19A Event Trees for Core Damage Sequences Initiated During Power Operation

Appendix 19A presents the event trees that delineate the core-damage sequences for internal events initiated during power operation. The event trees and summary of top events are provided in the following figures and tables, respectively:

Event Tree	Event Tree Description	Table and Figure Number
BDA	Loss of Divisional Emergency AC Power	19A-1
ATWS	Failure to Scram Following Loss of Main Feedwater	19A-2
GT	General transient	19A-3
IND SGTR	Induced Steam Generator Tube Rupture	19A-4
ISL-CCW RCPTB	ISLOCA Due to RCP Thermal Barrier Tube Break	19A-5
ISL-CVCS HPTR	ISLOCA Due to Tube Rupture in CVCS High Pressure Cooler	19A-6
ISL-CVCS INJ	ISLOCA Due to Rupture of High Pressure CVCS Pipe Outside Containment	19A-7
ISL-CVCS REDS	ISLOCA Due to Spurious Opening of Reducing Station	19A-8
ISL-SIS LHSI	ISLOCA Due to Break in LHSI Cold Leg Injection Valves with LHSI Rupture in Respective SAB	19A-9
ISL-SIS MHSI	ISLOCA Due to Break in MHSI Cold Leg Injection Valves with MHSI Rupture in Respective SAB	19A-10
ISL-SIS RHR	ISLOCA Due to Failure of Suction Line MOVs and Subsequent RHR Line Rupture in Respective SAB	19A-11
LBOP	Loss of Balance of Plant Closed Loop Cooling Water or Auxiliary Cooling Water	19A-12
LLOCA	Large Loss-of-Coolant Accident	19A-13
LOC	Loss of Main Condenser	19A-14
LOCCW	Loss of Component Cooling Water or Emergency Service Water	19A-15
LOMFW	Loss of Main Feedwater	19A-16
LOOP	Loss of Offsite Power	19A-17
MLOCA	Medium Loss-of-Coolant Accident	19A-18
MSSV	Spurious Opening of Main Steam Safety Valve	19A-19
SGTR	Steam Generator Tube Rupture	19A-20
SLBI	Steam-Line Break Inside Containment	19A-21
SLBO	Steam-Line Break Outside Containment	19A-22
SLOCA	Small Loss-of-Coolant Accident	19A-23

In each case, the summary tables provide the following information:

- The definition of the top event. Note that some of the top events are configured differently for particular branch points. These configurations reflect conditions (e.g., different success criteria or timing) presented by the initiating event or by other failures in the sequence. The event trees denote these conditional states by an integer at relevant branch points. These conditional states are identified in the table as well.

- The success criteria for the top event.

- The corresponding failure event that is developed for purposes of evaluating the core-damage sequence.

- The description for the failure event.

Table 19A-1—Event Tree Headings for Initiating Event BDA: Loss of Divisional Emergency AC Power
Sheet 1 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
BDA	Consequence* - loss of divisional emergency AC (switchgear BDA)	--	IE BDA (consequence)	Loss of divisional emergency AC (switchgear BDA)
RCP LOCA	RCP seal LOCA does not occur	Seal injection with CVCS or seal cooling with CCWS or standstill seal actuation or seals withstand challenge	RCP LOCA (FT top gate)	RCP seal LOCA
MHSI	Medium-head safety injection available (Condition 1)	1 of 4 MHSI pumps supply flow	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
OP FCD	Operator initiates fast cooldown within 40 min (Condition 1)	Action within 40 min	OPE-FCD-40M (basic event)	Operator fails to initiate fast cooldown for SLOCA
MFW	Main feedwater available	1 of 4 MFW pumps available to deliver flow to 1 of 4 steam generators (main condenser required with turbine bypass)	MFW (FT top gate)	Failure of the MFWS to deliver flow to 1 of 4 STs and to remove steam via turbine bypass
SSS	Startup and shutdown system available for secondary heat removal (Condition 1)	SSS flow to 1 of 4 steam generators for secondary heat removal – normal cooldown	SSS (FT top gate)	Failure of startup and shutdown system to deliver flow to 1 of 4 steam generators

Table 19A-1—Event Tree Headings for Initiating Event BDA: Loss of Divisional Emergency AC Power
Sheet 2 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
EFW	EFW available for:		EFW (FT top gate)	Failure of secondary heat removal and secondary cooldown
	Secondary heat removal (Condition 1)	1 of 4 EFW trains available for secondary heat removal (MSRVs or MSSVs)		
	Partial cooldown (Condition 2)	1 of 4 EFW trains available for partial cooldown (MSRVs only)		
	Fast cooldown (Condition 3)	1 of 4 EFW trains available for fast cooldown (MSRVs only)		
EFW INV	EFW maintains adequate inventory.	All 4 EFW tanks cross tied (or refilled)	EFW INV (FT top gate)	Failure to provide adequate EFW Inventory
OP FB	Operator initiates feed-and-bleed cooling for:			
	Transient, after Longer Time (low DH) (Condition 1)	Initiation of feed-and-bleed after 90 min	OPE-FB-L90M (basic event)	Operator fails to initiate feed-and-bleed for transient with low decay heat
	Transient, within 90 min (Condition 2)	Initiation of feed-and-bleed within 90 min	OPE-FB-90M (basic event)	Operator fails to initiate feed-and-bleed for transient
	SLOCA (i.e., RCP seal LOCA), within 40 min (Condition 3)	Initiation of feed-and-bleed within 40 min	OPE-FB-40M (basic event)	Operator fails to initiate feed-and-bleed for SLOCA
PBL	Primary bleed available	3 of 3 PSVs or 1 of 2 PDVs and steam generator relief (4 SGs)	PBL (FT top gate)	Failure of a PSV and both PDVs or steam generator relief valves (MSRTs and safeties) on the steam generators
MHSI FB	MHSI available for feed-and-bleed cooling	1 of 4 MHSI pumps available	MHSI 4/4 (FT tope gate)	Failure of 4 out of 4 MHSI trains

Table 19A-1—Event Tree Headings for Initiating Event BDA: Loss of Divisional Emergency AC Power
Sheet 3 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
LHSI	LHSI available for feed-and-bleed cooling (Condition 1)	1 of 4 LHSI pumps available	LHSI INJ 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains (injection mode only)
ACC	Accumulator injection available (Condition 1)	1 of 4 Accumulators available	ACC 4/4 (FT top gate)	Failure of 4 out of 4 Accumulator trains
	Accumulator injection available (Condition 2)	2 of 4 Accumulators available	ACC 3/4 (FT top gate)	Failure of 3 out of 4 Accumulator trains
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 1)	1 of 4 LHSI trains (with Htx) available OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)
	Long Term Cooling of IRWST via LHSI or SAHR (Condition 2)	1 of 4 LHSI trains (with Htx) available (SI signal required) OR 1 of 1 SAHR pump available in recirculation mode		

*This event tree structure is used for several initiating events in addition to BDA which includes FIRE-BATT, FIRE-CSR, FIRE-SAB14-ELEC, FIRE-SAB23-ELEC and FIRE-SAB-MECH.

Table 19A-2—Event Tree Headings for ATWS: Failure to Scram
Sheet 1 of 2

Event Tree Top Event		Success Criteria	Failure Event	Event Description
ATWS	Consequence* - anticipated transient without scram	--	ATWS (consequence)	ATWS – Anticipated Transient Without Scram
PSR	Pressurizer relief with RCP shutdown	Main feedwater available AND 3 of 3 PSR valves open (1 of 3 if RCPs Trip)	PSR (FT top gate)	Failure of pressurizer relief or corresponding RCP shutdown during ATWS event
PSV	Pressurizer safety valves reclose	3 of 3 PSR valves reclose	PSV (FT top gate)	Failure of pressurizer relief valves to reclose after opening
EBS	Boration via extra borating system (EBS) for:			
	Intact RCS, PSVs reclose (Condition 1)	1 of 2 EBS trains available – manual actuation in ATWS	EBS ATWS 2/2 (FT top gate)	Failure of boration via EBS – ATWS 1 (1 of 2 EBS trains required)
	Stuck-open PSV (Condition 2)	2 of 2 EBS trains – manual actuation in ATWS	EBS ATWS ½ (FT top gate)	Failure of boration via EBS – ATWS 1 (1 of 2 EBS trains required)
EFW	EFW available for:		EFW ATWS (FT top gate)	Failure of secondary heat removal and secondary cooldown (3 of 4 steam generators) – ATWS
	Secondary hear removal (Condition 7)	EFW to 2 of 4 steam generators available for secondary heat removal with relief by MSRTs		
	Partial cooldown (Condition 8)	EFW to 2 of 4 steam generators available for partial cooldown with relief by MSRTs		
EFW INV	EFW maintains adequate inventory.	All 4 EFW tanks cross tied (or refilled)	EFW INV (FT top gate)	Failure to provide adequate EFW Inventory
MHSI	MHSI available (Condition 2)	2 of 4 MHSI pumps available	MHSI ¾ (FT top gate)	Failure of 3 of 4 MHSI trains

Table 19A-2—Event Tree Headings for ATWS: Failure to Scram
Sheet 2 of 2

Event Tree Top Event		Success Criteria	Failure Event	Event Description
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 2)	1 of 4 LHSI trains (with Htx) available (SI signal required) OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)

*This event tree structure is used for several initiating events including GT, LBOP, LOC, LOMFW, LOOP, FIRE-FB, FIRE-MCR, FIRE-SWGR, FIRE-TB, FIRE XF YARD and FLD-TB.

Table 19A-3—Event Tree Headings for Initiating Event GT: General Transient
Sheet 1 of 2

Event Tree Top Event		Success Criteria	Failure Event	Event Description
GT	Consequence* - general transient (including turbine trip and reactor trip)	--	IE GT (consequence)	General transient (including turbine trip and reactor trip)
RT	Reactor Trip (Condition 1 signals – high RCS pressure or high steam line pressure)	2 out of 4 RPS input signals and 1out of 2 twice for reactor trip breakers or 2 out 4 contactors	RT1 (FT top gate)	Failure of reactor trip 1 (turbine trip type events)
MFW	Main feedwater available	1 of 4 MFW pumps available to deliver flow to 1 of 4 steam generators (main condenser required with turbine bypass)	MFW (FT top gate)	Failure of the MFWS to deliver flow to 1 of 4 STs and to remove steam via turbine bypass
SSS	Startup and shutdown system available for secondary heat removal (Condition 1)	SSS flow to 1 of 4 steam generators for secondary heat removal – normal cooldown	SSS (FT top gate)	Failure of startup and shutdown system to deliver flow to 1 of 4 steam generators
EFW	EFW available for secondary heat removal (Condition 1)	1 of 4 EFW trains available for secondary heat removal (MSRVs or MSSVs)	EFW (FT top gate)	Failure of secondary heat removal and secondary cooldown
EFW INV	EFW maintains adequate inventory.	All 4 EFW tanks cross tied (or refilled)	EFW INV (FT top gate)	Failure to provide adequate EFW Inventory
OP FB	Operator initiates feed-and-bleed cooling for:			
	Transient, after Longer Time (low DH) (Condition 1)	Initiation of feed-and-bleed after 90 min	OPE-FB-L90M (basic event)	Operator fails to initiate feed-and-bleed for transient with low decay heat
	Transient, within 90 min (Condition 2)	Initiation of feed-and-bleed within 90 min	OPE-FB-90M (basic event)	Operator fails to initiate feed-and-bleed for transient

Table 19A-3—Event Tree Headings for Initiating Event GT: General Transient
Sheet 2 of 2

Event Tree Top Event		Success Criteria	Failure Event	Event Description
PBL	Primary bleed available	3 of 3 PSVs or 1 of 2 PDVs and steam generator relief (4 SGs)	PBL (FT top gate)	Failure of a PSV and both PDVs or steam generator relief valves (MSRTs and safeties) on the steam generators
MHSI FB	MHSI available for feed-and-bleed cooling	1 of 4 MHSI pumps available	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
LHSI	LHSI available for feed-and-bleed cooling (Condition 1)	1 of 4 LHSI pumps available	LHSI INJ 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains (injection mode only)
ACC	Accumulator injection available (Condition 1)	1 of 4 Accumulators available	ACC 4/4 (FT top gate)	Failure of 4 out of 4 Accumulator trains
	Accumulator injection available (Condition 2)	2 of 4 Accumulators available	ACC 3/4 (FT Top gate)	Failure of 3 out of 4 Accumulator trains
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 1)	1 of 4 LHSI trains (with Htx) available OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)

*This event tree structure is used for several initiating events in addition to GT which includes FIRE-FB and FIRE-XF YARD.

Table 19A-4—Event Tree Headings for Initiating Event IND SGTR: Induced Steam Generator Tube Rupture

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE IND SGTR	Induced steam generator tube rupture	--	IE IND SGTR (initiator)	Initiator - induced SGTR
TUBES	Induced SGTR – 1 tube broken (Condition 1)	--	1 TUBE (basic event)	1 ruptured SG tube
	Induced SGTR – 2-9 tubes broken (Condition 2)	--	2-9 TUBES (basic event)	2-9 ruptured SG tubes
	Induced SGTR – more than 10 tubes broken (Condition 3)	--	10 TUBES (basic event)	10 or more ruptured SG tubes
EFW	EFW available for partial cooldown (Condition 2)	1 of 4 EFW trains available for partial cooldown (MSRVs only)	EFW (FT top gate)	Failure of secondary heat removal and secondary cooldown
MHSI	Medium-head safety injection available (Condition 1)	1 of 4 MHSI pumps supply flow	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
OP RHR	Operator aligns and initiate RHR within T>12 hr (Condition 2)	Action after 12 hr	OPE-RHR-L12H (basic event)	Operator fails to initiate RHR (longer than 12 hours)
	Operator aligns and initiates RHR within 3 hr (Condition 4)	Action within 3 hr	OPE-RHR-3H (basic event)	Operator fails to initiate RHR within 3 hours
	Operator mitigates multiple (>10 tubes) induced SGTR (Condition 5)		OPE-RHR/ SG10TR (basic event)	Likelihood to survive multiple (10+) ruptured tubes
RHR	RHR available (Condition 3)	2 out of 4 LHSI pumps available for RHR	RHR 3/4 (FT top gate)	Failure of 3 out of 4 LHSI trains for RHR

Table 19A-5—Event Tree Headings for Initiating Event ISL-CCW RCPTB: ISLOCA Due to RCP Thermal Barrier Tube Break

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE ISL-CCW-RCPTB	ISLOCA due to break in RCP thermal barrier tube, allowing overpressure of CCW piping	--	IE ISL-CCW-RCPTB (initiator)	Initiator - ISLOCA due to break in RCP thermal barrier tube, allowing overpressure of CCW piping
EFW	EFW available for partial cooldown (Condition 2)	1 of 4 EFW trains available for partial cooldown (MSRVs only)	EFW (FT top gate)	Failure of secondary heat removal and secondary cooldown
MHSI	Medium-head safety injection available (Condition 1)	1 of 4 MHSI pumps supply flow	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
OP RHR	Operator aligns and initiates RHR within 4 hr (Condition 1)	Action within 4 hr	OPE-RHR-4H (basic event)	Operator fails to initiate RHR within 4 hours
RHR	RHR available (Condition 3)	2 out of 4 LHSI pumps available for RHR	RHR 3/4 (FT top gate)	Failure of 3 out of 4 LHSI trains for RHR

Table 19A-6—Event Tree Headings for Initiating Event ISL-CVCS HPTR: ISLOCA Due to Tube Rupture in CVCS High Pressure Cooler

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE ISL-CVCS HPTR	ISLOCA due to rupture of tube in CVCS high pressure cooler (0.4" tube)	--	IE ISL-CVCS HPTR (initiator)	Initiator - ISLOCA due to rupture of tube in CVCS high pressure cooler (0.4" tube)
EFW	EFW available for partial cooldown (Condition 2)	1 of 4 EFW trains available for partial cooldown (MSRVs only)	EFW (FT top gate)	Failure of secondary heat removal and secondary cooldown
MHSI	Medium-head safety injection available (Condition 1)	1 of 4 MHSI pumps supply flow	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
OP RHR	Operator aligns and initiates RHR within 4 hr (Condition 1)	Action within 4 hr	OPE-RHR-4H (basic event)	Operator fails to initiate RHR within 4 hours
RHR	RHR available (Condition 3)	2 out of 4 LHSI pumps available for RHR	RHR 3/4 (FT top gate)	Failure of 3 out of 4 LHSI trains for RHR

Table 19A-7—Event Tree Headings for Initiating Event ISL-CVCS INJ: ISLOCA Due to Rupture of High Pressure CVCS Pipe Outside Containment

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE ISL-CVCS INJ	ISLOCA due to rupture of high pressure CVCS pipe outside containment	—	IE ISL-CVCS INJ (initiator)	Initiator - ISLOCA due to rupture of high pressure CVCS pipe outside containment

Table 19A-8—Event Tree Headings for Initiating Event ISL-CVCS REDS: ISLOCA Due to Spurious Opening of Reducing Station

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE ISL-CVCS REDS	ISLOCA due to spurious opening of reducing station	--	IE ISL-CVCS REDS (initiator)	Initiator - ISLOCA due to spurious opening of reducing station
EFW	EFW available for partial cooldown (Condition 2)	1 of 4 EFW trains available for partial cooldown (MSRVs only)	EFW (FT top gate)	Failure of secondary heat removal and secondary cooldown
MHSI	Medium-head safety injection available (Condition 1)	1 of 4 MHSI pumps supply flow	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
OP RHR	Operator aligns and initiates RHR within 4 hr (Condition 1)	Action within 4 hr	OPE-RHR-4H (basic event)	Operator fails to initiate RHR within 4 hours
RHR	RHR available (Condition 3)	2 out of 4 LHSI pumps available for RHR	RHR 3/4 (FT top gate)	Failure of 3 out of 4 LHSI trains for RHR

Table 19A-9—Event Tree Headings for Initiating Event ISL-SIS LHSI: ISLOCA Due to Break in LHSI Cold Leg Injection Valves with LHSI Rupture in Respective SAB

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE ISL-SIS LHSI	ISLOCA due to break in LHSI cold leg injection valves with LHSI break in respective SAB	—	IE ISL-SIS LHSI (initiator)	Initiator - ISLOCA due to break in LHSI cold leg injection valves with LHSI break in respective SAB

Table 19A-10—Event Tree Headings for Initiating Event ISL-SIS MHSI: ISLOCA Due to Break in MHSI Cold Leg Injection Valves with MHSI Rupture in Respective SAB

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE ISL-SIS MHSI	ISLOCA due to break in MHSI cold leg injection valves with MHSI break in respective SAB	—	IE ISL-SIS MHSI (initiator)	Initiator - ISLOCA due to break in MHSI cold leg injection valves with MHSI break in respective SAB

Table 19A-11—Event Tree Headings for Initiating Event ISL-SIS RHR: ISLOCA Due to Failure of Suction Line MOVs and Subsequent RHR Line Rupture in Respective SAB

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE ISL-SIS RHR	ISLOCA due to failure of suction line MOVs and subsequent RHR line rupture in respective SAB	—	IE ISL-SIS RHR (initiator)	Initiator - ISLOCA due to failure of suction line MOVs and subsequent RHR line rupture in respective SAB

**Table 19A-12—Event Tree Headings for Initiating Event LBOP:
Loss of Balance of Plant Closed Loop Cooling Water or Auxiliary Cooling Water
Sheet 1 of 2**

