emergency 4160V Switchgear. However, an alternate pathway for the cable routing remains available.

Unit 2 Extraction Steam System

Running break 2-ES-015-R is on a 42-inch 2C extraction steam pipe. Sub-break 6 interacts with Column H-38 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure may result in the loss of Unit 2 EFW, degraded LPSW, and the TBVs failing open. The PSW and the SSF-ASW Systems would remain available to perform the EFW function. LPSW may be lost due to a pipe rupture on the SSW line. The PSW System would be utilized to supply cooling to the HPI pumps to mitigate the loss of LPSW to support the HPI function. If the PSW System is not available, the HPI function may be lost. The SSF in combination with the MSIVs would be available to mitigate the loss of HPI function. Damage repair procedures would be utilized to restore cooling water to a CCW pump to restore CCW and LPSW to enable a plant cooldown to the Cold Shutdown Condition. The failure of the column may impact the pre-defined pathway for motor replacement and power cable routing for the 3A LPSW Pump, should it be needed.

Running break 2-ES-019-R is on the 36-inch Hot Reheat piping from the 2A2 MSR. Sub-break 5 interacts with Column Fd-38 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure may result in degraded EFW, degraded LPSW, and the TBVs failing open. EFW is reduced to one MDEFWP to the 2B SG. PSW or SSF-ASW may be utilized to feed the SGs to mitigate a failure to the single available MDEFWP. Unit 1 & 2 LPSW is degraded by the loss of 'C' LPSW pump. Two LPSW pumps remain available to supply cooling water to the HPI pump motor coolers as well as the LPI coolers. The failure of the column does not impact any of the pre-defined pathways utilized in the damage repair procedures to establish the Cold Shutdown Condition.

Running break 2-ES-020-R is on a 36-inch Hot Reheat piping from the 2A1 MSR.

- Sub-break 3 interacts with Column H-39 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure may result in the loss of Unit 2 EFW, degraded LPSW, and the TBVs failing open. The PSW and the SSF-ASW Systems would remain available to perform the EFW function. LPSW could be lost due a rupture in the SSW line. The PSW System would be utilized to supply cooling to the HPI pumps to mitigate the loss of LPSW to support the HPI function. If the PSW System is not available, the HPI function may be lost. The SSF in combination with the MSIVs would be available to mitigate the loss of HPI function. Damage repair procedures would be utilized to restore cooling water to a CCW pump to allow restart of the CCW and LPSW Systems to enable a plant cooldown to the Cold Shutdown Condition. The failure of the column may impact the pre-defined pathway for motor replacement and power cable routing for the 3A LPSW Pump, if needed.
- Sub-breaks 4, 5, and 6 interact with columns G-37a, G-38, and G-33a, respectively. These interactions may result in the respective column failure. The combined effects from the direct interactions and the collateral damage created by the any of the column failures is similar to that previously described for sub-break 3 except the failure of any column does not impact any of the pre-defined pathways utilized in the damage repair procedures to establish the Cold Shutdown Condition.

Running break 2-ES-024-R is on a 42-inch 2C steam extraction pipe. Sub-break 6 interacts with Column C-38 and may result in its failure. The combined effects from direct interactions and the collateral damage created by the column failure may result in a loss of all AC power to Units 1 and 2 with a loss of the Unit 2 TDEFWP. In addition, a pipe rupture in the MS supply to the Unit 2

TDEFWP as well as possible failure of the TBVs in the open position may result in the blow-down of both the 2A and 2B MS lines. The PSW and HPI would be credited for event mitigation. The SSF in combination with the MSIVs would provide an alternate means of event mitigation. Damage repair procedures would be credited to restore power to one HPI pump (if PSW is not available) and LPI pump on Units 1 and 2 as well as the A LPSW pump to enable a plant cooldown to the Cold Shutdown Condition. The failure of the column does not impact any of the pre-defined pathways utilized in the damage repair procedures to establish the Cold Shutdown Condition.

Running break 2-ES-028-R is on the 36-inch Hot Reheat piping from the 2A2 and 2A2 MSRs. Sub-breaks 4L and 5L interact with Column Fd-38 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure may result in the loss of Unit 2 EFW and degraded LPSW. The PSW and the SSF-ASW Systems would remain available to perform the EFW function. Unit 1 & 2 LPSW may be degraded due to a loss of C LPSW Pump. Two LPSW pumps remain available to supply cooling water to the HPI pump motor coolers as well as the LPI coolers. The failure of the column does not impact any of the pre-defined pathways utilized in the damage repair procedures to establish the Cold Shutdown Condition.

Running break 2-ES-211-R is on a 24-inch 2C extraction steam pipe. Sub-breaks 1 and 2 interact with Column Dc-39 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure may result in the loss of Unit 2 EFW, degraded LPSW, and a loss of main steam branch line isolation with the potential blow-down of both 2A and 2B SGs. The PSW and the SSF-ASW Systems would remain available to perform the EFW function. Unit 1 & 2 LPSW may be degraded due to a loss of 'C' LPSW pump. Two LPSW pumps remain available to supply cooling water to the HPI pump motor coolers as well as the LPI coolers. The failure of the column does not impact any of the pre-defined pathways utilized in the damage repair procedures to establish the Cold Shutdown Condition.

Unit 2 Main Feedwater System

Running break 2-FDW-008-R is on the 24-inch outlet piping from the 2B2 Heater. Sub-break 6 interacts with Column L-35 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure may result in a complete loss of AC power to each unit and flooding of the Turbine Building. In addition, the TBVs may fail open on Units 1 and 2 resulting in the possible blow-down of 1A, 1B, 2A, and 2B MS lines. The PSW and HPI would be credited for event mitigation. The SSF in combination with the MSIVs would provide an alternate means of event mitigation. Damage repair procedures would be credited to restore power to one HPI pump (if PSW is not available) and LPI pump on each unit. Power would also need to be restored to one CCW pump, the A LPSW Pump, and the 3A LPSW Pump to enable a plant cooldown to the Cold Shutdown Condition. The failure of the column may impact the pre-defined cable routing pathway utilized in the damage repair procedures for providing DC power to the Emergency 4160V Switchgear. However, an alternate pathway for the cable routing remains available.

Running break 2-FDW-033-R is on the 30-inch discharge piping from the Main Feedwater Pumps.

- Sub-breaks 2 and 3 interact with Column K-32 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure may result in a loss of AC power to Unit 2, flooding of the Turbine Building, and the TBVs failing open. The PSW and HPI would be credited for event mitigation. The SSF in combination with the MSIVs would provide an alternate means of event mitigation. Damage repair procedures would be credited to replace the A LPSW Pump Motor and the 3A LPSW Pump Motor (due to flooding) and restore power to one HPI pump (if PSW is not available) and LPI pump on Unit 2 to enable a plant cooldown to the Cold Shutdown Condition. The failure of this column may impact the pre-defined cable routing pathway utilized in the damage repair procedures for providing DC power to the Emergency 4160V Switchgear and power to the HPI and LPI pumps for all three units. However, an alternate pathway for the cable routing remains available.
- Sub-breaks 4 and 5 interact with Columns G-32 and L-33 and may result in their failure. The combined effects from the direct interactions and the collateral damage created by the column failure may result in a complete loss of AC power to all three units, flooding of the Turbine Building, a rupture in the B LPSW Essential Header, and the TBVs failing open on Units 1 and 2. The PSW and HPI would be credited for event mitigation. The SSF in combination with the MSIVs would provide an alternate means of event mitigation. Damage repair procedures would be credited to restore power to one HPI pump (if PSW is not available) and LPI pump on each unit. Power would also need to be restored to one CCW pump, the A LPSW Pump, and 3A LPSW pump to enable a plant cooldown to the Cold Shutdown Condition. The failure of these columns may impact the pre-defined cable routing pathway utilized in the damage repair procedures for providing DC power to the Emergency 4160V Switchgear. An alternate pathway for the cable routing remains available.
- Sub-breaks 7, 9L and 10L interact with Column Ga-31 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure may result in the loss of Unit 2 EFW, a rupture in the SSW piping, Turbine Building flooding, and the TBVs failing open. The PSW and HPI would be credited for event mitigation. The SSF in combination with the MSIVs would provide an alternate means of event mitigation. Damage repair procedures would be credited to replace the A LPSW Pump Motor, the 3A LPSW Pump Motor, and providing an alternate means of cooling for a CCW pump to enable a plant cooldown to the Cold Shutdown Condition. The failure of this column may impact the pre-defined cable routing pathway utilized in the damage repair procedures for providing DC power to the Emergency 4160V Switchgear. An alternate pathway for the cable routing remains available.

Running break 2-FDW-034-R02 is on a 24-inch inlet piping to the 2B1 Heater. Sub-breaks 1L and 2L interact with Column K-35 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure do not impact any safe shutdown equipment. The failure of the column does not impact any of the pre-defined pathways utilized in the damage repair procedures to establish the Cold Shutdown Condition.

Running break 2-FDW-035-R02 is on the 24-inch inlet piping to the 2B2 Heater. Sub-breaks 4 and 5 interact with Column L-35 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure may result in a complete loss of AC power to all three units, Turbine Building flooding, a rupture in the 2B MS line to the TBVs, and the TBVs failing open on Units 1 and 2. The PSW and HPI would be credited for event mitigation. The SSF in combination with the MSIVs would provide an alternate means of event mitigation. Damage repair procedures would be credited to restore power to one HPI pump (if PSW is not available) and LPI pump on each unit. Power would also need to be restored to one CCW pump, the A LPSW Pump, and the 3A LPSW Pump to enable a plant cooldown to the Cold Shutdown Condition. The failure of the column may impact the pre-defined cable routing pathway utilized in the damage repair procedures for providing DC power to the Emergency 4160V Switchgear. However, an alternate pathway for the cable routing remains available.

Unit 2 Heater Drain System

Running break 2-HD-021-R is on the 18-inch discharge piping from the 2D1 Heater Drain Pump. Sub-break 1 interacts with Column K-38 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure do not impact any safe shutdown equipment. The failure of the column does not impact any of the pre-defined pathways utilized in the damage repair procedures to establish the Cold Shutdown Condition.

Unit 2 Moisture Separator Reheater Drain System

Running break 2-MSRD-020-R02 is on the 18-inch outlet piping from the SSRH Drain Tanks. Sub-breaks 12 and 13 interact with Column L-37 and may result in its failure. The combined effects from the direct interactions and the collateral damage created by the column failure may result in a complete loss of AC power to all three units, a rupture in the 36-inch 2A MS line, and a rupture in a 12-inch 2B MS branch line. The PSW and HPI would be credited for event mitigation. The SSF in combination with the MSIVs would provide an alternate means of event mitigation. Damage repair procedures would be credited to restore power to one HPI pump (if PSW is not available) and LPI pump on each unit. Power would also need to be restored to one CCW pump, the A LPSW Pump, and the 3A LPSW Pump to enable a plant cooldown to the Cold Shutdown Condition. The failure of the column may impact the pre-defined cable routing pathway utilized in the damage repair procedures for providing DC power to the Emergency 4160V Switchgear. However, an alternate pathway for the cable routing remains available.

Unit 3 HELB Structural Interactions:

Structural components that are postulated to fail are contained in Tables 6.2-1 through 6.2-11. No structural damage was caused by the following systems inside the Turbine Building:

- Auxiliary Steam System
- Heater Vent System
- Plant Heating System
- Steam Seal System
- Steam Drain System

However, some localized structural damage to the Turbine Building was caused by specific breaks on the Condensate, Extraction Steam, Main Feedwater, Heater Drain, Main Steam, and Moisture Separator Reheater Drain Systems. These interactions are discussed in the subsequent paragraphs.

Unit 3 Condensate System

Running Break 3-C-001-R is located on the 24-inch discharge piping of the Condensate Booster Pumps.

- Sub-breaks 2 and 6 interact with Column H-50 and Sub-break 6 also interacts with Column G-49a. Interactions with these columns may result in the failure of the columns. The combined effects from the direct interactions and collateral damage created by the column failures degrade the Unit 3 EFW System, may cause a loss of the SSW System in all three (3) units, cause a loss of Transformer CT3, cause the loss of the AFIS trip signal to the FWPTs, and cause a loss of the Unit 2 Channel 4 AFIS MS pressure signal. This postulated HELB may also cause the TBVs to fail open and the valves that isolate the MS system from the SSRHs may fail open, which would result in the blow-down of both the 3A and 3B MS lines. This postulated HELB may also cause Turbine Building flooding. The Turbine Building flooding will result in the loss of all EFW and possibly all LPSW Systems in all three (3) Units. The Chilled Water System that is used to provide cooling for all three (3) units' Control Rooms would also be lost.

  The PSW and HPI would be credited for event mitigation. The SSF, in combination with MSIVs, would provide an alternate means of event mitigation. A Safe Shutdown condition can be maintained from the respective Control Rooms for an extended period of time using the PSW and HPI Systems with no credit being taken for control area cooling systems. A Safe Shutdown condition can also be maintained from the SSF Control Room using SSF Systems. Plant cooldown to Cold Shutdown Conditions requires the use of the LPI and LPSW Systems. Following Turbine Building flooding events where LPSW pumps are lost, damage repair measures are credited for replacement of motors on one LPSW Pump shared by Units 1 and 2 and one LPSW Pump for Unit 3. There are pre-defined pathways for LPSW Pump motor replacement activities. The failure of Columns H-50 and G-49a do not result in structural damage that would block these pre-defined pathways. Therefore, damage repairs to restore LPSW remain available.

- Sub-breaks 4 & 5 interact with Column G-46 and may result in the failure of this column. The combined effects from the direct interaction and collateral damage created by the column failure degrade the Unit 3 EFW System, cause the loss of the SSW System on all three (3) units, and cause the loss of the AFIS trip signal to the FWPTs & the closure signal to the FWCVs. This postulated HELB may also cause Turbine Building flooding that will result in the loss of all EFW and all LPSW Systems in all three (3) Units. The Chilled Water System that is used to provide cooling for all three (3) units' Control Rooms would also be lost.

  The PSW and HPI would be credited for event mitigation. The SSF, in combination with MSIVs, would provide an alternate means of event mitigation. A Safe Shutdown condition can be maintained from the respective Control Rooms for an extended period of time using the PSW and HPI Systems with no credit being taken for control area cooling systems. A Safe Shutdown condition can also be maintained from the SSF Control Room using SSF

Systems. Plant cooldown to Cold Shutdown Conditions requires the use of the LPI and LPSW Systems. Damage repair procedures would be utilized to restore cooling water to a CCW Pump to allow restart of the CCW and LPSW Systems to enable a plant cooldown to the Cold Shutdown Condition. Following Turbine Building flooding events where LPSW Pumps are lost, damage repair measures are credited for replacement of motors on one LPSW Pump shared by Units 1 and 2 and one LPSW Pump for Unit 3. There are pre-defined pathways for LPSW Pump motor replacement activities. The failure of Column G-46 does not result in structural damage that would block these pre-defined pathways. Therefore, damage repairs to restore LPSW remain available. Sub-breaks 4 & 5 effects and their mitigation strategies are further discussed in Subsection 6.2.2.2 of this report.

Running Break 3-C-005-R is located on the 16" Condensate Booster Pump "3C" discharge line. Sub-break 3 interacts with Column H-46. Interactions with this column may result in the failure of this column. The combined effects from the direct interactions and collateral damage created by the column failure cause loss of the SSW system, loss of the unit 3 EFW System, loss of Transformer CT3, loss of the AFIS trip signal to the FWPTs, loss of the AFIS signal to close the FWCVs, and loss of the unit 2 AFIS Channel 4 MS Pressure signal. In addition, this postulated HELB may cause the isolation valves between the Unit 3 MS System and the SSRH to fail open. PSW or SSF-ASW may be utilized to feed the SGs to mitigate the failure of the Unit 3 EFW System. LPSW could be lost due to a rupture in the SSW line. The PSW System would be utilized to supply cooling water to the HPI pumps to mitigate the loss of LPSW to support the HPI function. If the PSW System is not available, the HPI function may be lost. The SSF in combination with the MSIVs would be available to mitigate the loss of HPI function. Damage repair procedures would be utilized to restore cooling water to a CCW pump to allow restart of the CCW and LPSW Systems to enable a plant cooldown to the Cold Shutdown Condition. The failure of Column H-46 may impact the pre-defined pathway for motor replacement and power cable routing for a Unit 3 LPSW Pump, should it be needed. However, an alternate pathway for motor replacement and cable routing remains available.

Running Break 3-C-006-R is located on the 16" Condensate Booster Pump "3B" discharge line. Sub-breaks 3 & 4 interact with Column H-47a. Interactions with this column may result in the failure of this column. The combined effects from the direct interactions and collateral damage created by the column failure and mitigation of this event are similar to the analysis for running Break 3-C-005-R, except that the TBVs may fail open, and the AFIS signal to close the FWCV's is not affected.

Running Break 3-C-007-R is located on the 16" Condensate Booster Pump "3A" discharge line. Sub-break 3 interacts with Column H-48. Interactions with this column may result in the failure of this column. The combined effects from the direct interactions and collateral damage created by the column failure and mitigation of this event are similar to the analysis for running Break 3-C-005-R, except for three (3) items:

- The TBVs may fail open
- The AFIS signal to close FWCVs is not affected

- The failure of Column H-48 does not result in structural damage that would block any pre-defined pathways for motor replacement and power cable routing. Therefore, damage repairs to restore LPSW remain available.

Running Break 3-C-033-R02 is on the 30" outlet line from the "3C" Heaters. Sub-break 2 interacts with Column B-55. Interactions with this column may result in the failure of the column. The combined effects from the direct interactions and collateral damage created by the column failure may cause the isolation valves between the Unit 3 MS System and the SSRH to fail open and the rupture of the 8" Feedwater Pump Turbine 3B MS line after valve 3MS-36. This condition can be mitigated by closure of the upstream MS System branch line isolation valves or the MSIVs. No other Shutdown Equipment is adversely affected, and the failure of this beam does not impact any pre-defined pathways utilized in damage repair procedures to establish the Cold Shutdown Condition.

Running break 3-C-037-R is on the 24" outlet line from the "3F" Heaters. Sub-break 3 interacts with Column H-46, and Sub-break 4 interacts with Column H-47a. These sub-breaks have the same interaction effects as HELB breaks 3-C-005-R-3 and 3-C-006-R-3 & 4, respectively. Hence, the evaluations for breaks 3-C-005-R-3 and 3-C-006-R-3 & 4 are applicable to the respective 3-C-037-R Sub-breaks, and no further evaluation of the 3-C-037-R sub-breaks is required.

Unit 3 Extraction Steam System

Running Break 3-ES-015-R is located on the 42" High Pressure Turbine exhaust line to the "3A1" Moisture Separator Reheater. Sub-break 3 interacts with Column H-52, and interactions with this column may result in the failure of this column. The combined effects from the direct interactions and collateral damage created by the column would result in the failure of Shutdown Equipment and Turbine Building flooding the same as for postulated HELBs 3-C-001-R-2 & 6. Hence the evaluation description for the two postulated Condensate system HELBs apply to this break, and no further evaluation is required. The failure of Column H-52 does not result in structural damage that would block these pre-defined pathways. Therefore, damage repairs to restore LPSW remain available.

Running Break 3-ES-019-R is located on the 36" MSRH "3A2" outlet line to the "3A" Low Pressure Turbine. Sub-break 3 interacts with Column Fd-52, and interactions with this column may result in the failure of this column. The combined effects from the direct interactions and collateral damage created by the column failure may cause the loss of EFW Header 3A, the loss of the Unit 3 TDEFW Pump and loss of the Unit 3 AFIS trip signal to the FWPTs. This postulated HELB may also cause the TBVs to fail open and the valves that isolate the MS system from the SSRHs may fail open, which would result in the blow-down of both the 3A and 3B MS lines. This postulated HELB may also cause Turbine Building flooding. The Turbine Building flooding will result in the loss of all EFW possibly all LPSW Systems in all three (3) Units. The Chilled Water System that is used to provide cooling for all three (3) units' Control Rooms would also be lost. Because of the similarity to postulated HELBs 3-C-001-R-2 & 6, the evaluations for these breaks would also apply to break 3-ES-019-R-3, and no further evaluation is required. The failure of Column Fd-52 does not result in structural damage that would block these pre-defined pathways. Therefore, damage repairs to restore LPSW remain available.

Running Break 3-ES-020-R is located on the 36" MSRH "3A1" outlet line to the "3C" Low Pressure Turbine.

- Sub-break 2 interacts with Columns G-52 and G51a, and interactions with these columns may result in the failure of these columns. The combined effects from the direct interactions and collateral damage created by the column failures may cause the loss of EFW Header 3A, the loss of the SSW System, the loss of the Unit 3 TDEFW Pump, the loss of the ESV on all units, and the loss of the AFIS trip signal to the unit 3 FWPTs. This postulated HELB may also cause the valves that isolate the MS System from the SSRHs may fail open, which would result in the blow-down of both the 3A and 3B MS lines. This postulated HELB may also cause Turbine Building flooding. The Turbine Building flooding will result in the loss of all EFW possibly all LPSW Systems in all three (3) Units. The Chilled Water System that is used to provide cooling for all three (3) units' Control Rooms would also be lost.

  Because of the similarity to postulated HELBs 3-C-001-R-2 & 6, the evaluations for these breaks would also apply to break 3-ES-019-R-3, and no further evaluation is required. The failure of Columns G-52 and G-51a do not result in structural damage that would block any pre-defined pathways. Therefore, damage repairs to restore LPSW remain available.

