7.5 Information Systems Important to Safety

The information in this section of the reference ABWR DCD, including all subsections and tables, is incorporated by reference with the following departures and supplements.

STD DEP T1 2.3-1 (Table 7.5-2)

STD DEP T1 2.14-1 (Table 7.5-2, 7.5-6)

STD DEP 1.8-1 (Table 7.5-1)

~~STD DEP 6.2-2 (Tables 7.5-2, 7.5-3, 7.5-4)~~

STD DEP 7.5-1 (Tables 7.5-2, ~~7.5-8~~7.5-3, 7.5-4)

STD DEP 11.5-1 (Table 7.5-2)

STD DEP Admin (Tables 7.5-2, 7.5-4)

7.5.1.1 Post Accident Monitoring System

STD DEP Admin

(1) Variable Types

Regulatory Guide 1.97 defines five "types" and three "categories" of plant variables for accident monitoring instrumentation. A discussion of these classifications ~~categories~~ is provided below. Each variable has been defined as to both type and ~~classification~~ category*. Plant variables are divided into types according to the purpose of the indication to the plant operator. Any one variable may belong to more than one type.*

(h) Type A

Type A variables are limited to those variables which are necessary (primary) to alert the control room operator of the need to perform preplanned manual actions for safety systems to perform their safety functions, such as, initiating ~~suppression pool cooling and~~ containment spray to permit the systems to perform safety functions for which no automatic system controls are provided. Variables that require actions specified by the Emergency Procedure Guidelines (EPGs) in response to specific operating limits have also been considered in performing the assessment documented in this chapter.

7.5.2 Systems Analysis

7.5.2.1 Post Accident Monitoring System

STD DEP Admin

STD DEP T1 2.3-1

STD DEP T1 2.14-1

~~STD DEP 6.2-2~~

STD DEP 7.5-1

(1) Type A Variables

(a) Type A Variable Evaluation and Analysis

Chapter 15 contains discussions of numerous events, not all of which are design basis accidents. Appendix 15A is a plant Nuclear Safety Operational Analysis (NSOA) which addresses these events in the following categories:

(i)	*Normal operations*	
(ii)	*Anticipated Operational Transients*	*(Table ~~5.7-4~~* 7.5-4*)*
(iii)	*Abnormal Operational Transients*	*Table ~~5.7-5~~* 7.5-5*)*
(iv)	*Design Basis Accidents*	*(Table ~~5.7-6~~* 7.5-6*)*
(v)	*Special Events*	*(Table ~~5.7-7~~* 7.5-7*)*

(2) General Variable Assessments

(b) Drywell Pressure

Requirements for monitoring of drywell pressure are specified for both narrow range (from about -34.32 kPaG to + 34.32 kPaG) and wide range (from 0 to 110% of design pressure). The narrow range monitoring requirement is satisfied in the existing safety-related design by the four divisions of drywell pressure instruments which provide inputs to the initiation of the reactor protection (trip) system (RPS) and the emergency core cooling systems (ECCS). The requirement for unambiguous wide range drywell pressure monitoring are satisfied with two channels of drywell pressure instrumentation integrated with two channels of wetwell pressure instrumentation. Given the existence of (1) the normal pressure suppression vent path between the drywell and wetwell and (2) the wetwell to drywell vacuum breakers, the long-term pressure within the drywell and wetwell will be approximately the same. Therefore, if the two wide range drywell pressure indications disagreed, the operator could refer to the wetwell containment pressure indications to determine which of the two drywell pressure indications is correct. In order to provide full range pressure comparisons between the drywell wide range and wetwell pressure instruments, the drywell pressure instrument range is 689.4 kPa. This value exceeds the required value of 110% of design pressure. Drywell pressure is a Type A variable because it is used to initiate drywell spray to maintain the Reinforced

Concrete Containment Vessel (RCCV) below temperature limits in LOCA.