Event Tree Top Event		Success Criteria	Failure Event	Event Description
LBOP	Consequence* - loss of balance of plant – closed cooling water or auxiliary cooling water	--	IE LBOP (consequence)	Loss of balance of plant – closed cooling water or auxiliary cooling water
RT	Reactor Trip (Condition 2 signals – low DNBR or low steam generator level)	2 out of 4 RPS input signals and 1out of 2 twice for reactor trip breakers or 2 out 4 contactors	RT2 (FT top gate)	Failure of reactor trip 1 (loss-of-feedwater type events)
EFW	EFW available for secondary heat removal (Condition 1)	1 of 4 EFW trains available for secondary heat removal (MSRVs or MSSVs)	EFW (FT top gate)	Failure of secondary heat removal and secondary cooldown
EFW INV	EFW maintains adequate inventory.	All 4 EFW tanks cross tied (or refilled)	EFW INV (FT top gate)	Failure to provide adequate EFW Inventory
OP FB	Operator initiates feed-and-bleed cooling for:			
	Transient, after Longer Time (low DH) (Condition 1)	Initiation of feed-and-bleed after 90 min	OPE-FB-L90M (basic event)	Operator fails to initiate feed-and-bleed for transient with low decay heat
	Transient, within 90 min (Condition 2)	Initiation of feed-and-bleed within 90 min	OPE-FB-90M (basic event)	Operator fails to initiate feed-and-bleed for transient
PBL	Primary bleed available	3 of 3 PSVs or 1 of 2 PDVs and steam generator relief (4 SGs)	PBL (FT top gate)	Failure of a PSV and both PDVs or steam generator relief valves (MSRTs and safeties) on the steam generators
MHSI FB	MHSI available for feed-and-bleed cooling	1 of 4 MHSI pumps available	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
LHSI	LHSI available for feed-and-bleed cooling (Condition 1)	1 of 4 LHSI pumps available	LHSI INJ 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains (injection mode only)

**Table 19A-12—Event Tree Headings for Initiating Event LBOP:
Loss of Balance of Plant Closed Loop Cooling Water or Auxiliary Cooling Water
Sheet 2 of 2**

Event Tree Top Event		Success Criteria	Failure Event	Event Description
ACC	Accumulator injection available (Condition 1)	1 of 4 Accumulators available	ACC 4/4 (FT top gate)	Failure of 4 out of 4 Accumulator trains
	Accumulator injection available (Condition 2)	2 of 4 Accumulators available	ACC 3/4 (FT top gate)	Failure of 3 out of 4 Accumulator trains
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 1)	1 of 4 LHSI trains (with Htx) available OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)

Table 19A-13—Event Tree Headings for Initiating Event LLOCA: Large Loss-of-Coolant Accident

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE LLOCA	Large loss-of-coolant accident (> 6 in break)	--	IE LLOCA (initiator)	Initiator - large LOCA (>6 in diameter)
MHSI	Medium-head safety injection available (Condition 1)	1 of 4 MHSI pumps supply flow	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
LHSI	LHSI available for feed-and-bleed cooling (Condition 2)	1 of 4 LHSI pump available (SI signal required)	LHSI ING 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains (injection mode only)
ACC	Accumulator injection available (Condition 1)	1 of 4 Accumulators available	ACC 4/4 (FT top gate)	Failure of 4 out of 4 Accumulator trains
	Accumulator injection available (Condition 2)	2 of 4 Accumulators available	ACC 3/4 (FT top gate)	Failure of 3 out of 4 Accumulator trains
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 2)	1 of 4 LHSI trains (with Htx) available (SI signal required) OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)

Table 19A-14—Event Tree Headings for Initiating Event LOC: Loss of Main Condenser
Sheet 1 of 2

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE LOC	Loss of main condenser (including MSIV closure)	--	IE LOC (initiator)	Initiator - loss of main condenser
RT	Reactor Trip (Condition 1 signals – high RCS pressure or high steam line pressure)	2 out of 4 RPS input signals and 1out of 2 twice for reactor trip breakers or 2 out 4 contactors	RT1 (FT top gate)	Failure of reactor trip 1 (turbine trip type events)
SSS	Startup and shutdown system available for secondary heat removal (Condition 1)	SSS flow to 1 of 4 steam generators for secondary heat removal – normal cooldown	SSS (FT top gate)	Failure of startup and shutdown system to deliver flow to 1 of 4 steam generators
EFW	EFW available for secondary heat removal (Condition 1)	1 of 4 EFW trains available for secondary heat removal (MSRVs or MSSVs)	EFW (FT top gate)	Failure of secondary heat removal and secondary cooldown
EFW INV	EFW maintains adequate inventory.	All 4 EFW tanks cross tied (or refilled)	EFW INV (FT top gate)	Failure to provide adequate EFW Inventory
OP FB	Operator initiates feed-and-bleed cooling for:			
	Transient, after Longer Time (low DH) (Condition 1)	Initiation of feed-and-bleed after 90 min	OPE-FB-L90M(basic event)	Operator fails to initiate feed-and-bleed for transient with low decay heat
	Transient, within 90 min (Condition 2)	Initiation of feed-and-bleed within 90 min	OPE-FB-90M (basic event)	Operator fails to initiate feed-and-bleed for transient
PBL	Primary bleed available	3 of 3 PSVs or 1 of 2 PDVs and steam generator relief (4 SGs)	PBL (FT top gate)	Failure of a PSV and both PDVs or steam generator relief valves (MSRTs and safeties) on the steam generators

Table 19A-14—Event Tree Headings for Initiating Event LOC: Loss of Main Condenser
Sheet 2 of 2

Event Tree Top Event		Success Criteria	Failure Event	Event Description
MHSI FB	MHSI available for feed-and-bleed cooling	1 of 4 MHSI pumps available	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
LHSI	LHSI available for feed-and-bleed cooling (Condition 1)	1 of 4 LHSI pumps available	LHSI INJ 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains (injection mode only)
ACC	Accumulator injection available (Condition 1)	1 of 4 Accumulators available	ACC 4/4 (FT top gate)	Failure of 4 out of 4 Accumulator trains
	Accumulator injection available (Condition 2)	2 of 4 Accumulators available	ACC 3/4 (FT top gate)	Failure of 3 out of 4 Accumulator trains
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 1)	1 of 4 LHSI trains (with Htx) available OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)

Table 19A-15—Event Tree Headings for Initiating Event LOCCW: Loss of CCWS or ESWS
Sheet 1 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
LOCCW	Consequence* - loss of component cooling water or emergency service water	--	IE LOCCW (consequence)	Loss of component cooling water or emergency service water
RCP LOCA	RCP seal LOCA does not occur	Seal injection with CVCS or seal cooling with CCWS or standstill seal actuation or seals withstand challenge	RCP LOCA (FT top gate)	RCP seal LOCA
MHSI	Medium-head safety injection available (Condition 1)	1 of 4 MHSI pumps supply flow	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
OP FCD	Operator initiates fast cooldown within 40 min (Condition 1)	Action within 40 min	OPE-FCD-40M (basic event)	Operator fails to initiate fast cooldown for SLOCA
MFW	Main feedwater available	1 of 4 MFW pumps available to deliver flow to 1 of 4 steam generators (main condenser required with turbine bypass)	MFW (FT top gate)	Failure of the MFWS to deliver flow to 1 of 4 STs and to remove steam via turbine bypass
SSS	Startup and shutdown system available for secondary heat removal (Condition 1)	SSS flow to 1 of 4 steam generators for secondary heat removal – normal cooldown	SSS (FT top gate)	Failure of startup and shutdown system to deliver flow to 1 of 4 steam generators

Table 19A-15—Event Tree Headings for Initiating Event LOCCW: Loss of CCWS or ESWS
Sheet 2 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
EFW	EFW available for:		EFW (FT top gate)	Failure of secondary heat removal and secondary cooldown
	Secondary heat removal (Condition 1)	1 of 4 EFW trains available for secondary heat removal (MSRVs or MSSVs)		
	Partial cooldown (Condition 2)	1 of 4 EFW trains available for partial cooldown (MSRVs only)		
	Fast cooldown (Condition 3)	1 of 4 EFW trains available for fast cooldown (MSRVs only)		
EFW INV	EFW maintains adequate inventory.	All 4 EFW tanks cross tied (or refilled)	EFW INV (FT top gate)	Failure to provide adequate EFW Inventory
OP FB	Operator initiates feed-and-bleed cooling for:			
	Transient, after Longer Time (low DH) (Condition 1)	Initiation of feed-and-bleed after 90 min	OPE-FB-L90M (basic event)	Operator fails to initiate feed-and-bleed for transient with low decay heat
	Transient, within 90 min (Condition 2)	Initiation of feed-and-bleed within 90 min	OPE-FB-90M (basic event)	Operator fails to initiate feed-and-bleed for transient
	SLOCA (i.e., RCP seal LOCA), within 40 min (Condition 3)	Initiation of feed-and-bleed within 40 min	OPE-FB-40M (basic event)	Operator fails to initiate feed-and-bleed for SLOCA
PBL	Primary bleed available	3 of 3 PSVs or 1 of 2 PDVs and steam generator relief (4 SGs)	PBL (FT top gate)	Failure of a PSV and both PDVs or steam generator relief valves (MSRTs and safeties) on the steam generators
MHSI FB	MHSI available for feed-and-bleed cooling	1 of 4 MHSI pumps available	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains

Table 19A-15—Event Tree Headings for Initiating Event LOCCW: Loss of CCWS or ESWS
Sheet 3 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
LHSI	LHSI available for feed-and-bleed cooling (Condition 1)	1 of 4 LHSI pumps available	LHSI INJ 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains (injection mode only)
ACC	Accumulator injection available (Condition 1)	1 of 4 Accumulators available	ACC 4/4 (FT top gate)	Failure of 4 out of 4 Accumulator trains
	Accumulator injection available (Condition 2)	2 of 4 Accumulators available	ACC 3/4 (FT top gate)	Failure of 3 out of 4 Accumulator trains
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 1)	1 of 4 LHSI trains (with Htx) available OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)
	Long Term Cooling of IRWST via LHSI or SAHR (Condition 2)	1 of 4 LHSI trains (with Htx) available (SI signal required) OR 1 of 1 SAHR pump available in recirculation mode		

*This event tree structure is used for several initiating events in addition to LOCCW which includes FIRE-ESW, FLD-ANN, FLD-EFW, FLD-ESW, FLD-SAB14 FB, FLD-SAB23 and FLD-SIS.

Table 19A-16—Event Tree Headings for Initiating Event LOMFW: Loss of Main Feedwater
Sheet 1 of 2

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE LOMFW	Total loss of main feedwater	--	IE LOMFW (initiator)	Initiator - total loss of main feedwater
RT	Reactor Trip (Condition 2 signals – low DNBR or low steam generator level)	2 out of 4 RPS input signals and 1 out of 2 twice for reactor trip breakers or 2 out 4 contactors	RT2 (FT top gate)	Failure of reactor trip 1 (loss-of-feedwater type events)
SSS	Startup and shutdown system available for secondary heat removal (Condition 1)	SSS flow to 1 of 4 steam generators for secondary heat removal – normal cooldown	SSS (FT top gate)	Failure of startup and shutdown system to deliver flow to 1 of 4 steam generators
EFW	EFW available for secondary heat removal (Condition 1)	1 of 4 EFW trains available for secondary heat removal (MSRVs or MSSVs)	EFW (FT top gate)	Failure of secondary heat removal and secondary cooldown
EFW INV	EFW maintains adequate inventory.	All 4 EFW tanks cross tied (or refilled)	EFW INV (FT top gate)	Failure to provide adequate EFW Inventory
OP FB	Operator initiates feed-and-bleed cooling for:			
	Transient, after Longer Time (low DH) (Condition 1)	Initiation of feed-and-bleed after 90 min	OPE-FB-L90M (basic event)	Operator fails to initiate feed-and-bleed for transient with low decay heat
	Transient, within 90 min (Condition 2)	Initiation of feed-and-bleed within 90 min	OPE-FB-90M (basic event)	Operator fails to initiate feed-and-bleed for transient
PBL	Primary bleed available	3 of 3 PSVs or 1 of 2 PDVs and steam generator relief (4 SGs)	PBL (FT top gate)	Failure of a PSV and both PDVs or steam generator relief valves (MSRTs and safeties) on the steam generators

Table 19A-16—Event Tree Headings for Initiating Event LOMFW: Loss of Main Feedwater
Sheet 2 of 2

Event Tree Top Event		Success Criteria	Failure Event	Event Description
MHSI FB	MHSI available for feed-and-bleed cooling	1 of 4 MHSI pumps available	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
LHSI	LHSI available for feed-and-bleed cooling (Condition 1)	1 of 4 LHSI pumps available	LHSI INJ 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains (injection mode only)
ACC	Accumulator injection available (Condition 1)	1 of 4 Accumulators available	ACC 4/4 (FT top gate)	Failure of 4 out of 4 Accumulator trains
	Accumulator injection available (Condition 2)	2 of 4 Accumulators available	ACC 3/4 (FT top gate)	Failure of 3 out of 4 Accumulator trains
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 1)	1 of 4 LHSI trains (with Htx) available OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)

Table 19A-17—Event Tree Headings for Initiating Event LOOP: Loss of Offsite Power
Sheet 1 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE LOOP	Loss of offsite power	--	IE LOOP (initiator)	Initiator - loss of offsite power
EDG	EDG buses available	1 of 4 EDGs available	EDG (FT top gate)	Failure of all EDGs
RT	Reactor Trip (Condition 1 signals – high RCS pressure or high steam line pressure)	2 out of 4 RPS input signals and 1out of 2 twice for reactor trip breakers or 2 out 4 contactors	RT1 (FT top gate)	Failure of reactor trip 1 (turbine trip type events)
I&C	Power supply for I&C available for 2-hr duration of LOOP	1 of 4 I&C buses available	I&C (FT top gate)	Failure of I&C buses during a LOOP
MSR	Main steam relief (Condition 1)	Steam relief from 4 of 4 steam generators secondary heat removal mode	MSR (FT top gate)	Failure of steam relief from 1 of 4 steam generators
RCP LOCA	RCP seal LOCA does not occur	Seal injection with CVCS or seal cooling with CCWS or standstill seal actuation or seals withstand challenge	RCP LOCA (FT top gate)	RCP seal LOCA
REC LOOP	Recovery of offsite power within:			
	1 hr – RCP seal LOCA (Condition 1)	Recovery within 1 hr	REC OSP 1HR (basic event)	Failure to recover offsite power within 1 hr
	2 hr (Condition 2)	Recovery within 2 hr	REC OSP 2HR (basic event)	Failure to recover offsite power within 2 hr
SBO	Station blackout diesel-generator buses available	Train 1 or Train 2 SBO diesel supplied BBH buses available	SBO (FT top gate)	Failure of the station blackout diesel generator buses

Table 19A-17—Event Tree Headings for Initiating Event LOOP: Loss of Offsite Power
Sheet 2 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
MHSI	Medium-head safety injection available (Condition 1)	1 of 4 MHSI pumps supply flow	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
OP FCD	Operator initiates fast cooldown within 40 min (Condition 1)	Action within 40 min	OPE-FCD-40M (basic event)	Operator fails to initiate fast cooldown for SLOCA
EFW	EFW available for:		EFW (FT top gate)	Failure of secondary heat removal and secondary cooldown
	Secondary heat removal (Condition 1)	1 of 4 EFW trains available for secondary heat removal (MSRVs or MSSVs)		
	Partial cooldown (Condition 2)	1 of 4 EFW trains available for partial cooldown (MSRVs only)		
	Fast cooldown (Condition 3)	1 of 4 EFW trains available for fast cooldown (MSRVs only)		
EFW INV	EFW maintains adequate inventory.	All 4 EFW tanks cross tied (or refilled)	EFW INV (FT top gate)	Failure to provide adequate EFW Inventory
OP FB	Operator initiates feed-and-bleed cooling for:			
	Transient, after Longer Time (low DH) (Condition 1)	Initiation of feed-and-bleed after 90 min	OPE-FB-L90M (basic event)	Operator fails to initiate feed-and-bleed for transient with low decay heat
	Transient, within 90 min (Condition 2)	Initiation of feed-and-bleed within 90 min	OPE-FB-90M (basic event)	Operator fails to initiate feed-and-bleed for transient
	SLOCA (i.e., RCP seal LOCA), within 40 min (Condition 3)	Initiation of feed-and-bleed within 40 min	OPE-FB-40M (basic event)	Operator fails to initiate feed-and-bleed for SLOCA

Table 19A-17—Event Tree Headings for Initiating Event LOOP: Loss of Offsite Power
Sheet 3 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
PBL	Primary bleed available	3 of 3 PSVs or 1 of 2 PDVs and steam generator relief (4 SGs)	PBL (FT top gate)	Failure of a PSV and both PDVs or steam generator relief valves (MSRTs and safeties) on the steam generators
MHSI FB	MHSI available for feed-and-bleed cooling	1 of 4 MHSI pumps available	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
LHSI	LHSI available for feed-and-bleed cooling (Condition 1)	1 of 4 LHSI pumps available	LHSI INJ 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains (injection mode only)
ACC	Accumulator injection available (Condition 1)	1 of 4 Accumulators available	ACC 4/4 (FT top gate)	Failure of 4 out of 4 Accumulator trains
	Accumulator injection available (Condition 2)	2 of 4 Accumulators available	ACC 3/4 (FT top gate)	Failure of 3 out of 4 Accumulator trains
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 1)	1 of 4 LHSI trains (with Htx) available OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)
	Long Term Cooling of IRWST via LHSI or SAHR (Condition 2)	1 of 4 LHSI trains (with Htx) available (SI signal required) OR 1 of 1 SAHR pump available in recirculation mode		

Table 19A-18—Event Tree Headings for Initiating Event MLOCA: Medium Loss-of-Coolant-Accident
Sheet 1 of 2

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE MLOCA	Medium loss-of-coolant accident (3 to 6 in break)	--	IE MLOCA (initiator)	Initiator - medium break LOCA (3 to 6 in break)
MHSI	Medium-head safety injection available (Condition 1)	1 of 4 MHSI pumps supply flow	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
OP FCD	Operator initiates fast cooldown within 30 min (Condition 2)	Action within 40 min	OPE-FCD-30M (basic event)	Operator fails to initiate fast cooldown for MLOCA
MSR	Main steam relief for:	Steam relief from 4 of 4 steam generators with at least one MRST train	MSR MLOCA (FT top gate)	Failure of steam relief from 1 of 4 steam generators
	Partial cooldown (Condition 2)			
	Fast cooldown (Condition 3)			
OP FB	Operator initiates feed-and-bleed cooling within 30 min (Condition 4)	Initiation of feed-and-bleed within 30 min	OPE-FB-30M (basic event)	Operator fails to initiate feed-and-bleed for MLOCA
PBL	Primary bleed available	3 of 3 PSVs or 1 of 2 PDVs and steam generator relief (4 SGs)	PBL (FT top gate)	Failure of a PSV and both PDVs or steam generator relief valves (MSRTs and safeties) on the steam generators
MHSI FB	MHSI available for feed-and-bleed cooling	1 of 4 MHSI pumps available	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
LHSI	LHSI available for feed-and-bleed cooling (Condition 1)	1 of 4 LHSI pumps available	LHSI INJ 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains (injection mode only)

Table 19A-18—Event Tree Headings for Initiating Event MLOCA: Medium Loss-of-Coolant-Accident
Sheet 2 of 2

Event Tree Top Event		Success Criteria	Failure Event	Event Description
ACC	Accumulator injection available (Condition 1)	1 of 4 Accumulators available	ACC 4/4 (FT top gate)	Failure of 4 out of 4 Accumulator trains
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 1)	1 of 4 LHSI trains (with Htx) available OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)
	Long Term Cooling of IRWST via LHSI or SAHR (Condition 2)	1 of 4 LHSI trains (with Htx) available (SI signal required) OR 1 of 1 SAHR pump available in recirculation mode		