- Sub-break 3 interacts with Column G-47a, and interactions with this column may result in the failure of this column. The combined effects from the direct interactions and collateral damage created by the column failure cause the loss of the SSW System, the loss of the unit 3 TDEFW Pump, the loss of the ESV on all units, and the loss of the AFIS trip signal to the Unit 3 FWPTs. This postulated HELB may also cause the valves that isolate the MS System from the SSRHs may fail open, which would result in the blow-down of both the 3A and 3B MS lines. This condition can be mitigated by closure of the upstream MS System branch line isolation valves or the MSIVs.

  The Unit 3 EFW System is reduced to the two (2) MDEFW Pumps. LPSW could be lost due to a rupture in the SSW line. If the LPSW is lost, the two (2) MDEFW Pumps would be lost. The PSW System would be utilized to supply cooling water to the HPI pumps to mitigate the loss of LPSW to support the HPI function. The EFW System function can be met by the crosstie to another unit's EFW System or use of the PSW-ASW Pump. If the PSW System is not available, the HPI function may be lost. The SSF in combination with the MSIVs would be available to mitigate the loss of HPI function. Damage repair procedures would be utilized to restore cooling water to a CCW pump to allow restart of the CCW and LPSW Systems to enable a plant cooldown to the Cold Shutdown Condition. The failure of Column G-47a does not impact the pre-defined pathway for motor replacement and power cable routing for a Unit 3 LPSW Pump. Therefore, damage repairs capabilities to restore LPSW remain available.

Running Break 3-ES-022-R is located on the 36" MSRH "3B1" outlet line to the "3C" Low Pressure Turbine. Sub-breaks 3 & 4 both interact with Columns B-49 and B-50, and interactions with these columns may result in the failure of these columns. The combined effects from the direct interactions and collateral damage created by the column failures may cause the loss of the Unit 3

TDEFW Pump and loss of the AFIS trip signal to FWPTs. The Unit 3 EFW System is reduced to two MDEFWPs. No other Shutdown Equipment is adversely affected. The failure of these columns do not impact any of the pre-defined pathways utilized in the damage repair procedures to establish the Cold Shutdown Condition.

Running Break 3-ES-024-R is located on the 42" extraction steam line from the High Pressure Turbine to the "3B1" Moisture Separator Reheater. Sub-break 5 interacts with Column C-52, and interactions with this column may result in the failure of this column. The combined effects from the direct interactions and collateral damage created by the column failure may cause the loss of the Unit 3 TDEFW Pump, may cause the valves that isolate the MS System from the SSRHs to fail open, and may cause the rupture of two MS branch lines, which would result in the blow-down of both the 3A and 3B MS lines. All of these failures can be can be mitigated by closure of the associated upstream MS System branch line isolation valve or the MSIVs. The Unit 3 EFW System is reduced to two MDEFWPs. No other Shutdown Equipment is adversely affected, and the failure of this column does not impact any of the pre-defined pathways utilized in the damage repair procedures to establish the Cold Shutdown Condition.

Unit 3 Main Feedwater System

Running Break 3-FDW-006-R is located on the 24" outlet line from Feedwater Heater "3B1." Sub-breaks 6 & 7 interact with column K-49 and may result in the failure of the column. The combined effects from the direct interactions and collateral damage created by the column failure do not adversely impact any Shutdown Equipment and no further evaluations are required. The failure of Column K-49 may impact the pre-defined pathway for motor replacement and power cable routing for a Unit 3 LPSW Pump, should it be needed. However, an alternate pathway for motor replacement and cable routing remains available.

Running Break 3-FDW-008-R is located on the 24" outlet line from Feedwater Heater "3B2." Sub-breaks 6 & 7 interact with column L-49 and may result in the failure of the column. The combined effects from the direct interactions and collateral damage created by the column failure cause the loss of transformer CT3, rupture of the 12" MS piping line downstream of valve 3MS-26, and the loss of the Unit 3 EFW System. This postulated HELB may also cause the TBVs 3MS-18 & 3MS-21 to fail open, the Ms to AS system isolation valves may fail open, the valves that isolate the MS System from the SSRHs may fail open, and the rupture of the 12" MS piping line, which would result in the blow-down of both the 3A and 3B MS lines. The mitigation of this condition would be made by closure of valves 3MS-17, 3MS-26, & 3MS-24 or the closure of the MSIVs. The shutdown Sequence for these postulated HELBs is to use the HPI System and the crosstie to another unit's EFW System. Power for unit would be provided through the Standby Buses. The Cold Shutdown Condition can be achieved by using the LPSW and the LPI Systems. These systems are backed up by the PSW and the SSF Systems, if any of the identified Shutdown Systems are not available. The failure of Column L-49 may impact the pre-defined pathway for motor replacement and power cable routing for a Unit 3 LPSW Pump, should it be needed. However, an alternate pathway for motor replacement and cable routing remains available.

Running Break 3-FDW-031-R is located on the 30"discharge line to the "3B" HP Heaters.

- Sub-break 4 interacts with Column K-46 and may result in the failure of the column. The combined effects from the direct interactions and collateral damage created by the column failure may cause the loss of the Unit 3 EFW System, the loss of the CT3 Transformer, the loss of both Unit 3 Main feeder Buses, the loss of the ESV System to all units, and the loss of the Unit 2 Channels 3 & 4 AFIS MS pressure signal. This postulated HELB may also cause Turbine Building flooding. The Turbine Building flooding will result in the loss of all EFW and possibly all LPSW Systems in all three (3) Units. The Chilled Water System that is used to provide cooling for all three (3) units' Control Rooms would also be lost.

  The PSW and HPI would be credited for event mitigation. The SSF, in combination with MSIVs, would provide an alternate means of event mitigation. A Safe Shutdown condition can be maintained from the respective Control Rooms for an extended period of time using the PSW and HPI Systems with no credit being taken for control area cooling systems. A Safe Shutdown condition can also be maintained from the SSF Control Room using SSF Systems. Plant cooldown to Cold Shutdown Conditions requires the use of the LPI and LPSW Systems. Following Turbine Building flooding events where LPSW pumps are lost, damage repair measures are credited for replacement of motors on one LPSW Pump shared by Units 1 and 2 and one LPSW Pump for Unit 3. There are pre-defined pathways for LPSW Pump motor replacement activities. The failure of Column K-46 may impact the pre-defined pathway for motor replacement and power cable routing for a Unit 3 LPSW Pump, should it be needed. However, an alternate pathway for motor replacement and cable routing remains available

- Sub-breaks 5, 6, & 8 interact with Column G-46, and Sub-break 8 also interacts with Column Ga-45. The combined effects from the direct interactions and collateral damage created by the column failure may cause the loss of numerous Shutdown Components. However, these postulated HELBs may also cause Turbine Building flooding that will result in the loss of all EFW and all LPSW Systems in all three (3) Units. The Chilled Water System that is used to provide cooling for all three (3) units' Control Rooms would also be lost.

  The PSW and HPI would be credited for event mitigation. The SSF, in combination with MSIVs, would provide an alternate means of event mitigation. A Safe Shutdown condition can be maintained from the respective Control Rooms for an extended period of time using the PSW and HPI Systems with no credit being taken for control area cooling systems. A Safe Shutdown condition can also be maintained from the SSF Control Room using SSF Systems. Plant cooldown to Cold Shutdown Conditions requires the use of the LPI and LPSW Systems. Damage repair procedures would be utilized to restore cooling water to a CCW Pump to allow restart of the CCW and LPSW Systems to enable a plant cooldown to the Cold Shutdown Condition. Following Turbine Building flooding events where LPSW Pumps are lost, damage repair measures are credited for replacement of motors on one LPSW Pump shared by Units 1 and 2 and one LPSW Pump for Unit 3. There are pre-defined pathways for LPSW Pump motor replacement activities. The failures of Columns G-46 & Ga-45 do not impact the pre-defined pathway for motor replacement and power cable routing for a Unit 3 LPSW Pump. Therefore, damage repairs to restore LPSW remain available.

Sub-breaks 4, 5, 6, & 8 and their effects and their mitigation strategies are further discussed in Subsection 6.2.2.4 of this report.

Running Break 3-FDW-034-R is located on the 20" bypass line around Feedwater Heater "3B2." Sub-break 1 interacts with column L-49 and may result in the failure of the column. The equipment adversely affected for this postulated HELB is the same as for breaks 3-FDW-008-R-6 & 7, and the same evaluation as for breaks 3-FDW-008-R-6 & 7 apply. As such, no further evaluation of this postulated HELB is required.

Running Break 3-FDW-036-R01 is located on the 24" inlet line to Feedwater Heater "3B2." Sub-breaks 2 & 4 interact with column L-49 and may result in the failure of the column. The equipment adversely affected for these postulated HELBs are the same as for breaks 3-FDW-008-R-6 & 7, and the same evaluation as for breaks 3-FDW-008-R-6 & 7 apply. As such, no further evaluation of these postulated HELBs are required.

Unit 3 Heater Drain System

Running Break 3-HD-021-R is located on the 18" discharge piping from the "3D1" Heater Drain Pump. Sub-break 1 interacts with column K-52 and may result in its failure. The combined effects from the direct interactions and collateral damage created by the column failure do not impact and Shutdown Equipment. Moreover, the failure of this column does not impact any of the pre-defined pathways utilized in the damage repair procedures to achieve the Cold Shutdown Condition.

Unit 3 Main Steam Line Breaks

Running Breaks 3-MS-066-R and 3-MS-067-R are located on the 8" piping immediately upstream of TBVs 3MS-22 & 3MS-19, respectively. Sub-Break 1 on each of these Running Breaks interacts with the Block Wall along Row N that separates the Turbine Building from the Auxiliary Building Reference 10.2.65). These postulated HELBs may result in the failure of the Block Walls.

The failure of these walls does not directly affect any Shutdown Equipment. The only Shutdown Component in the Ventilation Equipment Room 455 or the Vestibule 455B is the 24" Main Feedwater pipe, which cannot be targeted (References 10.2.59, 10.2.60, 10.2.66, & 10.2.67). Because of the failure of the wall along Row "N" neither room can pressurize and adversely affect the Main Feedwater line or the batteries in the adjacent Room 458. The only other concern would be the steam entering the Battery Room 458. This concern has been evaluated for the same condition in Unit 2 and found to not result in the loss of the 125 VDC Vital I & C Power System (Reference 10.2.50). Because of the lack of adverse interactions with Shutdown Equipment, no further evaluations are required, and the failure of this Block Wall does not impact any of the pre-defined pathways utilized in the damage repair procedures to achieve the Cold Shutdown Condition.

Unit 3 Moisture Separator Reheater Drain System

Running Break 3-MSRD-362-R02 is located on the 18" line from the Second Stage Reheater Drain Tanks "3A" & "3B" to the "A" Feedwater Heaters.

- Sub-breaks 1, 3L, & 4L interact with a North-South floor beam 5'-8' west of column H-52 and may result in the failure of the floor beam. The combined effects from the direct interactions and collateral damage created by the column failure may result in a loss of Transformer CT3, loss of the Unit 3 TDEFW Pump, loss of the 3A EFW header, loss of the SSW System, loss of the ESV System on all three (3) units, and the loss of the AFIS trip signal to the FWPT. In addition, the TBVs may fail open, the valves from the MS to the SSRHs may fail open and Turbine Building flooding may occur. The Turbine Building flooding will result in the loss of all EFW and possibly all LPSW Systems in all three (3) units. The Chilled Water System that is used to provide cooling for all three (3) units' Control Rooms would also be lost.

  The PSW and HPI would be credited for event mitigation. The SSF, in combination with MSIVs, would provide an alternate means of event mitigation. A Safe Shutdown condition can be maintained from the respective Control Rooms for an extended period of time using the PSW and HPI Systems with no credit being taken for control area cooling systems. A Safe Shutdown condition can also be maintained from the SSF Control Room using SSF Systems. Plant cooldown to Cold Shutdown Conditions requires the use of the LPI and LPSW Systems. Following Turbine Building flooding events where LPSW pumps are lost, damage repair measures are credited for replacement of motors on one LPSW Pump shared by Units 1 and 2 and one LPSW Pump for Unit 3. There are pre-defined pathways for LPSW Pump motor replacement activities. The failure of Column K-52 does not result in structural damage that would block these pre-defined pathways. Therefore, damage repairs to restore LPSW remain available.

- Sub-break 12 interacts with Column L-51 and may result in its failure. The combined effects from the direct interactions and collateral damage created by the column failure would be similar to that described in the previous item, except that the postulated Turbine Building flood would fail all LPSW Systems on all three (3) units. The pathway for achieving and maintaining a Safe Shutdown condition and the subsequent cooldown to the Cold Shutdown Condition would be the same as that described in the previous item.

Item 11 in the Giambusso Letter, as modified by the Schwencer letter, required that rupture of a pipe carrying high energy fluid will not directly or indirectly result in either:

a. loss of required redundancy in any portion of the protection system, Class 1E electrical system, engineered safeguards equipment, cable penetrations, or their interconnecting cables required to mitigate the consequences of that accident and place the reactor(s) in a Cold Shutdown Condition

OR

b. Environmental induced failures caused by a leak or rupture of the pipe which would not of itself result in protective action but does disable protection functions. In this regard, a loss of redundancy is permitted but a loss of function is not permitted. For such situations plant shutdown is required.

The core protection systems at ONS consist of the RPS and Engineered Safeguards Systems. The RPS trips the reactor to prevent exceeding acceptable fuel damage limits. The Engineered Safeguards System automatically initiates the HPI and LPI Systems on either a low RCS pressure or high RBU pressure. The cabinets for the RPS and Engineered Safeguards Systems are physically located inside the control complex. The cabinets are protected from the effects of postulated HELBs outside containment. HELBs outside containment can lead to either inadequate heat transfer or excessive heat transfer. The RPS trip on high RCS pressure is credited for inadequate heat transfer events. The RPS trip on low RCS pressure or variable low RCS pressure is credited for excessive heat transfer events. There are four RCS pressure and temperature instruments that feed the RPS. These instruments are located inside the RBU. The Engineered Safeguards System is only expected to be actuated following overcooling events. Overheating events result in high RCS pressure conditions. Overcooling events result in low RCS pressure conditions. The RBU pressure instruments are not required for HELBs outside containment. There are three RCS pressure transmitters that feed into the Engineered Safeguards System. These instruments are also located inside the RBU. The cabling from these instruments for RPS and Engineered Safeguards System are routed through the penetration rooms to the cable spreading room. The electrical penetrations and the associated cabling for the instruments are qualified for the environmental conditions inside the penetration room, and these cables are not directly impacted by any postulated HELBs in the penetration room. Therefore, there is no expected loss of required redundancy due to the effects of postulated HELBs outside containment.

The class 1E electrical system may be damaged by postulated HELBs inside the Turbine Building. The direct effects (pipe whip and jet impingement) from some HELBs may result in damage to the 4160VAC switchgears, 4160VAC main feeder buses, or associated cabling that may result in loss of the power sources to the 4160VAC/6900VAC electrical distribution systems. The effect would be similar to a station blackout. To address the consequence of a HELB induced blackout, two alternate means of achieving a Safe Shutdown condition are available. The first option is to activate the PSW System to maintain the Safe Shutdown condition from the unit Control Room. Electrical power to the PSW System is provided from either the 100kV power line or from a KHU aligned to the underground path. These sources of power are protected from the effects of HELBs inside the TB. The PSW pump can be started from the Control Room to feed either or both SGs to maintain secondary side heat removal. The PSW pump also supplies cooling water to the HPI pump motors. Power for one HPI pump can be restored from the PSW electrical system as well as selected motor-operated valves to align pump suction to the BWST and control flow to the RCS via the 'A' injection header and RCP seal injection. RCS pressure can be controlled by using pressurizer heaters powered from the PSW electrical system. Finally, the control batteries serving the 125VDC and 125VAC Vital I&C systems can be recharged from the battery chargers powered from the PSW electrical system. A second option would be to activate the SSF Systems to maintain the Safe Shutdown condition from the SSF Control Room. With the unit(s) being maintained in a Safe Shutdown condition, there is no immediate need for plant cooldown. Damage repair guidelines are credited to restore power to systems and components needed for plant cooldown to Cold Shutdown Conditions. As part of the damage repair procedures a portable valve control panel would be installed and wired to allow closure of the Core Flood Outlet Valves (CF-1 & CF-2) when conditions permit their closure. In addition, the portable valve control panel would allow the opening of the Decay Heat Drop Line Isolation Valves (LP-1 & LP-2) when entry conditions for normal decay heat removal are established. The portable valve control panel and associated cabling are part of the committed equipment used to meet the Appendix R program at ONS.

Some engineered safeguards equipment may be lost due to possible flooding inside the TB basement, specifically the LPSW pumps. The LPSW pumps for all three units are located in the TB basement. Some postulated HELBs inside the TB may result in ruptures to the CCW piping. Engineered safeguards equipment (HPI and LPI) located inside the AB are protected from the effects of flooding inside the Turbine Building by the existing flood protection measures/barriers and the TB drain located at the south end of the TB. The EFW pumps, although not classified as engineered safeguards equipment, are also located in the TB basement. TB flooding can result in the loss of LPSW and EFW on all three units. There are two alternate means of achieving and maintaining a Safe Shutdown condition using the PSW and SSF Systems. Damage repair guidelines are credited to restore the LPSW Systems once the source of flooding has been isolated to enable a plant cooldown to Cold Shutdown Conditions. Replacement motors and associated cabling for the LPSW pumps are part of the committed equipment used to meet the Appendix R program at ONS.

As a point of reference, the original HELB mitigation strategy, as documented in the MDS Report OS-73.2 (References 10.3.1 – 10.3.3), identified numerous break locations inside the TB that could result in the combined loss of main and Emergency Feedwater, as well as, the complete loss of 4160V power to Engineering Safeguards equipment on the affected unit. Modifications were implemented to provide an alternate means of providing the decay heat removal function utilizing Emergency Feedwater from an alternate unit to address the single active failure of the station auxiliary service water pump. However, a single HPI pump with a single source of electrical power, not vulnerable to HELB effects inside the TB, was credited for the plant cooldown function. In keeping with the original HELB mitigation strategy, two alternate means of achieving and maintaining a Safe Shutdown condition have been provided. Damage repair will continue to be credited to meet the plant cooldown function. Single active failures will not be postulated in establishing plant cooldown and the establishment of cold shutdown.

Item 12 in the Giambusso Letter requested that assurance be provided that the Control Room will be habitable and its equipment functional after a steam line or feedwater line break or that the capability for shutdown and cooldown of the unit(s) will be available in another habitable area.

Postulated Main Steam and Main Feedwater line breaks inside the AB is not expected to result in a loss of Control Room habitability. The integrity of the Control Room is protected by a reinforced concrete wall between it and the penetration room. However, a potential interaction with the Control Room HVAC System was discovered. Ductwork serving the Unit 1 Control Room is partially located inside a duct shaft adjacent to the penetration room. The unreinforced masonry walls of the duct shaft cannot be assured of not cracking and potentially failing due to the compartmental pressurization effects inside the penetration room. Potential damage to the ductwork could not be ruled out. Therefore, modifications will be implemented (See Section 9.0) to protect the affected ductwork from a possible failure of the unreinforced wall.

The cable spreading room is also protected by a combination of HELB blast walls and doors, as well as a reinforced concrete wall between it and the penetration room. However, the HVAC duct work serving the cable spreading room has a discharge register into the stairwell adjacent to the penetration room. The unreinforced masonry wall separating the stairwell from the penetration room cannot be assured of not cracking and potentially failing due to the compartmental pressurization effects inside the penetration room. A failure of this wall could fill the stairwell with steam from the postulated HELBs inside the penetration room. The discharge register from the cable room to the stairwell is equipped with a fire damper and should close if it were subjected to a steam environment. However, modifications will be implemented to assure that the environment in the stairwell does not communicate with the cable spreading room.

The electrical equipment room is located directly beneath the cable spreading room. The HVAC System serving this room is located in the same duct shaft that is adjacent to the penetration room above. Since the unreinforced masonry walls of the duct shaft above cannot be assured of not cracking and potentially failing, potential damage to the HVAC system and its associated duct work could not be ruled out. Therefore, modifications will be implemented to protect the HVAC unit and its associated ductwork inside the duct shaft from possible failure of the unreinforced wall above.

The 125VDC and 120VAC Vital I&C power system supports the continued operation of the systems and components needed for achieving and maintaining a Safe Shutdown condition. The associated unit's control batteries provide power to the 125VDC Vital I&C system. The control battery room is located adjacent to the penetration room. The battery room is protected by a blast wall and doors between it and the penetration room.

The Control Rooms, cable rooms, and electrical equipment rooms are provided with air conditioning systems, described in UFSAR Section 9.4.1, to maintain a suitable environment for personnel and equipment. Chilled water is supplied to the HVAC systems from the Control Room ventilation chilled water system as described in UFSAR Section 9.2.5. Electrical power to the HVAC systems as well as the chilled water system itself is vulnerable to the effects of HELBs inside the TB. A loss of HVAC systems does not result in an immediate loss of control from the Control Room. Analysis indicates that the Control Room, cable room, and electrical equipment rooms will remain habitable and the equipment located there remains functional should there be a loss of ventilation following a postulated HELB outside containment for an extended period of time (Reference 10.2.23). If needed, portable back-up ventilation systems can be provided for long term habitability. As a backup, the SSF Control Room is fully capable of monitoring and controlling the plant at SSD conditions using the SSF-ASW System and RCMU System.