(h) Coolant Radiation

~~*The indicator of coolant radiation leakage will be provided by theProcess Radiation Monitoring System (PRMS) Main Steamline (MSL) radiation monitor subsystem. This subsystem consists of four physically and electrically separated and redundant divisions. Each division has a single channel consisting of a local radiation detection assembly, control room readout and trip actuators (Figure 7.6-5, sh 1). Each channel is located such that it can monitor each mainsteam line. These four divisions of PRMS radiation instrumentation satisfy the Regulatory Guide requirement for unambiguous indication.*~~

A continuous post-accident monitor for this parameter is not necessary and is not included in the design. This is consistent with BTP HICB-10, Table 1.

(i) Suppression Pool Water Temperature

The ABWR Suppression Pool Temperature Monitoring (SPTM) System design requirements satisfy the Regulatory Guide 1.97 requirements regarding redundancy. The SPTM System is composed of four separate and independent instrument divisions. Each division has associated with it multiple thermocouples which are spatially distributed around the suppression pool. With this configuration, the bulk average suppression pool temperature can be determined even in the event of the loss of an entire division of instrumentation, since thermocouple sensors of each division will be located in close proximity to facilitate direct comparison. Although the ABWR design initiates reactor scram and suppression pool cooling automatically on high pool temperature, suppression pool water temperature variable is considered a Type A variable since ~~no credit is taken for automatic initiation in the safety analysis~~ the operator uses it for manual RPV depressurization.

(k) Drywell/Wetwell Hydrogen/Oxygen Concentration

The Containment Atmospheric Monitoring System (CAMS) consists of two independent and redundant nonsafety-related *drywell/containment oxygen and hydrogen concentration monitoring channels. Emergency response actions regarding these variables are consistently directed toward minimizing the magnitude of these parameters (i.e., there are no safety actions which must be taken to increase the hydrogen/oxygen levels if they are low).* Minimizing drywell containment oxygen and hydrogen concentrations is accomplished by manual operator actions using containment venting and purging or using containment spray.*Consequently, the two channel CAMS design provides adequate PAM indication, since, in the event that the two channels of information* *disagree, the operator can determine a correct and safe action based upon the higher of the two (in-range) indications.*

(q) ~~(g)~~ Drywell Spray Flow and Wetwell Spray Flow

The ABWR design does not provide direct Drywell Spray Flow indication. Regulatory Guide 1.97 suggests this as a Type D Variable for the purpose of monitoring drywell spray operation. As allowed by BTP HICB-10, RHR flow, drywell temperature and drywell pressure indications are provided as acceptable alternatives. RHR provides water to the drywell spray headers. Following a postulated accident, presence of drywell spray flow results in drywell pressure and temperature reduction. The operator confirms drywell spray operation by observing that there is RHR flow present and that the drywell pressure and temperature is within expected limits. Operator use of these variables allows accurate and reliable measurement of the effectiveness of the drywell spray in a timely manner. In addition, the position of the spray throttling valves can be monitored and the sprays adequately controlled from the control room using these alternative variables.

Table 7.5-1 Design and Qualifiction Criteria for Instrumentation

Category 1	Category 2	Category 3
4. Channel Availability		
The instrumentation channel is available prior to an accident except as provided in Paragraph 4.11, "Exception," as defined in IEEE-279, 1971, "Criteria for Protection the note for the paragraph 6.7, "Exception," in IEEE-603, "Standard Criteria for Safety noted in the Exception to Paragraph 6.7, "Maintenance Bypass," in IEEE-603, "Standard Criteria for Safety Systems for Nuclear Power Generating Stations," or as specified in the technical specifications.	The out-of-service interval is based on normal technical specification requirements on out-of-service for the system it serves where applicable or where specified by other requirements.	No specific provision