Table 19A-19—Event Tree Headings for Initiating Event MSSV: Spurious Opening of Main Steam Safety Valve
Sheet 1 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
MSSV	Consequence* - spurious opening of MSSV	--	IE MSSV (consequence)	Spurious opening of MSSV
MSIV ISO	MSIV isolation of affected steam generators	3 of 4 steam generators isolated		
	Two steam generators blowing down (Condition 4)	2 steam generators isolated	MSIV ISO SLBI 1 (FT top gate)	Failure to isolate impacted SG (SLBI – 2 SG blowing down)
	Three (or more) steam generators blowing down (Condition 5)	1 steam generator isolated	MSIV ISO SLBI 2 (FT top gate)	Failure to isolate impacted SG (SLBI – 3 or more SG blowing down)
EBS	Boration via extra borating system (EBS) for steam line break (Condition 3)	1 of 2 EBS trains available – manual actuation	EBS SLB 2/2 (FT top gate)	Boration with EBS – SLB (1 of 2 EBS trains required)
EFW	EFW available for:			
	Secondary heat removal, three steam generators available (Condition 5)	1 of 3 EFW trains available for secondary heat removal (MSRVs only)	EFW 3/3 (FT top gate)	Failure of 3 out of 3 EFW trains (with MSRVs)
	Secondary heat removal, two steam generators available (Condition 6)	1 of 2 EFW trains available for manual cooldown (MSRVs only)	EFW 2/2 (FT top gate)	Failure of 2 out of 2 EFW trains (with MSRVs)
EFW INV	EFW maintains adequate inventory.	All 4 EFW tanks cross tied (or refilled)	EFW INV (FT top gate)	Failure to provide adequate EFW Inventory

Table 19A-19—Event Tree Headings for Initiating Event MSSV: Spurious Opening of Main Steam Safety Valve
Sheet 2 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
OP FB	Operator initiates feed-and-bleed cooling for:			
	Transient, after Longer Time (low DH) (Condition 1)	Initiation of feed-and-bleed after 90 min	OPE-FB-L90M (basic event)	Operator fails to initiate feed-and-bleed for transient with low decay heat
	Transient, within 90 min (Condition 2)	Initiation of feed-and-bleed within 90 min	OPE-FB-90M (basic event)	Operator fails to initiate feed-and-bleed for transient
PBL	Primary bleed available	3 of 3 PSVs or 1 of 2 PDVs and steam generator relief (4 SGs)	PBL (FT top gate)	Failure of a PSV and both PDVs or steam generator relief valves (MSRTs and safeties) on the steam generators
MHSI FB	MHSI available for feed-and-bleed cooling	1 of 4 MHSI pumps available	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
LHSI	LHSI available for feed-and-bleed cooling (Condition 1)	1 of 4 LHSI pumps available	LHSI INJ 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains (injection mode only)
ACC	Accumulator injection available (Condition 1)	1 of 4 Accumulators available	ACC 4/4 (FT top gate)	Failure of 4 out of 4 Accumulator trains
	Accumulator injection available (Condition 2)	2 of 4 Accumulators available	ACC 3/4 (FT top gate)	Failure of 3 out of 4 Accumulator trains
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 1)	1 of 4 LHSI trains (with Htx) available OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)
OP RHR	Operator aligns and initiates RHR within T>12 hr (Condition 2)	Action after 12 hr	OPE-RHR-L12H (basic event)	Operator fails to initiate RHR (longer than 12 hours)

Table 19A-19—Event Tree Headings for Initiating Event MSSV: Spurious Opening of Main Steam Safety Valve
Sheet 3 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
RHR	RHR available (Condition 1)	1 out of 4 LHSI pumps available for RHR	RHR 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains for RHR

*This event tree structure is used for several initiating events in addition to MSSV which includes FIRE-MS-VR.

Table 19A-20—Event Tree Headings for Initiating Event SGTR: Steam Generator Tube Rupture
Sheet 1 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE SGTR	Steam generator tube rupture	--	IE SGTR (initiator)	Initiator - steam generator tube rupture
SG ISO	Operator isolates affected steam generators	Automatic isolation or operator isolation	SG ISO (FT top gate)	Failure to isolate SG after SGTR
MHSI	Medium-head safety injection available (Condition 1)	1 of 4 MHSI pumps supply flow	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
SSS	Startup and shutdown system available for secondary heat removal (Condition 1)	SSS flow to 1 of 4 steam generators for secondary heat removal – normal cooldown	SSS (FT top gate)	Failure of startup and shutdown system to deliver flow to 1 of 4 steam generators
	Partial cooldown (Condition 2)	SSS flow to 1 of 3 steam generators for secondary heat removal – partial cooldown	SSS SGTR (FT top gate)	Failure of startup and shutdown system to deliver flow to 1 of 3 steam generators (SGTR)
	Partial cooldown, MHSI failed (Condition 3)	SSS flow to 1 of 3 steam generators with steam relief from all MSRTs – partial cooldown	SSS MHSI F (FT top gate)	Failure of startup and shutdown system to deliver flow to 1 of 3 steam generators (SGTR MHSI=F))

Table 19A-20—Event Tree Headings for Initiating Event SGTR: Steam Generator Tube Rupture
Sheet 2 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
EFW	EFW available for:			
	Secondary heat removal (Condition 1)	1 of 4 EFW trains available for secondary heat removal (MSRVs or MSSVs)	EFW (FT top gate)	Failure of secondary heat removal and secondary cooldown
	Partial cooldown (Condition 2)	1 of 4 EFW trains available for partial cooldown (MSRVs only)		
	Partial cooldown (Condition 10)	1 of 3 EFW trains available for partial cooldown (all MSRVs available)	EFW SGTR (FT top gate)	Failure of 3 out of 3 EFW trains, all MSRTs required (SGTR with MHSI failed)
EFW INV	EFW maintains adequate inventory.	All 4 EFW tanks cross tied (or refilled)	EFW INV (FT top gate)	Failure to provide adequate EFW Inventory
OP FB	Operator initiates feed-and-bleed cooling for:			
	Transient, after Longer Time (low DH) (Condition 1)	Initiation of feed-and-bleed after 90 min	OPE-FB-L90M (basic event)	Operator fails to initiate feed-and-bleed for transient with low decay heat
	Transient, within 90 min (Condition 2)	Initiation of feed-and-bleed within 90 min	OPE-FB-90M (basic event)	Operator fails to initiate feed-and-bleed for transient
PBL	Primary bleed available	3 of 3 PSVs or 1 of 2 PDVs and steam generator relief (4 SGs)	PBL (FT top gate)	Failure of a PSV and both PDVs or steam generator relief valves (MSRTs and safeties) on the steam generators
MHSI FB	MHSI available for feed-and-bleed cooling	1 of 4 MHSI pumps available	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
ACC	Accumulator injection available (Condition 1)	1 of 4 Accumulators available	ACC 4/4 (FT top gate)	Failure of 4 out of 4 Accumulator trains

Table 19A-20—Event Tree Headings for Initiating Event SGTR: Steam Generator Tube Rupture
Sheet 3 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 1)	1 of 4 LHSI trains (with Htx) available OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)
OP RHR	Operator aligns and initiates RHR within T>12 hr (Condition 2)	Action after 12 hr	OPE-RHR-L12H (basic event)	Operator fails to initiate RHR (longer than 12 hours)
	Operator aligns and initiates RHR given EFW failure (Condition 3)	Action after EFW failure	OPE-RHR-EFW (basic event)	Operator fails to initiate RHR given EFW failure
RHR	RHR available (Condition 1)	1 out of 4 LHSI pumps available for RHR	RHR 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains for RHR

Table 19A-21—Event Tree Headings for Initiating Event SLBI: Steam-Line Break Inside Containment
Sheet 1 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE SLBI	Steam-line break inside containment	--	IE SLBI (initiator)	Initiator – steam-line break inside containment
MSIV ISO	MSIV isolation of affected steam generators	3 of 4 steam generators isolated		
	Two steam generators blowing down (Condition 4)	2 steam generators isolated	MSIV ISO SLBI 1 (FT top gate)	Failure to isolate impacted SG (SLBI – 2 SG blowing down)
	Three (or more) steam generators blowing down (Condition 5)	1 steam generator isolated	MSIV ISO SLBI 2 (FT top gate)	Failure to isolate impacted SG (SLBI – 3 or more SG blowing down)
FW ISO	MFW and isolated to affected steam generator(s):			
	One steam generator blowing down (Condition 1)	Feedwater lines to 1 of 1 affected steam generator isolated	FW ISO TR4 (FT top gate)	Failure to isolate FW to steam generator 4
	Two or more steam generators blowing down (Condition 2)	Feedwater lines to 2 or more affected steam generators isolated	FW ISO (FT top gate)	Failure to isolate FW to impacted SG (2 or more SGs blowing down)
	Four steam generators blowing down – EFW isolated (Condition 3)	Feedwater lines to all steam generators isolated and operator isolates EFW	FW ISO 3 (FT top gate)	Failure to isolate FW and EFW (4 SGs blowing down)
EBS	Boration via extra borating system (EBS) for steam line break (Condition 3)	1 of 2 EBS trains available – manual actuation	EBS SLB 2/2 (FT top gate)	Boration with EBS – SLB (1 of 2 EBS trains required)

Table 19A-21—Event Tree Headings for Initiating Event SLBI: Steam-Line Break Inside Containment
Sheet 2 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
EFW	EFW available for:			
	Secondary heat removal, three steam generators available (Condition 5)	1 of 3 EFW trains available for secondary heat removal (MSRVs only)	EFW 3/3 (FT top gate)	Failure of 3 out of 3 EFW trains (with MSRVs)
	Secondary heat removal, two steam generators available (Condition 6)	1 of 2 EFW trains available for manual cooldown (MSRVs only)	EFW 2/2 (FT top gate)	Failure of 2 out of 2 EFW trains (with MSRVs)
EFW INV	EFW maintains adequate inventory.	All 4 EFW tanks cross tied (or refilled)	EFW INV (FT top gate)	Failure to provide adequate EFW Inventory
OP FB	Operator initiates feed-and-bleed cooling for:			
	Transient, after Longer Time (low DH) (Condition 1)	Initiation of feed-and-bleed after 90 min	OPE-FB-L90M (basic event)	Operator fails to initiate feed-and-bleed for transient with low decay heat
	Transient, within 90 min (Condition 2)	Initiation of feed-and-bleed within 90 min	OPE-FB-90M (basic event)	Operator fails to initiate feed-and-bleed for transient
	SLB, within 4 hr (Condition 10)	Initiation of feed-and-bleed within 4 hr	OPD-FB/FW ISO-4H (basic event)	Dependency (LOW) between operator action to isolate FW/EFW and initiation of F&B
PBL	Primary bleed available	3 of 3 PSVs or 1 of 2 PDVs and steam generator relief (4 SGs)	PBL (FT top gate)	Failure of a PSV and both PDVs or steam generator relief valves (MSRTs and safeties) on the steam generators
MHSI FB	MHSI available for feed-and-bleed cooling	1 of 4 MHSI pumps available	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
LHSI	LHSI available for feed-and-bleed cooling (Condition 1)	1 of 4 LHSI pumps available	LHSI INJ 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains (injection mode only)

Table 19A-21—Event Tree Headings for Initiating Event SLBI: Steam-Line Break Inside Containment
Sheet 3 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
ACC	Accumulator injection available (Condition 1)	1 of 4 Accumulators available	ACC 4/4 (FT top gate)	Failure of 4 out of 4 Accumulator trains
	Accumulator injection available (Condition 2)	2 of 4 Accumulators available	ACC 3/4 (FT top gate)	Failure of 3 out of 4 Accumulator trains
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 1)	1 of 4 LHSI trains (with Htx) available OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)
OP RHR	Operator aligns and initiates RHR within T>12 hr (Condition 2)	Action after 12 hr	OPE-RHR-L12H (basic event)	Operator fails to initiate RHR (longer than 12 hours)
	Operator aligns and initiates RHR given FW isolation failure (Condition 9)		OPD-RHR/FW ISO (basic event)	Dependency (LOW) between operator actions for isolating FW and initiating RHR
RHR	RHR available (Condition 1)	1 out of 4 LHSI pumps available for RHR	RHR 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains for RHR

Table 19A-22—Event Tree Headings for Initiating Event SLBO: Steam-Line Break Outside Containment
Sheet 1 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
IE SLBO	Steam-line break downstream of MSIV	--	IE SLBO (initiator)	Initiator – steam-line break downstream of MSIV
MSIV ISO	MSIV isolation of affected steam generators, with:	4 of 4 steam generators isolated		
	One steam generator blowing down (Condition 1)	3 steam generators isolated	MSIV ISO SLBO 1/4 (FT top gate)	Failure of 1 out of 4 MSIV trains to isolate
	Two steam generators blowing down (Condition 2)	2 steam generators isolated	MSIV ISO SLBO 2/4 (FT top gate)	Failure of 2 out of 4 MSIV trains to isolate
	Three steam generators blowing down (Condition 3)	1 steam generator isolated	MSIV ISO SLBO 3/4 (FT top gate)	Failure of 3 out of 4 MSIV trains to isolate
EBS	Boration via extra borating system (EBS) for steam line break (Condition 3)	1 of 2 EBS trains available – manual actuation	EBS SLB 2/2 (FT top gate)	Boration with EBS – SLB (1 of 2 EBS trains required)
EFW	EFW available for:			
	Secondary heat removal (Condition 1)	1 of 4 EFW trains available for secondary heat removal (MSRVs or MSSVs)	EFW (FT top gate	Failure of secondary heat removal and secondary cooldown
	Secondary heat removal, three steam generators available (Condition 5)	1 of 3 EFW trains available for secondary heat removal (MSRVs only)	EFW 3/3 (FT top gate)	Failure of 3 out of 3 EFW trains (with MSRVs)
	Secondary heat removal, two steam generators available (Condition 6)	1 of 2 EFW trains available for manual cooldown (MSRVs only)	EFW 2/2 (FT top gate)	Failure of 2 out of 2 EFW trains (with MSRVs)

Table 19A-22—Event Tree Headings for Initiating Event SLBO: Steam-Line Break Outside Containment
Sheet 2 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
EFW INV	EFW maintains adequate inventory.	All 4 EFW tanks cross tied (or refilled)	EFW INV (FT top gate)	Failure to provide adequate EFW Inventory
OP FB	Operator initiates feed-and-bleed cooling for:			
	Transient, after Longer Time (low DH) (Condition 1)	Initiation of feed-and-bleed after 90 min	OPE-FB-L90M (basic event)	Operator fails to initiate feed-and-bleed for transient with low decay heat
	Transient, within 90 min (Condition 2)	Initiation of feed-and-bleed within 90 min	OPE-FB-90M (basic event)	Operator fails to initiate feed-and-bleed for transient
PBL	Primary bleed available	3 of 3 PSVs or 1 of 2 PDVs and steam generator relief (4 SGs)	PBL (FT top gate)	Failure of a PSV and both PDVs or steam generator relief valves (MSRTs and safeties) on the steam generators
MHSI FB	MHSI available for feed-and-bleed cooling	1 of 4 MHSI pumps available	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
LHSI	LHSI available for feed-and-bleed cooling (Condition 1)	1 of 4 LHSI pumps available	LHSI INJ 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains (injection mode only)
ACC	Accumulator injection available (Condition 1)	1 of 4 Accumulators available	ACC 4/4 (FT top gate)	Failure of 4 out of 4 Accumulator trains
	Accumulator injection available (Condition 2)	2 of 4 Accumulators available	ACC 3/4 (FT top gate)	Failure of 3 out of 4 Accumulator trains
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 1)	1 of 4 LHSI trains (with Htx) available OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)

Table 19A-22—Event Tree Headings for Initiating Event SLBO: Steam-Line Break Outside Containment
Sheet 3 of 3

Event Tree Top Event		Success Criteria	Failure Event	Event Description
OP RHR	Operator aligns and initiates RHR within T>12 hr (Condition 2)	Action after 12 hr	OPE-RHR-L12H (basic event)	Operator fails to initiate RHR (longer than 12 hours)
RHR	RHR available (Condition 1)	1 out of 4 LHSI pumps available for RHR	RHR 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains for RHR

Table 19A-23—Event Tree Headings for Initiating Event SLOCA: Small Loss-of-Coolant Accident
Sheet 1 of 2

Event Tree Top Event		Success Criteria	Failure Event	Event Description
SLOCA	Consequence* - small loss-of-coolant accident (0.6 to 3 in break)	--	IE SLOCA (consequence)	Small break LOCA (0.6 to 3 in break)
MHSI	Medium-head safety injection available (Condition 1)	1 of 4 MHSI pumps supply flow	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
OP FCD	Operator initiates fast cooldown within 40 min (Condition 1)	Action within 40 min	OPE-FCD-40M (basic event)	Operator fails to initiate fast cooldown for SLOCA
EFW	EFW available for:		EFW (FT top gate)	Failure of secondary heat removal and secondary cooldown
	Partial cooldown (Condition 2)	1 of 4 EFW trains available for partial cooldown (MSRVs only)		
	Fast cooldown (Condition 3)	1 of 4 EFW trains available for fast cooldown (MSRVs only)		
EFW INV	EFW maintains adequate inventory.	All 4 EFW tanks cross tied (or refilled)	EFW INV (FT top gate)	Failure to provide adequate EFW Inventory
OP FB	Operator initiates feed-and-bleed cooling for:			
	Transient, after Longer Time (low DH) (Condition 1)	Initiation of feed-and-bleed after 90 min	OPE-FB-L90M (basic event)	Operator fails to initiate feed-and-bleed for transient with low decay heat
	SLOCA, within 40 min (Condition 3)	Initiation of feed-and-bleed within 40 min	OPE-FB-40M (basic event)	Operator fails to initiate feed-and-bleed for SLOCA

Table 19A-23—Event Tree Headings for Initiating Event SLOCA: Small Loss-of-Coolant Accident
Sheet 2 of 2

Event Tree Top Event		Success Criteria	Failure Event	Event Description
PBL	Primary bleed available	3 of 3 PSVs or 1 of 2 PDVs and steam generator relief (4 SGs)	PBL (FT top gate)	Failure of a PSV and both PDVs or steam generator relief valves (MSRTs and safeties) on the steam generators
MHSI FB	MHSI available for feed-and-bleed cooling	1 of 4 LHSI pumps available	MHSI 4/4 (FT top gate)	Failure of 4 out of 4 MHSI trains
LHSI	LHSI available for feed-and-bleed cooling (Condition 1)	1 of 4 MHSI pumps available	LHSI INJ 4/4 (FT top gate)	Failure of 4 out of 4 LHSI trains (injection mode only)
ACC	Accumulator injection available (Condition 1)	1 of 4 Accumulators available	ACC 4/4 (FT top gate)	Failure of 4 out of 4 Accumulator trains
	Accumulator injection available (Condition 2)	2 of 4 Accumulators available	ACC 3/4 (FT top gate)	Failure of 3 out of 4 Accumulator trains
LTC	Long Term Cooling of IRWST via LHSI or SAHR (Condition 1)	1 of 4 LHSI trains (with Htx) available OR 1 of 1 SAHR pump available in recirculation mode	LTC (FT top gate)	Failure of IWRST Long Term Cooling (LHSI & SAHR)
	Long Term Cooling of IRWST via LHSI or SAHR (Condition 2)	1 of 4 LHSI trains (with Htx) available (SI signal required) OR 1 of 1 SAHR pump available in recirculation mode		

*This event tree structure is used for several initiating events in addition to SLOCA which includes FIRE-PZR.

