7.5 Safety-Related Display Information

7.5.1 Introduction

An analysis is conducted to identify the appropriate variables and to establish the appropriate design bases and qualification criteria for instrumentation employed by the operator for monitoring conditions in the reactor coolant system, the secondary heat removal system, the containment, and the systems used for attaining a safe shutdown condition. This selection of monitored variables is based on the guidance provided in Regulatory Guide 1.97. The variables and instrument design criterion selected for the AP1000 is described in subsections 7.5.2 and 7.5.3.

The safety-related display information is used by the operator to monitor and maintain the safety of the AP1000 throughout operating conditions that include anticipated operational occurrences and accident and post-accident conditions. The equipment which processes the safety-related display information and makes it available to the operator is discussed in subsection 7.5.4.

7.5.2 Variable Classifications and Requirements

Accident monitoring instrumentation is necessary to permit the operator to take actions to address design basis accident situations and for unforeseen situations (should plant conditions evolve differently than predicted by the safety analyses, the control room operating staff has sufficient information to evaluate and monitor the course of the event). Additional instrumentation is needed to indicate to the operating staff whether the integrity of the fuel cladding, the reactor coolant pressure boundary, or the reactor containment has degraded beyond the prescribed limits defined in the plant safety analyses and other evaluations.

Six types of variables are classified to provide this instrumentation:

- Variables that provide information needed by the operator to perform manual actions associated with design basis accident events, for which no automatic control is provided and that are required for the safety systems to accomplish their safety function, are designated as Type A.

- Variables needed to assess that the plant critical safety functions are accomplished or maintained, as identified in the plant safety analysis and other evaluations, are designated as Type B.

- Variables used to monitor for the gross breach or the potential for gross breach of the fuel cladding, the reactor coolant pressure boundary, or the containment are designated as Type C.

- Variables needed to assess the operation of individual safety-related systems are designated as Type D.

- Variables used in determining the magnitude of the postulated releases and continually assessing releases of radioactive materials are designated as Type E.

- Variables that provide information to manually actuate and to monitor the performance of nonsafety-related systems to prevent unnecessary actuation of safety-related systems following plant events are designated as Type F.

The six classifications of variables are not mutually exclusive. When a variable is included in one or more of the six classifications, the equipment monitoring this variable meets the requirements of the highest category identified.

Three categories of design and qualification criteria are used. This classification is made to identify the importance of the information and to specify the requirements placed on the accident monitoring instrumentation. Category 1 instrumentation has the highest performance requirements and is used for information that cannot be lost. Category 2 and Category 3 instruments are of lesser importance in determining the state of the plant and do not require the same level of operational assurance.

The primary differences between category requirements are in qualification, application of single failure, power supply, and display requirements. Category 1 requires seismic and environmental qualification, the application of a single-failure criterion, use of emergency power, and an immediately accessible display. Category 2 requires environmental qualification commensurate with the required function. It may require emergency power, but does not require the single failure criterion or an immediately accessible display. Category 2 requires a rigorous performance verification for a single instrument channel. Category 3, which is high quality commercial grade, does not require qualification, single failure criterion, emergency power, or an immediately accessible display.

Table 7.5-1 summarizes the following information for each variable identified:

- Instrument range or status
- Type and category
- Environmental qualification
- Seismic qualification
- Number of required channels
- Power supply
- Qualified data processing system (QDPS) indication

7.5.2.1 Variable Types

Accident monitoring variables and information display channels are those that enable the control room operating staff to perform the functions defined by the Types A, B, C, D, E, and F classifications.

Type A

Type A variables provide the primary information to permit the control room operating staff to:

- Perform the diagnosis in the AP1000 emergency operating instructions

- Take the specified, preplanned, manually-controlled actions, for which automatic controls are not provided, and that are required for safety-related systems to mitigate design basis accidents

There are no specific preplanned, manually-controlled actions for safety-related systems to mitigate design basis events in the AP1000 design. This includes the diagnosis of plant conditions required to take preplanned manual action. Variables used for contingency actions and additional variables that might be utilized are Types B, C, D, E, and F.

Type B

Type B variables provide the control room operating staff with information to assess the process of accomplishing or maintaining critical integrity safety-related functions (that is, reactivity control, reactor coolant system integrity, reactor coolant system inventory control, reactor core cooling, heat sink maintenance, and reactor containment environment).

Type C

Type C variables provide the control room operating staff information to monitor:

- The extent to which variables that indicate the potential for causing a gross breach of a fission product barrier have exceeded the design basis values

- The in-core fuel cladding, the reactor coolant pressure boundary, or the primary reactor containment that may have been subject to gross breach

These variables include those required to initiate the early phases of an emergency plan. Excluded are those associated with monitoring of radiological release from the plant that are included in Type E.

Type C variables used to monitor the potential for breach of a fission product barrier have an extended range. The extended range is chosen to minimize the probability of instrument saturation even if conditions exceed those predicted by the safety analysis.

Although variables selected to fulfill Type C functions may rapidly approach the values that indicate an actual gross failure, it is the final steady-state value reached that is important. Therefore, a high degree of accuracy and a rapid response time are not necessary for Type C instrument channels.

Type D

Type D variables provide the control room operating staff with sufficient information to:

- Monitor the performance of plant safety-related systems used for mitigating the consequences of an accident and subsequent plant recovery to attain a safe shutdown condition, including verification of the automatic actuation of safety-related systems

- Take specified, preplanned, manually controlled actions using safety-related systems for establishing and maintaining a safe shutdown condition

Type E

Type E variables provide the control room operating staff with information to:

- Monitor the plant areas where access may be required to service equipment necessary to monitor or mitigate the consequences of an accident
- Estimate the magnitude of release of radioactive material through identified pathways and continually assess such releases
- Monitor radiation levels and radioactivity in the environment surrounding the plant
- Monitor the habitability of the main control room

Type F

Type F variables provide the information that allows the control room operating staff to:

- Take specified, preplanned, manually controlled actions using nonsafety-related systems to prevent the unnecessary actuation of safety-related systems
- Monitor the performance of plant nonsafety-related systems used for mitigating the consequences of an accident and subsequent plant recovery to establish shutdown conditions, including verification of the automatic actuation of nonsafety-related systems
- Operate other nonsafety-related systems normally used for plant cooldown and to maintain plant shutdown conditions

7.5.2.2 Variable Categories

The qualification requirements of the Types A, B, C, D, E, and F accident monitoring instrumentation are subdivided into three categories. Descriptions of the three categories are given below. Table 7.5-2 summarizes the selection criteria for Types A, B, C, D, E, and F variables into each of the three categories. Table 7.5-3 summarizes the design and qualification requirements of the three designated categories.

