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October 29, 1985
ST-HL-AE-1480
File No.: G9.17

Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Responses to DSER/FSAR Items
Concerning Chapter 7 on Safety-Related Display Instrumentation

Dear Mr. Knighton:

The attachments enclosed provide STP's response to Draft Safety Evaluation Report (DSER) or Final Safety Analysis Report (FSAR) items.

The item numbers listed below correspond to those assigned on STP's internal list of items for completion which includes open and confirmatory DSER items, STP FSAR open items and open NRC questions. This list was given to your Mr. N. Prasad Kadambi on October 8, 1985 by our Mr. M. E. Powell.

The attachment includes mark-ups of FSAR pages which will be incorporated in a future FSAR amendment unless otherwise noted below.

The items which are attached to this letter are:

Attachment	Item No.*	Subject
1	F 7.5-1 F 7.5-21 F 7.5-22	Safety-Related Display Instrumentation

* Legend
D - DSER Open Item C - DSER Confirmatory Item
F - FSAR Open Item Q - FSAR Question Response Item

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B001
1/1

If you should have any questions concerning this matter, please contact Mr. Powell at (713) 993-1328.

Very truly yours,

M. R. Wisenburg
Manager, Nuclear Licensing

MEP/bl

Attachments: See above

L1/DSER/aav

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Revised 9/25/85

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TABLE 1.1-1 (Continued)

ACRONYMS USED IN THE FSAR

LPG	liquid petroleum gas	
LPMS	Loose Parts Monitoring System	39
LPZ	low population zone	
LRPT	lead radiation protection technician	38
LRTS	Liquid Radwaste Treatment System	
LSA	low specific activity	
LTMD	less than minimum detectable (concentration)	
LVDT	linear variable differential transformer	
LWPS	Liquid Waste Processing System	
MAB	Mechanical Auxiliary Building	
MCARS	Main Condenser Air Removal System	39
MCB	main control board	
MCC	motor control center	
MCR	Main Cooling Reservoir	35
MDC	moderator density coefficient	
MDWS	Makeup Demineralized Water System	
MEAB	Mechanical-Electrical Auxiliaries Building	
MEB	Mechanical Engineering Branch	
MET	Meteorological System	X
MFIV	main feedwater isolation valves	41
MG	motor generator	
MIL	military standards	
MLW	mean low water	
MOL	middle-of-life	
MOV	motor-operated valve	
MPC	maximum permissible concentration	

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Question 032.17

State your conformance with Regulatory Guide 1.97 "Instrumentation for Light Water Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident." Justify any exception taken.

Response

As stated in Table 3.12-1, STP conforms to the intent of Regulatory Guide 1.97, Revision 2 (12/80) ~~although the guide is not applicable to STP due to its implementation date~~. A detailed discussion of post-accident monitoring instrumentation is presented in Section 7.5 and Appendix 7B. 40

TABLE 3.12-1 (Continued)

REGULATORY GUIDE MATRIX

NO.	REGULATORY GUIDE TITLE	FSAR REFERENCE	REVISION STATUS	STATUS ON STP	
1.97	Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident	Table 7.1-1 Figure 7.1-1 7.5 ~~7.5.1~~ Table 7.5-1 App. 7A App. 7B	Rev 2 (8/77)	B See Note 3 and 64	40 43
1.98	Assumptions Used for Evaluating the Potential Radiological Consequences of a Radioactive Offgas System Failure in a Boiling Water Reactor			NA See Note 1	
1.99	Effects of Residual Elements on Predicted Radiation Damage to Reactor Vessel Materials	5.3.2.1	Rev 1 (4/77)	D See Note 57	33
1.100	Seismic Qualification of Electric Equipment for Nuclear Power Plants	Table 7.1-1 Figure 7.1-1 3.10.1 3.10.2.2 3.10.2.2.1 3.10.2.2.2.2 3.10.4.1	Rev 1 (8/77)	B See Note 3	36 43
1.101	Emergency Planning for Nuclear Power Plants	9.5.1.A pg 18	Withdrawn	See Note 37	32
1.102	Flood Protection for Nuclear Power Plants	3.4 3.8.4.2.3	Rev 1 (9/76)	A	33
1.103	Post-Tensioned Prestressing Systems for Concrete Reactor Vessels and Containments	3.8.1.2.2 3.8.1.6.5.1	Rev 1 (10/76)	A	45
1.104	Overhead Crane Handling Systems for Nuclear Power Plants	9.1.4.3.1.6 Table 9.1-3	Rev 0 (2/76) FC	B See Note 34	23
1.105	Instrument Setpoints	Table 7.1-1 Figure 7.1-1	Rev 1 (11/76)	B See Note 3, Note 28	33
1.106	Thermal Overload Protection for Electric Motors on Motor-operated Valves	8.3.1.2.12 8.3.2.2.7	Rev 1 (3/77)	A See Note 14	38 | 49 Q430.13CN
1.107	Qualifications for Cement Grouting for Prestressing Tendons in Containment Structures			NA See Note 11	23
1.108	Periodic Testing of Diesel Generators Used as Onsite Electric Power Systems at Nuclear Power Plants	8.3.1.1.4.7 8.3.1.2.10	Rev 1 (8-77)	C See Note 40	38
1.109	Calculations of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50, Appendix I	11.A.1 12.4.2	Rev 0 (3/76) FC Rev 1 (10/77)	A	32

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TABLE 3.12-1 (Cont'd.)
REGULATORY GUIDE MATRIX
NOTES

If a work activity and contract is for a two-month period or less, an audit is not necessary when a facility preaward audit has been conducted. 43

The QA program for operations will conform to the requirements of RG 1.94 Revision 1, with the same clarification: 45

55. Refer to Sections 3.7.4.1 and 3.7.4.2 for the discussion on seismic instrumentation.

56. Refer to Section 5.2.3.3.2 for Westinghouse alternate approach to RG 1.71. Also, refer to Section 10.3.6.2, for the BOP conformance to RG 1.71.

57. STP alternate approach to RG 1.99 is discussed in Section 5.3.2.1.

58. STP alternate approach to RG 1.121 is discussed in Section 3.12.1.

59. Revision 0 is utilized during the construction phase for RG 1.58, Positions C.5, C.6, C.7, C.8, and C.10 of Rev. 1 are also utilized. 33

60. With respect to Section 3.1.2 of ANSI N45.2.3-1973, HL&P interprets the lighting level of 100 footcandles to be guidance. It is HL&P's normal practice that the lighting level for determining "metal clean" of accessible surfaces of piping and components is determined by the inspector. Typically he uses a standard two-cell flashlight supplemented by other lighting as he deems necessary.

61. STP conforms to RG 1.140, with the exception that instrumentation is provided only to monitor and alarm pertinent pressure drops at critical points in the duct. Therefore, STP is in partial compliance with Position C.2.cc.

38

62. RG 1.1 as clarified by NUREG 75/087.

63. The basis for meeting the intent of RG 1.46 is the implementation of NRC Branch Technical Position (BTP) MEB 3-1, NRC BTP ASB 3-1, WCAP-8082-P-A, and WCAP-8172-A. Tables 3.6.1-2 and 3.6.1-3 provide a summary of the compliance with MEB 3-1 and ASB 3-1. 40

64. ~~Exceptions to revision 2 are identified in FSAR reference sections.~~

65. The QA program during operations will conform to the requirements of Revision 2.

66. The QA program for operations will conform to the requirements of Position C.2 of Regulatory Guide 1.137 with the following clarification: 43

The discussion of STP conformance to RG 1.97 Rev. 2 is presented in Table 7.5-1 and Appendix 7B. As explained in Appendix 7B, implementation of RG 1.97 requirements was integrated with the control room design review and was performed using the Westinghouse Owners Group Emergency Response Guidelines, and conforms with the intent of the RG.