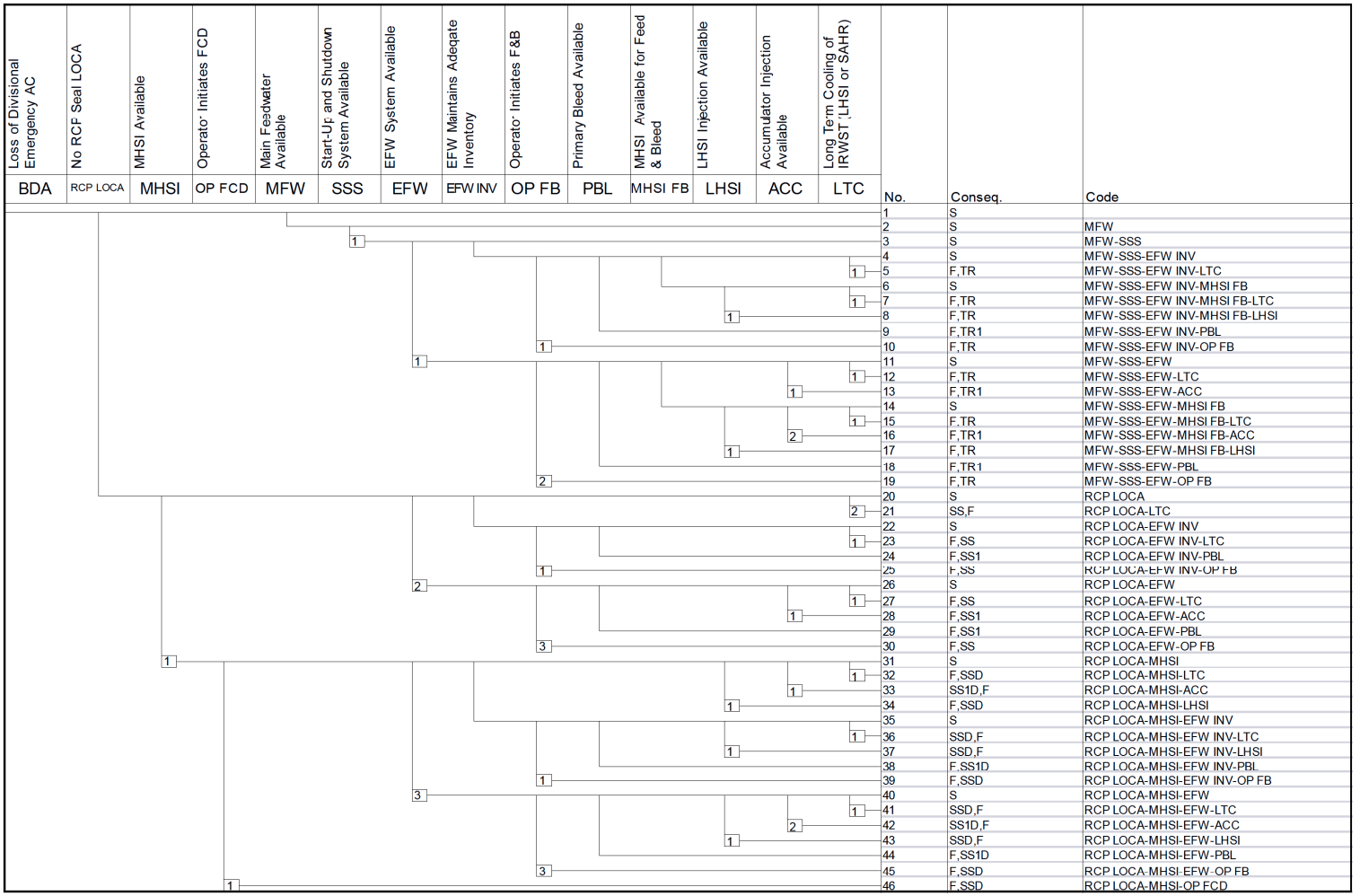
Table 19A-24—Event Tree Headings for Initiating Event FLD-ANN: Flooding in Annulus (FWDS Pipe Break)
Sheet 1 of 2

Event Tree Top Event		Success Criteria	Failure Event	Event Description
FLD-ANN	Flooding in annulus (FWDS pipe break)	--	IE FLD-ANN (initiator)	Initiator – flood in the reactor building annulus
AFS ISO	Annulus FWDS motor-operated valves closed	FWDS isolation motor-operated valves closed	FWDS ISOL (FT top gate)	Failure of the FWDS isolation MOVs on the 8 in line in the annulus
AFS BRK	Break size of FWDS pipe:	---		
	1 in (Condition 1)		BREAK 1IN (basic event)	FWDS pipe break with 1 in flow
	Between 1 and 2 in (Condition 2)		BREAK LESS 2IN (basic event)	FWDS pipe break with less than 2 in flow
	Greater than 2 in (Condition 3)		BREAK MORE 2IN (basic event)	FWDS pipe break with more than 2 in flow
AFS ISO	Annulus FWDS ring header isolation valves	FWDS ring header isolation valves closed	FWDS HEADER ISO (FT top gate)	Failure of FWDS rind header isolation
OP AFS-S1	Operator isolates annulus FWDS break before water level reaches ground level within:	Action within allotted time		
	10 hr for 1 in break (Condition 1)		OPE-AFS-10H (basic event)	Operator fails to isolate FWDS pipe break (flow from 1 in line)
	2 hr for less than 2 in break (Condition 2)		OPE-AFS-2H (basic event)	Operator fails to isolate small (< 2 in) FWDS pipe break
	40 min for 2 in break (Condition 3)		OPE-AFS-40M (basic event)	Operator fails to isolate large (> 2 in) FWDS pipe break

Table 19A-24—Event Tree Headings for Initiating Event FLD-ANN: Flooding in Annulus (FWDS Pipe Break)
Sheet 2 of 2

Event Tree Top Event		Success Criteria	Failure Event	Event Description
OP AFS-S2	Operator isolates annulus FWDS break before water level reaches penetration level within:	Action within allotted time		
	32 hr for 1 in break (Conditions 1 & 2)		OPD-AFS-S2-32H (basic event)	Operator fails to isolate break before penetration level in 32 hr
			OPD-AFS-S2-32H=S (basic event)	Operator isolates break before penetration level in 32 hr
	8 hr for less than 2 in break (Conditions 3 & 4)		OPD-AFS-S2-8H (basic event)	Operator fails to isolate break before penetration level in 8 hr
			OPD-AFS-S2-8H=S (basic event)	Operator isolates break before penetration level in 8 hr
	120 min for 2 in break (Conditions 5 & 6)		OPD-AFS-S2-120M (basic event)	Operator fails to isolate break before penetration level in 120 min
			OPD-AFS-S2-120M=S (basic event)	Operator isolates break before penetration level in 120 min

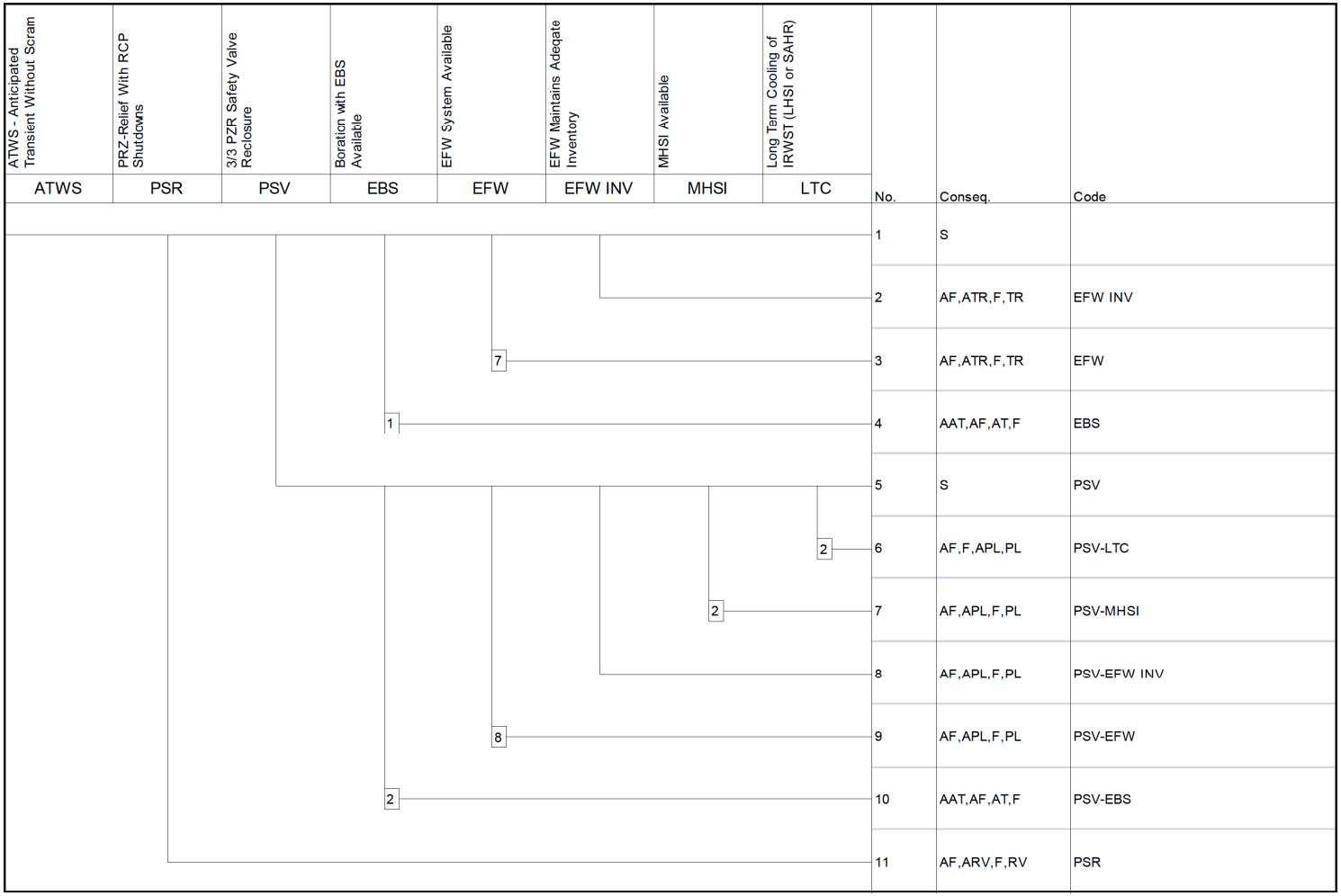
Figure 19A-1—Loss of Divisional Emergency AC Power



No.	Conseq.	Code
1	S	
2	S	MFW
3	S	MFW-SSS
4	S	MFW-SSS-EFW INV
5	F,TR	MFW-SSS-EFW INV-LTC
6	S	MFW-SSS-EFW INV-MHSI FB
7	F,TR	MFW-SSS-EFW INV-MHSI FB-LTC
8	F,TR	MFW-SSS-EFW INV-MHSI FB-LHSI
9	F,TR1	MFW-SSS-EFW INV-PBL
10	F,TR	MFW-SSS-EFW INV-OP FB
11	S	MFW-SSS-EFW
12	F,TR	MFW-SSS-EFW-LTC
13	F,TR1	MFW-SSS-EFW-ACC
14	S	MFW-SSS-EFW-MHSI FB
15	F,TR	MFW-SSS-EFW-MHSI FB-LTC
16	F,TR1	MFW-SSS-EFW-MHSI FB-ACC
17	F,TR	MFW-SSS-EFW-MHSI FB-LHSI
18	F,TR1	MFW-SSS-EFW-PBL
19	F,TR	MFW-SSS-EFW-OP FB
20	S	RCP LOCA
21	SS,F	RCP LOCA-LTC
22	S	RCP LOCA-EFW INV
23	F,SS	RCP LOCA-EFW INV-LTC
24	F,SS1	RCP LOCA-EFW INV-PBL
25	F,SS	RCP LOCA-EFW INV-OP FB
26	S	RCP LOCA-EFW
27	F,SS	RCP LOCA-EFW-LTC
28	F,SS1	RCP LOCA-EFW-ACC
29	F,SS1	RCP LOCA-EFW-PBL
30	F,SS	RCP LOCA-EFW-OP FB
31	S	RCP LOCA-MHSI
32	F,SSD	RCP LOCA-MHSI-LTC
33	SS1D,F	RCP LOCA-MHSI-ACC
34	F,SSD	RCP LOCA-MHSI-LHSI
35	S	RCP LOCA-MHSI-EFW INV
36	SSD,F	RCP LOCA-MHSI-EFW INV-LTC
37	SSD,F	RCP LOCA-MHSI-EFW INV-LHSI
38	F,SS1D	RCP LOCA-MHSI-EFW INV-PBL
39	F,SSD	RCP LOCA-MHSI-EFW INV-OP FB
40	S	RCP LOCA-MHSI-EFW
41	SSD,F	RCP LOCA-MHSI-EFW-LTC
42	SS1D,F	RCP LOCA-MHSI-EFW-ACC
43	SSD,F	RCP LOCA-MHSI-EFW-LHSI
44	F,SS1D	RCP LOCA-MHSI-EFW-PBL
45	F,SSD	RCP LOCA-MHSI-EFW-OP FB
46	F,SSD	RCP LOCA-MHSI-OP FCD

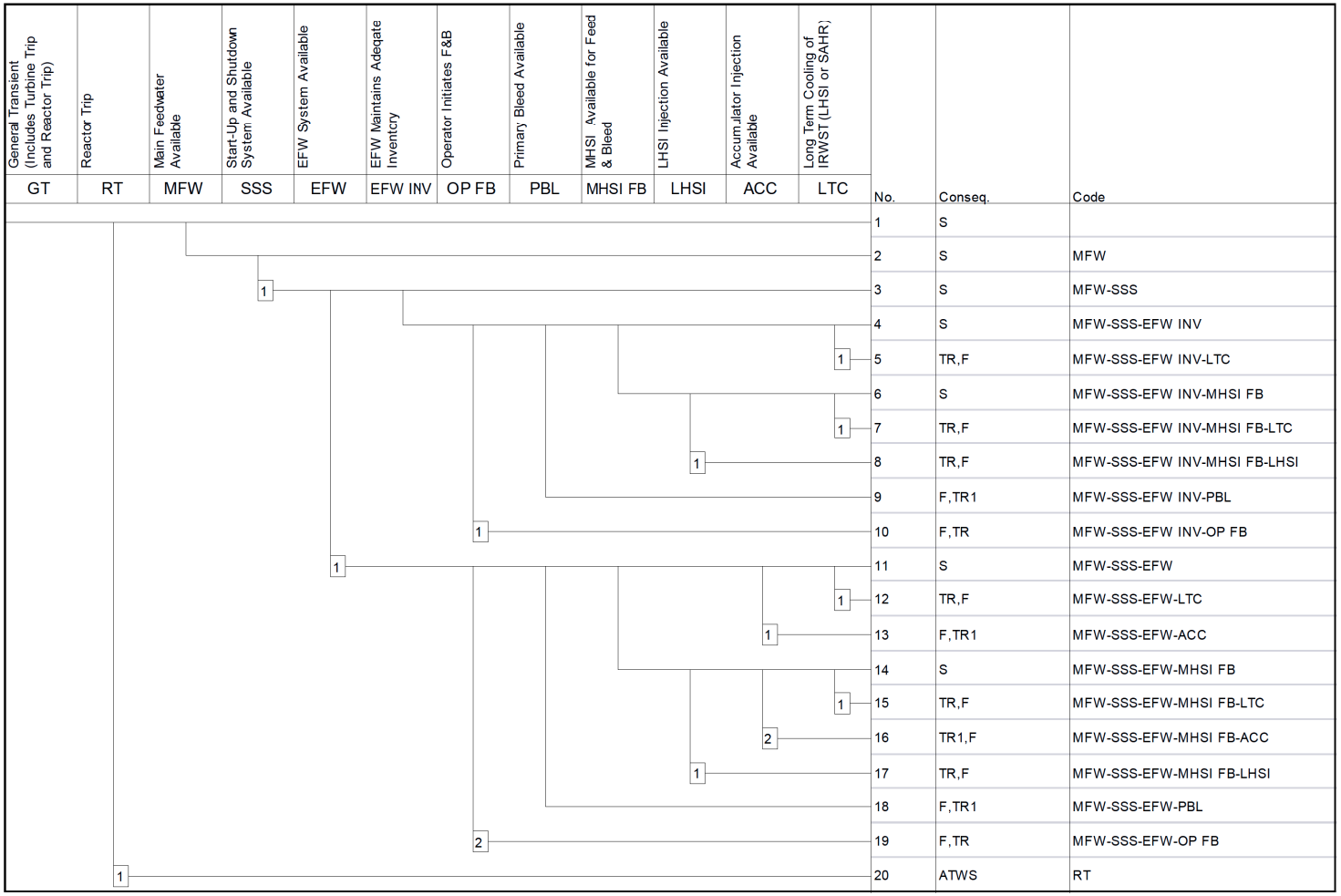
REV 005
EPR6500 T2

Figure 19A-2—Anticipated Failure without Scram



REV 005
EPR6505 T2

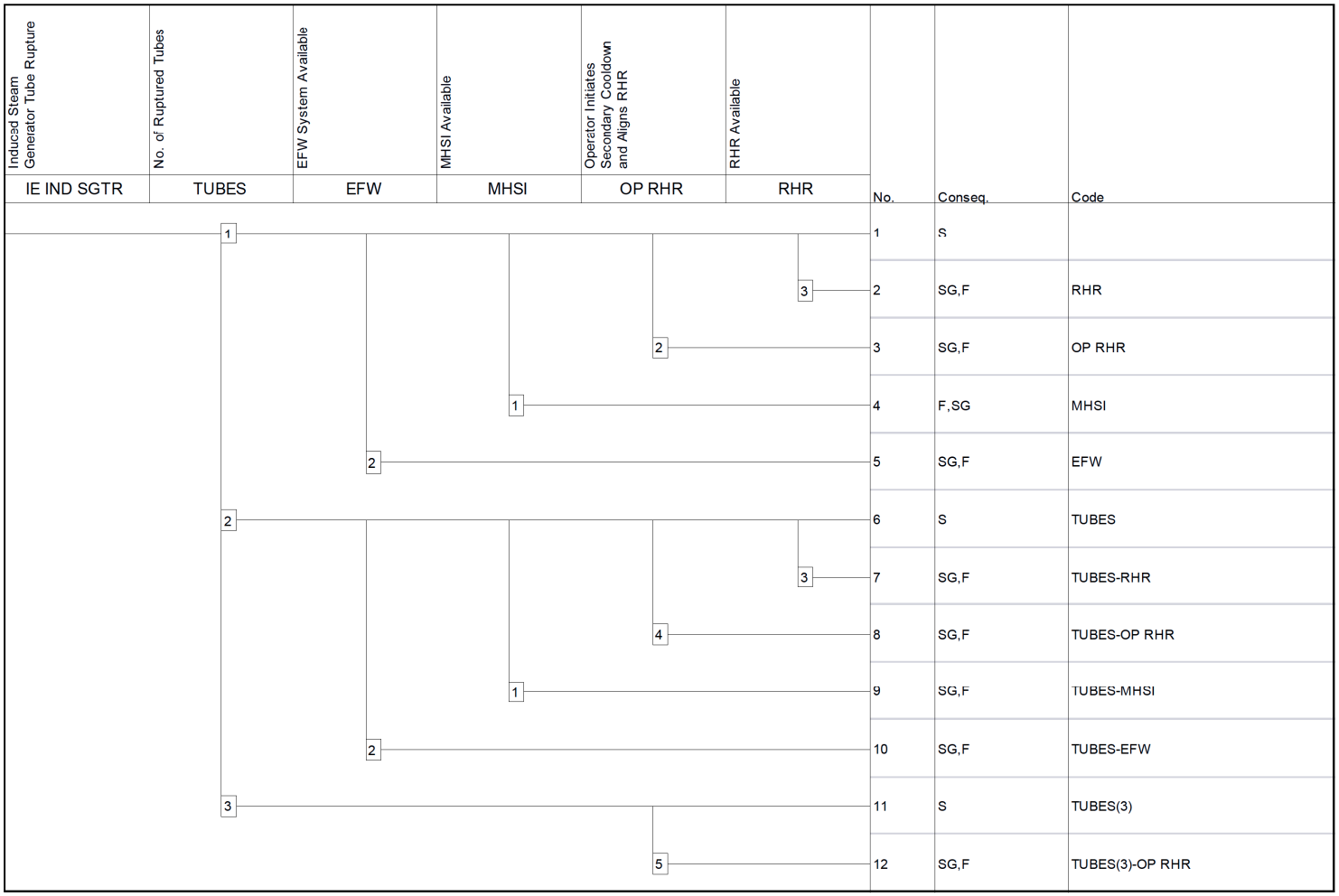
Figure 19A-3—General Transient



No.	Conseq.	Code
1	S	
2	S	MFW
3	S	MFW-SSS
4	S	MFW-SSS-EFW INV
5	TR,F	MFW-SSS-EFW INV-LTC
6	S	MFW-SSS-EFW INV-MHSI FB
7	TR,F	MFW-SSS-EFW INV-MHSI FB-LTC
8	TR,F	MFW-SSS-EFW INV-MHSI FB-LHSI
9	F,TR1	MFW-SSS-EFW INV-PBL
10	F,TR	MFW-SSS-EFW INV-OP FB
11	S	MFW-SSS-EFW
12	TR,F	MFW-SSS-EFW-LTC
13	F,TR1	MFW-SSS-EFW-ACC
14	S	MFW-SSS-EFW-MHSI FB
15	TR,F	MFW-SSS-EFW-MHSI FB-LTC
16	TR1,F	MFW-SSS-EFW-MHSI FB-ACC
17	TR,F	MFW-SSS-EFW-MHSI FB-LHSI
18	F,TR1	MFW-SSS-EFW-PBL
19	F,TR	MFW-SSS-EFW-OP FB
20	ATWS	RT