7.5.2.2.1 Category 1

Selection Criteria for Category 1

The selection criteria for Category 1 variables are subdivided according to the variable type. For Type A, those primary variables used for providing information for preplanned operator action, required for the safety-related systems to accomplish their safety function for design basis accidents, are designated as Category 1. For Type B, those primary variables used for monitoring the process of accomplishing or maintaining critical safety functions are designated Category 1.

For Type C, those primary variables used for monitoring the potential for breach of a fission product barrier are designated as Category 1. There are no Types D, E, or F Category 1 variables.

Qualification Criteria for Category 1

The Category 1 instrumentation is seismically and environmentally qualified as described in Sections 3.10 and 3.11. Instrumentation continues to read within the required accuracy following, but not necessarily during, a seismic event.

Each instrumentation channel is qualified from the sensor up to, and including, the display. Subsection 7.5.2.2.4 details the extended range instrumentation qualification.

Design Criteria for Category 1

The following design criteria apply to Category 1:

- No single failure (within either the accident monitoring instrumentation, its auxiliary supporting features, or its power sources), concurrent with the failures that are a cause of or result from a specific accident, prevents the control room operating staff from receiving the required information. Where failure of one accident monitoring channel results in information ambiguity (that is, the redundant displays disagree), additional information is provided to allow the control room operating staff to analyze the actual conditions in the plant. This is accomplished by providing additional independent channels of information of the same variable (an identical channel), or by providing independent channels which monitor different variables which bear known relationships to the channels (a diverse channel(s)). Redundant or diverse channels are electrically independent and physically separated from each other and from equipment not classified as safety-related.

  If ambiguity does not result from failure of the channel, then a redundant or diverse channel is not provided.

- The instrumentation is energized from the uninterruptible power supply inverter subsystem from the Class 1E dc system.

- Servicing, testing, and calibration programs are specified to maintain the capability of the monitoring instrumentation. For those instruments where the required interval between testing is less than the normal time interval between shutdowns, a capability for testing during power operation is provided.

- The design provides administrative control of the access for removing channels from service.

- The design provides administrative control of the access to setpoint adjustments, module calibration adjustments, and test points.

- The monitoring instrumentation design minimizes the development of conditions that cause displays to give anomalous indications that are potentially confusing to the control room operating staff.

- The instrumentation is designed to promote the recognition, location, replacement, repair, or adjustment of malfunctioning components or modules.

- To the extent practicable, monitoring instrumentation inputs are from sensors that directly measure the desired variables. An indirect measurement is made only when it is shown by analysis to provide unambiguous information.

- Periodic checking, testing, calibration, and calibration verification is performed.

- The range selected for the instrumentation encompasses the expected operating range of the monitored variable.

Information Processing and Display Interface Criteria for Category 1

The following interface criteria are implemented in the processing and displaying of the information:

- The control room operating staff has immediate access to the information from redundant or diverse channels in familiar units of measure. For example, degrees are used, not volts, for temperature readings. Where two or more instruments are needed to cover a particular range, overlapping instrument spans are provided.

- Continuous recording of these channels is provided following an accident until continuous recording of such information is not necessary. The term continuous recording does not exclude the use of discrete time sample data storage systems. This recording is available when required and does not need to be immediately accessible. The recording function is provided by the non-Class 1E data display and processing system.

7.5.2.2.2 Category 2

Selection Criteria for Category 2

The selection criteria for Category 2 variables are subdivided according to the variable type. For Types A, B, and C, some variables that provide backup information are designated Category 2. For Type D, those primary variables that are used for monitoring the performance of safety systems are designated as Category 2. For Type E, those primary parameters monitored for use in determining the magnitude of the release of radioactive materials and for continuously assessing such releases are designated as Category 2. For Type F, those primary parameters monitored for use in implementing preplanned actions using nonsafety-related systems or for monitoring the status of nonsafety-related system operation are designated as Category 2.

Qualification Criteria for Category 2

Category 2 instrumentation is qualified from the sensor up to, and including, the channel isolation device for the environment in which it operates to serve its intended function.

Design Criteria for Category 2

The following design criteria apply to Category 2:

- Category 2 instrumentation that is required for operation of a safety-related component is energized from the Class 1E dc uninterruptible power supply system. Otherwise, the instrumentation is energized from the non-Class 1E dc uninterruptible power system.

- The out-of-service interval is based on the technical specification requirements on out-of-service for the system the instrument serves where applicable.

- Servicing, testing, and calibration programs are implemented to maintain the capability of the monitoring instrumentation. For those instruments where the required interval between testing is less than the time interval between shutdowns, a capability for testing during power operation is provided.

- The design provides administrative control of the access for removing channels from service.

- The design provides administrative control of the access to setpoint adjustments, module calibration adjustments, and test points.

- The monitoring instrumentation design minimizes the potential for the development of conditions that cause displays to give anomalous indications that are potentially confusing to the control room operating staff.

- The instrumentation is designed to facilitate the recognition, location, replacement, repair, or adjustment of malfunctioning components or modules.

- To the extent practicable, monitoring instrumentation inputs are from sensors that directly measure the desired variables. An indirect measurement is made only when it can be shown by analysis to provide unambiguous information.

- Periodic checking, testing, calibration, and calibration verification is performed.

- The range selected for the instrumentation encompasses the expected operating range of the monitored variable.

Information Processing and Display Interface Criteria for Category 2

The instrumentation signal is processed for display on demand. Recording requirements are determined on a case-by-case basis.

7.5.2.2.3 Category 3

Selection Criteria for Category 3

The selection criteria for Category 3 variables are subdivided according to the variable type. Types B, C, D, E, and F variables which provide backup information are designated as Category 3.

Qualification Criteria for Category 3

The instrumentation is high quality, commercial grade which is not required to provide information when exposed to a post-accident adverse environment.