7.5 Safety-Related Display Instrumentation

7.5.1 Post Accident Monitoring Instrumentation

7.5.1.1 Description. A task analysis was conducted to identify the appropriate variables and establish appropriate design bases and qualification criteria for instrumentation employed by the operator for monitoring conditions in the Reactor Coolant System (RCS), the secondary heat removal system, and the Containment, including Engineered Safety Features (ESF) and other systems normally employed for attaining and maintaining a safe shutdown condition. The instrumentation is used by the operators to monitor the South Texas Plant throughout various operating conditions including anticipated operational occurrences and post-accident conditions. The analysis process ensures that the information available to the operator following an accident is derived from specially designed and qualified instrumentation installed at the plant. 40 X

7.5.1.2 Analysis. The task analysis performed in response to Regulatory Guide (RG) 1.97 is described in Appendix 7B. Table 7.5-1 provides a listing of the variables identified in the task analysis. In addition, the table includes the following information on the STP instrumentation utilized for each variable: (a) instrument range; (b) type and category (per the definitions found in Appendix 7B); (c) environmental qualification; (d) seismic qualification; (e) number of channels available; (f) display device and location; (g) the schedule for implementation; (h) power supply; and (i) a statement of conformance to RG 1.97, Revision 2, or justification for deviations. 40 Q32.18

Seismic and environmental qualifications are further discussed in Sections 3.10 and 3.11. X

To assist in understanding the information provided in Table 7.5-1, the following explanation of column headings is provided:

Variable: This column contains the RG 1.97 variable as defined in Appendix 7B.

Range/Status: This column contains the range of instruments used on STP for RG 1.97 purposes and a description of STP indications of valve position or pump status. The ranges indicated meet or exceed the requirements described in Appendix 7B. 40

Type/Category: This column contains the types and categories applicable to each variable as defined in Appendix 7B.

Environmental and Seismic Qualification: This column ~~describes~~ indicates whether or not the STP instrumentation is seismically or environmentally qualified. A "yes" in the Environmental Qualification column indicates that the channel is environmentally qualified to a level which meets or exceeds the requirements specified in Appendix 7B for that variable. X

Number of Channels: This column contains the number of instrument channels available on STP for post-accident monitoring purposes. This column does not take into account control room indication or recording capability. The number X

of channels available meets or exceeds the requirements in Appendix 7B, except for the cases in which justification for deviation from Appendix 7B is provided in Table 7.5-1.

INSERT 'A'

Control Room Indication: This column describes the control room indication and recording capability on STP for each variable. The control room indication and recording capability meets or exceeds the requirements described in Appendix 7B.

Implementation Date: This column contains the STP schedule for implementing the RG.

Power Supply: This column describes the power supply which powers the STP instrumentation for each variable. The power supply provided meets or exceeds the requirements described in Appendix 7B.

Emergency Operations ~~Facility~~ Center (~~EOF~~ EOC) Indication: This column ~~describes~~ provides the STP Emergency Operations ~~Facility~~ Center indication capability for each variable.

Technical Support Center (TSC) Indication: This column ~~describes~~ provides the STP Technical Support Center indication capability for each variable.

Conformance: This column provides a statement of the conformance to RG 1.97, Revision 2 or justification for deviation.

Further information concerning conformance to RG 1.97, Revision 2 is provided in Appendix 7B, which describes (a) the plant accident conditions under which the instrumentation must be operable; (b) the selection criteria (Type A, B, C, D, or E); (c) the qualification criteria (Category 1, 2, or 3): (d) the design criteria (number of channels, power requirements, servicing requirements, etc); and (e) the processing and display criteria (accessibility, historical record, etc.). 40

The post-accident monitoring instrumentation consists of the instrumentation identified in Table 7.5-1. The display systems for the post-accident monitoring instrumentation are identified in Table 7.5-1 and are further described in the sections identified below:

1. Qualified Display Processing System (QDPS) - Section 7.5.6.

2. Emergency Response Facilities Data Acquisition and Display System (ERFDADS) - Section 7.5.7.

3. Radiation Monitoring System (RMS) - Section 11.5. ~~(later)~~

7.5.2 Reactor Trip System

Display instrumentation for monitoring during normal operation in the Reactor Trip System is discussed in Sections 7.2 and 7.7.

7.5.3 Safe Shutdown

Display instrumentation provided for monitoring safe shutdown during normal operations is discussed in Section 7.4.

Insert A'

an entry of "QDPS" indicates that display of the variable is ~~immediately~~ STET accessible on the Qualified Display Processing System (QDPS) plasma display units via a single pushbutton action.

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X

1. Visual indication (through lampbox lights) that specific ESF equipment has been bypassed or deliberately rendered inoperable during normal plant operating modes.

2. Annunciation to alert the operator that an ESF system or any of its support systems has been bypassed or deliberately rendered inoperable during normal plant operating modes.

The bypass/inoperable status indication subsystem continuously monitors the status of field contacts and automatically indicates that a specific piece of ESF equipment has been bypassed or deliberately rendered inoperable. The following conditions (as applicable) are automatically detected for each monitored component of the ESF systems:

1. Loss of control power

2. Control handswitch in pull-to-lock position

3. Circuit breaker not in operating position

4. Control transferred from the control room to a remote panel

5. Component not in its proper aligned position

The bypass/inoperable status indication is accomplished by lighting up the component level window. This indication also provides individual system level annunciation to alert the control room operator that an ESF system has been bypassed or rendered inoperable. 41

In accordance with RG 1.47, bypass or inoperable status indication is provided automatically for conditions which meet all three of the following guidelines:

1. The bypass or inoperable condition affects a system that is designed to automatically perform a safety-related function.

2. The bypass is utilized by plant personnel or the inoperable condition can reasonably be expected to occur more frequently than once per year and,

3. The bypass or inoperable condition is expected to occur when the affected system is normally required to be operable.

Deliberate manual actions which render ESF actuated components and devices inoperable (once a year or more frequently) are automatically displayed on a component level. Active components not directly actuated by ESF signal but rendered inoperative once a year or more frequently such that it compromises the safety functions of the ESF system are also automatically displayed on a component level to the control room operator.

Rendering a piece of ESF equipment inoperative through the use of features provided strictly for infrequent maintenance (less than once a year) is not automatically indicated. Such maintenance features may include manual valves provided for isolation of the equipment for repair and electrical cable connections, screw terminals or manual disconnects. The bypass/inoperable indication of these conditions is manually initiated on an ESF system level.

The capability for initiating a manual bypass indication and an alarm is provided via a system level manual bypass switch to indicate the bypass/inoperable condition to the operator for those components or conditions which are not automatically monitored. X 41

Manual bypass/inoperable indication may be set up or removed under administrative control. The automatic indication feature of the ESF Status Monitoring System can not be removed by operator action.