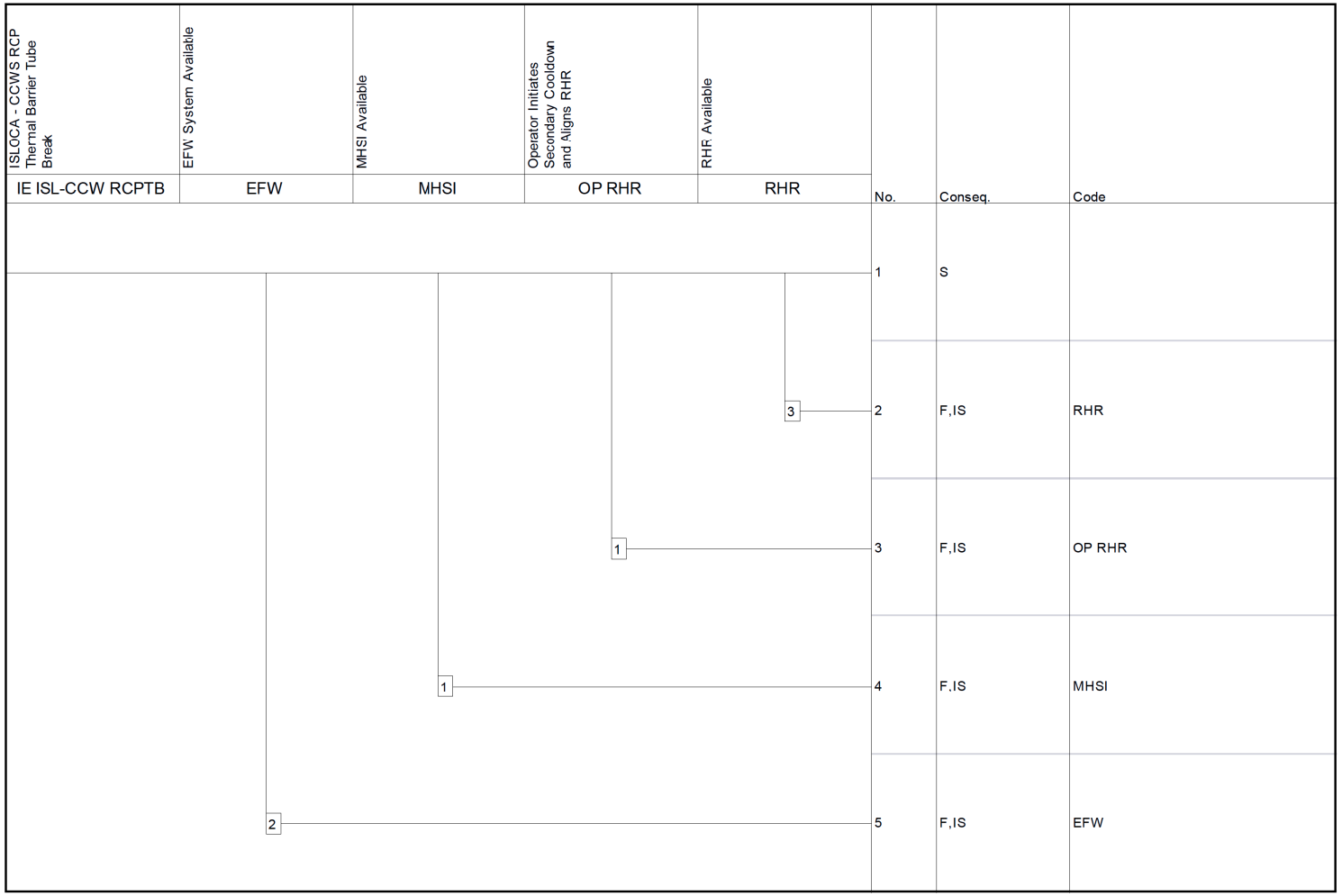
REV 005
EPR6510 T2

Figure 19A-4—Induced Steam Generator Tube Rupture



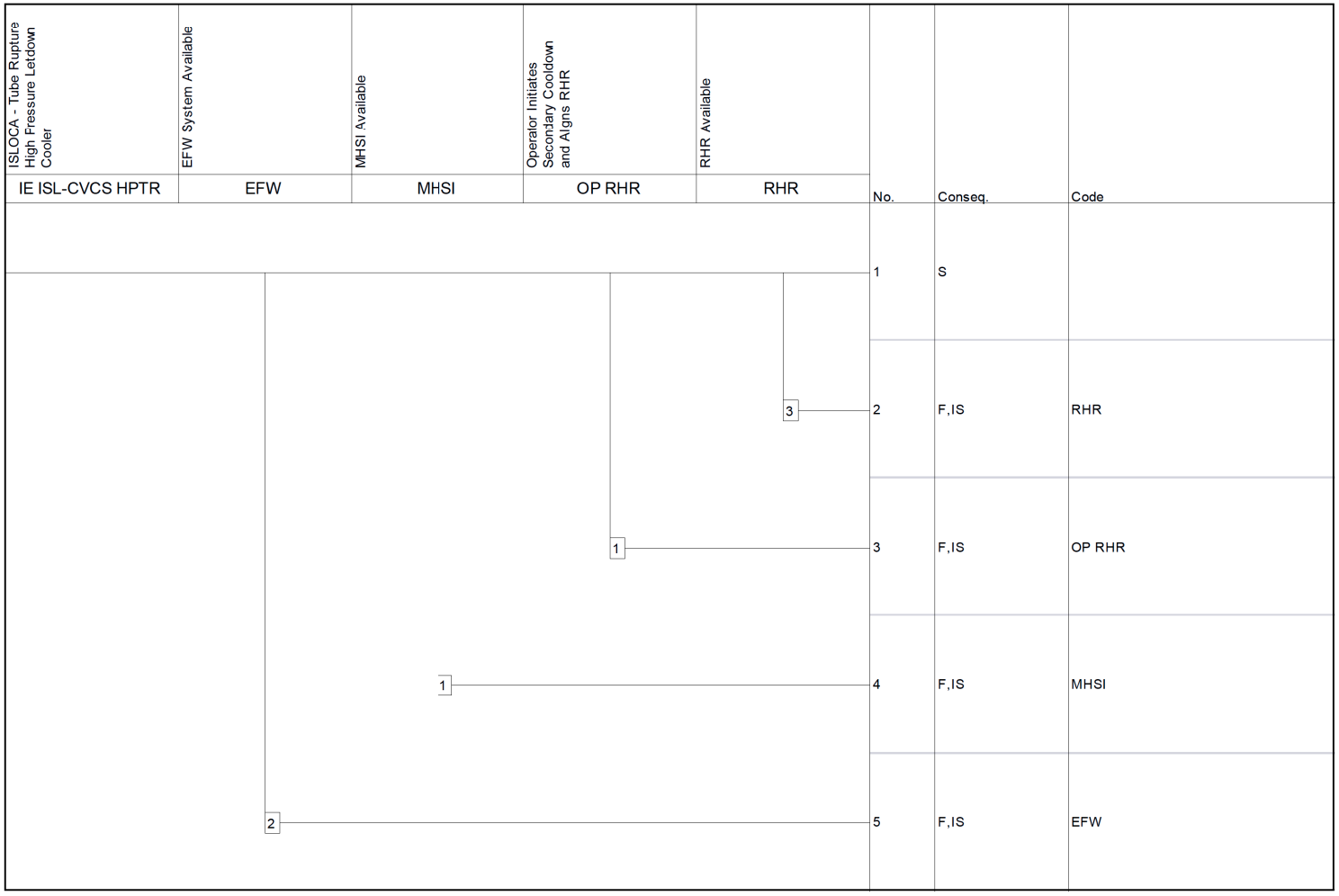
REV 005
EPR6515 T2

Figure 19A-5—ISLOCA Due to RCP Thermal Barrier Tube Break



REV 005
EPR6520 T2

Figure 19A-6—ISLOCA Due to Tube Rupture in CVCS High Pressure Cooler



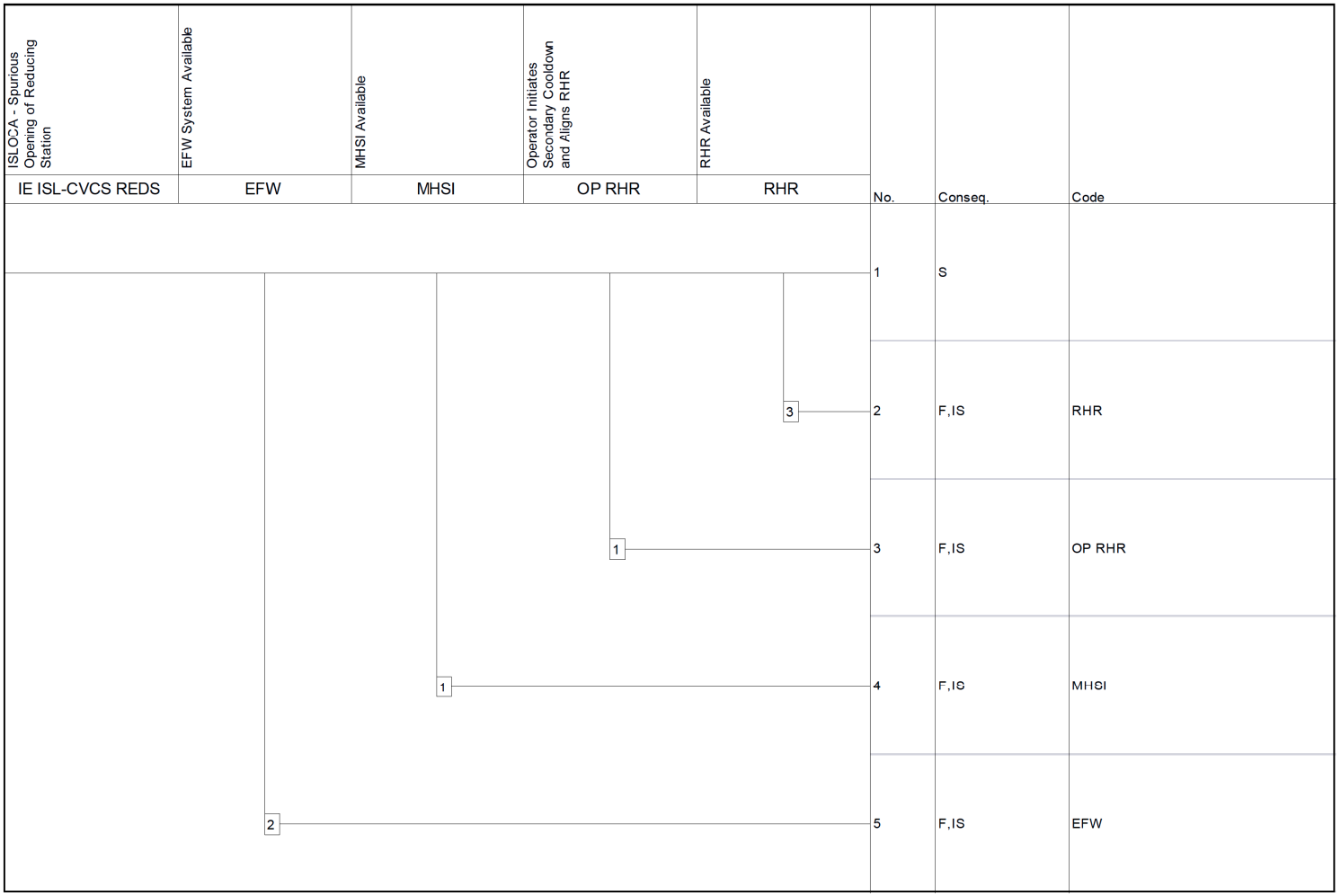
REV 005
EPR6525 T2

Figure 19A-7—ISLOCA Due to Rupture o High Pressure CVCS Pipe Outside Containment

ISLOCA - High Pressure CVCS Pipe Rupture Outside Containment			
IE ISL-CVCS INJ	No.	Conseq.	Code
	1	F,IS	

REV 005
EPR6530 T2

Figure 19A-8—ISLOCA Due to Spurious Opening of Reducing Station



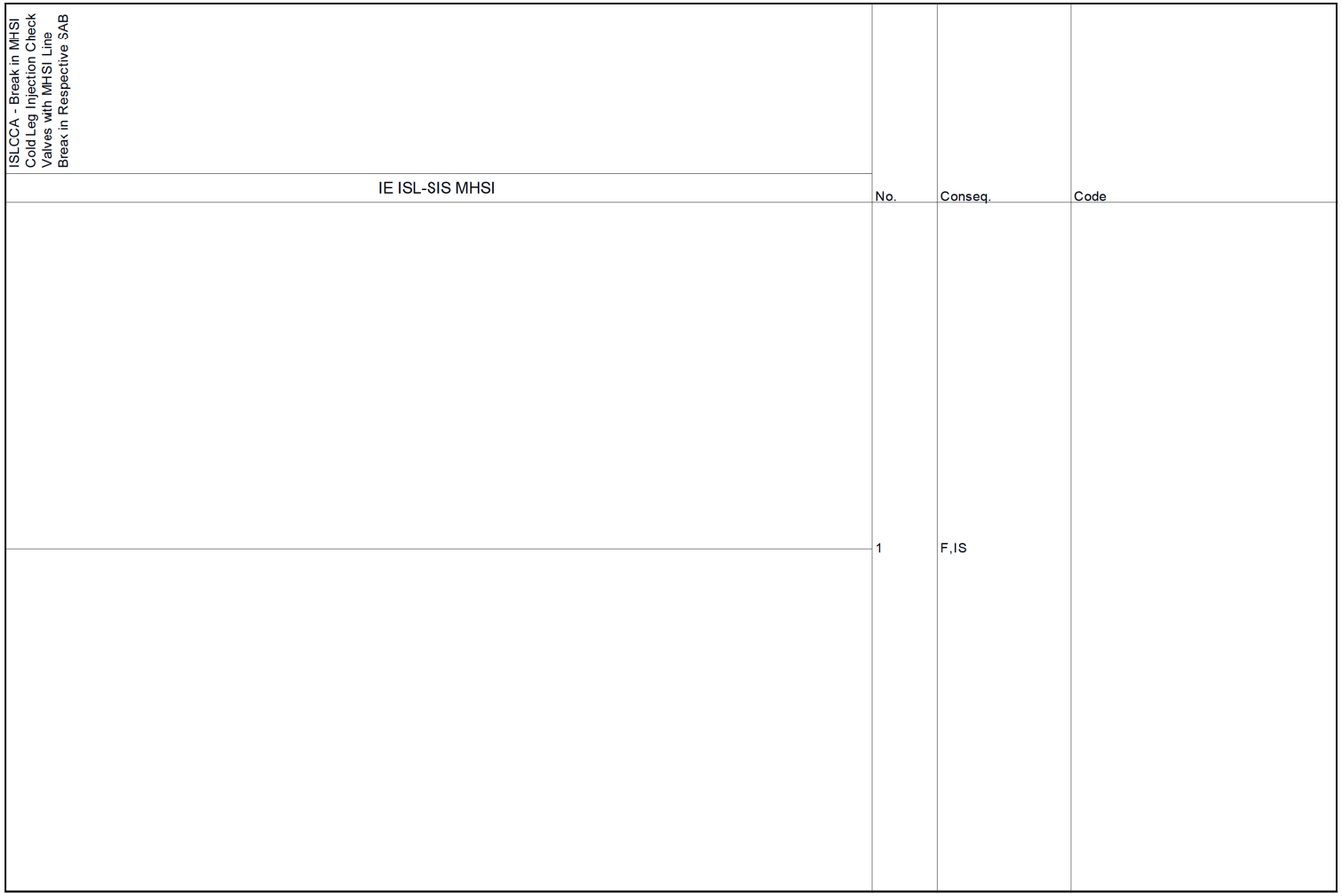
REV 005
EPR6535 T2

Figure 19A-9—ISLOCA Due to Break in LHSI Cold Leg Injection Valves with LHSI Rupture in Respective SAB

ISLOCA - Break in LHSI Cold Leg Injection Check Valves with LHSI Line Break in Respective SAB			
IE ISL-SIS LHSI	No.	Conseq.	Code
	1	F,IS	

REV 005
EPR6540 T2

Figure 19A-10—ISLOCA Due to Break in MHSI Cold Leg Injection Valves with MHSI Rupture in Respective SAB