Item 13 in the Giambusso Letter, as modified by the Schwencer letter, requested that environmental qualifications be demonstrated by test for that electrical equipment required to function in the steam-air environment resulting from a high energy fluid line break. The information required includes:

a. Identify all electrical equipment necessary to mitigate the consequences of the break and to bring the reactor to a Cold Shutdown Condition. Provide the time after the accident in which they are required to operate.

b. The test conditions and the results of test data showing that the systems will perform their intended function in the environment resulting from the postulated accident and the time interval of the accident. Environmental conditions used for the tests should be selected from a conservative evaluation of accident conditions.
c. The results of a study of steam systems identifying locations where barriers will be required to prevent steam jet impingement from disabling a protection system. The design criteria for the barriers should be stated and the capability of the equipment to survive within the protected environment should be described.
d. An evaluation of the capability for safety related electrical equipment in the Control Room to function in the environment that may exist following a pipe break accident should be provided. Environmental conditions used for the evaluation should be selected from conservative calculation of accident conditions.
e. An evaluation to assure that the onsite power distribution system and onsite sources (diesels and batteries) will remain operable throughout the event.

The only area of the plant considered to be a harsh environment following a postulated HELB outside containment is the penetration rooms. The breaks of concern are the Main Steam line breaks and the Main Feedwater line breaks. The worse case environmental profile created by these breaks has been documented in the EQCM (Reference 10.3.19). The equipment credited to mitigate the consequences of these breaks has been qualified for the resultant environment profile (Calculation OSC-8505 – Reference 10.2.17). Equipment located inside the TB will not be adversely affected by postulated HELBs inside the penetration room.

HELBs located inside the TB were previously determined to have negligible effects on the pressure and temperature inside the TB. As such, equipment located inside the TB has no EQ requirements applied to them. Duke will not be reanalyzing the environmental profile for the TB. Nor will any qualification testing be performed for equipment located inside the TB.

Due to the direct effects from pipe whip and jet impingement, the electrical distribution system inside the Turbine Building can be lost. As previously discussed two alternate means of achieving and maintaining a Safe Shutdown condition have been established. Power for these systems does not rely on any electrical equipment located inside the TB. The electrical system for the new PSW is located outside the TB. The cable routes will be made through the AB, if possible. Any cable routes through the Turbine Building will be protected from effects of postulated HELBs. The SSF electrical system is contained within the SSF structure. The cable routes for the SSF controlled systems do not pass through the TB.

Item 14 in the Giambusso Letter requested design diagrams and drawings of the steam and feedwater lines including branch lines showing the routing from containment to the Turbine Building. The drawings should show elevations and include the location relative to the piping runs of safety related equipment including ventilation equipment, intakes, and ducts.

The high energy boundaries of the MFDW and MS Systems are shown in Sections 4.1, 5.1, and 6.1 of this report. The interaction analyses for the postulated breaks and their impact on Shutdown Equipment are given in Section 4.2-4.3, 5.2 – 5.3 & 6.2 – 6.3 of this report.

Item 15 in the Giambusso Letter requested that a discussion be provided of the potential for flooding of safety related equipment in the event of failure of a feedwater line or any other line carrying high energy fluid.

Postulated pipe failures in the Main Feedwater System can lead to flooding inside the EPR. Flood protection modifications have been installed in these rooms. Flood outlet devices have been installed inside each EPR. The design assures that flood water from the Main Feedwater line breaks are released to outside at a rate sufficient to prevent submergence of the electrical penetrations in the EPR. The resulting water level inside of the EPR will be limited to two (2) feet. The Auxiliary Building floor structure can sustain a 2 foot flood height without failure (Reference 10.2.16). Flood impoundment walls were installed in each EPR to limit flood water from being released to other areas of the AB. Any water released to other areas of the AB could eventually reach the HPI pump rooms. The flood impoundment walls protect the HPI pump rooms from flooding caused by line breaks inside the EPR.

Postulated pipe ruptures on the discharge of the 'A' or 'B' HPI pumps could lead to flooding of the HPI pump rooms. Each Oconee unit has three (3) HPI Pumps and two HPI injection flow paths to the Reactor Coolant System. Sufficient time exists for the operators to diagnose and isolate the break to preclude the loss of all HPI pumps due to flooding. However, the current methods for isolation of the break could result in one HPI Pump and one flow path remaining available. Therefore, modifications will be implemented to support isolation of the faulted pump and maintain the HPI System in a configuration that maintains two pumps and two flow paths available for achieving and maintaining a Safe Shutdown condition (See Sections 4.2, 5.2, 6.2, and 9.0 of this report).

As previously discussed, certain HELBs inside the TB can result in a rupture to the CCW piping. Floods in the Turbine building can be identified by a flood detection system, which provides Control Room alarms of a flood. No flood protection will be provided for systems and components located in the TB basement. Achieving and maintaining a Safe Shutdown condition can be assured from either of the two alternate methods (PSW or SSF). Existing flood protection measures that prevent TB flooding from causing AB flooding is credited. Damage repair guidelines will be credited to terminate the source of flooding and repair those systems and components necessary to reach CSD (LPSW).

Item 16 in the Giambusso letter requested a description be provided of the quality control and inspection programs that will be required or have been utilized for piping systems outside containment.

Oconee has instituted an inspection program (Reference 10.3.26) that ensures that the Auxiliary Building (AB) MS and MFDW girth and accessible attachment welds are inspected, at least once, during each 10 year ASME Section XI in-service inspection interval. Girth welds will be inspected for internal weld flaws and weld thickness. Attachment welds will be inspected for surface indications. Initial inspections of the MS and MFDW girth and attachment welds located in the AB have been completed.

Unit 1
There are three (3) girth welds and one (1) attachment weld, located on the 'A' MS line in the East Penetration Room (EPR):

Weld ID	Weld Type	Inspection Type
1-MS9A-A	Girth (Shop)	UT
1-MS-0070-2BD	Girth (Field)	UT
1-MS10A-A	Girth (Shop)	UT
1-01A-O-550-H1	Attachment	MT or PT

The straight piping of the MS System in the EPR contains a longitudinal seam weld. This weld was made in the shop prior to installation. A one-time inspection of this seam weld was conducted in 2008 for Unit 1 (Reference 10.3.28).

For the MFDW System, there are fifteen (15) girth welds and three (3) attachment welds, located on both the 'A' and 'B' lines in the EPR:

Weld ID	Weld Type	Header	Inspection Type
1FWD-64-A	Girth (Shop)	A	UT
1-03-3-3 x 4	Girth (Field)	A	UT
1FWD-64-C	Girth (Shop)	A	UT
1-03-3-25C	Girth (Field)	A	UT
1-03-3-25D	Girth (Field)	A	UT
1-03-3-26C	Girth (Field)	A	UT
1-03-4-23B	Girth (Field)	A	UT
1-03-4-23G	Girth (Shop)	A	UT
1-FPA-27	Attachment (Rupture Restraint)	A	MT or PT
1-03-3-35C	Girth (Field)	B	UT
1-03-3-34C	Girth (Field)	B	UT
1-03-3-34G	Girth (Shop)	B	UT
1-03-3-33B	Girth (Field)	B	UT
1-03-3-32B	Girth (Field)	B	UT
1-03-3-32G	Girth (Shop)	B	UT
1-03-3-33G	Girth (Shop)	B	UT
1-FPA-26	Attachment (Rupture Restraint)	B	MT or PT
1-03-O-439A-H63	Attachment	B	MT or PT

In addition, the accessible terminal end welds inside the respective rupture restraint guard pipe on the 'A' and 'B' MFDW trains have received an initial inspection. A program has been initiated to inspect these terminal end welds during each 10 year ASME Section XI in-service inspection interval.

Inspections of piping base metal downstream of the respective MFDW isolation valves have been included with the weld inspection program noted above or included as part of the station's flow accelerated corrosion (FAC) inspection program. The table given below provides the scope of those inspections:

Weld ID or FAC ID	Weld / FAC Location	Header	Inspection Type
1FWD-64-C	Weld	A	UT
1-03-3-3 x 4	Weld	A	UT
1FWD-64-A	Weld	A	UT
1FDW076	FAC	A	UT
1-03-3-26C	Weld	A	UT
1FDW067	FAC	A	UT
1-03-3-25D	Weld	A	UT
1FDW068	FAC	B	UT
1-03-3-35C	Weld	B	UT

Oconee has committed to implement an inspection program that ensures that critical cracks located at welds and in the base metal away from welds, for other high energy lines located in the Auxiliary Building, would receive an inspection, at least once, during each 10 year ASME Section XI in-service inspection interval. Oconee has determined that no critical crack locations at welds or at base metal locations away from welds for other high energy lines exist in the Auxiliary Building. As such an inspection program is not needed at this time.

The new PSW System will be designed and constructed to meet Duke's standards for a safety related system (QA-1).

Unit 2

There are three (3) girth welds and one (1) attachment weld, located on the 'A' MS line in the East Penetration Room (EPR):

Weld ID	Weld Type	Inspection Type
2-MS9A-A	Girth (Shop)	UT
2-MS-0103-39	Girth (Field)	UT
2-MS10A-A	Girth (Shop)	UT
2-01A-O-1441-H1	Attachment	MT or PT

The straight piping of the MS System in the EPR contains a longitudinal seam weld. This weld was made in the shop prior to installation. A one-time inspection of this seam weld was conducted in 2008 for Unit 2 (Reference 10.3.29).

For the MFDW System, there are seventeen (17) girth welds and five (5) attachment welds, located on both the 'A' and 'B' lines in the EPR:

Weld ID	Weld Type	Header	Inspection Type
2-03-18-43A	Girth (Field)	A	UT
2-FWD60-A	Girth (Shop)	A	UT
2-FWD-60A-B	Girth (Shop)	A	UT
2-03-18-44AA	Girth (Field)	A	UT
2-03-18-43AA	Girth (Field)	A	UT
2-03-18-45	Girth (Field)	A	UT
2-03-18-44AB	Girth (Field)	A	UT
2-03-18-46G	Girth (Shop)	A	UT
2-03-18-46	Girth (Field)	A	UT
2-FPA-27	Attachment (Rupture Restraint)	A	MT or PT
2-03-O-1439B-H62	Attachment	A	MT or PT
2FDW-225-22B	Girth (Field)	B	UT
2-03-18-22C	Girth (Field)	B	UT
2-03-18-23A	Girth (Field)	B	UT
2-03-18-23G	Girth (Shop)	B	UT
2-03-18-24	Girth (Field)	B	UT
2-03-18-24G	Girth (Shop)	B	UT
2-03-18-25	Girth (Field)	B	UT
2-03-18-25G	Girth (Shop)	B	UT
2-FPA-25	Attachment (Rupture Restraint)	B	MT or PT
2-03-O-1439A-H63	Attachment	B	MT or PT
2-03-O-1439A-H61	Attachment	B	MT or PT

In addition, the accessible terminal end welds inside the respective rupture restraint guard pipe on the 'A' and 'B' MFDW trains have received an initial inspection. A program has been initiated to inspect these terminal end welds during each 10 year ASME Section XI in-service inspection interval.

Inspections of piping base metal downstream of the respective MFDW isolation valves have been included with the weld inspection program noted above or included as part of the station's flow accelerated corrosion (FAC) inspection program. The table given below provides the scope of those inspections:

Weld ID or FAC ID	Weld / FAC Location	Header	Inspection Type
2-FWD-60A-B	Weld	A	UT
2-03-18-43A	Weld	A	UT

Weld ID or FAC ID	Weld / FAC Location	Header	Inspection Type
2-FWD60-A	Weld	A	UT
2FDW043	FAC	A	UT
2-03-18-43AA	Weld	A	UT
2-03-18-45	Weld	A	UT
2FDW036	FAC	A	UT
2-03-18-44AA	Weld	A	UT
2FDW-225-22B	Weld	B	UT
2FDW037	FAC	B	UT

Oconee has committed to implement an inspection program that ensures that critical cracks located at welds and in the base metal away from welds, for other high energy lines located in the Auxiliary Building, would receive an inspection, at least once, during each 10 year ASME Section XI in-service inspection interval. Oconee has determined that no critical crack locations at welds or at base metal locations away from welds for other high energy lines exist in the Auxiliary Building. As such an inspection program is not needed at this time.

Unit 3

There are three (3) girth welds and one (1) attachment weld, located on the 'A' MS line in the East Penetration Room (EPR):

Weld ID	Weld Type	Inspection Type
3-MS9B-A	Girth (Shop)	UT
3-01A-13-01	Girth (Field)	UT
3-MS10B-A	Girth (Shop)	UT
3-01A-O-2441-H1	Attachment	MT or PT

The straight piping of the MS System in the EPR contains a longitudinal seam weld. This weld was made in the shop prior to installation. A one-time inspection of this seam weld was conducted in 2007 for Unit 3 (Reference 10.3.31).

For the MFDW System, there are seventeen (13) girth welds and six (6) attachment welds, located on both the 'A' and 'B' lines in the EPR:

Weld ID	Weld Type	Header	Inspection Type
3-03-31-8	Girth (Field)	A	UT
3-03-31-10	Girth (Field)	A	UT
3-03-31-10G	Girth (Shop)	A	UT
3-03-31-13	Girth (Field)	A	UT
3-03-31-13G	Girth (Shop)	A	UT
3-03-31-15A	Girth (Field)	A	UT
3-03-31-15G	Girth (Shop)	A	UT
3-03-31-16A	Girth (Field)	A	UT

Weld ID	Weld Type	Header	Inspection Type
2-03-18-46	Girth (Field)	A	UT
3-FPA-27	Attachment (Rupture Restraint Lug Attachments)	A	MT or PT
3-03-O-2439B-H54	Attachment	A	MT or PT
3-PEN-27-WHIP	Attachment (Rupture Restraint Collar Weld)	A	Visual
3-03-31-3	Girth (Field)	B	UT
3-03-31-3G	Girth (Field)	B	UT
3-03-31-5A	Girth (Field)	B	UT
3-03-31-5G	Girth (Shop)	B	UT
3-03-31-6A	Girth (Shop)	B	UT
3-FPA-25	Attachment (Rupture Restraint Lug Attachments)	B	MT or PT
3-03-O-2439B-H64	Attachment	B	MT or PT
3-PEN-25-WHIP	Attachment (Rupture Restraint Collar Weld)	B	MT or PT

The weld IDs 3-PEN-27-WHIP and 3-PEN 25-WHIP are the accessible terminal end (collar) welds inside the respective rupture restraint guard pipe on the 'A' and 'B' MFDW trains. These welds have also received an initial visual inspection. A program has been initiated to visually inspect these terminal end welds during each 10 year ASME Section XI in-service inspection interval.

Inspections of piping base metal downstream of the respective MFDW isolation valves have been included with the weld inspection program noted above or included as part of the station's flow accelerated corrosion (FAC) inspection program. The table given below provides the scope of those inspections:

Weld ID or FAC ID	Weld / FAC Location	Header	Inspection Type
3-03-31-16A	Weld	A	UT
3-FDW-046	FAC	A	UT
3-FDW-047	FAC	B	UT

Oconee has committed to implement an inspection program that ensures that critical cracks located at welds and in the base metal away from welds, for other high energy lines located in the Auxiliary Building, would receive an inspection, at least once, during each 10 year ASME Section XI in-service inspection interval. Oconee has determined that no critical crack locations at welds or at base metal locations away from welds for other high energy lines exist in the Auxiliary Building. As such an inspection program is not needed at this time.

Item 17 in the Giambusso Letter requested that if leak detection equipment is to be used in the proposed modifications, a discussion of its capabilities should be provided.

No leak detection equipment was used in the design of the FOD and flood impoundment features inside the EPR. No operator action is required to prevent unacceptable flooding inside the EPR. A postulated break in the RCP seal injection line in the WPR can result in potential flooding inside the WPR. However, due to the small line size and the flow controls provided by the seal injection flow control valve upstream of the break, the flow rate into the room is limited to approximately 40 gpm. A break in this line would be initially detected by a decreasing LDST level. The break on a seal injection line could be identified by observing the individual seal injection flow gauges inside the Control Room.

HPI pump discharge breaks are detected by decreasing LDST levels and the standby HPI pump auto starting on low seal injection flow.

There are two LDST level instruments. The instruments are QA-1 and are powered from a battery-backed source of power. They have a range of 0 to 100 inches. The LDST has a high and a low level alarm inside the Control Room. The level instruments are not vulnerable to the effects of a postulated break in the HPI System.

There is one RCP seal injection flow indication for each individual seal injection line. The instruments and indicators are non-QA and are powered from a non-battery backed source of power. Each flow indication has a range of 0 to 15 gpm. The flow instruments are not vulnerable to postulated seal injection line breaks. A loss of station power is not postulated concurrent with the postulated breaks requiring these instruments. Therefore, these instruments are judged to be available to diagnose a postulated break in the seal injection lines.

Item 18 in the Giambusso Letter requested that a summary be provided of the emergency procedures that would be followed after a pipe break accident, including the automatic and manual operations required to place the reactor unit(s) in a Cold Shutdown Condition. The estimated time following the accident for all equipment and personnel operational actions should be included in the procedure summary.

The consequences of the postulated pipe ruptures are described in Sections 4.2, 4.3, 5.2, 5.3, 6.2, & 6.3. Section 7.0 addresses the plant response for Main Steam line breaks, feedwater line breaks, and the letdown line break. These sections describe the actions (automatic and manual) that are needed to safely shutdown the reactor, maintain the reactor in a Safe Shutdown condition, and cool the unit down to the Cold Shutdown Condition.

The controlling procedure for mitigation of events that result in a reactor trip is EP/1, 2,3/A/1800/001, Emergency Operating Procedure (EOP) (Reference 10.3.12). This emergency procedure provides the guidance necessary to mitigate overheating events (loss of Main Feedwater), overcooling events (Main Steam Line Breaks), and loss of coolant events (Letdown Line Break). This procedure also provides guidance on plant cooldown when normal plant cooldown procedures cannot be used due to a loss of systems used during a normal plant cooldown.

Should the unit experience a loss of AC power or blackout condition, the EOP directs the operators to use AP/1,2,3/A/1700/011, Recovery From Loss of Power (Reference 10.3.13), to recover power to the main feeder buses and the 4160VAC switchgears. If RCP seal injection and the CC System are lost, the EOP directs the operators to use AP/0/A/1700/025, SSF Emergency Operating Procedure (SSF-EOP) (Reference 10.3.14), to reestablish RCP seal cooling. If Main Feedwater, Emergency Feedwater and HPI are lost, the EOP directs the operators to use the SSF-EOP to establish feedwater to the SGs from the SSF-ASW System. When the PSW System modifications are complete, the EOP will be revised to utilize the PSW System as the primary means of mitigating these consequences. The SSF would be used as a backup to the PSW System.

Turbine Building Flooding may be a consequence of certain HELBs inside the TB. The EOP direct the operators to use AP/1,2,3/A/1700/010, Turbine Building Flood (Reference 10.3.15), to mitigate the effects of flooding.

The SSF alone is not capable of supporting a plant cooldown. The Plant Assessment and Alignment Following Major Site Damage Procedure (References 10.3.21 & 10.3.22) could be used by the operators to assess availability of systems needed for plant cooldown and the establishment of cold shutdown. The assessment would identify repairs that would be needed to proceed to the Cold Shutdown Condition. The Cooldown Following Major Site Damage Procedure (References 10.2.21 & 10.2.23) would be used after the completion of damage repairs identified by the damage assessment procedure. The cooldown procedure provides the guidance to establish Cold Shutdown Conditions.

Item 19 in the Giambusso Letter requested a description be provided of the seismic and quality classifications of the high energy fluid piping systems including the steam and feedwater piping that run near structures, systems, or components important to safety.

Unit 1 Configuration

There are twelve (12) Unit 1 High Energy Systems outside of the Containment identified for the ONS. These HE Systems are identified at the beginning of Section 4.0 of this report. The HE Systems and their HE piping are located in the Turbine Building, Auxiliary Building, Service (Administration) Building, and the Yard. Only the Main Steam System is located in the Yard, and only the Plant Heating System is located in the Service Building. All of the HE Systems except for the High Pressure Injection System are located in the Turbine Building, and only the MS, MFDW, HPI, and PH Systems are located in the Auxiliary Building. A detailed description of the location of each of the twelve (12) HE Systems and their sizes and operating parameters are provided in Section 4.1 of this report. The description of the classification and seismic status of the HE Systems in each building are discussed in the subsequent paragraphs.

Yard

The only HE System located in the Yard is the Main Steam System. The MS System in the Yard is seismically analyzed and is classified as Duke Class "F" piping. The MS System piping in the Yard is not routed near any systems important to safety, and the postulated HELBs or CRs in this area do not target the Containment.

Service Building

The only HE System in the Service Building is the Plant Heating System. The PH System piping in the Service Building is non-seismically analyzed Duke Piping Class "G" piping. There are no structures, systems, or components important to safety located in the Service Building.

Auxiliary Building

There are four (4) HE Systems located in the Auxiliary Building. These HE Systems include:

- Main Steam
- (Main) Feedwater
- High Pressure Injection (Charging Section & Letdown Section)
- Plant Heating

With the exception of the Plant Heating System piping and the HPI Pump "mini-flow" lines, all other HE piping in the Auxiliary Building is seismically analyzed.

The Plant Heating System piping is classified as Duke Piping Class "G," non-seismic piping. One of these piping lines is routed just outside of the Control Complex. However, because of the low internal pressure in the piping, the ZOI for this line does not affect the Control Complex. This PH System piping line is also routed near the booster fans for the Control Complex HVAC System, but no credit is taken for the use of these fans. For the other two (2) PH System piping lines in the Auxiliary Building one of the lines is isolated and is excluded as HE piping. The other is not routed near any equipment important to safety in the Auxiliary Building.