Bypass and/or status indication on a system level is provided for the following safety-related systems:

1. Solid-State Protection System (bypass/inoperable only) 41

2. Safety Injection System (SIS) (including RHR system components required for accident mitigation or safe shutdown)

3. Containment Spray System (CSS)

4. Containment Isolation Phase A

5. Containment Ventilation Isolation 41 2 Q3 7

6. Class 1E 125 vdc and 120 v Vital AC Systems

7. Combustible Gas Control System (bypass/inoperable only)

8. Containment Heat Removal System

9. Fuel Handling Building (FHB) heating, ventilating, and air conditioning (HVAC) Exhaust Subsystem X

10. Electrical Penetration Space HVAC System

11. Control Room Envelope and Electrical Auxiliary Building (EAB) Main Area HVAC System

12. Feedwater Isolation 41

13. Steam Line Isolation

14. Auxiliary Feedwater System (AFWS)

add 15. Penetration Space HVAC Exhaust Subsystem X

The following support systems activate bypass indication of all supported safety systems listed above when they are bypassed or rendered inoperable:

1. Component Cooling Water System (CCWS)

2. Essential Cooling Water System (ECWS)

3. ESF Bus System (including the standby diesel generators and the ESF load sequencers) 41

4. Essential Chilled Water System

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5. Supporting HVAC equipment

The ESF Status Monitoring System is not required to operate during or after a design basis seismic event; however, the indicator light panels are mounted on the seismically designed and qualified control benchboard. The indicator panels are designed and have been type tested to prove their structural integrity. 41

No credit is taken in the accident analyses of Chapter 15 for the operability of the ESF Status Monitoring System. The system is not designed to safety-related requirements. Interfaces with safety-grade equipment are through qualified isolation devices, in accordance with IEEE 384 and RG 1.75. These isolation devices are part of the Emergency Response Facilities Data Acquisition and Display System (ERFDADS) (see Section 7.5.7). 41

7.5.5 ~~Normal Operations Monitoring~~ (Deleted)

~~This information has been provided in Table 7.5-1.~~

7.5.6 Qualified Display Processing System

7.5.6.1 Description. The QDPS is an integrated system designed to perform the following functions:

1. Data acquisition and qualified displays for post-accident monitoring.

2. Safety grade control and position indication of several safety-related valves.

3. Data acquisition, display, and control to address the separation requirements of the STP design approach to a control room (CR) or relay room (RR) fire.

4. Steam generator narrow range water level compensation for the effect of temperature changes in the reference leg fluid. 40

5. Averaging for RCS hot leg RTD signals. (RTD Bypass manifold elimination)

7.5.6.1.1 System Description. The system functions are performed by several subsystems. These subsystems, though related, have sufficient independence such that the individual functions can be performed with maximum reliability and minimum unnecessary interaction between functions. A block diagram indicating the interconnections of the various QDPS subsystems as well as interfaces with other systems is provided in Figure 7.5.6-1.

7.5.6.1.1.1 Data Acquisition and Qualified Display for Post Accident Monitoring - The data acquisition and qualified display function is performed by a subsystem referred to as Plant Safety Monitoring System (PSMS). It is a modular and flexible general purpose system which performs the following functions:

1. Implements qualified monitoring channels to comply with post-accident monitoring category 1 equipment design and qualification criteria defined in Appendix 7B.

2. Provides safety grade signal processing for instrumentation to detect inadequate core cooling as defined in NUREG-0737, Item II.F.2. This includes signal processing for:

   - Reactor vessel water level
   - Core exit temperature
   - RCS subcooling

   REFER TO APPENDIX 7A.II.F.2 FOR A DETAILED DESCRIPTION.

3. Isolates Class 1E and associated signals to make them available to non-Class 1E equipment including the Emergency Response Facilities Data Acquisition and Display System (ERFDADS) (see Section 7.5.7).

4. Provides consolidated, unambiguous, human-factored displays of appropriate parameters to address the requirements of paragraph 4.20 of IEEE 279-1971. See Figure 7.5.6-20 for a schematic representation of signal processing for display consolidation.

The PSMS consists of four redundant, channelized, Class 1E data acquisition processors called remote processing units (RPUs). These RPUs send data to redundant database processing units (DPUs), which subsequently provide information to the operator via plasma display modules. A fifth, non-Class 1E RPU (RPU N) provides data acquisition for non-Class 1E signals which are needed to complete logical graphic displays. The RPUs perform the engineering units conversion, limit checks, and isolation or buffering as required. The DPUs perform redundant sensor algorithms and auctioneering functions and then output the data base to the plasma display modules. The plasma display modules provide graphic and alphanumeric display pages containing comprehensive, human engineered display information. Display page selection is performed using a function keyboard for each display module. 40

The variables required in the PSMS database are categorized into three types:

1. Safety grade parameters required to address post-accident and safe shutdown monitoring requirements.

2. Variables identified for monitoring the minimum functions required to achieve safe shutdown under postulated fire conditions.

3. Parameters included for display consolidation on the main control panels.

7.5.6.1.1.2 <u>Safety Grade Control and Position Indication of Safety-Related Valves</u> - The safety grade valve control function is performed by a microprocessor based control system (Eagle 21). This consists of a set of Class 1E equipment used to provide the following process control functions:

1. Closed-loop control and position indication for the steam generator (SG) power-operated relief valves (PORV).

2. Contact output signals for automatic control and position indication of auxiliary feedwater (~~FW~~ AFW) ~~control~~ flow throttle valves within upper and lower flow limits.

Amendment 40

3. Open-loop control and position indication for the reactor vessel head vent valves.
4. Closed-loop control and position indication for ECW flow control to the essential HVAC chillers.

The SG PORV control equipment provides hardware to meet the requirements for full analog valve control including transfer, without position change, of operation from the control room to the auxiliary shutdown panel. A separate transfer switch selects the active control station. Each control loop accepts the steam line pressure, valve position, and the setpoints as input variables and outputs a 4-20 mA signal to control the valve.

Each auxiliary feedwater throttle valve control loop accepts an input from a flow-transmitter and supplies two bistable output signals, low and high limits, to the valve controller. These signals maintain ~~auxiliary FW~~ AFW flow within acceptable limits until manual control is assumed by the operator.

The reactor vessel head vent control loop accepts signal inputs from a pair of manual stations, one located in the control room and the other on the auxiliary shutdown panel. A separate transfer switch for each loop selects the active ~~control~~ manual station.

Insert A1 →

7.5.6.1.1.3 Data Acquisition, Display, and Control to Address Separation Requirements of the STP Design Approach to a CR or RR Fire - Signal buffering to meet fire protection isolation and separation requirements is achieved by using microprocessor based equipment, which provides interface with the NSSS process protection and control cabinets.

Field inputs for variables identified for monitoring the minimum functions required to achieve safe shutdown following a CR or RR fire are routed to the QDPS auxiliary process cabinets (APCs). The signals are split into two independently buffered outputs. One of these outputs is routed to the process protection or control cabinets, and the other serves as an input to the RPU (see Figure 7.5.6-3). With this configuration, the QDPS displays of these parameters are available should any failure occur in the process protection or control cabinets or input and output cabling. 40

7.5.6.1.1.4 Steam Generator Narrow Range Water Level Compensation and Display - The ~~S~~team ~~G~~enerator ~~N~~arrow ~~R~~ange ~~W~~ater ~~L~~evel ~~C~~ompensation system automatically compensates the SG water level signals for the effect of temperature changes in the reference leg fluid. This system serves to increase operating margin and to improve the accuracy of post-accident level indications. With reference leg temperature compensation of the SG water level signals, the required increase in the low-low SG water level reactor trip setpoint to account for reference leg heat-up following a high energy line break inside containment is minimized. The compensation system is designed to limit the reference leg heatup error to 2 percent of the level instrument span. SG water levels are displayed on the ~~QDPS~~ plasma displays and on main control panel indicators. For additional QDPS information, refer to Section 7.2.