Design Criteria for Category 3

The following design criteria apply to Category 3:

- Servicing, testing, and calibration programs are implemented to maintain the capability of the monitoring instrumentation. For those instruments where the required interval between testing is less than the normal time interval between plant shutdowns, a capability for testing during power operation is provided.
- The design provides administrative control of the access for removing channels from service.
- The design provides administrative control of the access to setpoint adjustments, module calibration adjustments, and test points.
- The monitoring instrumentation design minimizes the potential for the development of conditions that cause displays to give anomalous indications that are potentially confusing to the control room operating staff.
- The instrumentation is designed to facilitate the recognition, location, replacement, repair, or adjustment of malfunctioning components or modules.
- To the extent practicable, monitoring instrumentation inputs are from sensors that directly measure the desired variables. An indirect measurement is made only when it can be shown by analysis to provide unambiguous information.

Information Processing and Display Interface Criteria for Category 3

The instrumentation signal is processed for display on demand. Recording requirements are determined on a case-by-case basis.

7.5.2.2.4 Extended Range Instrumentation Qualification Criteria

The qualification environment for extended range instrumentation is based on the design basis accident events. The qualification value of the monitored variable is equal to the maximum range for the variable. The monitored variable is assumed to approach this peak by extrapolating the

most severe initial ramp associated with the design basis accident events. The decay is considered proportional to the decay for this variable associated with the design basis accidents. No additional qualification margin is added to the extended range variable. Since extended variable ranges are nonmechanistically determined, extension of associated parameter levels is not justifiable and is, therefore, not implemented. For example, a sensor measuring containment pressure is qualified for the measured process variable range (that is, four times design pressure for steel containments), but the corresponding ambient temperature is not mechanistically linked to that pressure. Rather, the ambient temperature value is the bounding value for design basis accident events analyzed in Chapter 15. The extended range instrument provides information if conditions degrade beyond those postulated in the safety analysis.

7.5.3 Description of Variables

7.5.3.1 Type A Variables

Type A variables provide primary information to permit the control room operating staff to:

- Perform the diagnosis in the AP1000 emergency operating procedures.
- Take specified preplanned, manually-controlled actions, for which automatic controls are not provided, and that are required for safety-related systems to mitigate design basis accidents.

There are no specific preplanned, manually-controlled actions for safety-related systems to mitigate design basis events in the AP1000 design. This includes the diagnosis of plant conditions required to take preplanned manual action. Therefore, as reflected in Table 7.5-4, there are no Type A variables.

7.5.3.2 Type B Variables

Type B variables provide information to the control room operating staff to assess the process of accomplishing or maintaining critical safety functions, including the following:

- Reactivity control
- Reactor coolant system integrity
- Reactor coolant system inventory control
- Reactor core cooling
- Heat sink maintenance
- Containment environment.

Variables which provide the most direct indication (primary variable) to assess each of the six critical safety functions are designated as Category 1. Backup variables are designated as Category 2 or Category 3. These variables are listed in Table 7.5-5.

7.5.3.3 Type C Variables

Type C variables provide the control room operating staff with information to monitor the potential for breach or the actual gross breach of:

- Incore fuel cladding
- Reactor coolant system boundary
- Containment boundary.

Variables associated with monitoring radiological release from the plant are included in Type E.

Those Type C variables that provide the most direct measure of the potential for breach of one of the three fission product boundaries are designated as Category 1. Backup information that indicates potential for breach or actual breach is designated as Category 2 or Category 3. These variables are listed in Table 7.5-6.

7.5.3.4 Type D Variables

Type D variables provide sufficient information to the control room operating staff to:

- Monitor the performance of plant safety-related systems used for mitigating the consequences of an accident and subsequent plant recovery to attain a safe shutdown condition, including verification of the automatic actuation of safety-related systems

- Take specified, preplanned, manually controlled actions using safety-related systems used for establishing and maintaining a safe shutdown condition

Primary Type D variables are designated as Category 2. Backup information is designated as Category 3. These variables are listed in Table 7.5-7.

7.5.3.5 Type E Variables

Type E variables provide the control room operating staff with information to:

- Monitor the plant areas where access may be required to service equipment to monitor or mitigate the consequences of an accident

- Estimate the magnitude of release of radioactive materials through identified pathways

- Monitor radiation levels and radioactivity in the environment surrounding the plant

- Monitor the habitability of the main control room

Primary Type E variables are designated as Category 2. Backup variables are designated as Category 3. These variables are listed in Table 7.5-8.

7.5.3.6 Type F Variables

Type F variables provide the control room operating staff with information to:

- Take preplanned manual actions using nonsafety-related systems to prevent unnecessary actuation of the safety-related systems
- Monitor the performance of the nonsafety-related systems used to mitigate the consequences of an accident
- Operate other nonsafety-related systems normally used for plant cooldown and to maintain plant shutdown conditions

Primary Type F variables are designated as Category 2. Backup variables are designated as Category 3. These variables are listed in Table 7.5-9.

7.5.4 Processing and Display Equipment

The AP1000 processing and display function is performed by equipment which is part of the protection and safety monitoring system, plant control system, and the data display and processing system. A description of each of these processing systems is provided in Section 7.1.

The protection and safety monitoring system provides signal conditioning, communications, and display functions for Category 1 variables and for Category 2 variables that are energized from the Class 1E dc uninterruptible power supply system. The plant control system and the data display and processing system provides signal conditioning, communications and display functions for Category 3 variables and for Category 2 variables that are energized from the non-Class 1E dc uninterruptible power system. The data display and processing system also provides an alternate display of the variables which are displayed by the protection and safety monitoring system. Electrical separation of the data display and processing system and the protection and safety monitoring system is maintained through the use of isolation devices in the interconnections connecting the two systems, as discussed in subsection 7.1.2.10. The portion of the protection and safety monitoring system which is dedicated to providing the safety-related display function for post-accident monitoring is referred to as the qualified data processing subsystems and are discussed in subsection 7.1.2.5.

The qualified data processing subsystems are divided into two separate electrical divisions. Each of the two electrical divisions is connected to a Class 1E dc uninterruptible power system with sufficient battery capacity to provide necessary electrical power for at least 72 hours. If all ac power sources are lost for a period of time that exceeds 72 hours, the power supply system will be energized from the ancillary diesel generator or from ac power sources which are brought to the site from other locations. See Section 8.3.

Instrumentation associated with primary variables that are energized from the Class 1E dc uninterruptible power supply system are powered from one of the two electrical divisions with 72 hour battery capacity. Instrumentation associated with other variables that are energized from the Class 1E dc uninterruptible power supply system are powered from one of four electrical divisions with 24 hour battery capacity. If a variable exists only to provide a backup to a primary

variable, it may be powered by an electrical division with a 24 hour battery capacity. In such cases, provisions are provided to enable this variable to be powered by an alternate source if it is needed to resolve a discrepancy between two primary variables in the event that all ac power sources are lost for a period in excess of 24 hours.