The HPI System HE piping is classified as Duke Piping Class "B" for the Charging Section (or HPI Pump discharge piping) piping and Duke Piping Class "C" for the Letdown Section piping. The Charging Section of HPI piping, including the RCP Seal Injection piping, is routed through the EPR & WPR from the HPI Pump Rooms. The interaction analysis for the HPI System piping in the Auxiliary Building is provided in Sections 4.2 and 4.3 of this report.

The Main Steam and (Main) Feedwater System piping in the Auxiliary Building is classified as Duke piping Class "F." These piping lines are routed through the EPR of the Auxiliary Building. The interaction analysis for these HE piping lines is provided in Sections 4.2 and 4.3 of this report.

Turbine Building

With the exception of the HPI System all of the other identified HE Systems are located in the Turbine Building. The only seismically analyzed HE piping in the Turbine Building are the Main Steam System & the associated Main Steam piping drains and the (Main) Feedwater System. The interaction analysis for each HE System in the Turbine Building is provided in Sections 4.2 and 4.3 of this report.

The (Main) Feedwater System HE piping is seismically analyzed from the inlet valves 1FDW-26 & 1FDW-21, of the "A" HP Feedwater Heaters to the Containment Penetrations. The seismically analyzed portions of the MFDW piping are Duke Piping Class "G" from these valves to the Feedwater valves 1FDW-41 & 1FDW-42 and 1FDW-32 & 1FDW-33. Downstream of these valves the MFDW System HE piping is Duke Piping Class "F." The MFDW System HE piping is Duke Piping Class "F," when the MFDW piping enters the Auxiliary Building.

The Main Steam System HE piping in the Turbine Building is mostly seismically analyzed piping lines. The only exceptions are the MS branch piping lines routed to the Auxiliary Steam header, the Condenser Steam Air Ejectors and the Emergency Air Ejector. The non-seismic MS system piping is Duke Class "G" piping. The seismically analyzed MS System HE piping is classified as Duke Class "F" along the MS piping lines to the Main Turbine and the TDEFWP Turbine. The piping to the Main Feedwater Pump Turbines downstream of valves 1MS-35 and 1MS-36 are classified as Duke Piping Class "G," and the piping downstream of valves 1MS-26, 1MS-17, 1MS-24, 1MS-33, 1MS-76, & 1MS-79 is classified as Duke Piping Class "G."

Unit 2 Configuration

There are twelve (12) Unit 2 High Energy Systems outside of the Containment identified for the ONS. These HE Systems are identified at the beginning of Section 5.0 of this report. The HE Systems and their HE piping are located in the Turbine Building, Auxiliary Building, and the Yard. Only the Main Steam System is located in the Yard. All of the HE Systems except for the High Pressure Injection System are located in the Turbine Building, and only the MS, MFDW, HPI, and PH Systems are located in the Auxiliary Building. A detailed description of the location of each of the twelve (12) HE Systems and their sizes and operating parameters are provided in Section 5.1 of this report. The description of the classification and seismic status of the HE Systems in each building are discussed in the subsequent paragraphs.

Yard

The only HE System located in the Yard is the Main Steam System. The MS System in the Yard is seismically analyzed and is classified as Duke Class "F" piping. The MS System piping in the Yard is not routed near any systems important to safety, and the postulated HELBs or CRs in this area do not target the Containment.

Auxiliary Building

There are four (4) HE Systems located in the Auxiliary Building. These HE Systems include:

- Main Steam
- (Main) Feedwater
- High Pressure Injection (Charging Section & Letdown Section)
- Plant Heating

With the exception of the Plant Heating System piping and the HPI Pump "mini-flow" lines, all other HE piping in the Auxiliary Building is seismically analyzed.

The Plant Heating System piping is classified as Duke Piping Class "G," non-seismic piping. There are three (3) Plant Heating System piping lines in the Auxiliary Building. One of these piping lines is routed to the Unit 2 Reactor Building Purge Heaters in the WPR. The second PH System piping line in the Auxiliary Building is routed to Air Handling Unit – 16 in the Ventilation Equipment Room 520. This piping line is routed directly into Room 520 from the Turbine Building. The third piping line is routed from the Turbine Building into Storage (Room) 408B and then over to the Package Steam Fired Water Heater within Room 408B. The interaction analysis for these PH System piping lines in the Auxiliary Building is provided in Section 5.2.1.4 of this report.

The HPI System HE piping is classified as Duke Piping Class "B" for the Charging Section (or HPI Pump discharge piping) piping and Duke Piping Class "C" for the Letdown Section piping. The Charging Section of HPI piping, including the RCP Seal Injection piping, is routed through the EPR & WPR from the HPI Pump Rooms. The interaction analysis for the HPI System piping in the Auxiliary Building is provided in Sections 5.2 and 5.3 of this report.

The Main Steam and (Main) Feedwater System piping in the Auxiliary Building is classified as Duke Piping Class "F." These piping lines are routed through the EPR of the Auxiliary Building. The interaction analysis for these HE piping lines is provided in Sections 5.2 and 5.3 of this report.

Turbine Building

With the exception of the HPI System all of the other identified HE Systems are located in the Turbine Building. The only seismically analyzed HE piping in the Turbine Building are the Main Steam System & the associated Main Steam piping drains and the (Main) Feedwater System. The interaction analysis for each HE System in the Turbine Building is provided in Sections 5.2 and 5.3 of this report.

The (Main) Feedwater System HE piping is seismically analyzed from the inlet valves 2FDW-26 & 2FDW-21, of the "A" HP Feedwater Heaters to the Containment Penetrations. The seismically analyzed portions of the MFDW piping are Duke Piping Class "G" from these valves to the Feedwater valves 2FDW-41 & 2FDW-42 and 2FDW-32 & 2FDW-33. Downstream of these valves the MFDW System HE piping is Duke Piping Class "F." The MFDW System HE piping is Duke Piping Class "F," when the MFDW piping enters the Auxiliary Building.

The Main Steam System HE piping in the Turbine Building is mostly seismically analyzed piping lines. The only exceptions are the MS branch piping lines routed to the Auxiliary Steam header, the Condenser Steam Air Ejectors, Steam Seal System, and the Emergency Air Ejector. The non-seismic MS system piping is Duke Class "G" piping. The seismically analyzed MS System HE piping is classified as Duke Class "F" along the MS piping lines to the Main Turbine and the TDEFWP Turbine. The piping to the Main Feedwater Pump Turbines downstream of valves 2MS-35 and 2MS-36 are classified as Duke piping Class "G," and the piping downstream of valves 2MS-26, 2MS-17, 2MS-24, 2MS-33, 2MS-76, & 2MS-79 is classified as Duke Piping Class "G."

Unit 3 Configuration

There are twelve (12) Unit 3 High Energy Systems outside of the Containment identified for the ONS. These HE Systems are identified at the beginning of Section 6.0 of this report. The HE Systems and their HE piping are located in the Turbine Building, Auxiliary Building, and the Yard. Only the Main Steam System and the Auxiliary Steam are located in the Yard. All of the HE Systems except for the High Pressure Injection System are located in the Turbine Building, and only the MS, MFDW, HPI, and PH Systems are located in the Auxiliary Building. A detailed description of the location of each of the twelve (12) HE Systems and their sizes and operating parameters are provided in Section 6.1 of this report. The description of the classification and seismic status of the HE Systems in each building are discussed in the subsequent paragraphs.

Yard

The only HE Systems located in the Yard are the Main Steam System and the Auxiliary Steam System. The MS System in the Yard is seismically analyzed and is classified as Duke Class "F" piping. The MS System piping in the Yard is not routed near any systems important to safety, and the postulated HELBs or CRs in this area do not target the Containment. The AS System piping in the Yard is non-seismic, Duke Class "G" piping. The interaction analysis for the Unit 3 AS System HELBS is provided in Section 6.2.2 of this report.

Auxiliary Building

There are four (4) HE Systems located in the Auxiliary Building. These HE Systems include:

- Main Steam
- (Main) Feedwater
- High Pressure Injection (Charging Section & Letdown Section)
- Plant Heating

With the exception of the Plant Heating System piping and the HPI Pump "mini-flow" lines, all HE piping on the other systems is seismically analyzed.

The Plant Heating System piping is classified as Duke Piping Class "G," non-seismic piping. There are two (2) Plant Heating System piping lines routed from the Turbine Building into the Auxiliary Building. One of these piping lines is routed to the Unit 3 Reactor Building Purge Heaters in Room 669. The second PH System piping line, which is routed from the Turbine Building into the Auxiliary Building, is routed into the Ventilation Equipment Room 565. This piping line then tees within Room 565 with one branch routed to AHU 3-7 & AHU 3-8 within Room 565. The other branch is routed out of Room 565, through the Unit 3 EPR, and then up to AHU 3-9 & AHU 3-10 in Room 651. The interaction analysis for these PH System piping lines in the Auxiliary Building is provided in Section 6.2.1.4 of this report

The HPI System HE piping is classified as Duke Piping Class "B" for the Charging Section (or HPI Pump discharge piping) piping and Duke Piping Class "C" for the Letdown Section piping. The

Charging Section of HPI piping, including the RCP Seal Injection piping, is routed through the EPR & WPR from the HPI Pump Rooms. The interaction analysis for the HPI System piping in the Auxiliary Building is provided in Sections 6.2 and 6.3 of this report.

The Main Steam and (Main) Feedwater System piping in the Auxiliary Building is classified as Duke Piping Class "F." These piping lines are routed through the EPR of the Auxiliary Building. The interaction analysis for these HE piping lines is provided in Sections 6.2 and 6.3 of this report.

Turbine Building

With the exception of the HPI System all of the other identified HE Systems are located in the Turbine Building. The only seismically analyzed HE piping in the Turbine Building are the Main Steam System & the associated Main Steam piping drains and the (Main) Feedwater System. The interaction analysis for each HE System in the Turbine Building is provided in Sections 6.2 and 6.3 of this report.

The (Main) Feedwater System HE piping is seismically analyzed from the inlet valves 3FDW-26 & 3FDW-21, of the "A" HP Feedwater Heaters to the Containment Penetrations. The seismically analyzed portions of the MFDW piping are Duke Piping Class "G" from these valves to the Feedwater valves 3FDW-41 & 3FDW-42 and 3FDW-32 & 3FDW-33. Downstream of these valves the MFDW System HE piping is Duke Piping Class "F." The MFDW System HE piping is Duke Piping Class "F," when the MFDW piping enters the Auxiliary Building.

The Main Steam System HE piping in the Turbine Building is mostly seismically analyzed piping lines. The non-seismically analyzed portions of the MS System in the Turbine Building include:

- MS piping downstream of the Turbine Bypass Inlet Block Valves 3MS-18, 3MS-21, 3MS-27, & 3MS-30
- MS branch piping to the Main Feedwater Pump Turbines downstream of valves 3MS-35 & 3MS-36
- MS branch to the Condenser Steam Air Ejectors
- MS branch piping to the Steam Seal System
- MS branch piping to the Emergency Air Ejector
- MS branch piping to the Auxiliary Steam System header from just upstream of valve 3AS-1

The non-seismic MS System piping is Duke Class "G" piping. The seismically analyzed MS System HE piping is classified as Duke Class "F" along the MS piping lines to the Main Turbine and the TDEFWP Turbine. The piping to the Main Feedwater Pump Turbines downstream of valves 3MS-35 and 3MS-36 are classified as Duke Piping Class "G," and the piping downstream of valves 3MS-26, 3MS-17, 3MS-24, 3MS-33, 3MS-76, & 3MS-79 is classified as Duke Piping Class "G."

Item 20 in the Giambusso Letter requested a description should be provided of the assumptions, methods, and results of analyses, including steam generator blowdown, used to calculate the pressure and temperature transients in compartments, pipe tunnels, intermediate buildings, and the Turbine Building following a pipe rupture in those areas. The equipment assumed to function in the analyses should be identified and the capability of systems required to function to meet a single active component failure should be described.

The only area of the plant analyzed for pressure and temperature transient was the penetration room inside the Auxiliary Building. The analysis is documented in Reference 10.2.3 and the equipment assumed to function is documented in Section 7.0 of this report. The analysis was performed using GOTHIC 4.0/DUKE (Reference 10.3.16). The blowout panel strengths and the various blowdown data for Main Steam line and Main Feedwater line breaks were used as inputs to the analysis. For MSLBs, the analysis assumes that no operator action is taken within the first 10 minutes of the event. The Main Feedwater pumps are assumed to be tripped by AFIS when the actuation setpoint is reached, but the Main Feedwater control valve is assumed to fail open. Main Feedwater is assumed to continue feeding the faulted SG via the Condensate Booster Pumps until Main Feedwater is isolated by the operator at 10 minutes. The turbine-driven EFW pump is assumed to be automatically stopped by AFIS when the actuation setpoint is reached. For FWLBs, the analysis assumes Main Feedwater continues until the condensate inventory is depleted (i.e. no operator action assumed to isolate Main Feedwater).

The results of a postulated Main Feedwater line break show a peak room pressure between 2.0 and 2.3 psig occurring between 0.5 and 0.6 seconds. The peak room temperature is between 218°F and 219°F and occurs at 36 seconds.

The results of a postulated Main Steam line break show a peak room pressure between 3.6 and 4.12 psig occurring between 0.1 and 0.2 seconds. The peak room temperature is approximately 528°F and occurs at 4.5 seconds.

Item 21 in the Giambusso Letter requested that a description be provided of the methods or analyses performed to demonstrate that there will be no adverse effects on the primary and/or secondary containment structures due to a pipe rupture outside these structures.

In general the RBU penetrations represent terminal ends in the piping analyses. These RBU penetrations are designed to withstand the forces and moments applied to the terminal end that could occur from postulated breaks located either inside or outside of containment.

The design of the MS and MFDW RBU penetrations differ from the other RBU penetrations. For these lines, structural anchors have been installed adjacent to the RBU penetrations. The MS anchors are located inside the RBU, while the MFDW anchors are located in the EPR. These anchors are designed to absorb the large forces and moments that could occur in the aftermath of either a postulated MS or MFDW break. The MS and MFDW anchors consist of a collar wrapped around the outside diameter of the piping. The collar is connected at both ends to the piping via two circumferential fillet welds. The collar is in turn welded to a series of structural wide flange members that span back to the RBU wall. The wide flange members are then welded to embedded structural tees located in the RBU wall. A simplified sketch of the MFDW anchor is show for Item 5 on Page 8-4 of this report.

9.0 MODIFICATIONS TO THE ONS TO MITIGATE THE EFFECTS OF POSTULATED HELBS

As a result of conducting the HELB evaluations for the ONS, changes (modifications) to the physical configuration of the station are necessary. This section describes these changes and their function relative to postulated HELBs in the ONS. Unless otherwise stated, the modifications described in this section of the report are applicable to all three (3) ONS Units. These changes are as follows:

East Penetration Room (EPR) Flood Protection

The EPR has been modified by addition of a Flood Outlet Device (FOD) and a flood impoundment barrier. These features consist of a drain (the FOD) from the EPR to outside of the Auxiliary Building and a water retention barrier around the inside perimeter of the EPR to retain flood waters inside of the EPR. The purpose of these features is to prevent postulated HELB induced floods in the EPR from spreading to the other compartments of the Auxiliary Building, and potentially adversely affecting other Shutdown Equipment. These features have been installed primarily to mitigate the flooding from a postulated HELB on a Feedwater System line, but they are also used for HPI Pump discharge line HELBs and the postulated HELB on the Letdown line at Containment Penetration #6.

Protected Service Water (PSW) System

The PSW System is designed as an additional backup system to the existing shutdown systems at the ONS. Its primary function is to provide an alternate means of a Unit shutdown, independent of any equipment in the Turbine Building. PSW is capable of achieving a Safe Shutdown condition for each Unit and maintaining that condition. It can also be used to cool the RCS (water) to ~250°F and maintain that temperature until the LPSW and the LPI Systems can be returned to an operational status. PSW, in conjunction with the SSF System, is used for achieving and maintaining a Safe Shutdown condition for the Units in the event that a postulated HELB in the Turbine Building causes the loss of the Shutdown Equipment in the Turbine Building.

PSW is a single train system capable of providing auxiliary power for selected Shutdown Equipment to all three (3) ONS Units simultaneously. The only component common to all three (3) Units is the PSW Pump, which consists of a primary pump and booster pump. This pump is sized to supply water to all six (6) SGs simultaneously. PSW is operated from the Main Control Room and consists of the following major equipment:

- Protected Service Water Pump for secondary side heat removal
- Alternate power supply to the "A" or "B" HPI Pumps in each Unit
- PSW Power Distribution System in a separate building with power feeds from Keowee via an underground line and the 100 kV overhead line
- Alternate power source for HPI valves, Pressurizer Heater Banks, Reactor Vessel & RCS vent valves, and 125 VDC I&C Battery Chargers
- Alternate Cooling Water Supply to HPI Pump Motor Coolers

Main Steam Isolation Valves (MSIVs)

MSIVs will be installed on each Main Steam (MS) Line just outside of the Turbine Building (TB). These valves will provide a stable platform for operation of the Standby Shutdown Facility and planned Protected Service Water system; obviate the need to use equipment in the TB; provide an assured means of MS pressure boundary control following damage in the TB; and facilitate repair of plant equipment following damage in the TB. These modifications will require an LAR whose submittal date has not been determined.

Upgrades of Valves xHP-1 and xHP-2

The inlet isolation valves to the Letdown Coolers on the Letdown Line, xHP-1 & xHP-2, will be upgraded to permit their use following a postulated HELB on the Letdown Line at Containment Penetration #6. With these valves upgraded either could then be closed if a single active failure of one of the inboard containment isolation valves, xHP-3 & xHP-4, occurs. With this modification the Letdown Line HELB would be isolated with any postulated single active failure on the Letdown Line.

Control Complex HVAC Modifications

Two sets of Control Complex HVAC modifications have been identified. The first modification will isolate certain Control Complex HVAC registers that communicate with unprotected areas of the Auxiliary Building that may be exposed to a steam air environment following either a MS or MFDW breaks in the EPR. The duct registers are located in rooms or passageways adjacent to the EPR. The barriers between the EPR and the adjacent rooms may not be structurally sufficient to provide protection from the effects of the MS or MFDW break. The registers will be covered to prevent the remote possibility of steam migrating through the open registers into the Control Complex.

The second set of Control Complex HVAC modifications regard certain portions of the system that is enclosed by an unreinforced block wall adjacent to the EPR. The wall has the potential to crack and possibly fail following a MS or MFDW break in the EPR. The modification will provide either a structural barrier to prevent the remote possibility of a portion of the unreinforced block wall from penetrating the Control Complex HVAC ducting and possibly allowing steam to migrate through the opening, or install HELB actuated dampers in the Control Complex HVAC ducting.

Modification of the HPI Pump Suction Line Valves (xHP-103 & xHP-107)

The valves (xHP-103 & xHP-107) on the individual suction lines to the "A" & "B" HPI pumps are being upgraded to allow the remote operation of these valves. The remote operation of these valves allow the isolation of postulated HELBs on the discharge side of the HPI Pumps without compromising the availability of the other HPI Pumps and the need for maintaining the LDST aligned to the HPI Pump suction piping. For a single active failure of either valve xHP-103 or xHP-107 to close, a redundant remotely operated valve is provided on each of the HPI Pumps A and B suction lines to assure HELB mitigation.

Plant Heating System Configuration Change

The position of one Plant Heating System isolation valve in each unit, xAS-182, is being changed from "OPEN" to "CLOSED." This position change will eliminate the need to postulate Plant Heating System HELBs in the EPR and WPR, because these piping lines will isolated during Normal Plant Conditions of the station.

125 VDC Cable Rerouting

The following125 VDC Vital I&C Power System cabling in the Turbine Building is vulnerable to postulated HELBs therein:

- Cables from the Control Batteries to the 125 VDC Control Power Distribution Centers
- Cables from the unit's 125 VDC Control Power Distribution Centers to an alternate unit's 125 VDC Instrumentation and Control Power Panelboards

As part of the PSW Project this cabling will be removed from the Turbine Building and rerouted in order to eliminate their vulnerabilities to postulated HELBs in the Turbine Building.

Upgrade of Turbine Building Structural Support Columns D-24 & D-26 (Unit 1)

Turbine Building Structural Support Columns D-24 & D-26 will be modified to prevent its potential failure. This upgrade prevents the blockage of the pathway for routing temporary cabling to the LPI and LPSW Pump motors.

Upgrade of Turbine Building Structural Support Column D-29 & D-31 (Unit 2)

Turbine Building Structural Support Columns D-29 & D-31 will be modified to prevent their potential failure.

Upgrade of Turbine Building Structural Support Column M-20 (Unit 1)

Turbine Building Structural Support Column M-20 will be modified to prevent its potential failure. This upgrade prevents a potential local buckling of the subject column.

Upgrade of Turbine Building Structural Support Column M-35 (Unit 2)

Turbine Building Structural Support Column M-35 will be modified to prevent its potential failure. This upgrade prevents a potential local buckling of the subject column.

Upgrade of Turbine Building Structural Support Column D-43 & D-45 (Unit 3)

Turbine Building Structural Support Columns D-43 & D-45 will be modified to prevent their potential failure.

Upgrade of Turbine Building Structural Support Column M-49 (Unit 3)

Turbine Building Structural Support Column M-49 will be modified to prevent its potential failure. This upgrade prevents a potential local buckling of the subject column.

Upgrade of Turbine Building Structural Support Column L-47 (Unit 3)

Turbine Building Structural Support Columns L-47 will be modified to prevent its potential failure. This upgrade prevents a potential bending failure of the subject column.

CCW Discharge Stop Gates

The existing CCW Discharge Stop Gates will be replaced, and four (4) additional Stop Gates will be provided. These Stop Gates will be used to terminate all reverse flow through HELB damaged LPSW and CCW piping. This modification is required, in order to recover from a Turbine Building flood event caused by a postulated HELB therein.