Insert A2 →

7.5.6.1.2 Equipment Description: The QDPS consists of the following equipment: four Class 1E APCs, two Class 1E database processing units, eight Class 1E plasma display units, three non-Class 1E demultiplexer units, and one non-Class 1E RPU. Refer to Figure 7.5.6-1 for system configuration.

INSERT "A1"

new paragraph

The essential ~~chilled~~ cooling water (ECW) ~~valve~~ flow control equipment to the essential HVAC chiller condenser provides hardware to meet the requirements for full analog valve control based upon essential chiller condenser pressure. The hardware provides the capability for transfer, without position change, of operation from the main control room to the auxiliary shutdown panel. A seperate transfer switch selects the active control station. Each control loop accepts the essential chiller condenser pressure, essential chiller compressor run status, valve position and the setpoints as input variables and outputs a 4-20 mAdc signal to control the valve.

INSERT 'A2'

7.5.6.1.1.5 Averaging for RCS T_{hot} RTD Signals -

(later)

7.5.6.1.2.1 Auxiliary Process Cabinets - The four redundant APCs comply with IEEE 279-1971. Each channelized APC contains an RPU chassis, control system chassis, signal isolation/buffering equipment and associated DC power supplies for field inputs originating from this respective instrument channel. Data is output via datalinks and individual analog signals as required. Each datalink is independently buffered such that no fault on a datalink will degrade system function beyond loss of data on that link. The APCs are located in four physically separated fire areas, such that no single fire will affect more than one APC. The APCs are powered from the four separate 120 vac vital instrument buses.

7.5.6.1.2.2 Database Processing Units (DPU) - The two redundant DPUs comply with IEEE 279-1971. Each DPU contains signal processing equipment, signal isolation/ buffering equipment and the DC power supply. The DPUs receive data inputs from each of the RPUs and transmit data outputs to the Class 1E plasma display units, non-Class 1E DMUX, and other destinations as necessary. Each datalink is buffered such that no fault on a datalink will degrade system function beyond loss of information carried on that link. The DPUs are located in physically separated rooms with the separation group A and C APCs, and are powered by the separation group A and C 120 vac vital instrument buses, respectively. ~~Separation groups A and C correspond to instrument channels I and IV respectively.~~

7.5.6.1.2.3 Plasma Display Units - The eight plasma display units are grouped into two redundant sets of three display units each in the control room and the two redundant display units on the auxiliary shutdown panel. The plasma display units conform to IEEE 279-1971. Each plasma display unit contains the microprocessor equipment and DC power supply to receive data from each DPU and generate graphic and alphanumeric display pages. A function keyboard attached to each display unit allows operator selection of specific display pages. One redundant set of plasma display units is powered by the separation group A 120 vac vital instrument bus and the other set by separation group C vital instrument bus. 40

7.5.6.1.2.4 Demultiplexers - Two of the three DMUX units are located in the control room. The third DMUX unit is located in the auxiliary shutdown panel. The DMUX units are non-Class 1E devices which provide system outputs to drive analog panel meters and recorders. The units are seismically qualified in accordance with IEEE 344-1975 such that the recorder output will remain functional following a seismic event. The DMUX units are powered from the non-Class 1E instrument bus backed-up by station batteries.

7.5.6.1.2.5 Remote Processing Unit N (RPU N) - The single non-Class 1E RPU N provides data acquisition for certain non-Class 1E signals. The RPU is not required to function post-accident and is not redundant. RPU N is located in the relay room, electrical auxiliary building (EAB) elevation 35', and is powered from the non-Class 1E instrument bus.

7.5.6.2 Analysis. Even though IEEE 279-1971 was not a design basis of the QDPS, an analysis was conducted to determine those criteria stated in the standard that were met by the system design. The following sections discuss the applicability of the QDPS to the respective sections of IEEE 279-1971. In performing this evaluation the functions performed by the QDPS are subdivided 49

Insert

A3

to the Database Processing Units, non-Class 1E DMUX units and ERFDADS.

A4

analog outputs to conventional indicators and recorders and contact outputs to provide qualified status information.

A5 (Separation groups are discussed in Section 8.3.1.4.)

throttle

into the following subgroups: (a) steam generator water level compensation system (SGWLCS), (b) ESF qualified controllers (e.g., auxiliary feedwater (AFW) ~~regulator~~ valve control), (c) qualified controllers utilized for achieving a safe shutdown, and (d) post-accident monitoring displays. References to the QDPS from a system level in the succeeding discussion indicates that all QDPS subsystems meet the stated requirement. Furthermore, the applicability of the General Design Criteria (GDCs) are indicated below. 49

7.5.6.2.1 <u>General Functional Requirement:</u> This criteria only applies to the SGWLCS and the ESF qualified controllers. Other functions do not automatically initiate appropriate protective action.

7.5.6.2.2 <u>Single-Failure Criterion</u>: The QDPS is designed to provide edundant instrument channels for each safety-grade function as described in 40
Section 7.5.6.1. These redundant channels are electrically and physically independent. A single failure in the QDPS will not prevent proper response at the system level. The loss of power to any vital instrument bus will result 49
at most in loss of display from one channel. A failure modes and effects analysis has been performed and is presented in Table 7.5-4. The design meets the requirements of GDC 21, 22, and 23. 40

7.5.6.2.3 <u>Quality of Components and Modules</u>: The QDPS meets the 99 percent availability requirement defined in NUREG-0696 Section 1.5 under all pressure and temperature conditions exceeding cold shutdown conditions. 49

7.5.6.2.4 <u>Equipment Qualification</u>: The QDPS is seismically and environ- 40
mentally qualified to IEEE 344-1975 and IEEE 323-1974, and meets the requirements of GDC 2 and 4 with the exception of RPU N which performs non-Class 1E functions. The DMUX units are seismically qualified. Equipment qualification is also discussed in Sections 3.10 and 3.11. 49

7.5.6.2.5 <u>Channel Integrity</u>: The QDPS is designed to operate during accident conditions and maintain necessary functional capability and accuracy under extremes of conditions relating to environment, energy supply, malfunctions, and accidents. 40

7.5.6.2.6 <u>Channel Independence</u>: Channels that provide signals for the 49
same function are electrically independent and physically separated to accomplish decoupling of the effects of unsafe environmental factors, electric 40
transients, and physical accident consequences. The system is designed to 49
minimize the potential for interactions between channels during maintenance 40
operations or in the event of channel malfunction. The QDPS features two redundant physically separated independent trains of display. The design ensures that an initiating failure (short circuit, fault, etc.) in either a DPU or display unit will not result in the loss of both trains of DPUs and/or 49
display units. The design meets the requirements of GDC 22.

7.5.6.2.7 <u>Control and Protection System Interaction</u>: The only subsystem that is used for both protective and control functions is SGWLCS. Furthermore, control grade signals are output from the post-acident monitoring QDPS subsystem.

