18F Emergency Operation Information and Controls

18F.1 Introduction

This appendix contains the results of an analysis of information and control needs of the main control room operators. The analysis is based upon the operation strategies given in the ABWR Emergency Procedure Guidelines (EPGs) as presented in Appendix 18A and the significant operator actions determined by the Probabilistic Risk Assessment (PRA) described in Section 19D.7. The minimum inventory of controls, displays and alarms from this analysis are presented in Tables 18F–1 through 18F–3. The information and controls identified from this analysis do not necessarily include those from other design requirements (such as those from Section 18.4.2.11, SPDS). Supporting information is provided in Appendix 18H.

Information and control needs for each operative instruction or action were developed through task analyses conducted in the following manner:

- Each specific step in the EPGs (referred to as the EPG step) or specific operator action referenced in the PRA (herein referred to as the PRA operator action) was individually identified.
- A summary description of the step or PRA operator action was developed for each EPG step and PRA operator action.
- Information needs required for the operator to perform the specific EPG step or PRA operator action were then identified.
- Next, the control functions that the operators perform to execute the actions specified in the EPG step or PRA operator action were identified.
- The plant process parameters or other displays needed for execution of the individual EPG step or PRA operator action, were then identified.
- Similarly, the controls needed for the execution of each step, were identified.
- Alarms to perform step and alarms to provide feedback information to the operator were identified.
- Operator aids, such as supplementary procedures or other information needed to execute the step, were identified.
- Displays needed to provide confirmatory feedback to the operators that the specified control functions have been initiated or accomplished, were identified.
- Position of control devices that provide feedback to the operators to confirm that proper controls are manipulated to the correct positions, were identified.

- Annunciators which provide feedback to the operators to confirm that proper control actions are initiated or accomplished were identified.
- Operator aids, which provide feedback to the operators to confirm that proper control actions are initiated or accomplished, were identified.

The following operator actions are considered to be important operator actions in the ABWR PRA (refer to Section 19D.7):

(1) Backup manual initiation of HPCF

(2) Recovery of feedwater following a scram

(3) Use of condensate injection following scram with reactor depressurized

(4) Control of reactor water level in an ATWS

(5) Emergency depressurization of the reactor

(6) Alignment and initiation of firewater for RPV injection with ECCS failure

(7) Alignment and initiation of firewater for drywell spray

(8) Initiation of wetwell spray using RHR

(9) Isolation of water sources in an internal flooding

These actions are already specified in the EPGs and are included in the analyses.

Based upon the results of those operator task analyses, the listings of controls, displays and alarms that will be provided in the implemented ABWR design to support execution of the EOPs and PRA significant operator actions (as presented in Tables 18F-1, 18F-2, and 18F-3), were generated.

Table 18F-1
Inventory of Controls Based Upon the ABWR EPGs and PRA

No.	Fixed Position Controls
1	Manual Scram Initiation SW(A)
2	Manual Scram Initiation SW(B)
3	Reactor Mode SW
4	Div. I Main steamline Manual Isolation SW
5	Div. II Main steamline Manual Isolation SW
6	Div. III Main steamline Manual Isolation SW
7	Div. IV Main steamline Manual Isolation SW
8	Primary Containment Div. I Manual Isolation SW
9	Primary Containment Div. II Manual Isolation SW
10	Primary Containment Div. III Manual Isolation SW
11	RCIC Initiation SW
12	HPCF (B) Initiation SW
13	HPCF (C) Initiation SW
14	RHR (A) Initiation SW
15	RHR (B) Initiation SW
16	RHR (C) Initiation SW
17	DG(A) Start SW
18	DG(B) Start SW
19	DG(C) Start SW
20	RCIC System Standby Mode Initiation SW
21	Condensate Pump Standby Mode Initiation Switches (8)
22	Reactor Feedpump Standby Mode Initiation Switches (4)
23	Condensate Pump Startup Mode Initiation Switches (8)
24	Reactor Feedpump Startup Mode Initiation Switches (4)
25	SLC (A) Pump CS
26	SLC (B) Pump CS
27	ADS (A) Inhibit SW
28	ADS (B) Inhibit SW
29	RHR(A) Standby Mode SW
30	RHR(B) Standby Mode SW
31	RHR(C) Standby Mode SW
32	Main Steam Isolation Valve CS (8)
33	Div. I Manual/Auto Main Steamline Isolation Reset SW
34	Div. II Manual/Auto Main Steamline Isolation Reset SW

Table 18F-1
Inventory of Controls Based Upon the ABWR EPGs and PRA (Continued)