Upgrade of Viking Electrical Penetration Enclosures

Weep holes are being installed in the bottom of the outside-containment junction box enclosures for the Viking Electrical Penetrations. These weep holes prevent the buildup of water within the enclosure. Also, the electrical penetration inspection procedure is being amended to inspect the weep holes for blockage.

10.0 REFERENCES

10.1 Regulatory Documents & Correspondence

10.1.1 Letter dated 15 December 1972 from A. Giambusso (AEC) to A. C. Thies (DPC) transmitting the "General Information Required for Consideration of the Effects of a Piping System Break Outside Containment"

10.1.2 Clarification Letter (related to the 15 December 1972 letter), dated 17 January 1973, from A. Schwencer (AEC) to A. C. Thies (DPC)

10.1.3 Standard Review Plan (SRP) 3.6.1 – "Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment", Rev.1 – July 1981 (Contains Branch Technical Position ASB 3-1)

10.1.4 Standard Review Plan (SRP) 3.6.2 – "Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping", Rev. 1 – July 1981

10.1.5 NRC Generic Letter 87-11, Relaxation in Arbitrary Intermediate Pipe Rupture Requirements (Rev. 2 of BTP MEB 3-1), June 19, 1987

10.1.6 Letter (ONS2006001) dated November 30, 2006, from Henry B. Barron (Duke) to James Dyer (NRC) transmitting "Tornado/HELB Mitigation Strategies and Regulatory Commitments"

10.1.7 Letter dated January 25, 2008, from Henry B. Barron (Duke) to Document Control Desk, Nuclear Regulatory Commission, "Revision to Tornado/HELB Mitigation Strategies and Regulatory Commitments"

10.1.8 Code of Federal Regulations, Title 10, 10CFR50.67, Accident Source Term, January 1, 2000

10.2 ONS Calculations & Drawings

10.2.1 Calculation OSC-8385 – Normal Operating Conditions for High Energy Line Break (HELB) Analysis (ONS Units 1, 2, & 3)

10.2.2 Calculation OSC-7516.01 – ONS Unit 1 High Energy Line Break Stress Evaluation

10.2.3 Calculation OSC-8104 – High Energy Line Breaks in the Penetration Room (ONS Units 1, 2, & 3)

10.2.4 Calculation OSC-8089.01 – High Energy Line Break (HELB) Safe Shutdown Target List (SSTL) – ONS Units 1, 2, & 3

10.2.5 Calculation OSC – 6182 – Main Steam Line Break (MSLB) Event Mitigation Requirements – ONS Units 1, 2, & 3

10.2.6 Calculation OSC-7516.02 - ONS – Unit 1 – Pipe Rupture Evaluation HELB Outside Containment Plant Walkdowns

10.2.7 Calculation OSC-7516.03 - Unit 1 HELB Turbine Building Structural Interactions Evaluations (ONS)

10.2.8 Calculation OSC-7516.04- Safe Shutdown Equipment Damage Assessment for HELB – ONS Unit 1

10.2.9 Calculation OSC-7516.06 – TB STRUDL Model for Detailed HELB Evaluations – ONS Unit 1

10.2.10 Calculation OSC-7516.07 – ONS Unit 1 – HELB Cable Interactions – Failure Modes and Effects

10.2.11 Calculation OSC-7516.08 – Failure Modes and Effects Analysis for HELBs – ONS Unit 1

10.2.12 Calculation OSC-7516.09 – ONS Unit 1 Collateral Damage to Systems, Structures, and Components Located in the Turbine Building from postulated HELBs

10.2.13 Calculation OSC-7516.10 – Collateral Damage Assessment for Structural Interactions for Postulated HELBs – ONS Unit 1

10.2.14 Calculation OSC-2034 – East Penetration Rooms Low Pressure Blowout Panels (ONS Units 1, 2, & 3)

10.2.15 Calculation OSC-8089.02 – High Energy Line Break (HELB) Safe Shutdown Target List (SSTL) Pressure Boundary Piping (ONS Units 1, 2, & 3)

10.2.16 Calculation OSC-8265 – East Penetration Room Flooding from Feedwater Line Breaks (ONS Units 1, 2, & 3)

10.2.17 Calculation OSC-8505 – Oconee HELB EQ Analysis for Penetration Rooms (ONS Units 1, 2, & 3)

10.2.18 Calculation OSC-8556 – High Energy Line Break Safe Shutdown Component Analysis (ONS Units 1, 2, & 3)

10.2.19 Calculation OSC-8602 – Evaluation of East Penetration (Room) Structural Components (ONS Units 1, 2, & 3)

10.2.20 Calculation OSC-9076 – HPI HELB at Penetration 9 – Flow Rate into the East Penetration Room (ONS Units 1, 2, & 3)

10.2.21 Calculation OSC-9082 – HELB at HPI Pump – Pump Operating Point & Time to Flood (ONS Units 1, 2, & 3)

10.2.22 Calculation OSC-9204 – Determination of Flooding Rates and Flood Heights in the Turbine Building as a Result of Postulated High Energy Line Breaks (ONS Units 1, 2, & 3)

10.2.23 Calculation OSC-9212 – Temperature Response of the Control Room Complex for Postulated HELBs in the East Penetration Room Using RT^3 (ONS Units 1, 2, & 3)

10.2.24 Calculation OSC-9213 – Determination of Flooding Rates and Flood Heights in the East & West Penetration Rooms (ONS Units 1, 2, & 3)

10.2.25 Calculation OSC-9276 – HELB Letdown Line Break Analysis (ONS Units 1, 2, & 3)

10.2.26 Calculation OSC-9281 – Radiological Dose Consequences of a HELB Letdown Line Break Event (ONS Units 1, 2, & 3)

10.2.27 Calculation OSC–7726 – Oconee Feedwater Line Break Analysis (ONS Units 1, 2, & 3)

10.2.28 Calculation OSC-9333 – "Evaluation of West Penetration Room Structural Components" (ONS Units 1, 2, & 3)

10.2.29 Calculation OSC-8036 – "Flow From FDW (Feedwater) Line Crack Into Penetration Room" (ONS Units 1, 2, & 3)

10.2.30 Drawing O-16, General Arrangement, Auxiliary Building, Plan – EL. 758+0

10.2.31 Calculation OSC-9352 – ROTSG Double Steam Line Break Evaluation (ONS Units 1, 2, & 3)

10.2.32 Calculation OSC-6104 – Loss of Main Feedwater Event Mitigation Requirements (ONS Units 1, 2, & 3)

10.2.33 Calculation OSC-0688 – Turbine Building Drain (ONS Units 1, 2, & 3)

10.2.34 Calculation OSC-9344 - Evaluation of Jet Lengths from the Terminal End Main Feedwater HELBs in the East Penetration Rooms – ONS Units 1, 2, & 3

10.2.35 Calculation OSC-9355 - Double Steam Line Break Analysis – ONS Units 1, 2, & 3

10.2.36	Drawing, O-331, Condenser Cooling Water Intake & Discharge Pipe General Layout – ONS Units 1, 2, & 3
10.2.37	Drawing, O-332, Condenser Cooling Water Intake Pipe, Layout & Details – ONS Units 1 & 2
10.2.38	Calculation OSC-4171 – SSF ASW System Design Inputs
10.2.39	Calculation OSC-7517.01 – ONS Unit 2 High Energy Line Break Stress Evaluation
10.2.40	Calculation OSC-7517.02 - ONS – Unit 2 Pipe Rupture Evaluation HELB Outside Containment Plant Walkdowns
10.2.41	Calculation OSC-7517.03 - Unit 2 HELB Turbine Building Structural Interactions Evaluations (ONS)
10.2.42	Calculation OSC-7517.04- Safe Shutdown Equipment Damage Assessment for HELB – ONS Unit 2
10.2.43	Calculation OSC-7517.06 – TB STRUDL Model for Detailed HELB Evaluations – ONS Unit 2
10.2.44	Calculation OSC-7517.07 – ONS Unit 2 HELB Cable Interactions – Failure Modes and Effects
10.2.45	Calculation OSC-7517.08 – Failure Modes and Effects Analysis for HELBs – ONS Unit 2
10.2.46	Calculation OSC-7517.09 – ONS Unit 2 Collateral Damage to Systems, Structures, and Components Located in the Turbine Building from postulated HELBs
10.2.47	Calculation OSC-7517.10 – Collateral Damage Assessment for Structural Interactions for Postulated HELBs – ONS Unit 2
10.2.48	Drawing O-510N, Piping Layout, Miscellaneous Piping, El. 822'+0" – Auxiliary Building, Plans & Sections
10.2.49	Drawing O-510L, Piping Layout, Miscellaneous Piping, El. 809'+3" – Auxiliary Building, Plans & Sections
10.2.50	Calculation OSC-9603 – Evaluation of Postulated Plant Heating System High Energy Line Breaks (HELBs) in Rooms 520 (Ventilation Equipment Room) and Room 408B (Storage Room)
10.2.51	Calculation OSC-9554 – Ventilation Equipment Room 520 HELB Analysis

10.2.52 Calculation OSC-7518.01 – ONS Unit 3 High Energy Line Break Stress Evaluation

10.2.53 Calculation OSC-7518.02 - ONS Unit 3 Pipe Rupture Evaluation HELB Outside Containment Plant Walkdowns

10.2.54 Calculation OSC-7518.03 - Unit 3 HELB Turbine Building Structural Interactions Evaluations (ONS)

10.2.55 Calculation OSC-7518.04- Safe Shutdown Equipment Damage Assessment for HELB – ONS Unit 3

10.2.56 Calculation OSC-7518.06 – TB STRUDL Model for Detailed HELB Evaluations – ONS Unit 3

10.2.57 Calculation OSC-7518.07 – ONS Unit 3 HELB Cable Interactions – Failure Modes and Effects

10.2.58 Calculation OSC-7518.08 – Failure Modes and Effects Analysis for HELBs – ONS Unit 3

10.2.59 Calculation OSC-7518.09 – ONS Unit 3 Collateral Damage to Systems, Structures, and Components Located in the Turbine Building from postulated HELBs

10.2.60 Calculation OSC-7518.10 – Collateral Damage Assessment for Structural Interactions for Postulated HELBs – ONS Unit 3

10.2.61 Calculation OSC-9656 – Determination and Documentation of Input Parameters for Ventilation Room 565 HELB Analysis – ONS Unit 3

10.2.62 Calculation OSC-9693 – Ventilation Equipment Room 565 – HELB Analysis – ONS Unit 3

10.2.63 Calculation OSC-9575 – High Energy Line Break Inside the Turbine Building with SSF Restoration – ONS units 1, 2, & 3

10.2.64 Calculation OSC-9696 – ONS HELB Analysis – DSLB with PSW Recovery – ONS Units 1, 2, & 3

10.2.65 Drawing, O-1025-09, Auxiliary Building – Unit 3; Architectural, Plan at El. 809+3, East Penetration Room

10.2.66 O-2510M, Miscellaneous Piping, Elevation 809'+3", Auxiliary Building, Plans & Elevation – Unit 3

10.2.67 O-2439A – Piping Layout, East Penetration Room, Elevation 809'-3", Auxiliary Building – Unit 3

10.3 **Other ONS Documents**

10.3.1 MDS Report No. OS-73.2, Analysis of Effects Resulting from Postulated Piping Breaks Outside Containment for Oconee Nuclear Station, Units 1, 2, & 3, prepared by Duke Power company, dated April 25, 1973.

10.3.2 MDS Report No. OS-73.2, Supplement 1, Analysis of Effects Resulting from Postulated Piping Breaks Outside Containment for Oconee Nuclear Station, Units 1, 2, & 3, prepared by Duke Power company, dated June 22, 1973.

10.3.3 MDS Report No. OS-73.2, Supplement 2, Analysis of Effects Resulting from Postulated Piping Breaks Outside Containment for Oconee Nuclear Station, Units 1, 2, & 3, prepared by Duke Power company, dated March 12, 1974.

10.3.4 Safety Evaluation Report (From AEC) for Oconee Units 2 & 3, July 6, 1973.

10.3.5 Problem Investigation Process, Oconee Nuclear Station, O-98-03902, Investigation of Pipe Rupture Design Basis at the Oconee Nuclear Site (PIP is based upon the CEN Self Assessment O-CEN-013-98)

10.3.6 Design Basis Specification for the Oconee Single Failure Criterion, OSS-0254.00-00-4013 – Units 1, 2, & 3

10.3.7 Oconee Nuclear Station, Units 1, 2, & 3 – Technical Specifications, Section 1.1 – Definitions, Amendment Nos. 300, 300, & 300..

10.3.8 Oconee Nuclear Station, Units 1, 2, & 3 – Updated Final Safety Analysis Report, Revision 15 (Issue Date June 30, 2006)

10.3.9 Letter, from McCollum (Duke Energy), to U. S. Nuclear Regulatory Commission, Dated July 3, 2002; Attachment 1 – High Energy Line Break Methodology

10.3.10 Letter, from R. A. Jones (Duke Energy), to U. S. Nuclear Regulatory Commission, "High Energy Line Break Outside Reactor Building – Methodology", dated August 20, 2003; Attachment 1 – High Energy Line Break Methodology

10.3.11 ANSI/ANS – 58.2 – 1998, "American National Standard, Design Basis for Protection of Light Water Nuclear Power Plants Against the Effects of Postulated Pipe Rupture."

10.3.12 Emergency Operating Procedure, EP/1,2,3/A/1800/001, "Emergency Operating Procedure" – Units 1,2, & 3

10.3.13 Abnormal Procedure, AP/1,2,3/A/1700/011, "Recovery From Loss of Power" – Units 1, 2, & 3

10.3.14 Abnormal Procedure, AP/0/A/1700/025, "SSF Emergency Operating Procedure (SSF-EOP)" – Units 1, 2, & 3

10.3.15 Abnormal Procedure, AP/1,2,3/A/1700/010, "Turbine Building Flood" – Units 1, 2, & 3

10.3.16 SDQA-30164, Rev. O, GOTHIC Version 4.0/DUKE (#860)

10.3.17 HELB Outside Containment Walkdown Criteria & Requirements, ONS, Units 1, 2, & 3

10.3.18 OSS-0254.00-00-4017 - Design Basis Specification for the "Pipe Rupture" – ONS Units 1, 2, & 3

10.3.19 Equipment Qualification Criteria Manual (EQCM), Duke Energy, ONS – Units 1, 2, & 3

10.3.20 Abnormal Procedure, AP/1,2,3/A/1700/014, "Loss of Normal HPI Makeup and/or RCP Seal Injection" – ONS Units 1, 2, & 3

10.3.21 Emergency Plan Procedure, RP/0/B/1000/022, "Procedure for Major Site Damage Assessment and Repair" – ONS Units 1, 2, & 3

10.3.22 Emergency Procedure, OP/0/A/1102/024, "Plant Assessment and Alignment Following Major Site Damage" - ONS Units 1, 2, & 3

10.3.23 Emergency Procedure, OP/0/A/1102/025, "Cooldown Following Major Site Damage" - ONS Units 1, 2, & 3

10.3.24 Emergency Procedure, IP/0/A/0050/002, "Site Damage Control Procedure - ONS Units 1, 2, & 3

10.3.25 Emergency Procedure, MP/0/A/3009/012, "Emergency Plan for Replacement of HPI, LPI, and LPSW Motors Following a Fire in Turbine Building or Auxiliary Building" - ONS Units 1, 2, & 3

10.3.26 ONS Units 1, 2, & 3 – ISI Program

10.3.27 Abnormal Procedure, AP/1,2,3/A/1700/032, "Loss of Letdown" – ONS Units 1, 2, & 3

10.3.28 Weld Examination Summary Report, 1-MS-Long Seam, UT Pipe & Base Metal Weld Examination, May 2008.

10.3.29 Weld Examination Report: Work Order 01754704-01; UT Calibration Reports; UT Pipe Weld Examination (2MS-0103 Long Seam at Weld 38), November 2008.

10.3.30 Engineering Change Request for Main Steam Isolation Valves (2008).

10.3.31 UT Base Metal Examination, Oconee Unit 3, NDE-640, Work Order 01733573, November 28.2207

10.3.32 Operating Procedure, OP/1,2,3/A/1104/002, "HPI System" – ONS Units 1, 2, & 3

Tab 4

Updated Tornado and HELB Regulatory Commitments

No.	Tornado Commitments	Due Date	Complete (Y/N)[1]
1T	U3 Control Room North Wall Modification.	-	Y
2T	SSF Diesel Fuel Vent Modification.	-	Y
3T	SSF and CT-5 Trenches Intersection Modification SSF Trench at north end of SSF (TORMIS).	-	Y
4T	Borated Water Storage Tank Modifications.	-	Y
5T	West Penetration Room (WPR) and Cask Decontamination Tank Room (CDTR) Wall Modifications.	-	Y
6T	Fiber Reinforced Polymer (FRP) LAR for strengthening selected masonry walls for tornado wind and ΔP.	-	Y
7T	Tornado Mitigation Strategy LAR.	-	Y
8T	PSW/HPI modifications.	7-2012	N
9T	Missile inventory program developed.		Y
10T	Verbally notify in advance the Deputy Director, Division of Reactor Licensing of the NRC, followed by a written communication, of significant changes in the scope and/or completion dates of the commitments. The notification will include the reason for the changes and the modified commitments and/or schedule.	6-2016	N
11T 12T 13T	Installation of MSIVs.	U1: 12-2014 U2: 12-2015 U3: 06-2016	N
14T	Fiber Reinforced Polymer (FRP) LAR for strengthening selected "brick" masonry walls for tornado wind and ΔP.	-	Y
15T	Analyze the double column set which support each unit's Main Steam lines outside of the containment building, and provide modifications, as necessary, to meet tornado criteria	-	Y
16T	Physically protect the Atmospheric Dump Valve's (ADV's) function per RG 1.76, Rev. 1.	U1: 12-2014 U2: 12-2015 U3: 06-2016	N
17T	Improve protection of the Standby Shutdown Facility (SSF) double doors (large 8'x12' doors located on the south side of the SSF structure) per UFSAR SSF tornado criteria.	12-31-2013	N
18T	Revise and clarify the tornado LB description as documented in UFSAR Section 3.2.2; add the TORMIS methodology results to UFSAR Section 3.5.1.3, and correct inaccurate tornado design information for the Auxiliary Building Cable and Electrical Equipment Rooms as	After issuance of the SER.	N

[1] As of December 16, 2011.

No.	Tornado Commitments	Due Date	Complete (Y/N)[1]
	described in UFSAR Table 3-23.		
19T	The SSF BASES for TS 3.10.1 will be clarified to address degradation of passive civil features as not applying to operability under Technical Specifications Limiting Condition for Operation (TS LCO) 3.10.1, "Standby Shutdown Facility," but rather as UFSAR commitments outside of the ONS TS.	After issuance of the SER.	N
20T[2]	Duke will perform qualification testing and reporting in accordance with ICC AC125 [Reference 5 of Enclosure 2] for the selected FRP System.	-	Y
21T	Duke will perform and document a technical evaluation of the FRP system (fibers and polymeric resin) in accordance with Duke's Supply Chain Directive SCD230 [Reference 7 of Enclosure 2] to demonstrate that: 1. The item qualifies as a commercial grade item. 2. The supplier is capable of supplying a quality product. 3. The quality of the item can be reasonably assured.	-	Y
22T	Duke will utilize technical procedures to control testing of concrete substrate and installation and inspection of the FRP system in accordance with ICC AC125 [Reference 5 of Enclosure 2], ACI 440.2R-02 [Reference 6 of Enclosure 2], and ICC AC178 [Reference 8 of Enclosure 2].	-	Y
23T	Duke will perform long-term inspection of the FRP system as described in UFSAR Section 18.3.13 and EDM-410, and in accordance with ICC AC125 [Reference 5 of Enclosure 2], ACI 440.2R-02 [Reference 6 of Enclosure 2], and ICC AC178 [Reference 8 of Enclosure 2], on a nominal 5 year interval. This inspection frequency may be reduced to a nominal 10 year interval with appropriate justification based on the structure, environment, and previous long-term inspection results. Inspections of the installed FRP system will include: • visual inspections of test walls and selected portions of WPR walls for changes in color, debonding, peeling, blistering, cracking, crazing, deflections and other anomalies; and, • tension adhesion testing of cored samples taken from	-	Y [see 27T]

[2] Tornado commitments 20-23 originate from the FRP LAR dated 6-1-2006 (NRC SER dated 2-21-2008).

No.	Tornado Commitments	Due Date	Complete (Y/N)[1]
	test walls using methods specified in ASTM D4541 [Reference 9 of Enclosure 2] or ACI 530R-02 [Reference 16 of Enclosure 2].		
24T[3]	Duke Energy will perform qualification testing and reporting in accordance with ICC AC125 [Approved 10/2006, Effective 1/1/2007] for the selected FRP System.	-	Y
25T	Duke Energy will perform and document a technical evaluation of the FRP system (fibers and polymeric resin) in accordance with Duke Energy's Supply Chain Directive SCD230 [Reference 7 of Enclosure 2] to demonstrate that: • The item qualifies as a commercial grade item. • The supplier is capable of supplying a quality product. • The quality of the item can be reasonably assured.	-	Y
26T	Duke Energy will utilize technical procedures to control testing of concrete substrate and installation and inspection of the FRP system in accordance with ICC AC125 [Approved 10/2006, Effective 1/1/2007], ACI 440.2R-02 [Effective 7/1/2002], and ICC AC178 [Approved 6/2003, Effective 7/1/2003, editorially revised 6/2008].	-	Y
27T	Duke Energy will implement a long-term inspection program of the FRP system that will be described in UFSAR Section 18.3.13 and EDM-410, and meeting the requirements of ICC AC125 [Approved 10/2006, Effective 1/1/2007], ACI 440.2R-02 [Effective 7/1/2002], and ICC AC178 [Approved 6/2003, Effective 7/1/2003, editorially revised 6/2008], on the following schedule: at each unit's outage cycle for the first six years from 2012 through 2017, then, if justified based on no observed FRP degradation, transition to every-other outage cycle for the next four years from 2018 through 2021, then, if justified based on continued no observed FRP degradation, transition to every third outage cycle thereafter from 2022 until end of license in July 2034. Inspections of the installed FRP system will include: • visual inspections of test walls and portions (both random and controlled locations) of WPR in-service walls for changes in color, debonding, peeling, blistering, cracking,	By the Unit 3 Spring 2012 refueling outage.	N

[3] Tornado commitments 20-26 are addressed in the NRC's FRP SER for brick masonry dated 6-27-2011. The completion status has been updated for several of the commitments.