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In all cases the transmission of signals from the QDPS for control or use by other non-Class 1E devices is through qualified isolation devices which are part of the QDPS system. Faults, such as short circuits, open circuits, ground, or the application of credible AC or DC fault potential at the output of an isolation device, will not prevent the associated protection system channel from meeting minimum performance requirements. 49

Noise and isolation testing will be addressed in a separate WCAP~~, to be submitted in the last quarter of 1985~~.

This design meets the requirements of GDC 24. 40

7.5.6.2.8 Derivation ~~Deviation~~ of System Inputs: To the maximum extent practicable, the QDPS inputs are derived from signals that are direct measures of the monitored variables. 49 X

7.5.6.2.9 Capability for Sensor Checks: The QDPS has built-in diagnostics for checking the operational availability of each system component and input sensor during reactor operation. This is achieved by continuous scanning by microprocessor based sensor data quality checks. A data quality is assigned to all ~~redundant~~ channels of data input. The routine processes the redundant sensor inputs and, when possible, returns a group value of the valid sensors for use in the upper level displays. 40 X X

7.5.6.2.10 Capability for Test and Calibration: The SGWLCS and ESF qualified controllers have the capability for testing and calibration during reactor operation. The post-accident monitoring subsystem has the capability for checking the operational availability for each channel during reactor operation by cross checking between channels that bear a known relationship to each other. The safe shutdown qualified controllers are only required to be tested during scheduled station shutdowns. Refer to Section 7.2.2.2.3.10 for a description of the testing of the protection loops. The design meets the requirements of GDC 21. 49

7.5.6.2.11 Channel Bypass or Removal from Operation: The SGWLCS subsystem is designed to permit all channels, one at a time, to be maintained, tested, or calibrated during power operation with no loss of safety function. The ESF qualified controllers are designed to permit all channels, one at a time, to be maintained, tested, or calibrated during power operation. Access to the cabinets for removing channels from service is administratively controlled.

7.5.6.2.12 Operating Bypasses: There are no operating bypasses in QDPS. 40

7.5.6.2.13 Indication of Bypasses: If one or more channels of the ESF qualified controllers have been deliberately rendered inoperable, this fact will be continuously indicated on the QDPS display. If one or more channels of the SGWLCS subsystem has been deliberately rendered inoperable in the QDPS hardware, the action will result in the partial trip of the respective channel. 49

2. Data acquisition and signal processing for the ESF Status Monitoring System.

3. Data acquisition and signal processing for other normal plant monitoring systems including the plant annunciators and the plant computer.

7.5.7.1.1 System Description: The ERFDADS functions are performed by several subsystems. Data acquisition is provided by multiplexers within the ERFDADS, the QDPS (see Section 7.5.6), the Meteorological (MET) System and of the Radiation Monitoring System (RMS) (see Section 11.5 later). The ERF computer performs the required data processing. CRT devices provide display in the control room (CR), Technical Support Center (TSC) and the EOF. A simplified interconnection diagram of the ERFDADS is shown in Figure 7.5.7-1. EOC X X

7.5.7.1.1.1 Safety Parameter Display - The Safety Parameter Display System, as described in NUREG-0696 and NUREG-0737 Supplement 1, is implemented via the ERFDADS. The design of the ERFDADS is integrated with the implementation of RG 1.97 (see Appendix 7B) and the Control Room Design Review (see Appendix 7A, Item I.D.1).

The ERFDADS provides plant (EOC) and environmental data to aid operators and management in the CR, TSC, and EOF to respond quickly to abnormal operating conditions and mitigate the consequences of an accident. The ERFDADS functions during normal operations and emergencies to provide the following services: X 40

1. Provide plant and environmental data that is needed for the reactor operators to quickly assess the safety status of the plant.

2. Allow technical personnel access to comprehensive plant data, enabling them to assist operators without adding to the number of personnel in the control room.

3. Provide reliable plant data to the CR, TSC, and EOF. EOC X

4. Aid the operators in the detection of abnormal operating conditions.

5. Assist in the identification of the causes leading to any abnormalities.

6. Monitor plant response to corrective actions.

7. Provide grouping of parameters to enhance the operators' ability to assess plant status quickly without surveying all control room displays.

8. Provide human factors engineered display formats (simple and consistent display patterns and coding).

9. Provide display information on a real time basis, along with validation of data and functional comparison capability.

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10. Provide display information on a real time basis for monitoring the RG 1.97 variables, as defined in Section 7.5.1 and Appendix 7B. These variables are utilized to monitor the critical safety functions of:

- Subcriticality ~~Reactivity control~~
- Reactor coolant system integrity ~~pressure control~~
- Reactor coolant inventory ~~control~~
- Reactor core cooling
- Heat sink maintenance
- ~~Primary reactor~~ Containment environment

The bases for the parameter selection are presented in Appendix 7B. 49

Table 7.5-1 identifies the specific parameters and indicates those available in the TSC and EOF.

7.5.7.1.1.2 Data Acquisition and Signal Processing for ESF Status Monitoring - The ERFDADS performs data acquisition and signal processing for the Status Monitoring System. Input to the ESF Status Monitoring System is via demultiplexers within the ERFDADS. The ESF Status Monitoring System is described in Section 7.5.4.

7.5.7.1.1.3 Data Acquisition and Signal Processing for Other Normal Plant Monitoring Systems - The ERFDADS performs data acquisition and signal processing for other normal plant monitoring systems including the plant annunciator and the plant computer. Input to the plant annunciator is via an ERFDADS demultiplexer.

7.5.7.1.2 Equipment Description:

7.5.7.1.2.1 Multiplexers (MUX) - Non-Class 1E multiplexers are utilized for data acquisition from field inputs, switch gear and relay racks for input into the ERF computer. The multiplexers are located in the electrical auxiliary building switch gear rooms A, B and C on elevations 10', 35' and 60', in the relay room on elevation 35'; and the separation group D distribution room on elevation 10'.

7.5.7.1.2.2 Demultiplexer - Non-Class 1E DMUXs are utilized to provide input from the ERF computer to other plant monitoring systems including the ESF Monitoring System and the plant annunciators. 40

7.5.7.1.2.3 ERF Computer - The ERF computer portion of the ERFDADS is located in the TSC (EAB, elevation 72') and provides data to the control room, TSC, and EOF display devices and offsite data links.

The ERF computer receives data consisting of the RG 1.97 defined analog and digital variables and other ~~variables~~ directly from the ERFDADS multiplexers, QDPS, Meteorological System and RMS via redundant high speed data links.

The ERF computer performs any data processing required beyond that performed by the data acquisition equipment. Redundant central processing units are provided with adequate memory capacity to support ERF data acquisition, management and transmission functions on a real time basis.

7.5.7.1.2.4 Man Machine Interface - CRT display devices are located in the CR, TSC, and EOF to present ERFDADS information to operators and management in a concise, easily intelligible format.

The primary SPDS display page is ~~dominant on at least one control room display device and one TSC display device. This display~~ is available on all ERFDADS display devices.

7.5.7.1.2.5 HVAC Support - HVAC, with sufficient reliability to support the above ERFDADS availability requirements, discussed in Section 7.5.7.1.3, is provided in the TSC computer room. ERFDADS equipment located outside the TSC computer room is designed to function in the normal design environment for the areas in which the equipment is located.

The TSC HVAC is further described in Section 9.4.1.