No.	Fixed Position Controls
35	Div. III Manual/Auto Main Steamline Isolation Reset SW
36	Div. IV Manual/Auto Main Steamline Isolation Reset SW
37	Primary Containment Div. I Isolation Reset SW
38	Primary Containment Div. II Isolation Reset SW
39	Primary Containment Div. III Isolation Reset SW
40	RHR(A) Shutdown Cooling Mode Initiation SW
41	RHR(B) Shutdown Cooling Mode Initiation SW
42	RHR(C) Shutdown Cooling Mode Initiation SW
43	ARI(A) Manual Initiation SW
44	ARI(B) Manual Initiation SW
45	Recirculation Runback Initiation SW(A)
46	Recirculation Runback Initiation SW(B)
47	RIP Start/Stop CS (10)
48	ARI(A) Logic Reset SW
49	ARI(B) Logic Reset SW
50	CRD Charging Water Pressure Low Scram Bypass SW(A)
51	CRD Charging Water Pressure Low Scram Bypass SW(B)
52	CRD Charging Water Pressure Low Scram Bypass SW(C)
53	CRD Charging Water Pressure Low Scram Bypass SW(D)
54	Manual Scram Reset SW
55	RPS Div. I Trip Reset SW
56	RPS Div. II Trip Reset SW
57	RPS Div. III Trip Reset SW
58	RPS Div. IV Trip Reset SW
59	RHR(A) Suppression Pool Cooling Mode Initiation SW
60	RHR(B) Suppression Pool Cooling Mode Initiation SW
61	RHR(C) Suppression Pool Cooling Mode Initiation SW
62	RHR(B) Primary Containment Vessel Spray Mode Initiation SW
63	RHR(C) Primary Containment Vessel Spray Mode Initiation SW
64	SGTS(B) Initiation SW
65	SGTS(C) Initiation SW
66	Div I Manual ADS Channel 1 Initiation SW
67	Div I Manual ADS Channel 2 Initiation SW
68	Div II Manual ADS Channel 1 Initiation SW

Table 18F-1
Inventory of Controls Based Upon the ABWR EPGs and PRA (Continued)

No.	Fixed Position Controls
69	Div II ADS Manual ADS Channel 2 Initiation SW
70	RCIC Div. I Isolation Logic Reset SW
71	RCIC Div. II Isolation Logic Reset SW
72	RCIC Inboard Isolation CS
73	RCIC Outboard Isolation CS
74	RHR(C) Manual Valves For Firewater Injection (F101, F102, F103)*
75	CUW Regenerative Heat Exchanger Manual Bypass Valve*
76	Turbine Building HVAC System Controls*
77	SLC Local Controls*
78	Fire Protection System Motor Pump Control SW†
79	Fire Protection System Diesel Pump Control SW†
80	Control Rod Scram Test Switches†
81	“A” Scram Solenoid Main Power Breaker CS†
82	“B” Scram Solenoid Main Power Breaker CS†
83	RPS Div. I Trip Inhibit SW†
84	RPS Div. II Trip Inhibit SW†
85	RPS Div. III Trip Inhibit SW†
86	RPS Div. IV Trip Inhibit SW†
87	Rod Worth Minimizer Bypass,†
88	CAMS(A) Operating Mode SW†
89	CAMS(B) Operating Mode SW†
90	CAMS(A) Sample Select SW†
91	CAMS(B) Sample Select SW†
92	Not Used
93	Not Used

* Provided outside the main control room.

† To be provided at main control room area panels, not at the operator control panels.

Table 18F-1
Inventory of Controls Based Upon the ABWR EPGs and PRA (Continued)

No.	Other Control Functions
1	HPCF(B) System controls for terminating system flow, injecting flow, and isolation of potential discharges to reactor building areas
2	HPCF(C) System controls for terminating system flow, injecting flow, and isolation of potential discharges to reactor building areas
3	RCIC System controls for terminating system flow, injecting flow, isolation of potential discharges to reactor building areas, and venting of the RPV to the main condenser
4	RHR(A) System controls for terminating system flow, injecting flow, suppression pool cooling, wetwell spray, drywell spray, shutdown cooling, and isolation of potential discharges to reactor building areas
5	RHR(B) System controls for terminating system flow, injecting flow, suppression pool cooling, wetwell spray, drywell spray, shutdown cooling, and isolation of potential discharges to reactor building areas
6	RHR(C) System controls for terminating system flow, injecting flow, suppression pool cooling, wetwell spray, drywell spray, shutdown cooling, and isolation of potential discharges to reactor building areas
7	Main steamline drain containment isolation valve controls
8	SRV opening and closing controls for each SRV
9	SGTS(B) System controls for venting of the primary containment, and control of secondary containment (reactor building) radiation
10	SGTS(C) System controls for venting of the primary containment, and control of secondary containment (reactor building) radiation
11	RBHVAC containment isolation valves controls
12	ACS containment isolation valves controls
13	SGTS(B) room cooler fan control
14	SGTS(C) room cooler fan control
15	CAMS(A) room cooler fan control
16	CAMS(B) room cooler fan control
17	RHR(A) pump room cooler fan control
18	RHR(B) pump room cooler fan control
19	RHR(C) pump room cooler fan control
20	HPCF(B) pump room cooler fan control
21	HPCF(C) pump room cooler fan control
22	RCIC pump room cooler fan control
23	Not Used
24	Not Used