Table 7.5-2 ABWR PAM Variable List

Variable	Range Required	Type	Cate-gory	Discussion Section
Drywell Pressure	0.034 MPaG to 0.021 MPaG (narrow range) ~~0–100~~ **0–110**% design pressure (wide range)-	**A,**B,C,D	1	Subsection 7.5.2.1(2)(a)
Containment Area Radiation	10^{-2} ~~Gy~~ **Sv**/h to 10^{5} ~~Gy~~ **Sv**/h	C,E	1	Subsection 7.5.2.1(2)(f)
~~Coolant Radiation~~	~~1/2 Tech Spec limit to 100 times Tech Spec limit~~	~~C~~	~~1~~	~~Subsection 7.5.2.1(2)(h)~~
Drywell/Wetwell Hydrogen Concentration	0–30 Volume%	C	~~1~~ **3**	Subsection 7.5.2.1(2)(k)
Drywell/Wetwell Oxygen Concentration	0–10 Volume%	C	~~1~~ **2**	Subsection 7.5.2.1(2)(k)
Service Area Radiation Exposure Rate	10^{-3} ~~Gy~~ **Sv**/h to 10^{2} ~~Gy~~ **Sv**/h	E	3	
Plant and Environs Radiation/Radioactivity (Portable Instruments)	10^{-5} ~~Gy~~ Sv/h to 10^{2} ~~Gy~~ Sv/h photons 10^{-5} ~~Gy~~ Sv/h to 10^{2} ~~Gy~~ Sv/h, beta and low energy photons	E	3	Portable Instruments *
Meteorological Data (Wind Speed, Wind Direction, and Atmospheric Stability)	~~0–360°~~ **0-22 m/s** ~~0–9.8 m/s~~ **0-360°** **-5°C to 10°C**	E	3	*
On Site Analysis Capability (Primary Coolant, Sump and Space Containment Air Grab Sampling)	Refer to Regulatory Guide 1.97	E	3	*
~~Secondary Containment Area Temperature~~		~~E~~	~~2~~	
Secondary Containment Area Radiation	10^{-3} ~~Gy~~ **Sv**/h to 10^{2} ~~Gy~~ **Sv**/h	E	2	
Suppression Chamber Spray (Wetwell) Flow	0-110% Design Flow	D	2	**Subsection 7.3.1.1.3(q)**

* *Out of ABWR Standard Plant Scope*

Table 7.5-3 ABWR Type A Variables

Suppression Pool Water Temperature

Drywell Pressure

Wetwell Pressure

Table 7.5-4 Anticipated Operational Transients

Event Description	NSOA Event Figure No.	Tier 2 Section No.	Manual Action Variables*
Manual or Inadvertent SCRAM	~~15A.6-7~~15A-12	15A.6.3.3 Event 7	P_{RPV}, L_{RPV}
Loss of Plant Instrument Service Air Systems	~~15A.6-8~~15A-13	15A.6.3.3 Event 8	T_{SP},P_{RPV}, L_{RPV}
Recirculation Flow Control Failure—One RIP Runout	~~15A.6-9~~15A-14	15.4.5	P_{RPV}, L_{RPV}
Recirculation Flow Control Failure—One RIP Runback	~~15A.6-10~~15A-15	15.3.2	P_{RPV}, L_{RPV}
Three RIPs Trip	~~15A.6-11~~15A-16	15.3.1	P_{RPV}, L_{RPV}
All MSIV Closure	~~15A.6-12~~15A-17	15.2.4	T_{SP},P_{RPV}, L_{RPV}
One MSIV Closure	~~15A.6-13~~15A-18	15.2.4	T_{SP},P_{RPV}, L_{RPV}
Loss of All Feedwater Flow	~~15A.6-14~~15A-19	15.2.7	P_{RPV}, L_{RPV}
Loss of a Feedwater Heater	~~15A.6-15~~15A-20	15.1.1	ϕ,P_{RPV}, L_{RPV}
Feedwater Controller Failure—Runout of One Feedwater Pump	~~15A.6-16~~15A-21	15.1.2	P_{RPV}, L_{RPV}
Pressure Regulator Failure—Opening of One Bypass Valve	~~15A.6-17~~15A-22	15.1.3	P_{RPV}, L_{RPV}
Pressure Regulator Failure—Opening of One Control Valve	~~15A.6-18~~15A-23	15.2.1	P_{RPV}, L_{RPV}
Main Turbine Trip with Bypass System Operational	~~15A.6-19~~15A-24	15.2.3	T_{SP}, P_{RPV}, L_{RPV}
Loss of Main Condenser Vacuum	~~15A.6-20~~15A-25	15.2.5	P_{RPV}, L_{RPV}
Generator Load Rejection with Bypass System Operational	~~15A.6-21~~15A-26	15.2.2	T_{SP},P_{RPV},L_{RPV}
Loss of Unit Auxiliary Transformer	15A-27	15.2.6	T_{SP},P_{RPV}, L_{RPV}
Inadvertent Startup of HPCF Pump	15A-28	15.5.1	ϕ
Main Turbine Trip with One Bypass Valve Failure	15A-31	15.2.3	P_{RPV}, L_{RPV}
Generator Load Rejection with One Bypass Valve Failure	15.32	15.2.2	P_{RPV}, L_{RPV}