7.5.7.1.2.6 Power Supply - ERFDADS equipment including multiplexing equipment, the ERF computer and its peripherals, display devices, and printers~~, which are located within the power block,~~ ~~are~~ provided with 120 vac power from a dedicated non-Class 1E uninterruptible power supply (UPS) capable of maintaining system operation for 2 hours and capable of maintaining system memory for 8 hours. Normal AC power to the UPS is provided from a non-Class 1E diesel generator-backed bus.

ERFDADS equipment located within the EOF is provided with reliable 120 vac power from the EOF diesel generator-backed bus.

7.5.7.1.3 System Operational Requirements: The ERFDADS data channels meet the 99 percent availability requirement defined in NUREG-0696 Section 1.5 under pressure and temperature conditions exceeding cold shutdown conditions. The system meets an 80 percent availability requirement during plant cold shutdown condtions.

Data processed through ERFDADS is qualitatively comparable with other Post Accident Monitoring System, Radiation Monitoring System, and QDPS data displayed in the CR with respect to accuracy and response time.

7.5.7.2 Analysis. The ERFDADS design insures that any failure or malfunction of the ERFDADS equipment beyond the Class 1E isolation devices does not compromise any safety-related equipment, components, or structures.

A verification and validation plan is provided for the ERFDADS software to demonstrate conformance with the functional requirements of NUREG-0696 and NUREG-0737. This plan provides for an independent review of the system software. 40

Isolation and separation of Class 1E signals is provided in accordance with RG 1.75. Inputs to the ERFDADS are isolated at the exit point of the isolation devices (see Figures ~~7.6.5-1~~ and 7.5.7-1).

This system is designed to meet the following criteria:

1. No single-point failure in any ERFDADS component has any effect on the plant operation. Any such failure is monitored in the CR. Redundant hardware is utilized when required to satisfy this requirement and to improve reliability.

2. Where redundant devices or assemblies are utilized, failure of one is detected and indicated to the ERF computer, and causes automatic transfer of functions to the other device or assembly without effect upon system performance.

3. On line diagnostic routines and transmission error checking provisions in the data network and host processors aid in maintaining validity of all data interchanges and in verification of the continuous functional integrity of system equipment.

all heading changes are global

TABLE 7.5-1

POST ACCIDENT MONITORING INSTRUMENTATION

Variable	Range/Status	Type/Category	Sensor Qualification Environmental	Sensor Qualification Seismic	Number of Channels	Control Room Display	Implementation Date	Sensor Power Supply	ERF Indication	TSC Indication	Conformance to RG 1.97, Rev. 2
RCS Pressure (Wide Range)	0-3000 psig	A1,B1,B2, C1,C2,D2	Yes	Yes	1 per plant	QDPS 1 recorded	Core Load	1E	Yes	Yes	Note b
Wide Range T hot	0-700°F	A1,B1,B2	Yes	Yes	1 per loop	QDPS 4 recorded	Core Load	1E	Yes	Yes	Conforms
Wide Range T cold	0-700°F	A1,B1,B2	Yes	Yes	1 per loop	QDPS 4 recorded	Core Load	1E	Yes	Yes	Conforms
Wide Range Steam Generator Level	0-100% of span	A1,B1,B2, D2	Yes	Yes	1 per steam generator	QDPS 4 recorded	Core Load	1E	Yes	Yes	Conforms
Narrow Range Steam Generator Level	0-100% of span	A1,B1,B2, D2	Yes	Yes	4 per steam generator	QDPS 4 recorded	Core Load	1E	Yes	Yes	Conforms
Pressurizer Level	0-100% of span	A1,B1,D2	Yes	Yes	4 per plant	QDPS 1 recorded	Core Load	1E	Yes	Yes	Conforms
Containment Pressure	-5 to 60 psig	A1,B1,B2 C1,C2,D2	Yes	Yes	4 per plant	QDPS 2 recorded	Core Load	1E	Yes	Yes	Conforms
Steamline Pressure	0-1400 psig	A1,B1,D2	Yes	Yes	4 per loop	QDPS 1 per loop recorded	Core Load	1E	Yes	Yes	Conforms
Refueling Water Storage Tank Level	0-100% of span	A1,B1,D2	Yes	Yes	3 per tank	QDPS 2 meters 1 recorded	Core Load	1E	Yes	Yes	Conforms
Containment Water Level (Wide Range)	0-609,000 gal (0-6 ft.)	A1,B1,B2 C2,D2	Yes	Yes	3 per tank	QDPS 1 recorded	Core Load	1E	Yes	Yes	Conforms
Containment Water Level (Narrow Range)	Bottom of Sump to Top of Sump	A1,B2,C2 D2	Yes	Yes	2 per plant	QDPS 2 recorded	Core Load	1E	Yes	Yes	Conforms
Auxiliary Feedwater Storage Tank Level	0-100% of span	A1,B1,D2	Yes	Yes	3 per plant	QDPS 1 recorded	Core Load	1E	Yes	Yes	Conforms
Auxiliary Feedwater Flow	0-100% of span	A1,B1,D2	Yes	Yes	1 per loop	QDPS 4 recorded	Core Load	1E	Yes	Yes	Note o

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TABLE 7.5-1

POST ACCIDENT MONITORING INSTRUMENTATION (Continued)

Variable	Range/Status	Type/Category	Sensor Qualification Environmental	Sensor Qualification Seismic	Number of Channels	Control Room Display	Implementation Date	Sensor Power Supply	EOC ~~EOP~~ Indication	TSC Indication	Conformance to RG 1.97, Rev. 2
High Range Containment Radiation Level	1R/hr to 10^8 R/hr Gamma	A1,B1,B2, C2,E2	Yes	Yes	2 ~~per plant~~	QDPS 2 meters 2 recorded	Core Load	1E	Yes	Yes	Note s
Steam Generator Blowdown Radiation Level	~~(Later)~~ 10^{-2} to 10^6 uCi/cc	A1,B2,C2, E2	Yes	Yes	1 per blowdown line	QDPS 4 meters 4 recorded	Core Load	1E	Yes	Yes	Conforms
Steamline Radiation Level	~~(Later)~~ 10^{-2} to 10^6 uCi/cc	A1,B2,C2, E2	Yes	Yes	1 per steam line	QDPS 4 meters 4 recorded	Core Load	1E	Yes	Yes	Conforms
Core Exit Temperature	100-2200°F	A1,B1,C1	Yes	Yes	2 trains of 25 thermocouples each, equally distributed across core (in quadrants)	QDPS Hottest thermocouple ~~High~~ and average of hottest quadrant ~~values~~ recorded	Core Load	1E	Yes	Yes	Conforms
RCS Subcooling	200°F subcooling to 50 ~~35~~°F superheat	A1,B1	Yes	Yes	2 ~~per plant~~	QDPS 2 recorded	Core Load	1E	Yes	Yes	Conforms
Neutron Flux (Extended Range)	10^{-8} to 200% Full Power	B1,D2	Yes	Yes	2 ~~per plant~~	QDPS 2 recorded	Core Load	1E	Yes	Yes	Note r
Neutron Flux Startup Rate	-0.5 to +2.0 dpm	B1,D2	Yes	Yes	2 ~~per plant~~	QDPS 0 ~~1~~ recorded as neutron flux	Core Load	1E	Yes	Yes	Note r
Reactor Vessel Water Level	Upper Core Support Plate to top of vessel	B1,C2,D2	Yes	Yes	2 ~~per plant~~	QDPS 1 recorded	Core Load	1E	Yes	Yes	Conforms
Containment Isolation Valve Status	Open/Closed	C2,D2	Yes	Yes	1 per valve	1 pair of lights per valve	Core Load	1E	Yes	Yes	Note c
Containment Hydrogen Concentration	0-10% Concentration	B1,C1	Yes	Yes	2 ~~per plant~~	QDPS 1 recorded	Core Load	1E	Yes	Yes	Conforms