Table 18F-1
Inventory of Controls Based Upon the ABWR EPGs and PRA (Continued)

No.	Other Control Functions
25	FPC(A) room cooler fan control
26	FPC(B) room cooler fan control
27	Fuel Pool Cooling System controls for isolation of discharges into reactor building areas
28	RCIC steamline isolation logic bypasses (area temperature high, RPV pressure low, steamline pressure low, RCIC turbine exhaust pressure low)
29	CUW isolation logic bypass (SLC initiation, regenerative heat exchanger area temperature high, RPV water Level 2)
30	MSIV and main steamline drain isolation logic bypass (level 1.5, main steamline high flow, main steamline tunnel area temperature high, main steamline turbine area temperature high)
31	Logic bypass (RPV Level 3) of RBHVAC system isolation valves
32	Logic bypass (RPV Level 3) of atmospheric control system isolation valves
33	Logic bypass of high drywell pressure isolation for RBHVAC
34	High RPV water level (Level 8) HPCF(B) injection valve closure logic bypass
35	High RPV water level (Level 8) HPCF(C) injection valve closure logic bypass
36	Condensate and feedwater system controls for terminating flow and injecting flow into the RPV/containment
37	CRD System controls for terminating flow and injecting flow into the RPV/containment
38	Condensate Makeup Water System controls for terminating flow and injecting flow into the RPV/containment
39	SPCU System controls for terminating flow into the containment if aligned to take suction from the condensate storage tank
40	Feedwater Control System controls for terminating flow and injecting flow into the RPV/containment
41	Pressure Control System controls for the turbine bypass valves
42	Main Steam System controls for controlling main steamline drain and head vent valves
43	CUW System controls for alternate pressure control or decay heat removal
44	Rod Control and Information System controls for control rod insertions
45	Drywell Cooling System fan control
46	Nitrogen vent and purge mode of ACS
47	Containment purge mode of containment supply and purge subsystem of RBHVAC
48	RBHVAC System controls for venting of the containment
49	Atmospheric Control System controls for venting and purging of the containment
50	Main steam/feedwater tunnel HVAC fan controls
51	Logic bypasses for Alternate Rod Insertion (ARI) (high RPV pressure, RPV Water Level 2)

Table 18F-1
Inventory of Controls Based Upon the ABWR EPGs and PRA (Continued)

No.	Other Control Functions
52	Logic bypass of High RPV Water level (Level 8) trip of reactor feedpumps
53	Logic bypasses of drywell cooling fans and associated cooling water (RCW) [Drywell Pressure High, RPV Water Level 1]

Table 18F-2
Inventory of Displays Based Upon the ABWR EPGs and PRA

No.	Fixed Position Displays	No.	Fixed Position Displays
1	RPV Water Level ★★	27	RHR(C) Flow ★★
2	RCIC Turbine Speed	28	RHR(C) Injection Valve Status
3	Wetwell Pressure ★★	29	Emergency Diesel Generator (A) Operating Status ★★
4	Suppression Pool Bulk Average Temperature ★★	30	Emergency Diesel Generator (B) Operating Status ★★
5	HPCF(B) Flow ★★	31	Emergency Diesel Generator (C) Operating Status ★★
6	HPCF(C) Flow ★★	32	Primary Containment Water Level ★★
7	RPV Pressure ★★	33	Condensate Storage Tank Water Level ★★
8	Drywell Pressure ★★	34	SLC Pump(A) Discharge Pressure ★★
9	Reactor Power Level, (Neutron Flux, APRM) ★★	35	SLC Pump(B) Discharge Pressure ★★
10	Reactor Power Level (SRNM) ★★	36	Main Condenser Pressure
11	Reactor Thermal Power ★★	37	SRV Positions ★★
12	MSIV Position Status (Inboard And Outboard Valves) ★★	38	Suppression Pool Level ★★
13	Reactor Mode Switch Mode Indications	39	Main Steamline Flow ★★
14	Not Used	40	SLC Boron Tank Water Level ★★
15	Scram Solenoid Lights(8) Status	41	Recirculation Pump Speeds
16	Manual Scram SW(A) Indicating Light Status	42	Average Drywell Temperature ★★
17	Manual Scram SW(B) Indicating Light Status	43	Wetwell Hydrogen Concentration Level ★★
18	RPV Isolation Status Display ★★	44	Drywell Hydrogen Concentration Level ★★
19	RCIC Flow ★★	45	Drywell Oxygen Concentration ★★
20	RCIC Injection Valve Status	46	Wetwell Oxygen Concentration ★★
21	HPCF(B) Injection Valve Status	47	Not Used
22	HPCF(C) Injection Valve Status	48	Not Used
23	RHR(A) Flow ★★	49	Main Stack Radiation Level ★★
24	RHR(A) Injection Valve Status	50	Time