Class 1E position indication signals for valves and electrical breakers may be powered by an electrical division with 24 hour battery capacity. This is necessary to make full use of all four Class 1E electrical divisions to enhance fire separation criteria. The power associated with the actuation signal for each of these valves or electrical breakers is provided by an electrical division with 24 hour battery capacity, so there is no need to provide position indication beyond this period. The operator will verify that the valves or electrical breakers have achieved the proper position for long-term stable plant operation before position indication is lost. Once the position indication is lost, there is no need for further monitoring since the operator does not have any remote capability for changing the position of these components.

Electrically operated valves, which have the electrical power removed to meet the single failure criterion, are provided with redundant valve position sensors. Each of the two position sensors is powered from a different non-Class 1E power source.

7.5.5 Combined License Information

Combined License applicants referencing the AP1000 certified design will provide the information for variables listed as site specific in DCD Tables 7.5-1 and 7.5-8.

Table 7.5-1 (Sheet 1 of 12)

POST-ACCIDENT MONITORING SYSTEM

Variable	Range/ Status	Type/ Category	Qualification		Number of Instruments Required	Power Supply	QDPS Indication (Note 2)	Remarks
			Environmental	Seismic				
RCS wide range pressure	0-3300 psig	B1, B2, D2, C1, F2	Harsh	Yes	3 (Note 4)	1E	Yes	Located inside containment
RCS T_H (Wide Range)	50-700°F	B1, B2, D2, F2	Harsh	Yes	2	1E	Yes	Diverse Measurement: Core exit temperature
RCS T_C (Wide Range)	50-700°F	B1, B2, D2, F2	Harsh	Yes	3 (Note 4)	1E	Yes	
Steam generator water level (wide range)	0-100% of span	D2, F3	Harsh	Yes	1/steam generator	1E	Yes	
Steam generator water level (narrow range)	0-100% of span	D2, F2	Harsh	Yes	1/steam generator	1E	Yes	
Pressurizer level	0-100% of span	B1, D2, F2	Harsh	Yes	3 (Note 4)	1E	Yes	
Pressurizer reference leg temperature	50-420°F	B1, D2	Harsh	Yes	3 (Note 4)	1E	Yes	
Neutron flux	10^{-6}-200% power	B1	Harsh	Yes	3 (Note 4)	1E	Yes	
Control rod position	0-267 steps	B3, D3	None	None	1/control rod	Non-1E	No	
Containment water level	El. 72 ft. to 110 ft. in discrete steps	B1, C1, F2	Harsh	Yes	3 (Note 4)	1E	Yes	

Table 7.5-1 (Sheet 2 of 12)

POST-ACCIDENT MONITORING SYSTEM

Variable	Range/ Status	Type/ Category	Qualification		Number of Instruments Required	Power Supply	QDPS Indication (Note 2)	Remarks
			Environmental	Seismic				
Core exit temperature	200-2300°F	B1, C1, F2	Harsh	Yes	2/quadrant per Division	1E	Yes	
PRHR HX inlet temperature	50-650°F	D3	None	None	1	Non-1E	No	Primary indication is RCS T_H
PRHR HX outlet temperature	50-500°F	B1, D2	Harsh	Yes	1	1E	Yes	Diverse variable to PRHR flow
PRHR flow	700-3000 gpm	B1, D2, F2	Harsh	Yes	2	1E	Yes	Diverse measure-ment: PRHR outlet temperature
IRWST water level	0-100% of span	B1, D2, F2	Harsh	Yes	3 (Note 4)	1E	Yes	
RCS subcooling (Note 6)	200°F Sub-cooling to 35°F super heat	B1, F2	Harsh	Yes	2	1E	Yes	Diverse measure-ment: Core exit temperature & wide range RCS pressure
Passive containment cooling water flow	0-150 gpm	B1, D2	Mild	Yes	1 (Note 1)	1E	Yes	
PCS storage tank water level	5-100% of tank height	B1, D2	Mild	Yes	2	1E	Yes	Diverse measure-ment: PCS flow
IRWST surface temperature	50-300°F	D3	None	None	1	Non-1E	No	
IRWST bottom temperature	50-300°F	D3	None	None	1	Non-1E	No	
Steam line pressure	0-1300 psig	F2	Harsh/ Mild (Note 8)	Yes	1/steam generator (Note 11)	1E	No	

Table 7.5-1 (Sheet 3 of 12)

POST-ACCIDENT MONITORING SYSTEM

Variable	Range/ Status	Type/ Category	Qualification		Number of Instruments Required	Power Supply	QDPS Indication (Note 2)	Remarks
			Environmental	Seismic				
Startup feedwater flow	0-600 gpm	F2	Mild	Yes	1/steam generator (Note 11)	1E	No	
Startup feedwater control valve status	Open/ Closed	D2, F3	Harsh	Yes	1/valve (Note 7)	1E	Yes	
Containment pressure	-5 to 10 psig	B1, C2, D2, F2	Mild	Yes	3 (Note 4)	1E	Yes	
Containment pressure (extended range)	0 to 240 psig	C1	Mild	Yes	3 (Note 4)	1E	Yes	
Containment area radiation (high range)	10^0-10^7 R	C1, E2, F2	Harsh	Yes	3 (Note 4)	1E	Yes	
Reactor vessel hot leg water level	0-100% of span	B2, B3	Harsh	Yes	1	1E	Yes	Two instruments are provided
Plant vent radiation level	(Note 3)	C2, E2	Mild	None	1	Non-1E	No	
Remotely operated containment isolation valve status	Open/ Closed	B1, D2	Harsh/mild	Yes	1/valve (Note 7)	1E	Yes	Separate divisions on series valves
Containment vacuum relief valves	Open/ Closed	D2	Mild	Yes	1/valve (Note 7)	1E	Yes	
Boundary environs radiation	N/A	C3, E3	None	None	N/A	Non-1E	No	Site specific
Hydrogen concentration	0-20%	C3	None	None	1	Non-1E	No	Three instruments are provided

Table 7.5-1 (Sheet 4 of 12)