Table 7.5-4 Anticipated Operational Transients (Continued)

Abnormal Startup of the Idle Reactor Internal Pump	15A-45	15.4.4	P_{RPV}, L_{RPV}
Recirculation Flow Control Failure – All RIPs Runout	15A-46	15.4.5	ϕ, L_{RPV}
Recirculation Flow Control Failure – All RIPs Runback	15A-47	15.3.2	L_{RPV}
Feedwater Controller Failure Maximum Demand	15A-51	15.1.2	P_{RPV}, L_{RPV}
Pressure Regulator Failure – Opening of All Bypass and Control Valves	15A-52	15.1.3	P_{RPV}, L_{RPV}
Main Turbine Trip with Bypass Failure	15A-55	15.2.3	T_{SP}, P_{RPV}, L_{RPV}
Generator Load Rejection with Bypass Failure	15A-56	15.2.2	T_{SP}, P_{RPV}, L_{RPV}

* See Table 7.5-9 for Definition of symbols

Table 7.5-6 Design Basis Accidents

Event Description	NSOA Event Figure No.	Tier 2 Section No.	Manual Action Variables*
Loss-of-Coolant Accident Resulting from Spectrum of Postulated Piping Breaks within the RCPB Inside Containment	15A.6-32	15.6.5	H_{2C}, O_{2C}, L_{RPV}, L_{SP}, P_{RPV}, P_{DW}, Ø

Table 7.5-8 Summary of Manual Actions

Manual Action	Variable*	Source†
Emergency Action‡ If Exceed:		**E**
Heat Capacity Temperature Limit	T_{SP}, P_{RPV}	
Heat Capacity Level Limit	T_{SP}, L_{SP}	
Suppression Pool Load Limit	L_{SP}, P_{RPV}	
Reference Leg Boiling Limit	T_{DW}, T_{RPV} (or P_{RPV})	
SRV Tailpipe Level Limit	L_{SP}, P_{RPV}	
Maximum Primary Containment Water Level Limit	Lc, P_{WW}	
Maximum Drywell Temperature	T_{DW}	
Maximum Containment Temperature	P_{WW}, L_{SP}	
Maximum Containment Pressure	P_{WW}, L_{SP}	
Pressure Suppression Limit	P_{WW}, L_{SP}	
Maximum Secondary Containment Operating Valves	T_{2C}, R_{2C}, L_{2C}	
Offsite Release Rate	R_E	

* See Table for Definition of Symbols.

† E = EPG; T = Tier 2

‡ Scram, Emergency RPV Depressurization, RPV Flooding and/or Drywell Cooling.