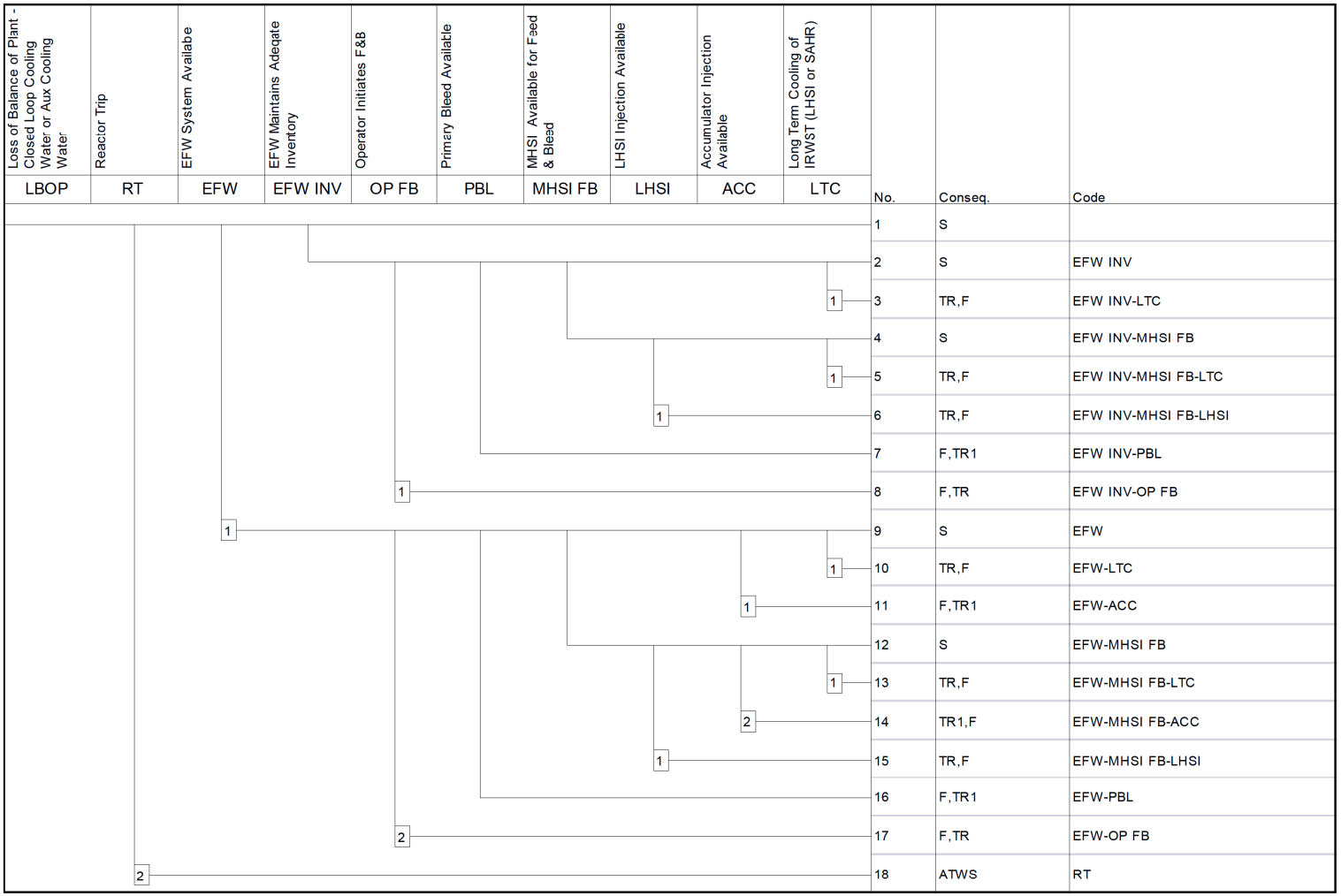
REV 005
EPR6545 T2

Figure 19A-11—ISLOCA Due to Failure of Suction Line MOVs and Subsequent RHR Line Rupture in Respective SAB

ISLOCA - Failure of Suction Line Isolation MOVs and Subsequent RHR Line Break in Respective SAB			
IE ISL-SIS RHR	No.	Conseq.	Code
	1	F,IS	

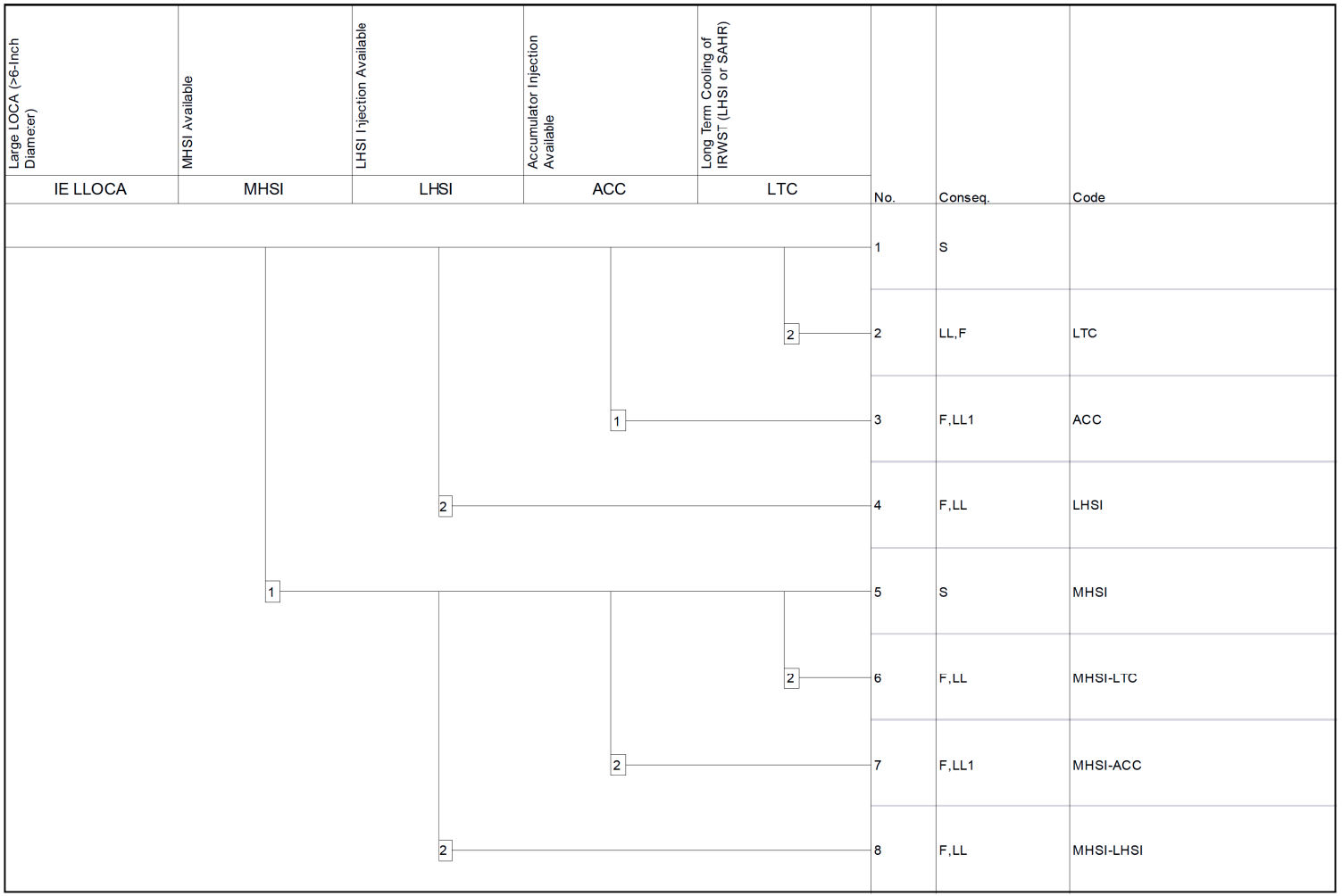
REV 005
EPR6550 T2

Figure 19A-12—Loss of Balance of Plant Closed Loop Cooling Water or Auxiliary Cooling Water



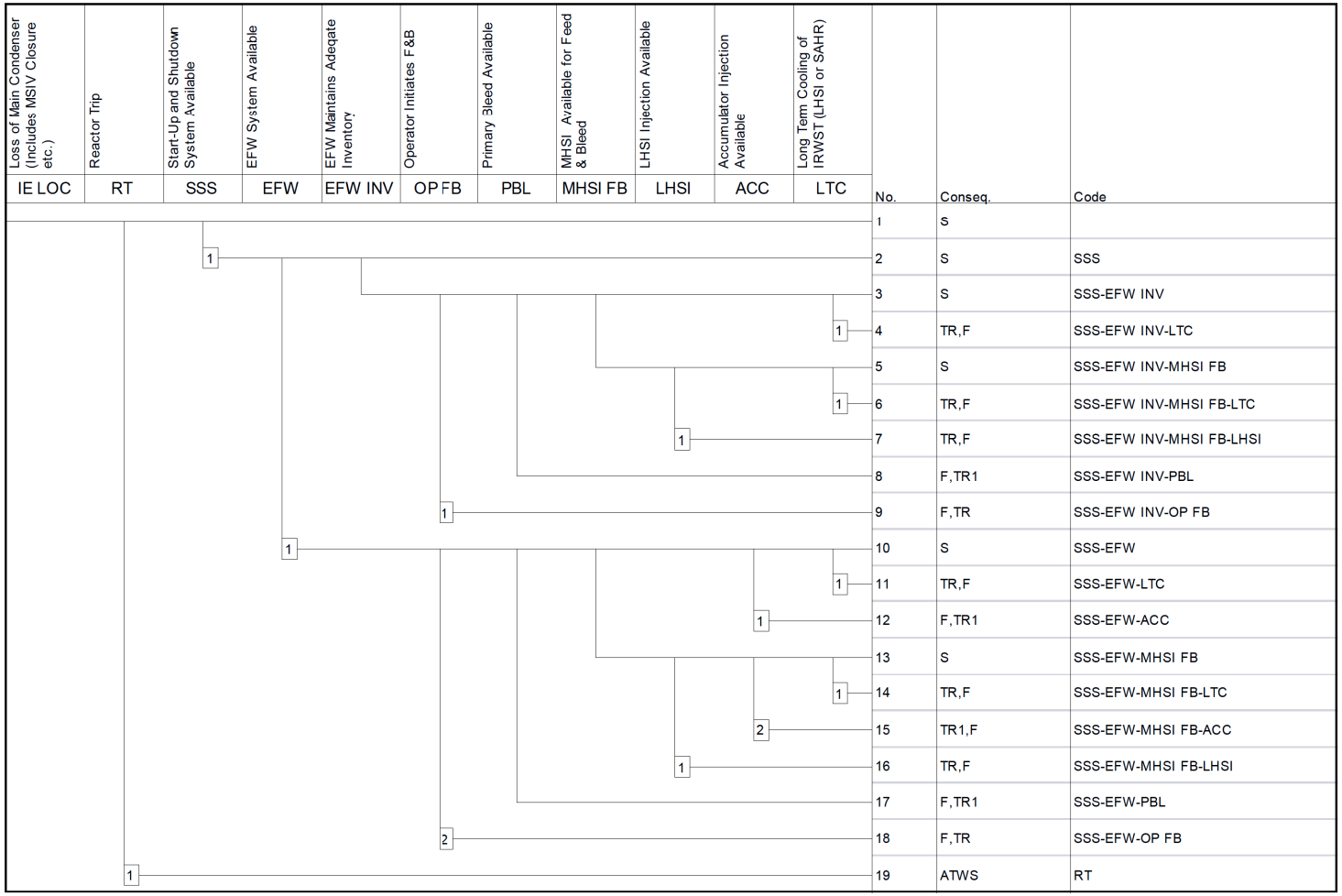
REV 005
EPR6555 T2

Figure 19A-13—Large Loss-of-Coolant Accident



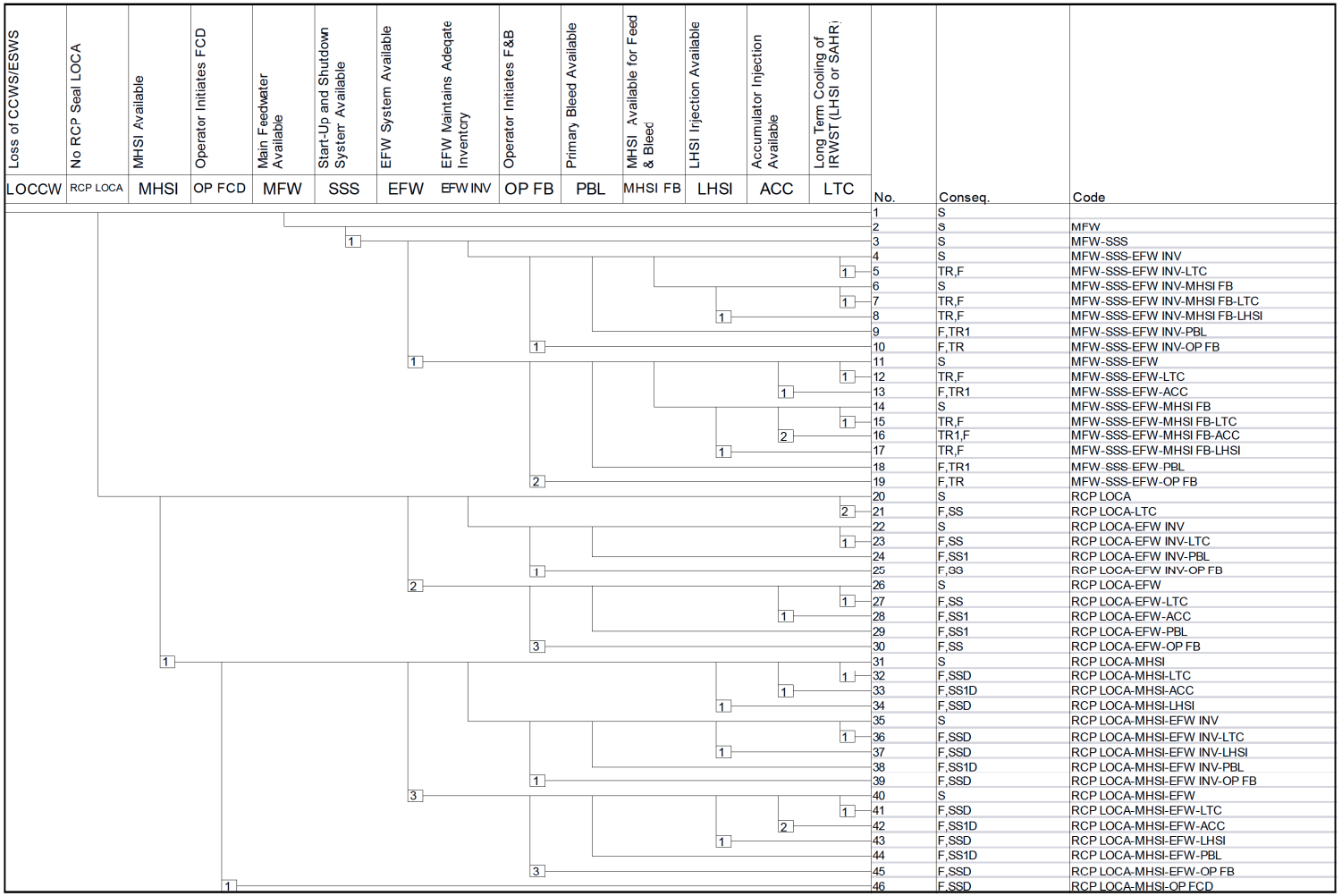
REV 005
EPR6560 T2

Figure 19A-14—Loss of Main Condenser



REV 005
EPR6565 T2

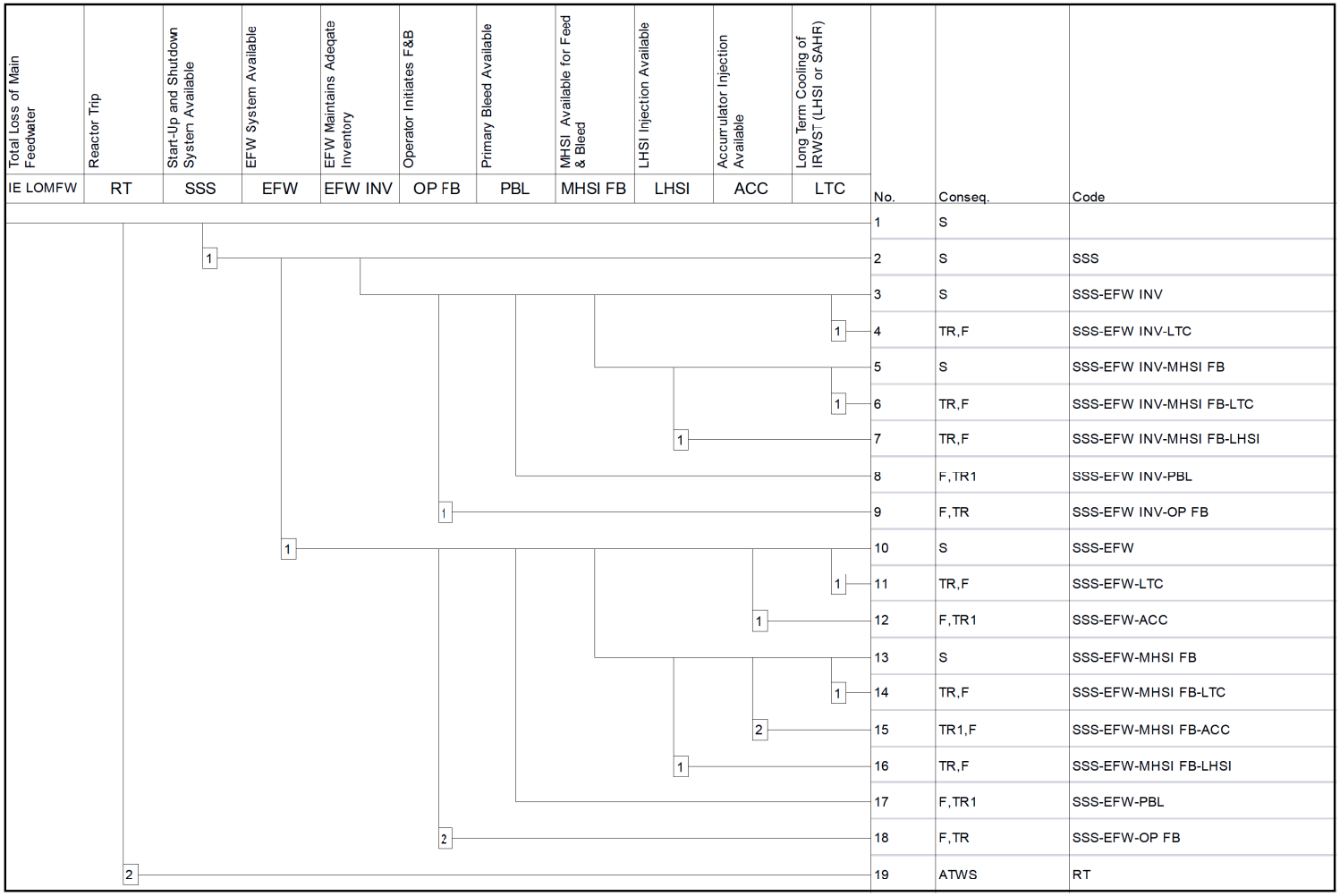
Figure 19A-15—Loss of Component Cooling Water or Emergency Service Water



No.	Conseq.	Code
1	S	
2	S	MFW
3	S	MFW-SSS
4	S	MFW-SSS-EFW INV
5	TR,F	MFW-SSS-EFW INV-LTC
6	S	MFW-SSS-EFW INV-MHSI FB
7	TR,F	MFW-SSS-EFW INV-MHSI FB-LTC
8	TR,F	MFW-SSS-EFW INV-MHSI FB-LHSI
9	F,TR1	MFW-SSS-EFW INV-PBL
10	F,TR	MFW-SSS-EFW INV-OP FB
11	S	MFW-SSS-EFW
12	TR,F	MFW-SSS-EFW-LTC
13	F,TR1	MFW-SSS-EFW-ACC
14	S	MFW-SSS-EFW-MHSI FB
15	TR,F	MFW-SSS-EFW-MHSI FB-LTC
16	TR1,F	MFW-SSS-EFW-MHSI FB-ACC
17	TR,F	MFW-SSS-EFW-MHSI FB-LHSI
18	F,TR1	MFW-SSS-EFW-PBL
19	F,TR	MFW-SSS-EFW-OP FB
20	S	RCP LOCA
21	F,SS	RCP LOCA-LTC
22	S	RCP LOCA-EFW INV
23	F,SS	RCP LOCA-EFW INV-LTC
24	F,SS1	RCP LOCA-EFW INV-PBL
25	F,SS	RCP LOCA-EFW INV-OP FB
26	S	RCP LOCA-EFW
27	F,SS	RCP LOCA-EFW-LTC
28	F,SS1	RCP LOCA-EFW-ACC
29	F,SS1	RCP LOCA-EFW-PBL
30	F,SS	RCP LOCA-EFW-OP FB
31	S	RCP LOCA-MHSI
32	F,SSD	RCP LOCA-MHSI-LTC
33	F,SS1D	RCP LOCA-MHSI-ACC
34	F,SSD	RCP LOCA-MHSI-LHSI
35	S	RCP LOCA-MHSI-EFW INV
36	F,SSD	RCP LOCA-MHSI-EFW INV-LTC
37	F,SSD	RCP LOCA-MHSI-EFW INV-LHSI
38	F,SS1D	RCP LOCA-MHSI-EFW INV-PBL
39	F,SSD	RCP LOCA-MHSI-EFW INV-OP FB
40	S	RCP LOCA-MHSI-EFW
41	F,SSD	RCP LOCA-MHSI-EFW-LTC
42	F,SS1D	RCP LOCA-MHSI-EFW-ACC
43	F,SSD	RCP LOCA-MHSI-EFW-LHSI
44	F,SS1D	RCP LOCA-MHSI-EFW-PBL
45	F,SSD	RCP LOCA-MHSI-EFW-OP FB
46	F,SSD	RCP LOCA-MHSI-OP FCD