POST-ACCIDENT MONITORING SYSTEM

Variable	Range/ Status	Type/ Category	Qualification		Number of Instruments Required	Power Supply	QDPS Indication (Note 2)	Remarks
			Environmental	Seismic				
Class 1E dc switchboard voltages	0-300 Vdc	D2	Mild	Yes	1/switchboard	1E	Yes	
Diesel generator status	On/Off	F3	None	None	1/diesel generator	Non-1E	No	
Diesel generator load	0-6000 kW	F3	None	None	1/diesel generator	Non-1E	No	
Voltage for diesel-backed buses	0-8600V	F3	None	None	3/bus	Non-1E	No	
Power supply to diesel-backed buses	On/Off	F3	None	None	1/supply source/bus	Non-1E	No	
RCP bearing water temperature	70-450°F	F3	Mild	Yes	1/RCP (Note 10)	1E	Yes	
RCP breaker status	Open/ Closed	D2, F3	Mild	Yes	1/breaker (Note 11)	1E	No	
Reactor trip breaker status	Open/ Closed	D2	Mild	Yes	1/breaker (Note 11)	1E	No	
MCR air storage bottle pressure	0-5000 psig	D2	Mild	None	1	Non-1E	No	Two instruments are provided
Turbine stop valve status	Open/ Closed	D2	None (Note 12)	None	1/valve	Non-1E	No	
Turbine control valve status	Open/ Closed	D2	None (Note 12)	None	1/valve	Non-1E	No	
Pressurizer pressure	1700-2500 psig	B1, D2	Harsh	Yes	3 (Note 4)	1E	Yes	
Pressurizer safety valve status	Open/ Closed	D2	Harsh	None	1/valve	Non-1E	No	
Pressurizer heater power (current)	0-800 amps	F3	None	None	1/group	Non-1E	No	
Steam generator PORV status	Open/ Closed	D2, F3	Harsh	Yes	1/valve (Note 7)	1E	Yes	

Table 7.5-1 (Sheet 5 of 12)

POST-ACCIDENT MONITORING SYSTEM

Variable	Range/ Status	Type/ Category	Qualification		Number of Instruments Required	Power Supply	QDPS Indication (Note 2)	Remarks
			Environmental	Seismic				
Steam generator PORV block valve status	Open/ Closed	D2, F3	Harsh	Yes	1/valve (Note 7)	1E	Yes	
Steam generator safety valve status	Open/ Closed	D2	Harsh	None	1/valve	Non-1E	No	
Main feedwater isolation valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
Main feedwater flow	0-9x10^6 lb/hr	F3	None	None	1/feedline	Non-1E	No	
Main feedwater control valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
Steam generator blowdown isolation valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
Steam flow	0-9x10^6 lb/hr	F3	None	None	1/steam generator	Non-1E	No	
Main steam line isolation valve status	Open/ Closed	D2, F3	Harsh	Yes	1/valve (Note 7)	1E	Yes	
Main steam line isolation bypass valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
Main feedwater pump status	On/Off	D2, F3	Mild	None	1/pump	Non-1E	No	
Main to startup feedwater crossover valve status	Open/ Closed	D2, F3	Mild	None	1/valve	Non-1E	No	
Startup feed-water pump status	On/Off	F3	None	None	1/pump	Non-1E	No	
Circulating water pump status	On/Off	F3	None	None	1/pump	Non-1E	No	
Condenser backpressure	0-1 atm	F3	None	None	1	Non-1E	No	

Table 7.5-1 (Sheet 6 of 12)

POST-ACCIDENT MONITORING SYSTEM

Variable	Range/ Status	Type/ Category	Qualification		Number of Instruments Required	Power Supply	QDPS Indication (Note 2)	Remarks
			Environmental	Seismic				
Startup feedwater Isolation valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
Condenser steam dump valve status	Open/ Closed	D2, F3	Mild	None	1/valve	Non-1E	No	
Condensate storage tank water level	0-100% of span	F3	None	None	1	Non-1E	No	
PCS water storage tank isolation valve status (Non-MOV)	Open/ Closed	D2	Mild	Yes	1/valve (Note 7)	1E	Yes	
PCS water storage tank series isolation valve status (MOV)	Open/ Closed	D2	Mild	Yes	1/valve (Note 7)	1E	Yes	
Containment temperature	32-400°F	D2, F3	Harsh	None	1	Non-1E	No	
CCS surge tank level	0-100% of span	F3	None	None	1	Non-1E	No	
CCS flow	0-15,000 gpm	F3	None	None	1	Non-1E	No	
CCS pump status	On/Off	F3	None	None	1/pump	Non-1E	No	
CCS flow to RNS valve status	Open/ Closed	F3	None	None	1/valve	Non-1E	No	
CCS flow to RCPs valve status	Open/ Closed	F3	None	None	1/valve	Non-1E	No	
CCS pump inlet temperature	50-200°F	F3	None	None	1	Non-1E	No	
CCS heat exchanger outlet temperature	50-130°F	F3	None	None	1	Non-1E	No	
Containment fan cooler status	On/Off	F3	None	None	1/fan	Non-1E	No	

Table 7.5-1 (Sheet 7 of 12)

POST-ACCIDENT MONITORING SYSTEM

Variable	Range/ Status	Type/ Category	Qualification		Number of Instruments Required	Power Supply	QDPS Indication (Note 2)	Remarks
			Environmental	Seismic				
Water-cooled chiller status	On/Off	F3	None	None	1/chiller	Non-1E	No	
Water-cooled chilled water pump status	On/Off	F3	None	None	1/pump	Non-1E	No	
Water-cooled chilled water valve status	Open/ Closed	F3	None	None	1/valve	Non-1E	No	
Spent fuel pool pump flow	0-1500 gpm	F3	None	None	1/pump	Non-1E	No	
Spent fuel pool temperature	50-250°F	F3	None	None	1	Non-1E	No	
Spent fuel pool water level	0-100% of span	D2, F3	Mild	Yes	3 (Note 4)	1E	Yes	
SFS to SGS compartment valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
SFS to cont. sump valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
SFS floodup valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
CMT discharge isolation valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
CMT inlet isolation valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
CMT upper water level sensor	74.5% - 64% of Volume	D2, F2	Harsh	Yes	1/tank	1E	Yes	
CMT lower water level sensor	27% - 17% of Volume	D2, F2	Harsh	Yes	1/tank	1E	Yes	
IRWST injection isolation valve (Squib)	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
IRWST line isolation valve status (MOV)	Open/ Closed	D3	None	None	1/valve	Non-1E	No	
ADS: first, second and third stage valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	

Table 7.5-1 (Sheet 8 of 12)