★★ Denotes Regulatory Guide 1.97 Parameter

Table 18F-2
Inventory of Displays Based Upon the ABWR EPGs and PRA (Continued)

No.	Fixed Position Displays	No.	Fixed Position Displays
25	RHR(B) Flow ★★	51	Drywell Radiation Level ★★
26	RHR(B) Injection Valve Status	52	Wetwell Radiation Level ★★
★★ Denotes Regulatory Guide 1.97 Parameter			

18F-2 Inventory of Displays Based Upon the ABWR EPGs and PRA (Continued)

No.	Other Displays
1	Reactor building differential pressure
2	Reactor building HVAC exhaust radiation level
3	Fuel handling area ventilation exhaust radiation level
4	RHR(A) pump room cooler operation status
5	RHR(B) pump room cooler operation status
6	RHR(C) pump room cooler operation status
7	HPCF(B) pump room cooler operation status
8	HPCF(C) pump room cooler operation status
9	RCIC pump room cooler operation status
10	Not Used
11	Not Used
12	FPC(A) room cooler operation status
13	FPC(B) room cooler operation status
14	SGTS(B) room cooler operation status
15	SGTS(C) room cooler operation status
16	CAMS(A) room cooler operation status
17	CAMS(B) room cooler operation status
18	Main Steamline Radiation ★★
★★ Denotes Regulatory Guide 1.97 Parameter	

Table 18F-3
Inventory of Alarms Based Upon the ABWR EPGs and PRA

No.	Fixed Position Alarms	No.	Fixed Position Alarms
1	Indicated RPV Water Level Abnormal	29	Leak Detection Isolation
2	RPV Water Level 3	30	CUW System Status
3	RPV Pressure High	31	Reactor Period Short
4	Drywell Pressure High	32	ADS Div. I Inhibited/Auto Out Of Service
5	Neutron Flux High–High	33	ADS Div. II Inhibited/Auto Out Of Service
6	Neutron Monitoring System Inoperative	34	Suppression Pool Bulk Average Temperature High
7	MSIV Closure	35	Drywell Average Temperature High,
8	CRD Charging Water Pressure Low	36	Suppression Pool Water Level High/Low
9	Rapid Core Flow Decrease	37	CAMS H_2/O_2 Level High
10	Main Turbine Trip	38	CAMS(A) System Abnormal
11	Main Generator Trip	39	CAMS(B) System Abnormal
12	Not Used	40	Reactor Building ΔP Low
13	Reactor Scram	41	Area Temperature High
14	RPV Level 3 Isolation Incomplete	42	Area HVAC ΔT High
15	RPV Level 2 Isolation Incomplete,	43	RBHVAC Exhaust Radiation High
16	RPV Level 1.5/Drywell Pressure High Isolation Incomplete	44	Reactor Building Area Radiation High
17	RPV Water Level 2	45	Reactor Building Floor Drain Sump Water Level High–High
18	RPV Water Level 1.5	46	RBHVAC System Status
19	RPV Water Level 1	47	Stack Radioactivity High
20	Control Rod Not Inserted To/Beyond MSBWP ★★	48	RCW Radioactivity High
21	RPV Water Level 8	49	Radwaste Effluent Radioactivity High
22	Fire Protection System Status	50	Turbine Building Ventilation System (TBVS) Status
23	ADS(A) Logic Initiated	51	Radiation Monitor High
24	ADS(B) Logic Initiated	52	RCIC System Status
25	SRV Open	53	HPCF (B) System Status
26	Main Steamline Flow High	54	HPCF (C) System Status
27	HPIN(A) System Status		

★★ Denotes Regulatory Guide 1.97 Parameter.

Table 18F-3
Inventory of Alarms Based Upon the ABWR EPGs and PRA (Continued)

No.	Fixed Position Alarms	No.	Fixed Position Alarms
28	HPIN(B) System Status		
★★ Denotes Regulatory Guide 1.97 Parameter.			

Table 18F-3 Inventory of Alarms Based Upon the ABWR EPGs and PRA (Continued)

No.	Other Alarms
1	RPS Div. I Trip Inhibited
2	RPS Div. II Trip Inhibited
3	RPS Div. III Trip Inhibited
4	RPS Div. IV Trip Inhibited
5	RPV Water Level ≤ Zero–Injection Water Level
6	Drywell Radiation Upscale
7	Wetwell Radiation Upscale
8	Lower Drywell Water Level High
9	APRM Downscale
10	Main Steamline Radiation High