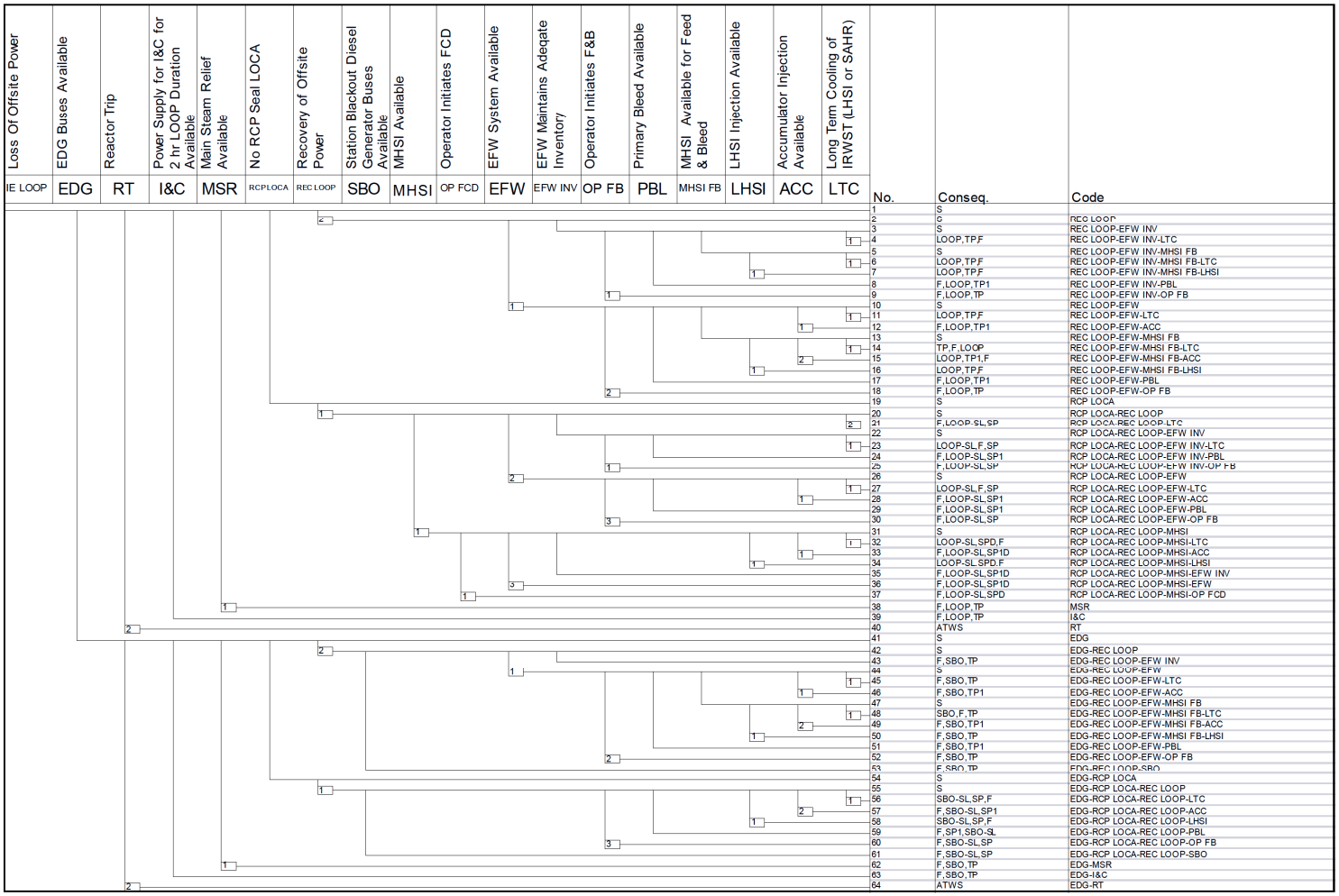
REV 005
EPR6570 T2

Figure 19A-16—Loss of Main Feedwater



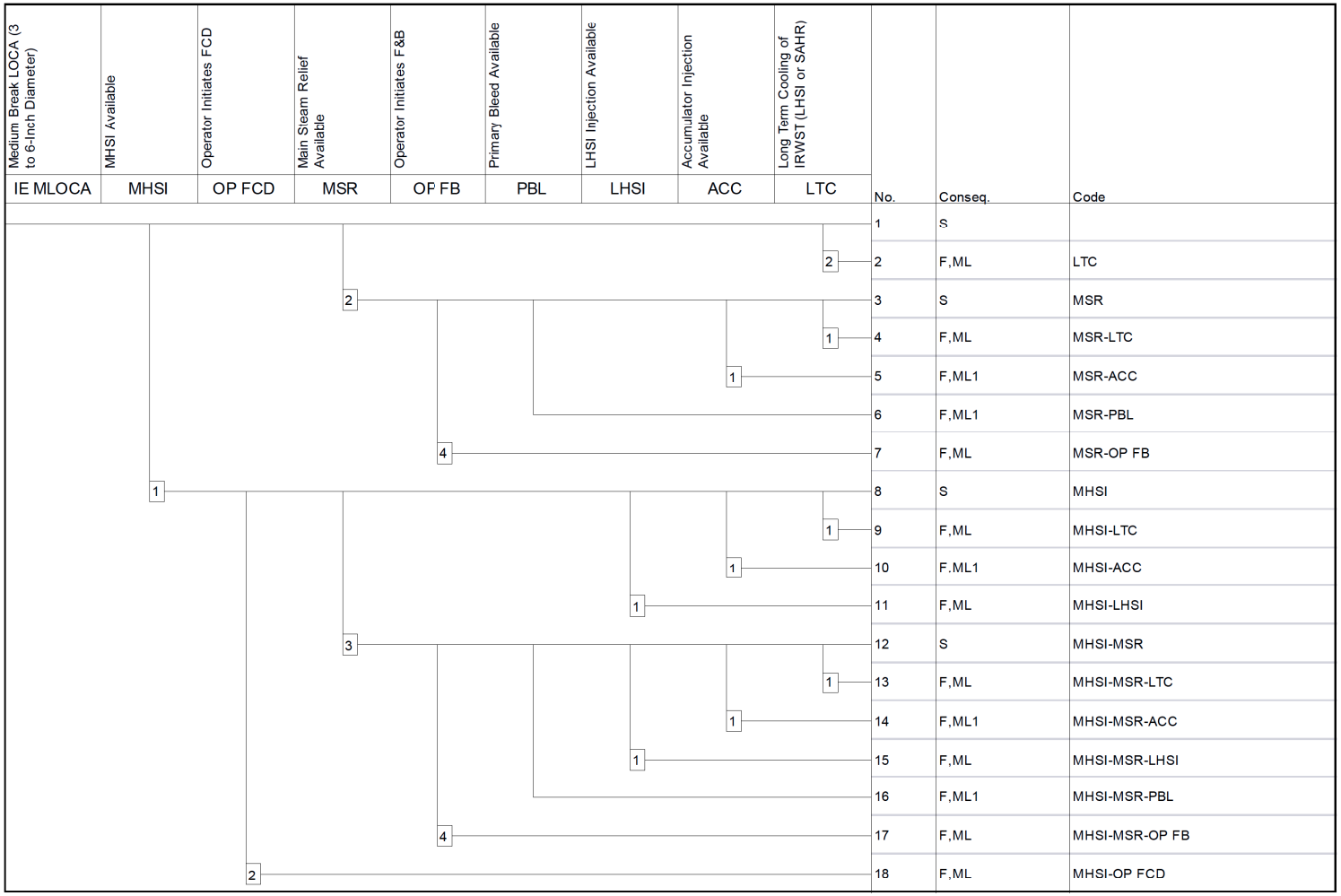
REV 005
EPR6575 T2

Figure 19A-17—Loss of Offsite Power



REV 005
EPR6580 T2

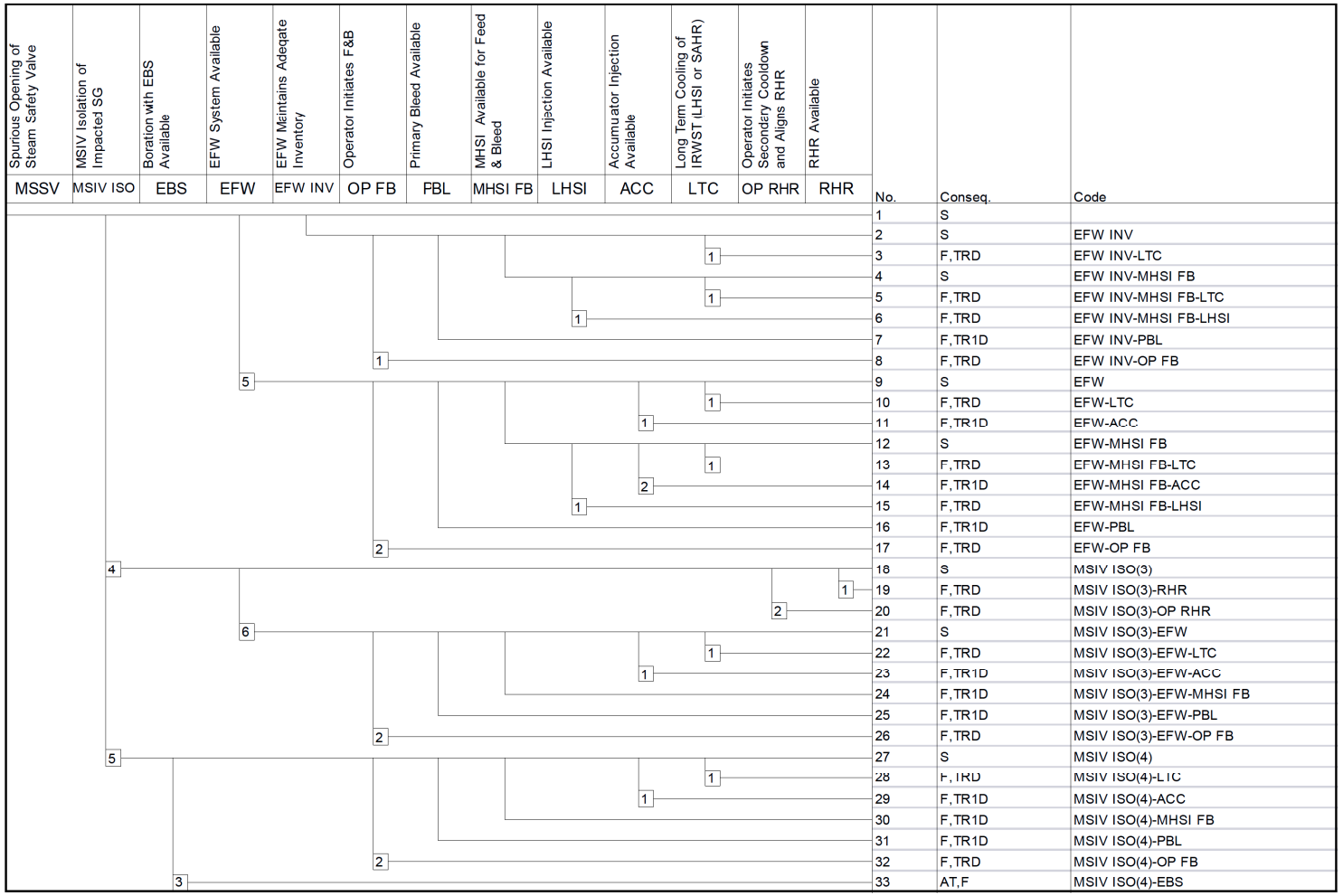
Figure 19A-18—Medium Loss-of-Coolant Accident



No.	Conseq.	Code
1	S	
2	F,ML	LTC
3	S	MSR
4	F,ML	MSR-LTC
5	F,ML1	MSR-ACC
6	F,ML1	MSR-PBL
7	F,ML	MSR-OP FB
8	S	MHSI
9	F,ML	MHSI-LTC
10	F,ML1	MHSI-ACC
11	F,ML	MHSI-LHSI
12	S	MHSI-MSR
13	F,ML	MHSI-MSR-LTC
14	F,ML1	MHSI-MSR-ACC
15	F,ML	MHSI-MSR-LHSI
16	F,ML1	MHSI-MSR-PBL
17	F,ML	MHSI-MSR-OP FB
18	F,ML	MHSI-OP FCD

REV 005
EPR6585 T2

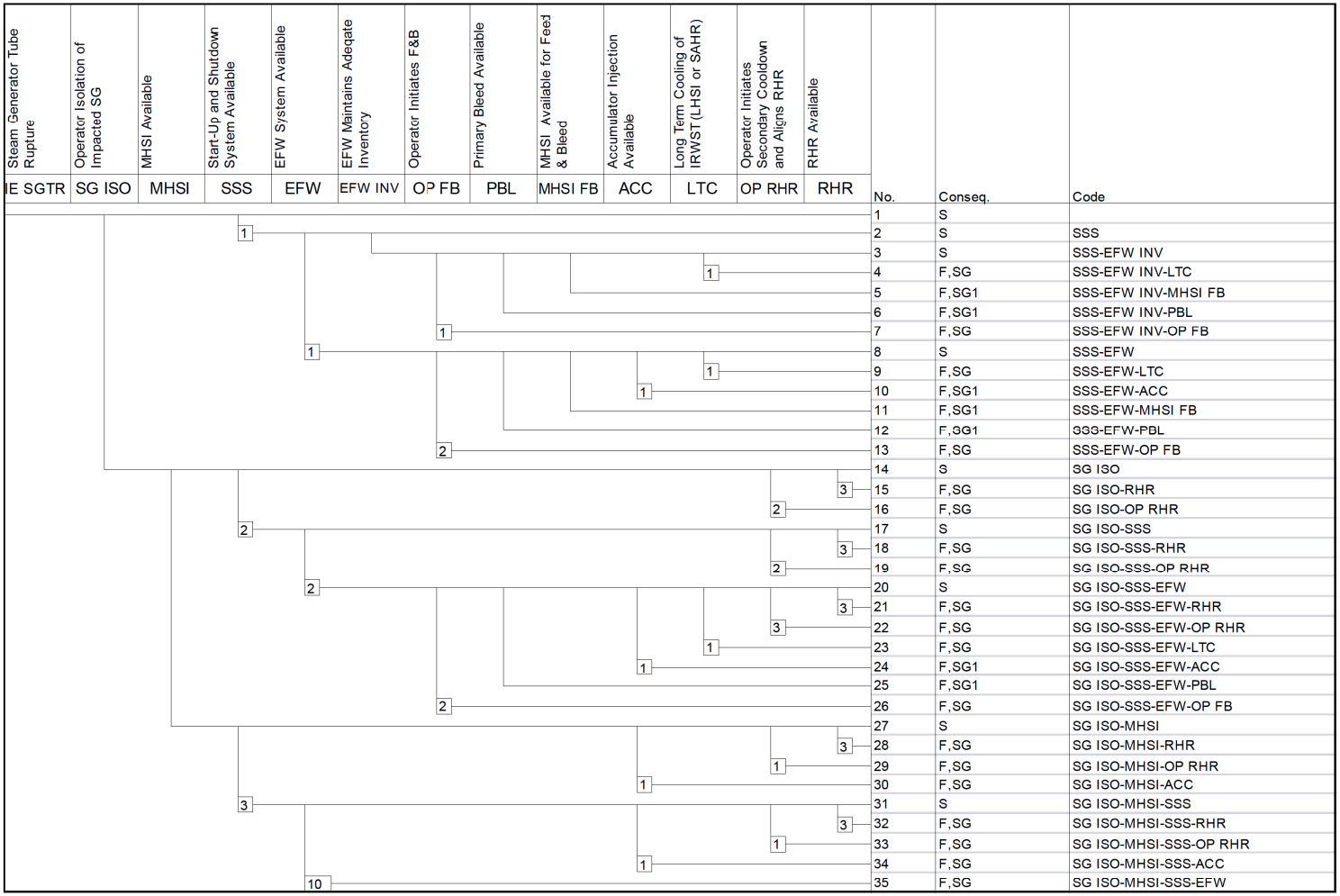
Figure 19A-19—Spurious Opening of Main Steam Safety Valve



No.	Conseq.	Code
1	S	
2	S	EFW INV
3	F,TRD	EFW INV-LTC
4	S	EFW INV-MHSI FB
5	F,TRD	EFW INV-MHSI FB-LTC
6	F,TRD	EFW INV-MHSI FB-LHSI
7	F,TR1D	EFW INV-PBL
8	F,TRD	EFW INV-OP FB
9	S	EFW
10	F,TRD	EFW-LTC
11	F,TR1D	EFW-ACC
12	S	EFW-MHSI FB
13	F,TRD	EFW-MHSI FB-LTC
14	F,TR1D	EFW-MHSI FB-ACC
15	F,TRD	EFW-MHSI FB-LHSI
16	F,TR1D	EFW-PBL
17	F,TRD	EFW-OP FB
18	S	MSIV ISO(3)
19	F,TRD	MSIV ISO(3)-RHR
20	F,TRD	MSIV ISO(3)-OP RHR
21	S	MSIV ISO(3)-EFW
22	F,TRD	MSIV ISO(3)-EFW-LTC
23	F,TR1D	MSIV ISO(3)-EFW-ACC
24	F,TR1D	MSIV ISO(3)-EFW-MHSI FB
25	F,TR1D	MSIV ISO(3)-EFW-PBL
26	F,TRD	MSIV ISO(3)-EFW-OP FB
27	S	MSIV ISO(4)
28	F,TRD	MSIV ISO(4)-LTC
29	F,TR1D	MSIV ISO(4)-ACC
30	F,TR1D	MSIV ISO(4)-MHSI FB
31	F,TR1D	MSIV ISO(4)-PBL
32	F,TRD	MSIV ISO(4)-OP FB
33	AT,F	MSIV ISO(4)-EBS