POST-ACCIDENT MONITORING SYSTEM

Variable	Range/ Status	Type/ Category	Qualification		Number of Instruments Required	Power Supply	QDPS Indication (Note 2)	Remarks
			Environmental	Seismic				
ADS fourth stage valve status (Non-MOV)	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
ADS fourth stage valve status (MOV)	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
PRHR HX inlet isolation valve status	Open/ Closed	D2	Harsh	Yes	1 (Note 7)	1E	Yes	
PRHR HX control valve status	Position	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
IRWST gutter bypass isolation valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
Accumulator pressure	100-800 psig	D2	Harsh	None	1/tank	Non-1E	No	
Accumulator isolation valve status	Open/ Closed	D3	None	None	1/valve	Non-1E	No	
Accumulator vent valve status	Open/ Closed	F3	None	None	1/valve	Non-1E	No	
Pressurizer spray valve status	Open/ Closed	F3	None	None	1/valve	Non-1E	No	
Auxiliary spray line isolation valve status	Open/ Closed	D2, F3	Harsh	Yes	1 (Note 7)	1E	Yes	
Purification stop valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 11)	1E	No	
Containment recirculation isolation valve status (Non-MOV)	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
Containment recirculation isolation valve status (MOV)	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	

Table 7.5-1 (Sheet 9 of 12)

POST-ACCIDENT MONITORING SYSTEM

Variable	Range/ Status	Type/ Category	Qualification		Number of Instruments Required	Power Supply	QDPS Indication (Note 2)	Remarks
			Environmental	Seismic				
Purification return line stop valve status	Open/ Closed	D2	Harsh	None	1	Non-1E	No	
Boric acid tank level	0-100%	F3	None	None	1	Non-1E	No	
Demineralized water isolation valve status	Open/ Closed	D2	Mild	Yes	1/valve (Note 7)	1E	Yes	
Boric acid flow	0-175 gpm	F3	None	None	1	Non-1E	No	
Makeup blend valve status	Position	F3	None	None	1	Non-1E	No	
Makeup flow	0-175 gpm	F3	None	None	1	Non-1E	No	
Makeup pump status	On/Off	F3	None	None	1/pump	Non-1E	No	
Makeup flow control valve status	Position	F3	None	None	1	Non-1E	No	
Letdown flow	0-120 gpm	F3	None	None	1	Non-1E	No	
RNS hot leg suction isolation valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
RNS flow	0-3000 gpm	F3	None	None	1/pump	Non-1E	No	
RCS sampling line isolation valve status	Open/ Closed	E3	Harsh	None	1/valve	Non-1E	No	

Table 7.5-1 (Sheet 10 of 12)

POST-ACCIDENT MONITORING SYSTEM

Variable	Range/ Status	Type/ Category	Qualification		Number of Instruments Required	Power Supply	QDPS Indication (Note 2)	Remarks
			Environmental	Seismic				
IRWST to RNS suction valve status	Open/ Closed	B1, F3	Harsh	Yes	1 (Note 7)	1E	Yes	
RNS discharge to IRWST valve status	Open/ Closed	F3	None	None	1/valve	Non-1E	No	
RNS pump status	On/Off	F3	None	None	1/pump	Non-1E	No	
Reactor vessel head vent valve status	Open/ Closed	D2	Harsh	Yes	1/valve (Note 7)	1E	Yes	
MCR return air isolation valve status	Open/ Closed	D2, F3	Mild	Yes	1/valve (Note 7)	1E	Yes	
MCR toilet exhaust isolation valve status	Open/ Closed	D2	Mild	Yes	1/valve (Note 7)	1E	Yes	
MCR supply air isolation valve status	Open/ Closed	D2, F3	Mild	Yes	1/valve (Note 7)	1E	Yes	
MCR differential pressure	-1" to +1" wg	D2	Mild	Yes	2	1E	Yes	
MCR air delivery flowrate	0-80 cfm	D2	Mild	Yes	2	1E	Yes	
MCR pressure relief isolation valve status	Open/ Closed	D2	Mild	Yes	1/valve	1E	Yes	

Table 7.5-1 (Sheet 11 of 12)

POST-ACCIDENT MONITORING SYSTEM

Variable	Range/ Status	Type/ Category	Qualification		Number of Instruments Required	Power Supply	QDPS Indication (Note 2)	Remarks
			Environmental	Seismic				
MCR air delivery isolation valve status	Open/ Closed	D2	Mild	Yes	1/valve (Note 7)	1E	Yes	
Instrument air header pressure	0-125 psig	F3	None	None	1	Non-1E	No	
Service water flow	0-10,000 gpm	F3	None	None	1/pump	Non-1E	No	
Service water pump status	On/Off	F3	None	None	1/pump	Non-1E	No	
Service water pump discharge valve status	Open/ Closed	F3	None	None	1/valve	Non-1E	No	
Service water pump discharge temperature	50-150°F	F3	None	None	1/pump	Non-1E	No	
Main control room supply air radiation	Note 5	E3, F3	Mild	Yes	2 (Note 9)	1E	No	
Plant vent air flow	0-110% design flow	E2	Mild	None	1	Non-1E	No	
Turbine island vent discharge radiation level	10^{-6} - 10^{+5} µCi/cc	C2, E2	Mild	None	1	Non-1E	No	
Steam generator blowdown discharge radiation	10^{-6} - 10^{-1} µCi/cc	C2	Mild	None	1	Non-1E	No	
Steam generator blowdown brine radiation level	10^{-6} - 10^{-1} µCi/cc	C2	Mild	None	1	Non-1E	No	

Table 7.5-1 (Sheet 12 of 12)

POST-ACCIDENT MONITORING SYSTEM

Variable	Range/ Status	Type/ Category	Qualification		Number of Instruments Required	Power Supply	QDPS Indication (Note 2)	Remarks
			Environmental	Seismic				
Main steam line radiation level	10^{-1} - 10^{3} µCi/cc	C2, E2	Mild	None	1/line	Non-1E	No	
Control support area radiation	10^{-1} - 10^{4} mR/hr	E3	None	None	1	Non-1E	No	
Meteorological parameters	N/A	E3	None	None	N/A	Non-1E	No	Site specific
Primary sampling station area radiation level	10^{-1} - 10^{7} mR/hr	E3	None	None	1	Non-1E	No	
VES passive air filtration flow	0-2000 cfm	E3	None	None	1	Non-1E	No	

Notes:

1. Total flow measurement is obtained from the sum of four branch flow devices.
2. The same information is available in the control support area via the monitor bus. Information available on the qualified data processing system is also available at the remote shutdown workstation.
3. Noble gas: 10^{-7} to 10^{5} µCi/cc
   Particulate: 10^{-12} to 10^{-7} µCi/cc
   Iodines: 10^{-11} to 10^{-6} µCi/cc
4. The number of instruments required after stable plant conditions is two. A third channel is available through temporary connections to resolve information ambiguity if necessary (See subsection 7.5.4).
5. Noble gas: 10^{-7} to 10^{-1} µCi/cc
   Particulate: 10^{-12} to 10^{-7} µCi/cc
   Iodines: 10^{-11} to 10^{-5} µCi/cc
6. Degree of subcooling is calculated from RCS wide range pressure and core exit temperature.
7. This instrument is not required after 24 hours.
8. Two steam line pressure instruments per SG are located inside containment, and are qualified for a harsh environment. Two steam line pressure instruments per SG are located outside containment (not in MSIV compartment), and are qualified for a mild environment.
9. MCR supply air radiation monitoring is not required after MCR has been isolated.
10. This instrument is only required when non-safety power is available.
11. This instrument is not required if non-Class 1E UPS power is not available.
12. These devices are backup verification to qualified system status parameters. These devices are purchased to perform in their anticipated service environments for the plant conditions for which they must function.

Table 7.5-2

SUMMARY OF SELECTION OF CRITERIA

Type	Category 1	Category 2	Category 3
A	Primary variables that are used for diagnosis or providing information necessary for operator action	Variables that provide backup information	None
B	Primary variables that are used for monitoring the process of accomplishing or maintaining critical safety functions	Variables that provide backup information	Variables that provide backup information
C	Primary variables that are used for monitoring the potential for breach of a fission product barrier	Variables that provide backup information	Variables that provide backup information
D	None	Primary variables used for monitoring the performance of plant safety-related systems	Variables that provide backup information and monitor the performance of plant safety-related systems
E	None	Primary variables to be monitored in determining the magnitude of the release of radioactive materials and for continuously assessing such releases.	Variables that provide backup information in determining the magnitude of the release of radioactive materials and for continuously assessing such releases
F	None	Primary variables to be monitored to implement preplanned manual actions using nonsafety-related systems	Variables that provide backup information and for monitoring the performance of nonsafety-related systems

Table 7.5-3

SUMMARY OF QUALIFICATION, DESIGN, AND INTERFACE REQUIREMENTS

	Category 1	Category 2	Category 3
Qualification			
Environmental	Yes	Yes	No
Seismic	Yes	As appropriate (See subsection 7.5.2.2.2.)	No
Design			
Single failure	Yes	No	No
Power supply	Class 1E dc battery	Class 1E dc or Non-Class 1E dc battery onsite (As appropriate, see subsection 7.5.2.2.2.)	Non-Class 1E
Channel out of service	Technical Specifications	As appropriate (See subsection 7.5.2.2.2.)	No specific requirement
Interface			
Minimum indication	Immediately accessible	On demand	On demand
Recording	Yes	As required (See subsection 7.5.2.2.2.)	As required (See subsection 7.5.2.2.3.)

Table 7.5-4

SUMMARY OF TYPE A VARIABLES

There are no Type A variables for AP1000.

Table 7.5-5

SUMMARY OF TYPE B VARIABLES

Function Monitored	Variable	Type/Category
Reactivity Control	Neutron flux Control rod position	B1 B3
Reactor Coolant System Integrity	RCS wide range pressure RCS wide range T_{hot} RCS wide range T_{cold} Containment water level Containment pressure	B1 B1 B1 B1 B1
Reactor Coolant Inventory Control	Pressurizer level Pressurizer reference leg temperature Pressurizer pressure Reactor vessel - hot leg water level	B1 B1 B1 B3
Reactor Core Cooling	Core exit temperature RCS subcooling RCS wide range T_{hot} RCS wide range T_{cold} RCS wide range pressure Reactor vessel - hot leg water level	B1 B1 B2 B2 B2 B2
Heat Sink Maintenance	IRWST water level PRHR flow PRHR outlet temperature PCS storage tank water level Passive containment cooling water flow IRWST to RNS suction valve status	B1 B1 B1 B1 B1 B1
Containment Environment	Containment pressure Remotely operated containment isolation valve status	B1 B1

Table 7.5-6

SUMMARY OF TYPE C VARIABLES

Function Monitored	Variable	Type/Category
Incore Fuel Clad	Core exit temperature	C1
RCS Boundary	RCS wide range pressure	C1
	Containment pressure	C2
	Containment water level	C1
	Containment area high range radiation	C1
	Turbine island vent discharge radiation level	C2
	Steam generator blowdown discharge radiation level	C2
	Steam generator blowdown brine radiation level	C2
	Main steam line radiation level	C2
Containment Boundary	Containment pressure (extended range)	C1
	Plant vent radiation level	C2
	Hydrogen concentration	C3
	Boundary environs radiation	C3

Table 7.5-7 (Sheet 1 of 4)

SUMMARY OF TYPE D VARIABLES

System	Variable	Type/Category
Reactivity Control System	Reactor trip breaker status	D2
	Control rod position	D3
Pressurizer Level and Pressure Control	Pressurizer safety valve status	D2
	Pressurizer level	D2
	RCS wide range pressure	D2
	Pressurizer pressure	D2
	Reference leg temperature	D2
RCS Loops	RCS wide range T_{hot}	D2
	RCS wide range T_{cold}	D2
	RCP breaker status	D2
Secondary Pressure and Level Control	Steam generator PORV status	D2
	Steam generator PORV block valve status	D2
	Steam generator safety valve status	D2
	Main feedwater isolation valve status	D2
	Steam generator level (wide range)	D2
	Steam generator level (narrow range)	D2
	Steam generator blowdown isolation valve status	D2

Table 7.5-7 (Sheet 2 of 4)

SUMMARY OF TYPE D VARIABLES

System	Variable	Type/Category
Secondary Pressure and Level Control (continued)	Main feedwater pump status	D2
	Main feedwater control valve status	D2
	Main steam line isolation valve status	D2
	Main steam line isolation bypass valve status	D2
Startup Feedwater	Startup feedwater control valve status	D2
	Startup feedwater isolation valve status	D2
	Main to startup feedwater crossover valve status	D2
Safeguards	Containment pressure	D2
	Accumulator pressure	D2
	Core makeup tank upper water level switch	D2
	Core makeup tank lower water level switch	D2
	IRWST/line isolation valve status (MOV)	D3
	IRWST/injection isolation valve status (Squib)	D2
	ADS first stage, second stage and third stage valve status	D2
	ADS fourth stage valve status (MOV)	D2
	ADS fourth stage valve status (non-MOV)	D2
	PRHR heat exchanger inlet isolation valve status	D3
	PRHR heat exchanger control valve status	D2
	Reactor vessel head vent valve status	D2
	CMT/discharge isolation valve status	D2
	CMT inlet isolation valve status	D2