No.	Tornado Commitments	Due Date	Complete (Y/N)[1]
	crazing, deflections and other anomalies; • tension adhesion testing of cored samples taken from designated test walls using methods specified in ASTM D7234; and, • visual inspections of mortar joints located along the bottom edge of FRP-strengthened masonry walls. For each inspection interval, the portions of FRP-strengthened masonry walls to be inspected will be chosen in accordance with a sampling plan developed from guidance provided by a) Draft Regulatory Guide DG-1070, "Sampling Plans Used for Dedicating Simple Metallic Commercial Grade Items for use in Nuclear Power Plants", and b) EPRI NP-7218 document "Guidelines for the Utilization of Sampling Plans for Commercial Grade Item Acceptance" (NCIG-19), as implemented at ONS by Supply Chain Directive SCD-290 [(new) Reference 21 of Enclosure 2]. Note: This response replaces the five (5) year inspection commitment made in FRP LAR (No. 2009-05) dated June 29, 2009, and will apply to the FRP application for both block and brick.		
28T	Duke Energy will install mechanical shear restraints along the brick masonry wall perimeter (top and sides only) and block masonry wall perimeter (top only) to remediate potentially limiting conditions of construction.	-	Y
29T	Duke Energy will incorporate the FRP testing and inspection program into Oconee Nuclear Station's Aging Management Program.	-	Y
30T	As discussed with the Staff, Fyfe Company, LLC, the manufacturer of the FRP products, will provide Duke Energy with a Certificate of Compliance certifying that both the FRP product and its installation meet all applicable requirements.	-	Y

No.	HELB Commitments	Due Date	Complete (Y/N)[4]
1H	Implement an inspection program for the Aux Bldg MS and FW girth and accessible attachment welds.	-	Y
2H	Implement an inspection program for other Aux. Bldg high energy piping critical crack locations at welds.	-	Y
3H	Initial ASME Section XI ISI interval UT of the Aux. Bldg MS and FW girth welds and accessible attachment welds.	-	Y
4H	Initial ASME Section XI ISI interval UT of other Aux. Bldg high energy piping critical crack locations at welds.	-	Y
5H	Implement an inspection program for accessible piping base metal downstream of the FW isolation valves located in the EPR.	-	Y
6H	Implement an inspection program for accessible piping base metal of other Aux. Bldg high energy piping critical crack locations not at welds.	-	Y
7H	Initial ASME Section XI ISI interval UT inspection of piping base metal downstream of FW isolation valves located in the EPR.	-	Y
8H	Initial ASME Section XI ISI interval UT inspection for accessible piping base metal of other Aux. Bldg high energy piping critical crack locations not at welds.	-	Y
9H	Implement an inspection program of accessible attachment welds at the terminal ends inside the FW guard pipe.	-	Y
10H	Initial visual inspections of accessible attachment welds at the terminal ends inside the FW guard pipe.	-	Y
11H	Inspect and repair the Unit 2 East Penetration Room electrical penetration termination enclosures to their correct configuration. Missing and/or damaged covers, gaskets, and fasteners will be repaired or replaced.	-	Y
12H	Inspect and repair the Unit 1 East Penetration Room electrical penetration termination enclosures to their correct configuration. Missing and/or damaged covers, gaskets, and fasteners will be repaired or replaced.	-	Y
13H	Inspect and repair the Unit 3 East Penetration Room electrical penetration termination enclosures to their correct configuration. Missing and/or damaged covers, gaskets, and fasteners will be repaired or replaced.	-	Y

[4] As of December 16, 2011.

No.	HELB Commitments	Due Date	Complete (Y/N)[4]
14H	Create an inspection plan to select a portion of Units 1, 2 and 3 enclosures to open and inspect for signs of internal debris and corrosion.	-	Y
15H	Revise station procedures and processes as needed to ensure penetration termination enclosures are maintained in their correct configurations.	-	Y
16H	Complete the design and installation of flood outlet devices for the Unit 1 East Penetration Room.	-	Y
17H	Complete the design and installation of flood outlet devices for the Unit 2 East Penetration Room.	-	Y
18H	Complete the design and installation of flood outlet devices for the Unit 3 East Penetration Room.	-	Y
19H	Complete the design and installation of flood impoundment and exterior door flood improvement features for the Unit 1 East Penetration Room	-	Y
20H	Complete the design and installation of flood impoundment and exterior door flood improvement features for the Unit 2 East Penetration Room.	-	Y
21H	Complete the design and installation of flood impoundment and exterior door flood improvement features for the Unit 3 East Penetration Room.	-	Y
22H 23H 24H	HELB LB and Mitigation Strategy LARs.	-	Y
25H	Verbally notify in advance the Deputy Director, Division of Reactor Licensing of the NRC, followed by a written communication, of significant changes in the scope and/or completion dates of the commitments. The notification will include the reason for the changes and the modified commitments and/or schedule.	As necessary until 7-2012	N
26H	The inlet isolation valves to the Letdown Coolers on the Letdown Line (1HP-1 & 1HP-2) will be upgraded to permit their use following a postulated HELB on the Letdown Line at Containment Penetration No. 6. With these valves upgraded, either could then be closed if either of the inboard containment isolation valves (1HP-3 & 1HP-4) fails to close in order to mitigate the postulated HELB on the Letdown line.	To be provided to the Staff upon issuance of the SER.	N

No.	HELB Commitments	Due Date	Complete (Y/N)[4]
27H	The ducting near the Control Complex is being upgraded with duct registers or cover plates to prevent the potential propagation of the HELB generated environment in the East Penetration Room to the Control Complex.	To be provided to the Staff upon issuance of the SER.	N
28H	The valves (1HP-103 & 1HP-107) on the individual suction lines to the "A" & "B" High Pressure Injection (HPI) pumps are being upgraded to allow the remote operation (operated outside the HPI pump room) of these valves. The remote operation of these valves allow the isolation of postulated HELBs on the discharge side of the HPI Pumps without compromising the availability of the other HPI Pumps and the need for maintaining the Letdown Storage Tank aligned to the HPI Pump suction piping. For a single active failure of either valve 1HP-103 or 1HP-107 to close, a redundant, remotely operated valve is provided on each of the HPI Pumps "A" and "B" to assure HELB mitigation.	-	Y
29H	The position of several Plant Heating System isolation valves is being changed from "OPEN" to "CLOSED." This position change will eliminate the need to postulate Plant Heating System HELBs in the East Penetration Room and West Penetration Room, because these piping lines will isolated during normal plant conditions of the station.	-	Y
30H	Turbine Building structural support column D-26 will be modified by adding a brace to the column. This brace is necessary to prevent potential failure of the column, when subjected to a pipe whip load. This upgrade prevents the loss of the routing to get temporary cabling to the Low Pressure Injection and Low Pressure Service Water pump motors.	To be provided to the Staff upon issuance of the SER.	N
31H	The existing Condenser Circulating Water (CCW) discharge stop gates will be replaced and four (4) new stop gates will be obtained. These stop gates will be used to terminate all reverse flow through HELB damaged Low Pressure Service Water and CCW piping. This modification is required, in order to recover from a Turbine Building flood event caused by a postulated HELB therein.	To be provided to the Staff upon issuance of the SER.	N
32H	Evaluate the ability of the Standby Shutdown Facility to perform its safety functions with a compromised main steam pressure boundary due to potential breaks in the main steam system and other HELBs.	-	Y

No.	HELB Commitments	Due Date	Complete (Y/N)[4]
33H	Weep holes will be installed in the bottom of the outside-containment junction box enclosures for the Viking Electrical Penetrations. Also, the electrical penetration inspection procedure is being amended to inspect the weep holes for blockage	-	Y
34H	The inlet isolation valves to the Letdown Coolers on the Letdown Line (2HP-1& 2HP-2) will be upgraded to permit their use following a postulated HELB on the Letdown Line at Containment Penetration No. 6. With these valves upgraded, either could then be closed if either of the inboard containment isolation valves (2HP-3 & 2HP-4) fails to close in order to mitigate the postulated HELB on the Letdown line.	To be provided to the Staff upon issuance of the SER.	N
35H	The Unit 2 HVAC ducting near the Control Complex is being upgraded with duct registers or cover plates to prevent the potential propagation of the HELB generated environment in the East Penetration Room to the Control Complex.	To be provided to the Staff upon issuance of the SER.	N
36H	The valves (2HP-103 & 2HP-107) on the individual suction lines to the "A" & "B" High Pressure Injection (HPI) pumps are being upgraded to allow the remote operation (operated outside the HPI pump room) of these valves. The remote operation of these valves allow the isolation of postulated HELBs on the discharge side of the HPI pumps without compromising the availability of the other HPI Pumps and the need for maintain the Letdown Storage Tank aligned to the HPI Pump suction piping. For a single active failure of either valves 2HP-103 or 2HP-107 to close, a redundant, remotely operated valves is provided on each of the HPI Pumps "A" and "B" to assure HELB mitigation.	To be provided to the Staff upon issuance of the SER.	N
37H	The position of several Unit 2 Plant Heating System isolation valves is being changed from "OPEN" to "CLOSED." This position change will eliminate the need to postulate Plant Heating System HELBs in the East Penetration Room and West Penetration Room, because these piping lines will be isolated during normal plant conditions of the station.	-	Y
38H	Turbine Building structural support Column D-29 & D-31 will be modified by adding a brace to the column. This brace is necessary to prevent potential failure of the column, when subjected to a pipe whip load.	To be provided to the Staff upon issuance of the SER.	N

No.	HELB Commitments	Due Date	Complete (Y/N)[4]
39H	Weep holes will be installed in the bottom of the Unit 2 outside-containment junction box enclosures for the Viking Electrical Penetrations. Also, the electrical penetration inspection procedure is being amended to inspect the weep holes for blockage.	-	Y
40H	The inlet isolation valves to the Letdown Coolers on the Letdown Line (3HP-1 and 3HP-2) will be upgraded to permit their use following a postulated HELB on the Letdown Line at Containment Penetration No. 6. With these valves upgraded, either could then be closed if either of the inboard containment isolation valves (3HP-3 and 3HP-4) fails to close in order to mitigate the postulated HELB on the Letdown Line.	To be provided to the Staff upon issuance of the SER.	N
41H	The Unit 3 Auxiliary Building HVAC ducting near the Unit 3 Control Complex is being upgraded with duct registers or cover plates to prevent the potential propagation of the HELB generated environment in the East Penetration Room to the Unit 3 Control Complex.	To be provided to the Staff upon issuance of the SER.	N
42H	The valves (3HP-103 and 3HP-107) on the individual suction lines to the "A" and "B" High Pressure Injection (HPI) pumps are being upgraded to allow the remote operation (operated outside the HPI pump room) of these valves. The remote operation of these valves allow the isolation of postulated HELBs on the discharge side of the HPI Pumps without compromising the availability of the other HPI Pumps and the need for maintaining the Letdown Storage Tank aligned to the HPI Pump suction piping. For a single active failure of either valve 3HP-103 or 3HP-107 to close, a redundant, remotely operated valve is provided on each of the HPI Pumps "A" and "B" to assure HELB mitigation.	-	Y
43H	The position of the Unit 3 Plant Heating System isolation valve 3AS-182 being changed from "OPEN" to "CLOSED." This position change will eliminate the need to postulate Plant Heating System HELBs in the East Penetration Room and West Penetration Room, because these piping lines will be isolated during Normal Plant Conditions of the station.	-	Y
44H	Turbine Building structural support columns M-20 (Unit 1), M-35 (Unit 2), D-43 and D-45 (Unit 3), M-49 (Unit 3), and L-47 (Unit 3) will be modified by adding a brace or reinforcement to each column. These modifications are necessary to prevent potential failure of the column(s), when subjected to a pipe whip load.	To be provided to the Staff upon issuance of the SER.	N

No.	HELB Commitments	Due Date	Complete (Y/N)[4]
45H	Weep holes will be installed in the bottom of the Unit 3 outside-containment junction box enclosures for the Viking Electrical Penetrations. Also, the electrical penetration inspection procedure is being amended to inspect the weep holes for blockage.	-	Y

Tab 5

UFSAR Changes and Revised Technical Specifications/Bases

ATTACHMENT 3

MARKED-UP PAGES:

UFSAR

3.6-1, 3.6-2

3.6 Protection Against Dynamic Effects Associated with the Postulated Rupture of Piping

3.6.1 Postulated Piping Failures in Fluid Systems Inside and Outside Containment

3.6.1.1 Design Bases

The basic design criteria for pipe whip protection is as follows:

1. All penetrations are designed to maintain containment integrity for any loss of coolant accident combination of containment pressures and temperatures.
2. All penetrations are designed to withstand line rupture forces and moments generated by their own rupture as based on their respective design pressures and temperatures.
3. All primary penetrations, and all secondary penetrations that would be damaged by a primary break, are designed to maintain containment integrity.
4. All secondary lines whose break could damage a primary line and also breach containment are designed to maintain containment integrity.

3.6.1.2 Description

The major components including reactor vessel, reactor coolant piping, reactor coolant pumps, steam generators, and the pressurizer are located within three shielded cubicles. Each of two cubicles contain one steam generator, two coolant pumps, and associated piping. One of the cubicles also contains the pressurizer. The reactor vessel is located within the third cubicle or primary shield. The reactor vessel head and control rod drives extend into the fuel transfer canal.

Openings are provided in the lower shield walls to provide vent area. Pipe lines carrying high pressure injection water are routed outside the shield walls entering only when connecting to the loop.

3.6.1.2.1 Core Flood/Low Pressure Injection System

After implementation of the passive Low Pressure Injection (LPI) cross connect modification on each Oconee Unit, the pipe rupture design basis of Core Flood (CF) / LPI system inside containment is based on the system function during full power operations. The CF section (defined as the "A" and "B" train piping downstream of LP-176 and LP-177 respectively) qualifies as high energy during full power operations. For this CF piping, up to but not including the CF / Reactor Vessel nozzles, Leak Before Break technology was employed to eliminate the dynamic effects associated with postulated breaks (Refer to Section 5.2.1.9). For the LPI section of the system (defined as the "A" and "B" train piping upstream of LP-176 and LP-177 to their respective Reactor Building penetrations, and including the cross connect piping between the "A" and "B" trains), USNRC Standard Review Plan Section 3.6.2 Branch Technical Position MEB 3-1 (Reference 3) was used for treatment of postulated pipe ruptures.

Add: Insert A

3.6.1.3 Safety Evaluation

An evaluation of potential non-safety grade control system interactions during design basis high energy line break accidents is contained in Reference 2.

INSERT A

3.6.1.1.1 High Energy Line Breaks (HELBs) Outside Containment

3.6.1.1.1.1 Design Basis

The basic design criteria for HELBs Outside Containment is that equipment necessary to shut down the reactor and maintain it in a safe shutdown condition, assuming a concurrent and unrelated single active failure, be protected from the effects of the postulated pipe rupture. The pipe rupture effects to be considered are pipe whip, jet impingement, environmental effects (temperature, pressure, and humidity), and flooding.

Piping systems with normal operating temperature above 200°F or normal operating pressure above 275 psig are considered to be high energy systems and are within the scope of HELB considerations. Normal operating conditions have been defined as plant conditions with the reactor at 100% full power. There are three break types that are considered, (1) full circumferential (double ended) breaks, (2) equivalent area longitudinal breaks, and (3) critical cracks. Critical cracks are treated as circular openings with an area equal to 1/2 the pipe minimum wall thickness times 1/2 the pipe inside diameter. Circumferential breaks and critical cracks are considered for piping exceeding 1-inch nominal pipe size (NPS). Longitudinal breaks are considered for piping exceeding 4-inch NPS. Piping 1-inch NPS or less is excluded from HELB considerations.

Certain high energy systems have been excluded from HELB consideration because they are not in a high energy state during normal power operation. These systems are the Emergency Feedwater, Reactor Building Spray, Low Pressure Injection, and Steam Generator Blow Down. In addition, gas systems (e.g. Nitrogen) and oil systems (e.g. EHC) were excluded from HELB considerations because they were judged to possess limited energy.

The following systems are within the scope for HELB consideration:

1. Auxiliary Steam
2. Condensate (Condensate Booster Pump Discharge)
3. Extraction Steam (including HP turbine exhaust and LP turbine inlet)
4. Main Feedwater
5. Heater Drains
6. Heater Vents
7. High Pressure Injection
8. Main Steam
9. Moisture Separator Reheater Drains (including the first and second stage drains)
10. Plant Heating
11. Steam Seals
12. Steam Drains

3.6.1.2 Safety Evaluation

The analysis for Unit 1 HELBs Outside Containment documenting the postulated break locations, effects resulting from the postulated break locations, and the ability to achieve and maintain safe shutdown is contained in Reference 4.

The analysis for Units 2 and 3 HELBs Outside Containment documenting the postulated break locations, effects resulting from the postulated break locations, and the ability to achieve and maintain safe shutdown is contained in Reference 1.

An evaluation of potential non-safety grade control system interactions during design basis high energy line break accidents is contained in Reference 2.

3.6.2 References

1. Duke Power MDS Report No. OS-73.2, dated April 25, 1973 including revisions through supplement 2.
2. Duke Power/B&W Report, Oconee Nuclear Station, "Evaluation of Potentially Adverse Environmental Effects on Non-Safety Grade Control Systems", October 5, 1979.
3. USNRC Standard Review Plan (NUREG 0800) Section 3.6.2 Branch Technical Position MEB 3-1.

THIS IS THE LAST PAGE OF THE TEXT SECTION 3.6.

Add:

"4. Oconee Nuclear Station Report, ONDS-351 [File No. OS-292.A] "Analysis of Postulated High Energy Line Breaks (HELBs) Outside of Containment," (Rev. 2).

5. NRC SER dated xx-xx-xxxx."

ATTACHMENT 4

REPRINTED PAGES:

UFSAR

3.6 (3 pages)
9.7 (4 pages)

TECHNICAL SPECIFICATIONS & BASES

TS 3.7.10 (3 pages)
TSB 3.7.10 (10 pages)
TS 3.7.10a (4 pages)
TSB 3.7.10a (8 pages)

3.6 Protection Against Dynamic Effects Associated with the Postulated Rupture of Piping

3.6.1 Postulated Piping Failures in Fluid Systems Inside and Outside Containment

3.6.1.1 Design Bases

The basic design criteria for pipe whip protection is as follows:

1. All penetrations are designed to maintain containment integrity for any loss of coolant accident combination of containment pressures and temperatures.
2. All penetrations are designed to withstand line rupture forces and moments generated by their own rupture as based on their respective design pressures and temperatures.
3. All primary penetrations, and all secondary penetrations that would be damaged by a primary break, are designed to maintain containment integrity.
4. All secondary lines whose break could damage a primary line and also breach containment are designed to maintain containment integrity.

3.6.1.2 Description

The major components including reactor vessel, reactor coolant piping, reactor coolant pumps, steam generators, and the pressurizer are located within three shielded cubicles. Each of two cubicles contain one steam generator, two coolant pumps, and associated piping. One of the cubicles also contains the pressurizer. The reactor vessel is located within the third cubicle or primary shield. The reactor vessel head and control rod drives extend into the fuel transfer canal.

Openings are provided in the lower shield walls to provide vent area. Pipe lines carrying high pressure injection water are routed outside the shield walls entering only when connecting to the loop.

3.6.1.2.1 Core Flood/Low Pressure Injection System

After implementation of the passive Low Pressure Injection (LPI) cross connect modification on each Oconee Unit, the pipe rupture design basis of Core Flood (CF) / LPI system inside containment is based on the system function during full power operations. The CF section (defined as the "A" and "B" train piping downstream of LP-176 and LP-177 respectively) qualifies as high energy during full power operations. For this CF piping, up to but not including the CF / Reactor Vessel nozzles, Leak Before Break technology was employed to eliminate the dynamic effects associated with postulated breaks (Refer to Section 5.2.1.9). For the LPI section of the system (defined as the "A" and "B" train piping upstream of LP-176 and LP-177 to their respective Reactor Building penetrations, and including the cross connect piping between the "A" and "B" trains), USNRC Standard Review Plan Section 3.6.2 Branch Technical Position MEB 3-1 (Reference 3) was used for treatment of postulated pipe ruptures.

3.6.1.2.2 High Energy Line Breaks (HELBs) Outside Containment

3.6.1.2.2.1 Design Basis

The basic design criteria for HELBs Outside Containment is that equipment necessary to shut down the reactor and maintain it in a safe shutdown condition, assuming a concurrent and unrelated single active failure, be protected from the effects of the postulated pipe rupture. The pipe rupture effects to be considered are pipe whip, jet impingement, environmental effects (temperature, pressure, and humidity), and flooding.