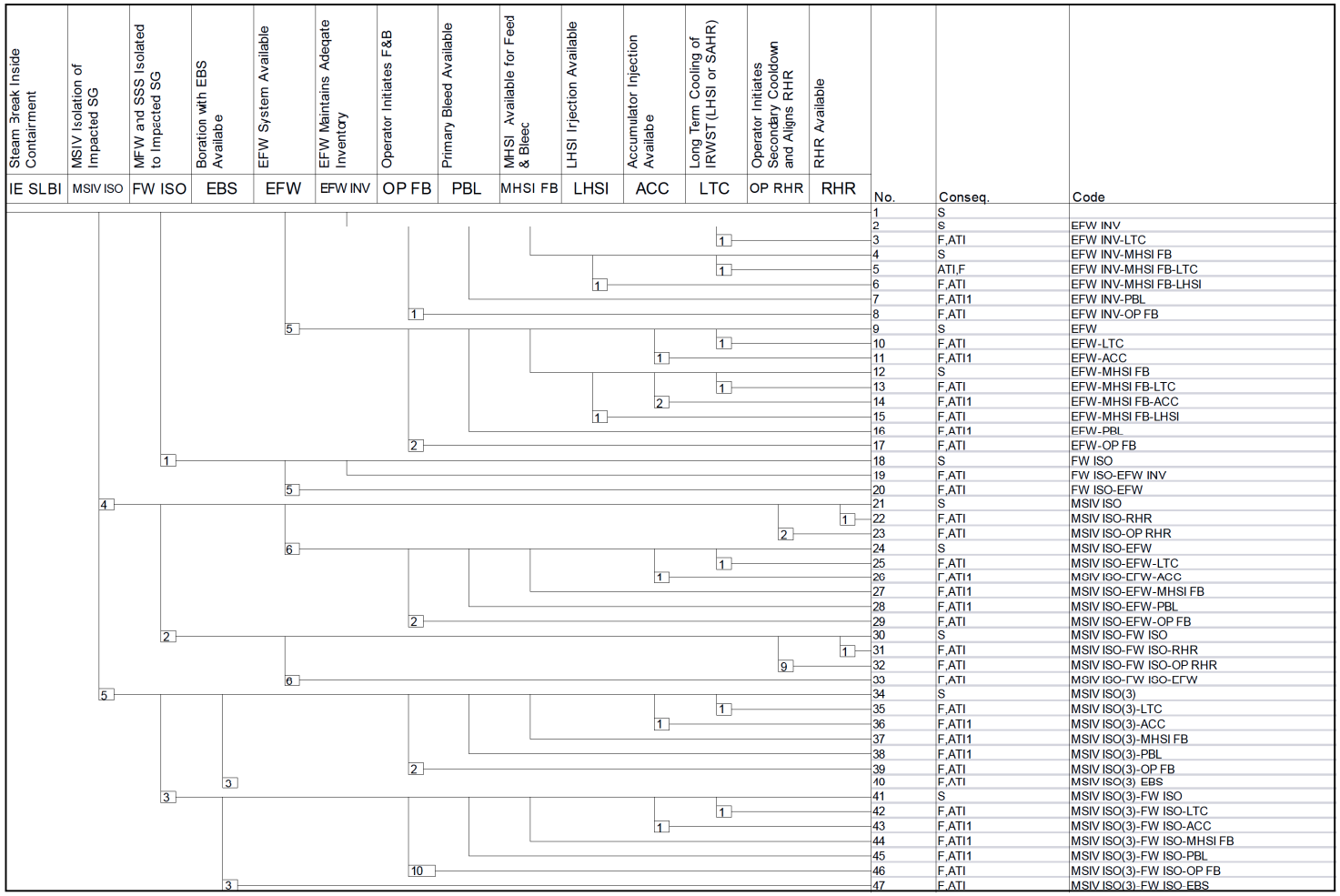
REV 005
EPR6590 T2

Figure 19A-20—Steam Generator Tube Rupture



REV 005
EPR6595 T2

Figure 19A-21—Steam-Line Break Inside Containment



No.	Conseq.	Code
1	S	
2	S	EFW INV
3	F,ATI	EFW INV-LTC
4	S	EFW INV-MHSI FB
5	ATI,F	EFW INV-MHSI FB-LTC
6	F,ATI	EFW INV-MHSI FB-LHSI
7	F,ATI1	EFW INV-PBL
8	F,ATI	EFW INV-OP FB
9	S	EFW
10	F,ATI	EFW-LTC
11	F,ATI1	EFW-ACC
12	S	EFW-MHSI FB
13	F,ATI	EFW-MHSI FB-LTC
14	F,ATI1	EFW-MHSI FB-ACC
15	F,ATI	EFW-MHSI FB-LHSI
16	F,ATI1	EFW-PBL
17	F,ATI	EFW-OP FB
18	S	FW ISO
19	F,ATI	FW ISO-EFW INV
20	F,ATI	FW ISO-EFW
21	S	MSIV ISO
22	F,ATI	MSIV ISO-RHR
23	F,ATI	MSIV ISO-OP RHR
24	S	MSIV ISO-EFW
25	F,ATI	MSIV ISO-EFW-LTC
26	F,ATI1	MSIV ISO-EFW-ACC
27	F,ATI1	MSIV ISO-EFW-MHSI FB
28	F,ATI1	MSIV ISO-EFW-PBL
29	F,ATI	MSIV ISO-EFW-OP FB
30	S	MSIV ISO-FW ISO
31	F,ATI	MSIV ISO-FW ISO-RHR
32	F,ATI	MSIV ISO-FW ISO-OP RHR
33	F,ATI	MSIV ISO-FW ISO-EFW
34	S	MSIV ISO(3)
35	F,ATI	MSIV ISO(3)-LTC
36	F,ATI1	MSIV ISO(3)-ACC
37	F,ATI1	MSIV ISO(3)-MHSI FB
38	F,ATI1	MSIV ISO(3)-PBL
39	F,ATI	MSIV ISO(3)-OP FB
40	F,ATI	MSIV ISO(3) EBS
41	S	MSIV ISO(3)-FW ISO
42	F,ATI	MSIV ISO(3)-FW ISO-LTC
43	F,ATI1	MSIV ISO(3)-FW ISO-ACC
44	F,ATI1	MSIV ISO(3)-FW ISO-MHSI FB
45	F,ATI1	MSIV ISO(3)-FW ISO-PBL
46	F,ATI	MSIV ISO(3)-FW ISO-OP FB
47	F,ATI	MSIV ISO(3)-FW ISO-EBS

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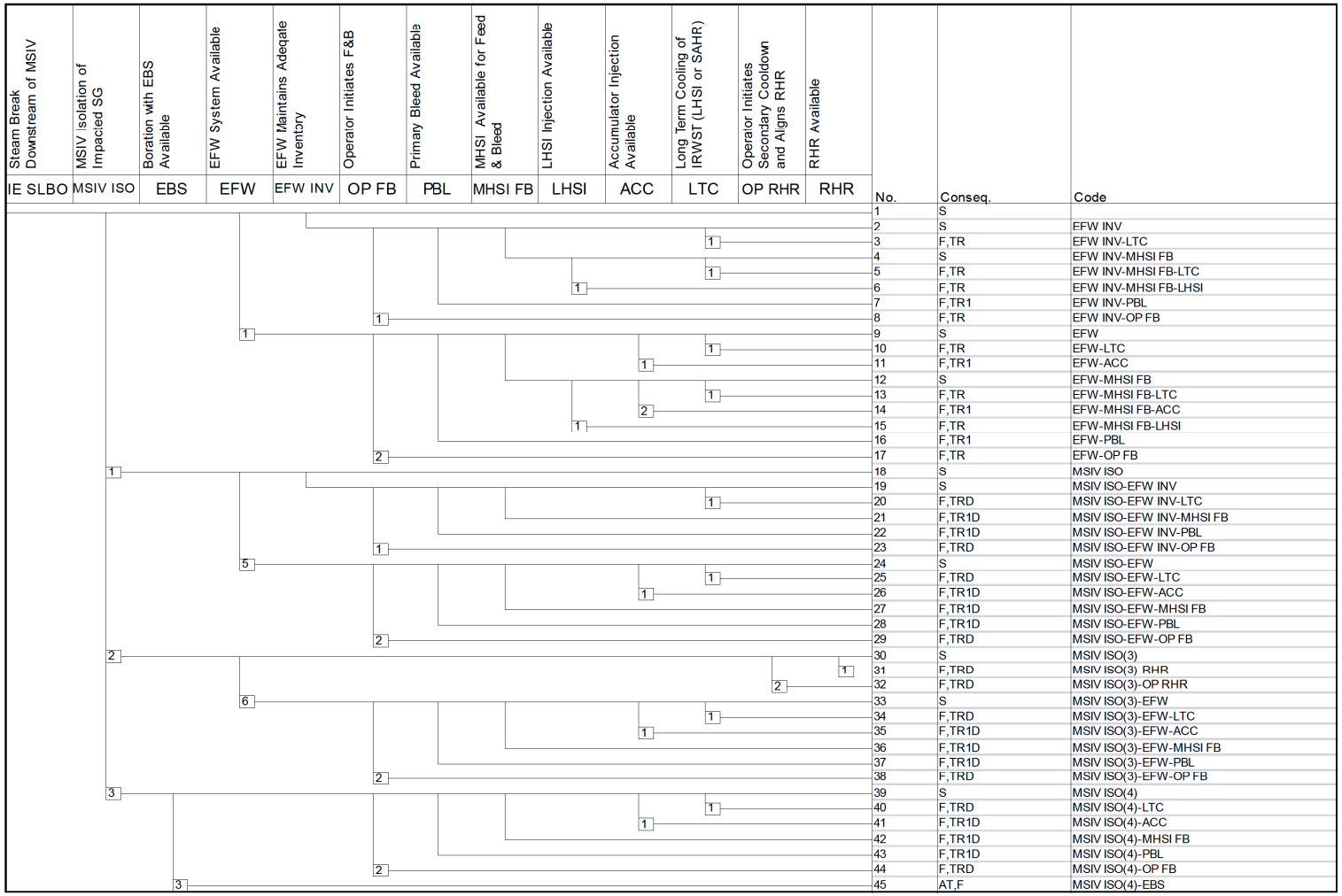
Figure 19A-22—Steam Line Break Outside Containment



No.	Conseq.	Code
1	S	
2	S	EFW INV
3	F,TR	EFW INV-LTC
4	S	EFW INV-MHSI FB
5	F,TR	EFW INV-MHSI FB-LTC
6	F,TR	EFW INV-MHSI FB-LHSI
7	F,TR1	EFW INV-PBL
8	F,TR	EFW INV-OP FB
9	S	EFW
10	F,TR	EFW-LTC
11	F,TR1	EFW-ACC
12	S	EFW-MHSI FB
13	F,TR	EFW-MHSI FB-LTC
14	F,TR1	EFW-MHSI FB-ACC
15	F,TR	EFW-MHSI FB-LHSI
16	F,TR1	EFW-PBL
17	F,TR	EFW-OP FB
18	S	MSIV ISO
19	S	MSIV ISO-EFW INV
20	F,TRD	MSIV ISO-EFW INV-LTC
21	F,TR1D	MSIV ISO-EFW INV-MHSI FB
22	F,TR1D	MSIV ISO-EFW INV-PBL
23	F,TRD	MSIV ISO-EFW INV-OP FB
24	S	MSIV ISO-EFW
25	F,TRD	MSIV ISO-EFW-LTC
26	F,TR1D	MSIV ISO-EFW-ACC
27	F,TR1D	MSIV ISO-EFW-MHSI FB
28	F,TR1D	MSIV ISO-EFW-PBL
29	F,TRD	MSIV ISO-EFW-OP FB
30	S	MSIV ISO(3)
31	F,TRD	MSIV ISO(3) RHR
32	F,TRD	MSIV ISO(3)-OP RHR
33	S	MSIV ISO(3)-EFW
34	F,TRD	MSIV ISO(3)-EFW-LTC
35	F,TR1D	MSIV ISO(3)-EFW-ACC
36	F,TR1D	MSIV ISO(3)-EFW-MHSI FB
37	F,TR1D	MSIV ISO(3)-EFW-PBL
38	F,TRD	MSIV ISO(3)-EFW-OP FB
39	S	MSIV ISO(4)
40	F,TRD	MSIV ISO(4)-LTC
41	F,TR1D	MSIV ISO(4)-ACC
42	F,TR1D	MSIV ISO(4)-MHSI FB
43	F,TR1D	MSIV ISO(4)-PBL
44	F,TRD	MSIV ISO(4)-OP FB
45	AT,F	MSIV ISO(4)-EBS

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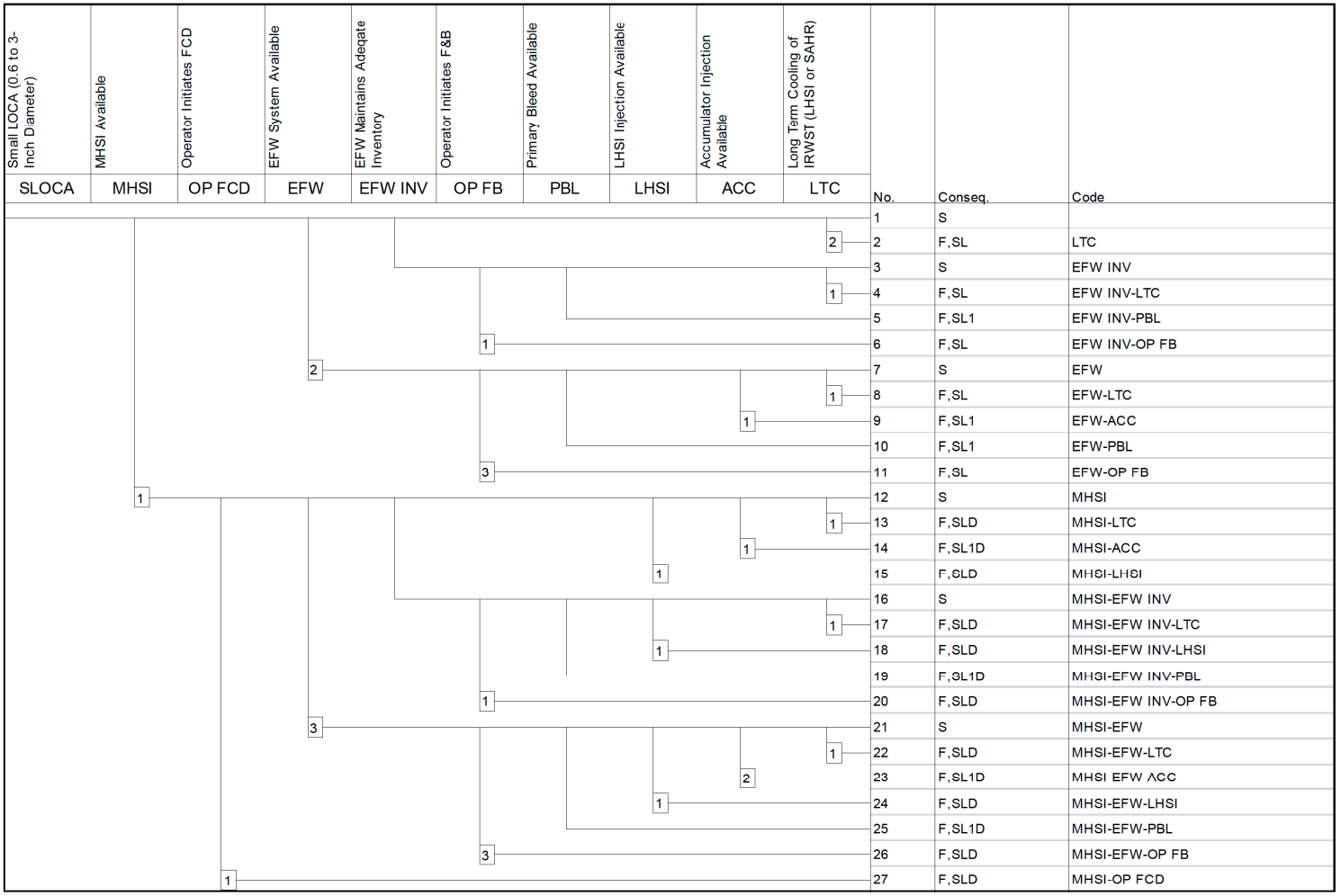
Figure 19A-23—Small Loss-of-Coolant Accident



No.	Conseq.	Code
1	S	
2	F,SL	LTC
3	S	EFW INV
4	F,SL	EFW INV-LTC
5	F,SL1	EFW INV-PBL
6	F,SL	EFW INV-OP FB
7	S	EFW
8	F,SL	EFW-LTC
9	F,SL1	EFW-ACC
10	F,SL1	EFW-PBL
11	F,SL	EFW-OP FB
12	S	MHSI
13	F,SLD	MHSI-LTC
14	F,SL1D	MHSI-ACC
15	F,SLD	MHSI-LHSI
16	S	MHSI-EFW INV
17	F,SLD	MHSI-EFW INV-LTC
18	F,SLD	MHSI-EFW INV-LHSI
19	F,SL1D	MHSI-EFW INV-PBL
20	F,SLD	MHSI-EFW INV-OP FB
21	S	MHSI-EFW
22	F,SLD	MHSI-EFW-LTC
23	F,SL1D	MHSI-EFW-ACC
24	F,SLD	MHSI-EFW-LHSI
25	F,SL1D	MHSI-EFW-PBL
26	F,SLD	MHSI-EFW-OP FB
27	F,SLD	MHSI-OP FCD

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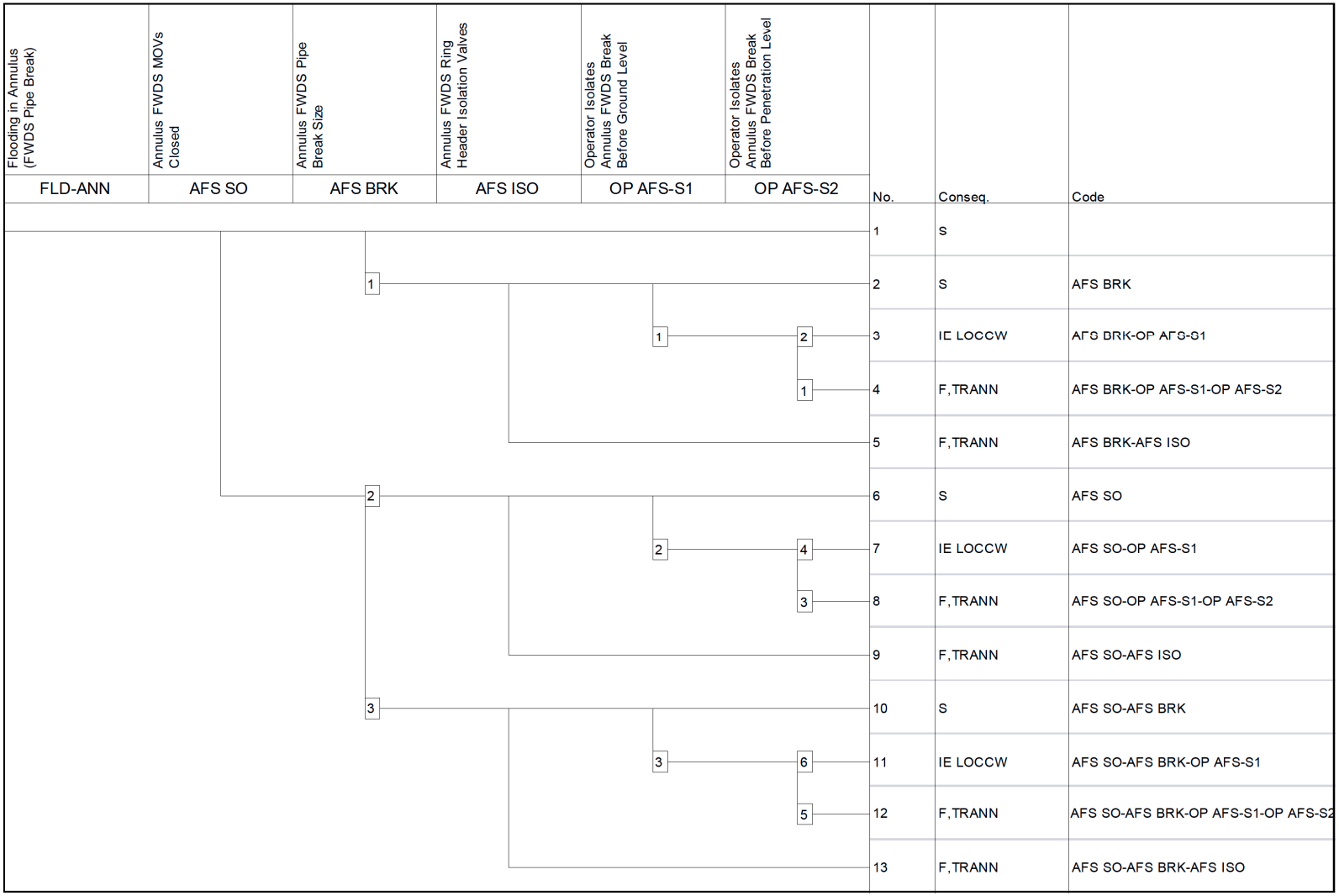
Figure 19A-24—Flooding in Annulus (FWDS Pipe Break)



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