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TABLE 7.5-1

POST ACCIDENT MONITORING INSTRUMENTATION (Continued)

Variable	Range/Status	Type/ Category	Sensor Qualification Environmental	Sensor Qualification Seismic	Number of Channels	Control Room Display	Implementation Date	Sensor Power Supply	EOF Indication	TSC Indication	Conformance to RG 1.97, Rev. #2
Control Rod Position Indication	Rods on Bottom	D3	No	No	1 per rod	LED	Core Load	N-1E	Yes	Yes	Conforms (Note x)
Containment Pressure (Extended Range)	0-180 psig	C1,C2	Yes	Yes	2 ~~per plant g~~	QDPS 1 recorded	Core Load	1E	Yes	Yes	Conforms
RCS Pressure (Extended Range)	0-3500 psig	A1,B1,C1	Yes	Yes	2 ~~per plant~~	QDPS 2 recorded	Core Load	1E	Yes	Yes	Note b
Primary Coolant Activity and Sampling	N/A	C3	No	No	1 post accident sampling system ~~per plant a~~	CRT (ERFDADS)	Core Load	N/A	Yes	Yes	Notes d, h
Unit Vent Radiation ~~Radioactivity~~ Level	(Note a)	C2,E2	Yes	No	1 ~~per plant~~	CRT (RMS)	Core Load	N-1E	Yes	Yes	Conforms (Note a, w)
Fuel Handling Bldg. Exhaust Radiation Level	10^{-6} to 10^{-1} uCi/cc	C2,E2	Yes	Yes	2 ~~per plant~~	QDPS 2 meters 2 recorded	Core Load	1E	Yes	Yes	Conforms
Adjacent Building Area Radiation Level	10^{-1} to 10^{4} mR/hr	C3	No	No	5 ~~per plant~~	CRT (RMS)	Core Load	N-1E	Yes	Yes	Note z STET
Site Environmental Radiation Level (Portable Monitoring)	N/A	C3,E3	No	No	N/A	Portable Sampling	Core Load	N-1E	No	No	Conforms
Pressurizer PORV Status	Open/Closed	B2,D2	Yes	Yes	1 per valve	1 pair of lights per valve	Core Load	1E	Yes	Yes	Conforms
Pressurizer PORV Block Valve Status	Open/Closed	D2	Yes	Yes	1 per valve	1 pair of lights per valve	Core Load	1E	Yes	Yes	Conforms

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TABLE 7.5-1

POST ACCIDENT MONITORING INSTRUMENTATION (Continued)

Variable	Range/Status	Type/ Category	Sensor Qualification Environmental	Sensor Qualification Seismic	Number of Channels	Control Room Display	Implementation Date	Sensor Power Supply	EOF Indication	TSC Indication	Conformance to RG 1.97, Rev. #2
Pressurizer Safety Valve Status	Open/Closed	B2,D2	Yes	Yes	1 per valve	1 Alarm CRT (ERFDADS)	Core Load	N-1E	Yes	Yes	Conforms
Pressurizer Heater Breaker Position	Open/Closed	D2	Yes	Yes	1 per bank	1 pair of lights per bank	Core Load	1E	Yes	Yes	Note e
Pressurizer Pressure	1700-2500 psig	B2	Yes	Yes	4 ~~per plant~~	QDPS 3 recorded	Core Load	1E	Yes	Yes	Conforms
RCP Status	On/Off	D2	No	No	1 per pump	1 pair of lights per pump	Core Load	N-1E	Yes	Yes	Conforms
Pressurizer Spray Valve Status	Open/Closed	D2	No	No	1 per valve	~~1 Light per Valve~~	Core Load	N-1E	Yes	Yes	Conforms
Charging ~~System~~ Flow	0-500 ~~gpm~~ gal/min	D2	Yes	Yes	1 ~~per plant~~	QDPS	Core Load	1E	Yes	Yes	Conforms
Letdown Flow	0-500 ~~gpm~~ gal/min	D2	Yes	Yes	1 ~~per plant~~	1 meter	Core Load	N-1E	Yes	Yes	Conforms
Volume Control Tank (VCT) Water Level	0-100% of span	D2	Yes	Yes	2 ~~per plant~~	1 meter	Core Load	1E	Yes	Yes	Conforms
CVCS Valve Status	Open/Closed	D2	Yes	Isolation Valves Only	1 per valve	1 pair of lights per valve	Core Load	1E/N-1E	Yes	Yes	Conforms (Note f)
Charging Pump Status	On/Off	D2	Yes	Yes	~~2 per plant~~ 1 per pump	1 pair of lights per pump	Core Load	1E	Yes	Yes	Conforms (Note f)
Boric Acid Transfer (BAT) Pump Status	On/Off	D2	Yes	Yes	~~2 per plant~~ 1 per pump	1 pair of lights per pump	Core Load	1E	Yes	Yes	Conforms (Note f)
RCP Seal Injection Flow	0-20 ~~gpm~~ gal/min	D2	Yes	Yes	1 per loop	QDPS 4 recorded	Core Load	1E	Yes	Yes	Conforms (Note f)

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TABLE 7.5-1

POST ACCIDENT MONITORING INSTRUMENTATION (Continued)

Variable	Range/Status	Type/ Category	Sensor Qualification Environmental	Seismic	Number of Channels	Control Room Display	Implementation Date	Sensor Power Supply	EOF Indication	TSC Indication	Conformance to RG 1.97, Rev. #2
SG Atmospheric PORV Status	0-100% Open	D2,E2	Yes	Yes	1 per valve	QDPS 1 meter per valve	Core Load	1E	Yes	Yes	Conforms
Main Steamline Isolation Valve Status	Open/Closed	B2,D2	Yes	Yes	1 per valve	1 pair of lights per valve	Core Load	1E	Yes	Yes	Conforms (Note f)
Main Steamline Bypass Valve Status	Open/Closed	B2,D2	Yes	Yes	1 per valve	1 pair of lights per valve	Core Load	1E	Yes	Yes	Conforms (Note f)
SC Safety Valve Status	Open/Closed	D2,E2	Yes	Yes	1 per valve	Alarm CRT (ERFDADS)	Core Load	N-1E	Yes	Yes	Conforms
Main Feedwater Control Valve Status	Open/Closed	D2	Yes	Yes	1 per valve	CRT (ERFDADS)	Core Load	1E	Yes	Yes	Conforms (Notes f, y)
Main Feedwater Control Bypass Valve Status	Open/Closed	D2	Yes	Yes	1 per valve	CRT (ERFDADS)	Core Load	1E	Yes	Yes	Conforms (Notes f, y)
Main Feedwater Isolation Valve Status	Open/Closed	D2	Yes	Yes	1 per valve	1 pair of lights per valve	Complete	1E	Yes	Yes	Conforms (Note f)
Main Feedwater Isolation ~~Valve~~ Bypass Valve Status	Open/Closed	D2	Yes	Yes	1 per valve	1 pair of lights per valve	Complete	1E	Yes	Yes	Conforms (Note f)
Main Feedwater Flow	0-5.0x10⁶ lbs/hr ~~0-100% of span~~	D2	Yes	Yes	3 per loop	QDPS 1 per loop recorded	Core Load	1E	Yes	Yes	Conforms
SG Blowdown Isolation Valve Status	Open/Closed	D2	Yes	Yes	1 per valve	1 pair of lights per valve	Complete	1E	Yes	Yes	Conforms (Note i)
SG Blowdown Samples Isolation Valve Status	Open/Closed	D2	Yes	Yes	1 per valve	1 pair of lights per valve	Complete	1E	Yes	Yes	Conforms (Note f)