Piping systems with normal operating temperature above 200°F or normal operating pressure above 275 psig are considered to be high energy systems and are within the scope of HELB considerations. Normal operating conditions have been defined as plant conditions with the reactor at 100% full power. There are three break types that are considered, (1) full circumferential (double ended) breaks, (2) equivalent area longitudinal breaks, and (3) critical cracks. Critical cracks are treated as circular openings with an area equal to 1/2 the pipe minimum wall thickness times 1/2 the pipe inside diameter. Circumferential breaks and critical cracks are considered for piping exceeding 1-inch nominal pipe size (NPS). Longitudinal breaks are considered for piping exceeding 4-inch NPS. Piping 1-inch NPS or less is excluded from HELB considerations.

Certain high energy systems have been excluded from HELB consideration because they are not in a high energy state during normal power operation. These systems are the Emergency Feedwater, Reactor Building Spray, Low Pressure Injection, and Steam Generator Blow Down. In addition, gas systems (e.g. Nitrogen) and oil systems (e.g. EHC) were excluded from HELB considerations because they were judged to possess limited energy.

The following systems are within the scope for HELB consideration:

1. Auxiliary Steam
2. Condensate (Condensate Booster Pump Discharge)
3. Extraction Steam (including HP turbine exhaust and LP turbine inlet)
4. Main Feedwater
5. Heater Drains
6. Heater Vents
7. High Pressure Injection
8. Main Steam
9. Moisture Separator Reheater Drains (including the first and second stage drains)
10. Plant Heating
11. Steam Seals
12. Steam Drains

3.6.1.3 Safety Evaluation

The analysis for Unit 1 HELBs Outside Containment documenting the postulated break locations, effects resulting from the postulated break locations, and the ability to achieve and maintain safe shutdown is contained in Reference 4.

The analysis for Units 2 and 3 HELBs Outside Containment documenting the postulated break locations, effects resulting from the postulated break locations, and the ability to achieve and maintain safe shutdown is contained in Reference 1.

An evaluation of potential non-safety grade control system interactions during design basis high energy line break accidents is contained in Reference 2.

3.6.2 References

1. Duke Power MDS Report No. OS-73.2, dated April 25, 1973 including revisions through supplement 2.

2. Duke Power/B&W Report, Oconee Nuclear Station, "Evaluation of Potentially Adverse Environmental Effects on Non-Safety Grade Control Systems", October 5, 1979.

3. USNRC Standard Review Plan (NUREG 0800) Section 3.6.2 Branch Technical Position MEB 3-1.

4. Oconee Nucelar Station Report, ONDS-351 [File No. OS-292.A], Analysis of Postulated High Energy Line Breaks (HELBs) Outside of Containment," (Rev. 2).

5. NRC Safety Evaluation Report dated xx/xx/xxxx.

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9.7 Protected Service Water System

9.7.1 General Description

The Protected Service Water (PSW) system is designed as a standby system for use under emergency conditions. The PSW System will include a dedicated power system. The PSW system provides additional "defense in-depth" protection by serving as a backup to existing safety systems and as such, the system is not required to comply with single failure criteria. The PSW system is provided as an alternate means to achieve and maintain a stable RCS pressure and temperature for one, two, or three units following postulated event scenarios, e.g., tornado and high energy line break (HELB) events (Ref.: 1).

Additionally, the PSW System is also capable of cooling the RCS to 250 °F and maintaining this condition until damage repairs can be implemented to proceed to cold shutdown. Failures in the PSW system will not cause failures or inadvertent operations in existing plant systems. The PSW system is fully operational from the Main Control Rooms (MCRs) and will be activated when existing diverse emergency systems are not available.

9.7.1.1 Design Bases

The basic design criteria for the PSW System are as follows:

- Maintain a minimum water level above the reactor core and maintain Reactor Coolant Pump Seal cooling.
- Assure natural circulation and core cooling by providing secondary side cooling water from Lake Keowee.
- Transfer decay heat from the fuel to an ultimate heat sink.
- Maintain the reactor 1% shutdown with the most reactive rod stuck fully withdrawn, after all normal sources of RCS makeup have become unavailable, by providing makeup via the High Pressure Injection (HPI) system which supplies makeup of a sufficient boron concentration from the Borated Water Storage Tanks (BWST).
- Be able to control the above functions from the main control rooms.

9.7.1.2 System Description

9.7.1.2.1 Mechanical

The mechanical portion of the PSW system is designed to provide decay heat removal by feeding Keowee Lake water to the secondary side of the steam generators. The system, consisting of one booster pump and one high head pump, shall be capable of providing 375 gpm per unit at 1082 psig within 15 minutes following the initiating event (Figure 9-44). In addition, the system is designed to supply Keowee Lake water at 10 gpm per unit to the HPI pump motor coolers.

The PSW system utilizes the inventory of lake water contained in the plant Unit 2 CCW embedded piping. The PSW pump is located in the Auxiliary Building at Elev. 771' and takes suction from the Unit 2 CCW embedded piping and discharges into the steam generators of each unit via separate lines into the emergency feedwater headers. The raw water is vaporized in the steam generator removing residual heat and dumped to atmosphere. The Unit 2 CCW embedded piping is interconnected with Units 1 & 3. For extended operation, a submersible pump, powered by PSW and accessories (electrical cables, flexible hoses and connectors) can be utilized via operator actions to pump water directly from Lake Keowee to the Unit 2 CCW embedded piping.

The piping system has pump minimum flow lines that discharge back into the Unit 2 CCW embedded piping. For flow testing to the steam generators, the system is connected to a condensate water source located in the Turbine Building that is normally isolated using valves in the Auxiliary Building.

The PSW pumps and motor operated valves required to bring the system into service are controlled from the Main Control Rooms. Check valves and manual handwheel operated valves are used to prevent back-flow, accommodate testing, or are used for system isolation. Pumps and valves will be ASME Section III Class 3. Piping will be designed to the 1967 Edition of USAS B31.1 (Oconee Class F).

9.7.1.2.2 Electrical

The PSW electrical system is designed to provide power to PSW mechanical and electrical components as well as other system components needed to establish and maintain a safe shutdown condition. A separate PSW electrical equipment structure is provided for major PSW electrical equipment. Power is provided from the KHU via tornado protected underground path. Alternate power is provided from the Central Tie Switchyard via a 100 kV transmission line to a 100/13.8 kV substation located adjacent to Oconee and then via a 13.8 kV overhead path where it enters an underground ductbank leading to the Protected Service Water building. These external power sources provide power to transformers, switchgear, breakers, load centers, batteries, and battery chargers located in the PSW electrical equipment structure.

The power system provides backup power to the following:

- 125 VDC Vital I&C Normal Battery Chargers
- One HPI pump (either "A" or "B") per unit
- HPI valves needed to align the HPI pumps to the Borated Water Storage Tanks (HP-24)
- HPI valves and instruments that support RCP seal injection and RCS makeup
- Pressurizer Heaters ($\geq$ 400 kW)
- RCS and Reactor Vessel Head high point vent valves
- Submersible pump
- Standby Shutdown Facility (SSF)

9.7.1.2.3 Instrumentation and Control (I&C)

The PSW system has dedicated instrumentation and controls located in each Main Control Room as follows:

- Two (2) high flow controllers (one per SG)
- Two (2) low flow controllers (one per SG)
- One (1) flow indicator (per SG)
- Two (2) SG header isolation valves (one per SG header)
- Two (2) HPI System power transfer switches per unit
- Power transfer switches to HPI valves needed to align the BWST to the HPI pumps

SG parameters and critical reactor coolant system parameters are monitored in the CR. The critical reactor parameters needed to support PSW event scenarios are:

- Two (2) Hot Leg Temperature
- Two (2) Cold Leg Temperature
- Twelve (12) Core Exit Thermocouples
- RCS Pressure (Trains A & B)
- RCP Seal Injection Flow
- HPI Injection Flow (Train A)
- Pressurizer Level (Train A & B)

The Operator Aid Computer (OAC) monitor provides PSW related indication for each unit as follows:

- Flow to each SG
- Power to the HPI pumps
- Power to HPI valves needed to align the BWST to the HPI pumps
- Power to HPI valves that provide RCS makeup and RCP seal injection
- Power to the Reactor Head Vent and RCS High Point vent valves

9.7.1.2.4 Civil

A separate PSW structure is provided for major electrical equipment. The structure is seismically qualified and designed to withstand tornado missiles, wind, and differential pressure. The Keowee Underground and the overhead Central Tie Switchyard feeds are routed to this structure. Both 4160 VAC and 600 VAC power is routed from the PSW structure to the Auxiliary Building via underground trenches.

9.7.1.3 Safety Evaluation

The safety function provided by the PSW system is supplying cooling water for decay heat removal at full system pressure to all six (6) steam generators following postulated event scenarios. A second safety function of the PSW electrical power system, in combination with the High Pressure Injection System, is providing borated water to the RCS pump seals and to provide primary RCS makeup. Two diverse sources of electrical power serve PSW SSCs.

Because portions of the PSW System are not completely protected from the effects of a tornado, the system is not credited during the initial 72 hours after a tornado strike to the station. During the first 72-hours, the SSF will be utilized until damaged portions of the PSW system, which would be required for continued cooldown of the units to approximately 250 °F., are repaired. For HELBs occurring in the Turbine Building, the PSW System can be used until restorations are made to additional systems needed to cool down the units to Mode 5 conditions.

9.7.2 References

1. Nuclear Station Report ONDS-351, "Analysis of Postulated High Energy Line Breaks (HELBs) Outside of Containment," (Rev. 2).
2. NRC Safety Evaluation Report dated xx/xx/xxxx.

THIS IS THE LAST PAGE OF THE TEXT SECTION 9.7.

3.7 PLANT SYSTEMS

3.7.10 Protected Service Water (PSW) System

LCO 3.7.10 The PSW System shall be OPERABLE

APPLICABILITY: MODES 1, 2, and 3
MODE 4 when steam generators are relied upon for heat removal.

ACTIONS

-----------------------------------NOTE-----------------------------------
LCO 3.0.4 is not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. PSW System is inoperable.	A.1 Restore PSW System to OPERABLE status.	14 days
B. PSW System is inoperable. AND SSF Systems are inoperable.	B.1 Restore PSW System to OPERABLE status.	7 days
C. Required Action and associated Completion Time of Condition A or B not met when PSW inoperable due to maintenance [contingency actions under development].	C.1 [contingency actions under development]. AND C.2 Restore to OPERABLE status.	[contingency actions under development]. 30 days from discovery of initial inoperability.

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. Required Action and associated Completion Time of Condition C not met. OR Required Action and associated Completion Time of Condition A or B not met for reasons other than Condition C.	D.1 Be in MODE 3. AND D.2 Be in MODE 4.	12 hours 84 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.10.1	Verify required PSW battery terminal voltage is ≥ 125 VDC on float charge.	7 days
SR 3.7.10.2	Verify that the KHU underground can be aligned to and power the PSW electrical system.	92 days
SR 3.7.10. 3	---------------NOTE--------------------------------- Not applicable to the PSW portable pump. -- Verify that the developed head of the PSW pumps at the flow test point is greater than or equal to the required developed head.	In accordance with the Inservice Testing Program
SR 3.7.10.4	Verify battery capacity of required battery is adequate to supply, and maintain in OPERABLE status, the required emergency loads for the design duty cycle when subjected to a battery service test.	24 months

(continued)

SURVEILLANCE		FREQUENCY
SR 3.7.10.5	Verify each PSW battery charger supplies ≥ 300 amps at greater than or equal to the minimum established float voltage for ≥ 8 hours <u>OR</u> Verify each battery charger can recharge the battery to the fully charged state within 24 hours while supplying the largest combined demands of the various continuous steady state loads, after a battery discharge to the bounding design basis event discharge state.	24 months
SR 3.7.10.6	Verify that the PSW switchgear can be aligned and power either the "A" or "B" HPI pumps	24 months
SR 3.7.10.7	Verify that the switches used for the "A" or "B" HPI pumps, pressurizer heaters, PSW control and electrical panels, and miscellaneous valves, are OPERABLE.	24 months
SR 3.7.10.8	Verify that the PSW pumps can be used to provide adequate cooling water flowrate to the HPI pump motor coolers.	24 months
SR 3.7.10.9	Verify the developed head of the PSW portable pump at the flow test point is greater than or equal to the required developed head.	24 months
SR 3.7.10.10	Verify that the PSW pumps can be aligned and provide flow to each unit's Steam Generator (SG)	48 months

B 3.7 PLANT SYSTEMS

B 3.7.10 Protected Service Water (PSW) System

BASES

BACKGROUND

The Protected Service Water (PSW) system is designed as a standby system for use under emergency conditions. The PSW System includes a dedicated power system. The PSW System provides added "defense in-depth" protection by serving as a backup to existing safety systems and as such, the system is not required to comply with single failure criteria. The PSW system is provided as an alternate means to achieve and maintain a stable RCS pressure and temperature for one, two, or three units following postulated event scenarios, e.g., tornado and high energy line break (HELB) events, and a loss of Lake Keowee event.

The PSW System is also capable of cooling the RCS to 250 °F and maintaining this condition until damage repairs can be implemented to proceed to cold shutdown. Failures in the PSW system will not cause failures or inadvertent operations in existing plant systems. The PSW system is fully controllable from the main control rooms and will be activated when existing redundant emergency systems are not available.

For a tornado event, the overall objective is to utilize the tornado-protected SSF system to maintain the units in Mode 3 for up to 72 hours while damage control measures are completed to restore any unavailable PSW/HPI system equipment needed to cooldown the units to approximately 250 °F. This temperature is the least that can be attained using the Steam Generators (SGs) for cooldown. The PSW/HPI systems can be used for an extended period of operation while additional repairs to systems, structures, and components (SSCs) required to transition the units to Mode 5 are completed.

For HELBs inside the Turbine building resulting in loss of 4160 essential power, either the SSF or the PSW system are used for safe shutdown. The SSF System is limited to 72 hours and is not credited for cooling the units beyond Mode 3 conditions (unless the initiating event causes the unit to be driven to a lower temperature). The PSW system is required to further cooldown to approximately 250 °F and for longer-term operation beyond the initial 72 hours. The PSW System can maintain

BACKGROUND (continued)

these conditions for all three units for an extended period of operation during which time other plant systems required to cool down to Mode 5 conditions will be restored and brought into service as required.

The mechanical portion of the PSW system is designed to provide decay heat removal by feeding Keowee Lake water to the secondary side of the steam generators. The system, consisting of one booster pump, one high head pump and a portable pump , shall be capable of providing 375 gpm per unit at 1082 psig within 15 minutes following the initiating event. In addition, the system is designed to supply Keowee Lake water at 10 gpm per unit to the HPI pump motor coolers.

The PSW system utilizes the inventory of lake water contained in the plant Unit 2 CCW embedded piping. The PSW pumps are located in the Auxiliary Building at Elev.771' (except the portable pump) and take suction from the Unit 2 CCW embedded piping and discharges into the steam generators of each unit via separate lines into the emergency feedwater headers. The raw water is vaporized in the steam generator removing residual heat and is dumped to atmosphere. The Unit 2 CCW embedded piping is interconnected with Units 1 & 3. For extended operation, the PSW portable pump with a flow path capable of taking suction from the intake canal and discharging into the Unit 2 CCW line, is designed to provide a backup supply of water to the PSW system in the event of loss of CCW and subsequent loss of CCW siphon flow. The PSW portable pump is installed manually according to procedures.

The piping system has pump minimum flow lines that discharge back into the Unit 2 CCW embedded piping. For flow testing to the steam generators, the system is connected to a condensate water source located in the Turbine Building that is normally isolated using valves in the Auxiliary Building.

The PSW pumps and motor operated and solenoid valves required to bring the system into service are controlled from the main control rooms. Check valves and manual handwheel operated valves are used to prevent back-flow, accommodate testing, or are used for system isolation. Periodic testing of the PSW valves and pumps (except the portable pump) will be performed in accordance with the In Service Testing (IST) program.

The PSW electrical system is designed to provide power to PSW mechanical and electrical components as well as other system components needed to establish and maintain a safe shutdown condition. A separate PSW electrical equipment structure is provided for major PSW electrical equipment. Power is provided from the KHU via a

BASES

BACKGROUND (continued)

tornado protected underground path. Alternate power is provided by a transformer connected to a 100 kV overhead transmission line that receives power from the Central Tie Switchyard located approximately 8 miles from the plant. These external power sources provide power to transformers, switchgear, breakers, load centers, batteries, and battery chargers located in the PSW electrical equipment structure.

The PSW HVAC is designed to maintain the Transformer Space (main equipment area) and the Battery rooms within their design temperature range. There are two redundant battery systems inside the PSW Building. The redundant battery banks are located in different rooms separated by fire rated walls. One HVAC system is QA-1; the other is non-QA. The hydrogen removal fans shall maintain the hydrogen in the Battery rooms below 2% in accordance with IEEE 484-2002. There are multiple thermostats in each Battery Room to ensure temperatures are maintained within acceptable limits.

APPLICABLE SAFETY ANALYSES

The safety function of the PSW system is to supply cooling water for secondary side decay heat removal at full system pressure to all six (6) steam generators (SGs) following postulated event scenarios. A secondary safety function of the PSW system is, in combination with the HPI System, to provide borated water to the RCS pump seals and to provide primary RCS makeup. Two redundant sources of electrical power serve the PSW electrical switchgear.

Because portions of the PSW System are not completely protected from the effects of a tornado, the system is not credited during the initial 72 hours after a tornado strike to the station. During the first 72 hours, the SSF will be utilized until damaged portions of the PSW system, which would be required for continued cooldown of the units to approximately 250 °F, are repaired. For HELBs occurring in the Turbine Building, the PSW System can be used as long as there is water contained in the underground CCW piping or until restorations are made to additional systems needed to cool down the units to Mode 5 conditions.

The PSW System is designed to mitigate the consequences of a loss of Lake Keowee event by providing emergency cooling water to one or more of the three Oconee Units' SGs and HPI pump motor coolers.

LCO

The PSW System is considered to be OPERABLE when its mechanical and electrical equipment, as well as associated support equipment, are OPERABLE. The system is designed to adequately perform these

BASES

LCO (continued)

functions for one, two, or all three units concurrently. The system is aligned, controlled, and monitored, from the main control rooms.

For OPERABILITY, the following are required:

- One (1) booster pump and one (1) high head pump.
- A viable suction source from the embedded Unit 2 CCW piping to the PSW pumping system.
- Five (5) of the six (6) 125 VDC Vital I&C Normal Battery Chargers

The following are required to be powered from PSW (each unit):

- Either the "A" or "B" High Pressure Injection Pump.
- HPI valves needed to align the HPI pumps to the Borated Water Storage Tanks (HP-24).
- HPI valves and instruments that support RCP seal injection and RCS makeup.
- PSW pumps flow to an HPI pump motor cooler.
- Pressurizer Heaters ($\geq$ 400 kW).
- RCS and Reactor Vessel Head high point vent valves
- PSW electrical system from either the KHU underground or 13.8 kV overhead power paths to support secondary side decay heat removal (SSDHR) and reactor coolant make-up (RCMU) functions.

PSW system dedicated instrumentation and controls located in each main control room:

- Two (2) high flow controllers (one per SG).
- Two (2) low flow controllers (one per SG).
- One (1) flow indicator (per SG).
- Two (2) SG header isolation valves (one per SG header).
- Two (2) HPI System power transfer switches per unit.
- Power transfer switches to HPI valves needed to align the BWST to the HPI pumps.

APPLICABILITY

In MODES 1, 2, and 3, the PSW System is required to be OPERABLE and to function in the event that all normal and emergency feedwater systems are lost. In MODE 4, with RCS temperature above 212 °F, the PSW

BASES

APPLICABILITY (continued)

System may be used for heat removal via the steam generators. In MODE 4, the steam generators are used for heat removal unless this function is being performed by the Low Pressure Injection System.

In MODE 4 steam generators are relied upon for heat removal whenever an RCS loop is required to be OPERABLE or operating to satisfy LCO 3.4.6, "RCS Loops – Mode 4."

In MODES 5 and 6, the steam generators are not used for SSDHR and the PSW System is not required.

ACTIONS

The exception for LCO 3.0.4, provided in the Note of the Actions, permits entry into MODES 1, 2, 3 or 4 with the PSW not OPERABLE. This is acceptable because the PSW is not required to support normal operation of the facility or to mitigate a design basis accident.

A.1

With the PSW system inoperable, action must be taken to restore the system to OPERABLE status within 14 days. The 14-day Completion Time is reasonable based on the SSF Auxiliary Service Water and RCMU systems being OPERABLE and a low probability of a tornado or HELB event occurring that would require the PSW System during the 14 day time period.

B.1

With both the PSW and SSF Systems inoperable, action must be taken to restore the PSW system to OPERABLE status within 7days. The required action is not intended for voluntary removal of both systems from service that provide alternate means for safe shutdown. This required action is applicable if the PSW system is inoperable for reasons other than maintenance and the SSF is found to be inoperable, or if both the PSW and the SSF systems are found to be inoperable at the same time. The 7 day Completion Time is based on the redundant heat removal capabilities afforded by other safety systems, reasonable times for repairs, and the low probability of a tornado or HELB event occurring that would require the PSW System during this time period.

BASES (continued)

ACTIONS (continued)

C.1 and C.2

If the Required Action and associated Completion Time of Condition A or B is not met when the PSW System is inoperable due to maintenance (e.g., dewatering of the Unit 2 CCW underground piping or repair of the PSW pump) [contingency actions under development], action must be taken to restore the PSW System to OPERABLE status within 30 days. Operation for 30 days is permitted [contingency actions under development]. The 30 days is from the time of discovery of initial inoperability.