Table 7.5-7 (Sheet 3 of 4)

SUMMARY OF TYPE D VARIABLES

System	Variable	Type/Category
Safeguards (continued)	Accumulator/isolation valve status	D3
	PRHR flow	D2
	Containment recirculation isolation valve status (MOV)	D2
	Containment recirculation isolation valve status (non-MOV)	D2
	PRHR HX inlet temperature	D3
	PRHR HX outlet temperature	D2
	IRWST surface temperature	D3
	IRWST bottom temperature	D3
	IRWST water level	D2
	IRWST gutter bypass isolation valve status	D2
	Remotely operated containment isolation valve status	D2
Chemical and Volume Control	Auxiliary spray line isolation valve status	D2
	Purification stop valve status	D2
	Purification return line stop valve status	D2
	Demineralized water isolation valve status	D2
Normal Residual Heat Removal	RNS hot leg suction isolation valve status	D2
Electric Power	Class 1E dc switchboard voltage	D2
Spent Fuel Pool	Spent fuel pool water level	D2
	SFS refueling cavity drain to SGS compartment isolation valve status	D2
	SFS refueling cavity drain to containment sump isolation valve status	D2
	SFS containment floodup isolation valve status	D2

Table 7.5-7 (Sheet 4 of 4)

SUMMARY OF TYPE D VARIABLES

System	Variable	Type/Category
Containment Cooling	Containment temperature	D2
	PCS water storage tank series isolation valve status (MOV)	D2
	PCS water storage tank isolation valve status (non-MOV)	D2
	Passive containment cooling water flow	D2
	PCS storage tank water level	D2
HVAC System Status	MCR return air isolation valve status	D2
	MCR toilet exhaust isolation valve status	D2
	MCR supply air isolation valve status	D2
	MCR air delivery isolation valve status	D2
	MCR pressure relief isolation valve status	D2
	MCR air storage bottle pressure	D2
	MCR differential pressure	D2
	MCR air delivery flowrate	D2
Main Steam	Turbine stop valve status	D2
	Turbine control valve status	D2
	Condenser steam dump valve status	D2

Table 7.5-8

SUMMARY OF TYPE E VARIABLES

Function Monitored	Variable	Type/Category
Containment Radiation	Containment area high range radiation level	E2
Area Radiation	Control support area radiation level	E3
	Primary sampling station area radiation level	E3
Airborne Radioactivity Released from Plant	Turbine island vent discharge radiation level	E2
	Plant vent radiation level	E2
	Plant vent air flow	E2
	Main steam line radiation level	E2
	Boundary environs radiation	E3
	Main control room supply air radiation level	E3
Environs Radiation and Radioactivity	Site specific	E3
Meteorology	Site specific	E3
Accident Sampling	Primary coolant	E3
	Containment air	E3
MCR Filtration Flow	MCR passive filtration induced flow rate	E3

Table 7.5-9 (Sheet 1 of 4)

SUMMARY OF TYPE F VARIABLES

Variable	Type/Category
Monitoring for preplanned manual nonsafety-related system actions	
RCS wide range pressure	F2
RCS wide range T_{hot}	F2
RCS wide range T_{cold}	F2
Steam generator level (NR)	F2
Pressurizer level	F2
Containment pressure	F2
Steam line pressure	F2
Containment water level	F2
IRWST water level	F2
Startup feedwater flow	F2
Containment area high range radiation level	F2
Core exit temperature	F2
RCS subcooling	F2
PRHR flow	F2
Core makeup tank upper water level switch	F2
Core makeup tank lower water level switch	F2
Monitoring for nonsafety-related system performance	
Pressurizer heater power (current)	F3
Steam generator PORV status	F3
Steam generator PORV block valve status	F3

Table 7.5-9 (Sheet 2 of 4)

SUMMARY OF TYPE F VARIABLES

Variable	Type/Category
Startup feedwater control valve status	F3
Main feedwater flow	F3
Steam generator level (WR)	F3
Steam flow	F3
Main steam line isolation valve status	F3
Main feedwater pump status	F3
Startup feedwater pump status	F3
Condenser steam dump valve status	F3
Condensate storage tank level	F3
Pressurizer spray valve status	F3
Auxiliary spray line isolation valve status	F3
Makeup flow	F3
Makeup pump status	F3
Letdown flow	F3
Circulating water pump status	F3
Condenser backpressure	F3
Accumulator vent valve status	F3

Table 7.5-9 (Sheet 3 of 4)

SUMMARY OF TYPE F VARIABLES

Variable	Type/Category
Boric acid tank level	F3
Boric acid flow	F3
Makeup blend valve status	F3
Makeup flow control valve status	F3
RNS flow	F3
RNS pump status	F3
IRWST to RNS suction valve status	F3
RNS discharge to IRWST valve status	F3
CCS surge tank level	F3
CCS flow	F3
CCS pump status	F3
CCS flow to RNS valve status	F3
CCS flow to RCPs valve status	F3
CCS pump inlet temperature	F3
CCS heat exchanger outlet temperature	F3
Diesel generator status	F3
Diesel generator load	F3
Voltage for diesel-backed buses	F3
Power supply to diesel-backed buses	F3
RCP bearing water temperature	F3
RCP breaker status	F3
Containment fan cooler status	F3
Water-cooled chiller status	F3
Water-cooled chilled water pump status	F3
Water-cooled chilled water valve status	F3
Containment temperature	F3
Main control room supply air isolation valve status	F3
Main control room return air isolation valve status	F3
Main control room supply air radiation	F3
Service water flow	F3

Table 7.5-9 (Sheet 4 of 4)

SUMMARY OF TYPE F VARIABLES

Variable	Type/Category
Service water pump status	F3
Service water pump discharge valve status	F3
Service water pump discharge temperature	F3
Instrument air header pressure	F3
Spent fuel pool pump flow	F3
Spent fuel pool temperature	F3
Spent fuel pool water level	F3
Main to startup feedwater crossover valve status	F3