[Contingency actions under development]

D.1 and D.2

If the Required Action and associated Completion Times of either Condition C or Conditions A or B are not met for reasons other than Condition C, the unit(s) must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to MODE 3 within 12 hours and MODE 4 within 84. The allowed Completion Times are appropriate to reach the required unit conditions from full power conditions in an orderly manner and without challenging plant systems, considering a three unit shutdown may be required.

BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.7.10.1

Verifying battery terminal voltage while on float charge for the batteries helps to ensure the effectiveness of the charging system and the ability of the batteries to perform their intended function. Float charge is the condition in which the charger is supplying the continuous charge required to overcome the internal losses of a battery (or battery cell) and maintain the battery (or a battery cell) in a fully charged state. The voltage requirements are based on the nominal design voltage of the battery and are consistent with the initial voltage assumed in the battery sizing calculations. The 7 day frequency is consistent with manufacturer recommendations and IEEE-450.

SR 3.7.10. 2

This SR verifies the availability of the KHU associated with the underground power path to the PSW electrical system. Power path verification is included to demonstrate breaker OPERABILITY from the KHU to the PSW electrical system. This is accomplished by closing the Keowee to PSW Feeder Breakers. The 92 day Frequency is adequate based on operating experience to provide reliability verification without excessive equipment cycling for testing.

SR 3.7.10.3

This SR requires the PSW pumps be tested in accordance with the IST Program. The IST verifies the required flow rate at a discharge pressure to verify OPERABILITY. The SR is modified by a note indicating that it is not applicable to the PSW portable pump.

The specified Frequency is in accordance with the IST Program requirements. Operating experience has shown that these components usually pass the SR when performed at the IST Frequency. Therefore, the Frequency was concluded to be acceptable from a reliability standpoint.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.7.10.4

A battery service test is a special test of the battery capability, as found, to satisfy the design requirements (battery duty cycle) of the DC electrical power system. The discharge rate and test length correspond to the design duty cycle requirements.

The Surveillance Frequency for this test is 24 months which is consistent with expected fuel cycle lengths.

SR 3.7.10.5

This SR verifies the design capacity of the battery charger. According to Regulatory Guide 1.32, the battery charger supply is recommended to be based on the largest combined demands of the various steady state loads and the charging capacity to restore the battery from the design minimum charge state to the fully charged state, irrespective of the status of the unit during these demand occurrences. The minimum required amperes and duration ensure that these requirements can be satisfied.

This SR provides two options. One option requires that each battery charger be capable of supplying 300 amps at the minimum established float voltage for 8 hours. The ampere requirements are based on the output rating of the charger. The voltage requirements are based on the charger voltage level after a response to a loss of AC power. The time period if sufficient for the charger temperature to have stabilized and to have been maintained for at least 2 hours.

The other option requires that the battery charger be capable of recharging the battery after a service test coincident with supplying the largest coincident demands of the various continuous steady state loads (irrespective of the status of the plant during which these demands occur). This level of loading may not normally be available following the battery service test and will need to be supplemented with additional loads. The duration for this test may be longer than the charger sizing criteria since the battery recharge is affected by float voltage, temperature, and the exponential decay in charging current. The battery is recharged when the measured charging current is $\leq$ 2 amps. The Surveillance Frequency is acceptable, given the unit conditions required to perform the test and the other administrative controls existing to ensure adequate charger performance during these 24 month intervals.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.7.10.6

This SR verifies that the PSW switchgear can be aligned and power either the "A" or "B" HPI pumps once every 24 months.

SR 3.7.10.7

This SR verifies that the power transfer switches for the HPI pumps, pressurizer heaters, PSW control and electrical panels, and miscellaneous valves, are functional every 24 months.

SR 3.7.10.8

This SR verifies that the PSW pumps can supply Keowee Lake water at a flow rate greater than or equal to 10 gpm to the "A" or "B" HPI pump motor coolers (should there be a loss of normal LPSW cooling to these pumps) every 24 months.

SR 3.7.10.9

This SR requires the PSW portable pump to be tested on a 24 month frequency and verifies the required flow rate at a discharge pressure to verify OPERABIITY.

The specified frequency is based on the pump being not QA grade and on operating experience that has shown it usually passes the SR when performed at the 24 month frequency.

SR 3.7.10.10

The ability to align, start, and control flow of the PSW system to each unit must be verified every 48 months. This includes verification that the PSW header isolation valves to each unit's SGs open upon demand and that flow can be throttled to each SG through the full range of operation.

BASES (continued)

REFERENCES

1. Nuclear Station Report ONDS-351, "Analysis of Postulated High Energy Line Breaks (HELBs) Outside of Containment," dated May 20, 2008.
2. IEEE-450-1995.
3. Regulatory Guide 1.32, February 1977
4. Regulatory Guide 1.129, December 1974

3.7 PLANT SYSTEMS

3.7.10a Protected Service Water (PSW) Battery Parameters

LCO 3.7.10a Battery parameters for the PSW batteries shall be within limits.

APPLICABILITY: When the PSW system is required to be OPERABLE.

ACTIONS

---------------------------------NOTES---------------------------------
Separate Condition entry is allowed for each battery.

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One battery on one train with one battery cell float voltage < 2.07 V.	A.1	Perform SR 3.7.10.1	2 hours
	AND		
	A.2	Perform SR 3.7.10a.1.	2 hours
	AND		
	A.3	Restore affected cell voltage ≥ 2.07 V.	24 hours
B. One battery on one train with float current > 2 amps.	B.1	Perform SR 3.7.10.1	2hours
	AND		
	B.2	Restore battery float current to ≤ 2 amps.	12 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
------------NOTE------------ Required Action C.2 shall be completed if electrolyte level was below the top of plates. -------------------------------	--------------NOTE--------------- Required Actions C.1 and C.2 are only applicable if electrolyte level was below the top of plates. --	
C. One battery on one train with one or more cells electrolyte level less than minimum established design limits.	C.1 Restore electrolyte level to above top of plates.	8 hours
	AND	
	C.2 Verify no evidence of leakage.	12 hours
	AND	
	C.3 Restore electrolyte level to greater than or equal to minimum established design limits.	31 days
D. One battery on one train with pilot cell electrolyte temperature less than minimum established design limits.	D.1 Restore battery pilot cell temperature to greater than or equal to minimum established design limits.	12 hours
E. One battery with battery parameters not within limits.	E.1 Restore battery parameters for battery within limits.	2 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
F. Required Action and associated Completion Time of Condition A, B, C, D, or E not met. OR One battery on one train with one or more battery cells float voltage < 2.07 V and float current > 2 amps.	F.1 Declare associated battery inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.10a.1	-------------------NOTE------------------- Not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.7.10.1. --- Verify battery float current is ≤ 2 amps.	7 days
SR 3.7.10a.2	Verify battery pilot cell voltage is ≥ 2.07 V.	31 days
SR 3.7.10a.3	Verify battery connected cell electrolyte level is greater than or equal to minimum established design limits.	31 days

(continued)

ACTIONS (continued)

SR 3.7.10a.4	Verify battery pilot cell temperature is greater than or equal to minimum established design limits.	31 days
SR 3.7.10a.5	Verify battery connected cell voltage is ≥ 2.07 V.	92 days
SR 3.7.10.a.6	-----------------------NOTE--------------------------- This Surveillance shall not be performed in MODE 1, 2, 3, or 4. However, portions of the Surveillance may be performed to reestablish OPERABILITY provided an assessment determines the safety of the plant is maintained or enhanced. Credit may be taken for unplanned events that satisfy this SR. -- Verify battery capacity is ≥ 80% of the manufacturer's rating when subjected to a performance discharge test or a modified performance discharge test.	 60 months <u>AND</u> 12 months when battery shows degradation or has reached 85% of the expected life with capacity < 100% of manufacturer's rating <u>AND</u> 24 months when battery has reached 85% of the expected life with capacity ≥ 100% of manufacturer's rating

B 3.9 PLANT SYSTEMS

B 3.7.10a PSW Battery Parameters

BASES

BACKGROUND

This LCO delineates the limits on battery float current as well as electrolyte temperature, level, and float voltage for the PSW Power system batteries. In addition to the limitations of this Specification, the PSW Battery Monitoring and Maintenance Program specified in Specification 5.5.xx for monitoring various battery parameters that is based on the recommendations of IEEE Standard 450-1995, "IEEE Recommended Practice For Maintenance, Testing, And Replacement Of Vented Lead- Acid Batteries For Stationary Applications."

The battery cells are of flooded lead acid construction with a nominal specific gravity of 1.215. This specific gravity corresponds to an open circuit battery voltage of approximately 120 V for 58 cell battery (i.e., cell voltage of 2.065 volts per cell (Vpc)). The open circuit voltage is the voltage maintained when there is no charging or discharging. Once fully charged with its open circuit voltage < 2.065 Vpc, the battery cell will maintain its capacity for 30 days without further charging per manufacturer's instructions. Optimal long term performance however, is obtained by maintaining a float voltage 2.20 to 2.2 Vpc. This provides adequate over-potential which limits the formation of lead sulfate and self discharge. The nominal float voltage of 2.22 Vpc corresponds to a total float voltage output of 128.8 V for a 58 cell battery.

APPLICABLE SAFETY ANALYSES

The safety function of the PSW system is to supply cooling water for the secondary side decay heat removal at full system pressure to all six (6) steam generators (SGs) following postulated event scenarios. A secondary safety function of the PSW system is, in combination with the HPI System, to provide borated water to the RCS pump seals and to provide primary RCS makeup. Two redundant sources of electrical power serve the PSW electrical switchgear.

Because portions of the PSW System are not completely protected from the effects of a tornado, the system is not credited during the initial 72 hours after a tornado strike to the station. During the first 72 hours, the SSF will be utilized until damaged portions of the PSW system, which would be required for continued cooldown of the units to approximately

BASES

APPLICABLE SAFETY ANALYSES (continued)

250°F, are repaired. For HELBs occurring in the Turbine Building, the PSW System can be used as long as there is water contained in the underground CCW piping or until restorations are made to additional systems needed to cool down the units to Mode 5 conditions.

The PSW System is designed to mitigate the consequences of a loss of Lake Keowee event by emergency cooling water to one or more of the three Oconee Units' SGs and HPI pump motor coolers.

LCO

PSW Battery parameters must remain within acceptable limits to ensure availability of the required PSW DC power system to shut down the reactor and maintain it in a safe condition after an occurrence of a Tornado or High Energy Line Break inside the Turbine Building. Battery parameter limits are conservatively established, allowing continued PSW DC electrical system function even with limits not met. Additional preventative maintenance, testing, and monitoring performed in accordance with the PSW Battery Monitoring and Maintenance Program is conducted as specified in Specification 5.5.xx.

APPLICABILITY

The battery parameters are required solely for the support of the associated PSW electrical power systems. Therefore, battery parameter limits are only required when the PSW DC power source is required to be OPERABLE.

ACTIONS

A.1, A.2, and A.3

With one or more cells in a battery < 2.07 V, the battery cell is degraded. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage (SR 3.7.10.1) and of the overall battery state of charge by monitoring the battery float charge current (SR 3.7.10a.1). This assures that there is still sufficient battery capacity to perform the intended function. Therefore, the affected battery is not required to be considered inoperable solely as a result of one or more cells in a battery < 2.07 V, and continued operation is permitted for a limited period up to 24 hours.

Since the Required Actions only specify "perform," a failure of SR 3.7.10.1 or SR 3.7.10a.1 acceptance criteria does not result in this Required Action not met. However, if one of the SRs is failed the appropriate Condition(s), depending on the cause of the failures, is entered. If SR 3.7.10a.1 is failed then there is no assurance that there is still sufficient battery capacity to perform the intended function and the battery must be declared inoperable immediately.

BASES

ACTIONS (continued)

B.1 and B.2

One battery with float current >2 amps indicates that a partial discharge of the battery capacity has occurred. This may be due to a temporary loss of a battery charger or possibly due to one or more battery cells in a low voltage condition reflecting some loss of capacity. Within 2 hours verification of the required battery charger OPERABILITY is made by monitoring the battery terminal voltage. If the terminal voltage is found to be less than the minimum established float voltage there are two possibilities, the battery charger is inoperable or is operating in the current limit mode. Condition A addresses charger inoperability. If the charger is operating in the current limit mode after 2 hours that is an indication that the battery has been substantially discharged and likely cannot perform its required design functions. The time to return the battery to its fully charged condition in this case is a function of the battery charger capacity, the amount of loads on the associated DC system, the amount of the previous discharge, and the recharge characteristic of the battery. The charge time can be extensive, and there is not adequate assurance that it can be recharged within 12 hours (Required Action B.2). The battery must therefore be declared inoperable.

If the float voltage is found to be satisfactory but there are one or more battery cells with float voltage less than 2.07 V, the associated "OR" statement in Condition F is applicable and the. battery must be declared inoperable immediately. If float voltage is satisfactory and there are no cells less than 2.07 V there is good assurance that, within 12 hours, the battery will be restored to its fully charged condition (Required Action B.2) from any discharge that might have occurred due to a temporary loss of the battery charger.

A discharged battery with float voltage (the charger setpoint) across its terminals indicates that the battery is on the exponential charging current portion (the second part) of its recharge cycle. The time to return a battery to its fully charged state under this condition is simply a function of the amount of the previous discharge and the recharge characteristic of the battery. Thus there is good assurance of fully recharging the battery within 12 hours, avoiding a premature shutdown with its own attendant risk.

If the condition is due to one or more cells in a low voltage condition but still greater than 2.07 V and float voltage is found to be satisfactory, this is not indication of a substantially discharged battery and 12 hours is a reasonable time prior to declaring the battery inoperable.

ACTIONS

B.1 and B.2 (continued)

Since Required Action B.1 only specifies "perform," a failure of SR 3.7.10.1 acceptance criteria does not result in the Required Action not met. However, if SR 3.7.10.1 is failed, the appropriate Condition(s), depending on the cause of the failure, is entered.

C.1, C.2, and C.3

With one battery with one or more cells electrolyte level above the top of the plates, but below the minimum established design limits, the battery still retains sufficient capacity to perform the intended function. Therefore, the affected battery is not required to be considered inoperable solely as a result of electrolyte level not met. Within 31 days the minimum established design limits for electrolyte level must be re-established.

With electrolyte level below the top of the plates there is a potential for dryout and plate degradation. Required Actions C.1 and C.2 address this potential (as well as provisions in Specification 5.5.xx, PSW Battery Monitoring and Maintenance Program). They are modified by a Note that indicates they are only applicable if electrolyte level is below the top of the plates. Within 8 hours level is required to be restored to above the top of the plates. The Required Action C.2 requirement to verify that there is no leakage by visual inspection and the Specification 5.5.xx. item to initiate action to equalize and test in accordance with manufacturer's recommendation are taken from Annex D of IEEE Standard 450. They are performed following the restoration of the electrolyte level to above the top of the plates. Based on the results of the manufacturer's recommended testing the battery may have to be declared inoperable and the affected cell[s] replaced.

D.1

With one battery with pilot cell temperature less than the minimum established design limits, 12 hours is allowed to restore the temperature to within limits. A low electrolyte temperature limits the current and power available. Since the battery is sized with margin, while battery capacity is degraded, sufficient capacity exists to perform the intended function and the affected battery is not required to be considered inoperable solely as a result of the pilot cell temperature not met.

BASES

ACTIONS (continued)

E.1

With one battery with parameters not within limits there is not sufficient assurance that battery capacity has not been affected to the degree that the battery can still perform their required function. The longer Completion Times specified for battery parameters not within limits are therefore not appropriate, and the parameters must be restored to within limits within 2 hours.

F.1

With one battery with any battery parameter outside the allowances of the Required Actions for Condition A, B, C, or D, sufficient capacity to supply the maximum expected load requirement is not assured and must be declared inoperable. Additionally, discovering one battery with one or more battery cells float voltage less than 2.07 V and float current greater than 2 amps indicates that the battery capacity may not be sufficient to perform the intended functions. The battery must therefore be declared inoperable immediately.

SURVEILLANCE REQUIREMENTS

SR 3.7.10a.1

Verifying battery float current while on float charge is used to determine the state of charge of the battery. Float charge is the condition in which the charger is supplying the continuous charge required to overcome the internal losses of a battery and maintain the battery in a charged state. The float current requirements are based on the float current indicative of a charged battery. Use of float current to determine the state of charge of the battery is consistent with IEEE-450. The 7 day Frequency is consistent with IEEE-450.

This SR is modified by a Note that states the float current requirement is not required to be met when battery terminal voltage is less than the minimum established float voltage of SR 3.7.10.1. When this float voltage is not maintained, actions should be taken to provide the necessary and appropriate verifications of the battery condition. Furthermore, the float current limit of 2 amps is established based on the nominal float voltage value and is not directly applicable when this voltage is not maintained.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.7.10a.2 and SR 3.7.10a.5

Optimal long term battery performance is obtained by maintaining a float voltage greater than or equal to the minimum established design limits provided by the battery manufacturer, which corresponds to 130.5 V at the battery terminals, or 2.25 Vpc. This provides adequate over-potential, which limits the formation of lead sulfate and self discharge, which could eventually render the battery inoperable. Float voltages in this range or less, but greater than 2.07 Vpc, are addressed in Specification 5.5.xx. SRs 3.7.10a.2 and 3.7.10a.5 require verification that the cell float voltages are equal to or greater than the short term absolute minimum voltage of 2.07 V. The Frequency for cell voltage verification every 31 days for pilot cell and 92 days for each connected cell is consistent with IEEE-450.

SR 3.7.10a.3

The limit specified for electrolyte level ensures that the plates suffer no physical damage and maintains adequate electron transfer capability. The Frequency is consistent with IEEE-450.

SR 3.7.10a.4

This Surveillance verifies that the pilot cell temperature is greater than or equal to the minimum established design limit (i.e., 40°F). Pilot cell electrolyte temperature is maintained above this temperature to assure the battery can provide the required current and voltage to meet the design requirements. Temperatures lower than assumed in battery sizing calculations act to inhibit or reduce battery capacity. The Frequency is consistent with IEEE-450.

SR 3.7.10a.6

A battery performance discharge test is a test of constant current capacity of a battery, normally done in the as found condition, after having been in service, to detect any change in the capacity determined by the acceptance test. The test is intended to determine overall battery degradation due to age and usage.

Either the battery performance discharge test or the modified performance discharge test is acceptable for satisfying SR 3.7.10a.6; however, only the modified performance discharge test may be used to satisfy the battery service test requirements of SR 3.7.10.4.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.7.10a.6 (continued)

A modified discharge test is a test of the battery capacity and its ability to provide a high rate, short duration load (usually the highest rate of the duty cycle). This will often confirm the battery's ability to meet the critical period of the load duty cycle, in addition to determining its percentage of rated capacity. Initial conditions for the modified performance discharge test should be identical to those specified for a service test.

It may consist of just two rates; for instance the one minute rate for the battery or the largest current load of the duty cycle, followed by the test rate employed for the performance test, both of which envelope the duty cycle of the service test. Since the ampere-hours removed by a one minute discharge represents a very small portion of the battery capacity, the test rate can be changed to that for the performance test without compromising the results of the performance discharge test. The battery terminal voltage for the modified performance discharge test must remain above the minimum battery terminal voltage specified in the battery service test for the duration of time equal to that of the service test.

The acceptance criteria for this Surveillance are consistent with IEEE-450 and IEEE-485. These references recommend that the battery be replaced if its capacity is below 80% of the manufacturer's rating. A capacity of 80% shows that the battery rate of deterioration is increasing, even if there is ample capacity to meet the load requirements. Furthermore, the battery is sized to meet the assumed duty cycle loads when the battery design capacity reaches this 80 percent limit.

The Surveillance Frequency for this test is normally 60 months. If the battery shows degradation, or if the battery has reached 85% of its expected life and capacity is < 100% of the manufacturer's rating, the Surveillance Frequency is reduced to 12 months. However, if the battery shows no degradation but has reached 85% of its expected life, the Surveillance Frequency is only reduced to 24 months for batteries that retain capacity ≥ 100% of the manufacturer's ratings. Degradation is indicated, according to IEEE-450, when the battery capacity drops by more than 10% relative to its capacity on the previous performance test or when it is ≥ 10% below the manufacturer's rating. These Frequencies are consistent with the recommendations in IEEE-450.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.7.10a.6 (continued)

This SR is modified by a Note. The reason for the Note is that performing the Surveillance would perturb the electrical distribution system and challenge safety systems. This restriction from normally performing the Surveillance in MODE 1, 2, 3, or 4 is further amplified to allow portions of the Surveillance to be performed for the purpose of reestablishing OPERABILITY (e.g., post work testing following corrective maintenance, corrective modification, deficient or incomplete surveillance testing, and other unanticipated OPERABILITY concerns) provided an assessment determines plant safety is maintained or enhanced. This assessment shall, as a minimum, consider the potential outcomes and transients associated with a failed partial Surveillance, a successful partial Surveillance, and a perturbation of the offsite or onsite system when they are tied together or operated independently for the partial Surveillance; as well as the operator procedures available to cope with these outcomes. These shall be measured against the avoided risk of a plant shutdown and startup to determine that plant safety is maintained or enhanced when portions of the Surveillance are performed in MODE 1, 2, 3, or 4. Risk insights or deterministic methods may be used for the assessment. Credit may be taken for unplanned events that satisfy this SR.

REFERENCES

1. IEEE-450-1995
2. UFSAR, Chapter 15.
3. IEEE-485-1983, June 1983.

Tab 6

HELB Diagrams and Figures (Units 1, 2, and 3)