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TABLE 7.5-1

POST ACCIDENT MONITORING INSTRUMENTATION (Continued)

Variable	Range/Status	Type/ Category	Sensor Qualification Environmental	Sensor Qualification Seismic	Number of Channels	Control Room Display	Implementation Date	Sensor Power Supply	EOF Indication	TSC Indication	Conformance to RG 1.97, Rev. #2	
~~Total~~ HHSI Flow	0-2000 gal/min	D2	Yes	Yes	2 per SI pump (hot leg, cold leg)	6 meters	Core Load	N-1E	Yes	Yes	Conforms	X
~~Total~~ LHSI Flow	0-~~5000~~ 3500 gal/min (hot leg) 0-5000 gal/min (cold leg)	D2	Yes	Yes	2 per SI pump (hot leg, cold leg)	6 meters	Core Load	N-1E	Yes	Yes	Conforms	X
ECCS Accumulator Pressure	0-700 psig	D2	Yes	Yes	2 per tank	6 meters	Core Load	N-1E	Yes	Yes	Conforms	
Auxiliary Feedwater Valve Status	Open/Closed	D2	Yes	Yes	1 per valve	1 pair of lights per valve	Core Load	1E	Yes	Yes	Conforms (Note f)	
Containment Spray Flow	0-100% of span	D2	Yes	Yes	1 per train	3 meters	Complete	N-1E	Yes	Yes	Conforms	40
Containment Spray System Valve Status	Open/Closed	D2	Yes	Yes	1 per valve	1 pair of lights per valve	Complete	1E	Yes	Yes	Conforms (Note f)	
Containment Spray Pump(s) Status	On/Off	D2	Yes	Yes	1 per pump	1 pair of lights per pump	Complete	1E	Yes	Yes	Conforms (Note f)	X
~~RCB~~ Reactor Containment Fan Cooler Differential Pressure/Status	3-4 in. water gage On/Off	D2	Yes	Yes	1 per fan	1 alarm per fan	Core Load	1E/N-1E	Yes	Yes	Note m	X
CCW Pump Discharge Pressure	0-150 psig	D2	Yes	Yes	1 per ~~header~~ train	~~3 meters~~ QDPS	Core Load	1E	Yes	Yes	Conforms (Note f)	X
Containment Ventilation ~~Damper~~ Valve Status	Open/Closed	D2	Yes	Yes	1 per ~~damper~~ valve,	1 pair of lights per ~~damper~~ valve	Core Load	1E	Yes	Yes	Conforms	X X X
CCW Header Temperature	~~0~~ 50-250°F	D2	Yes	Yes	1 per ~~header~~ train	~~3 meters~~ QDPS	Core Load	1E	Yes	Yes	Conforms	X
CCW Surge Tank Water Level	0-100% of span	D2	Yes	Yes	1 per tank compartment	~~3 meters~~ QDPS	Core Load	1E	Yes	Yes	Conforms (Note f)	X

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TABLE 7.5-1

POST ACCIDENT MONITORING INSTRUMENTATION (Continued)

Variable	Range/Status	Type/ Category	Sensor Qualification Environmental	Sensor Qualification Seismic	Number of Channels	Control Room Display	Implementation Date	Sensor Power Supply	EOF Indication	TSC Indication	Conformance to RG 1.97, Rev. #2
CCW Flow to ESF Components	0-~~100% of span~~ appropriate gal/min for component/header	D2	Yes	Yes	1 per ESF component, 1 per CCW header	QDPS	Core Load	1E	Yes	Yes	Conforms
CCW Valve Status	Open/Closed	D2	Yes	Yes	1 per valve	1 pair of lights per valve	Core Load	1E	Yes	Yes	Conforms (Note f)
ECW ~~Essential Cooling Water System~~ Flow To ESF Components	0-~~100% of span~~ appropriate gal/min for component/header	D2	Yes	Yes	1 per major ESF component	QDPS	Core Load	1E	Yes	Yes	Conforms (Note f)
~~Essential Cooling Water System~~ ECW Valve Status	Open/Closed	D2	Yes	Yes ~~(Isolation Valves Only)~~	1 per valve	1 pair of lights per valve or meter	Complete	1E/N-1E	Yes	Yes	Conforms (Note f)
ESF Environment Temperature	Temperature above setpoint	D2	Yes	Yes	1 per ESF component/ cubicle	1 alarm	Core Load	N-1E	Yes	Yes	Conforms (Note f)
ESF Cubicle Fan/Cooler Status	Fan Stopped/ Running	D2	Yes	Yes	1 per ESF component/ cubicle	1 pair of lights per item	Core Load	1E	Yes	Yes	Conforms (Note f)
Standby Power and Emergency Power Source Status	Bus Specific	D2	Yes	Yes	1 per bus	1 meter or alarm for each power source	Core Load	1E/N-1E	Yes	Yes	Conforms
Other Safety-Related Energy Sources	Component Specific	D2	Yes	Yes	1 per source	1 meter or alarm for each power source	Core Load	1E/N-1E	Yes	Yes	Conforms (Note y)
RHR Heat Exchanger Discharge Temperature	50-400°F	D2	Yes	Yes	1 per heat exchanger	QDPS 3 recorded	Core Load	1E	Yes	Yes	Conforms
RHR Flow	0-~~100% of span~~ 4000 gal/min	D2	Yes	Yes	1 per ~~RHR~~ train	QDPS 3 meters	Core Load	1E	Yes	Yes	Conforms

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POST ACCIDENT MONITORING INSTRUMENTATION (Continued)

Variable	Range/Status	Type/Category	Sensor Qualification Environmental	Sensor Qualification Seismic	Number of Channels	Control Room Display	Implementation Date	Sensor Power Supply	EOF Indication	TSC Indication	Conformance to RG 1.97, Rev. #2
RHR Valve Status	Open/Closed	D2	Yes	Yes (Isolation Valves Only)	1 per valve	1 pair of lights per valve	Core Load	1E/N-1E	Yes	Yes	Conforms (Note f)
Reactor Trip Breaker Position	Open/Closed	D2	Yes	Yes	1 per breaker	QDPS, 1 pair of lights per breaker	Complete	1E	Yes	Yes	Conforms (Note f)
Turbine Governor Valve Position	Open/Closed	D2	Yes	No	1 per valve	1 pair of lights per valve	Complete	N-1E	Yes	Yes	Conforms (Notes f,z)
Turbine Stop Valve Position	Open/Closed	D2	Yes	No	1 per valve	1 pair of lights per valve	Complete	N-1E	Yes	Yes	Conforms (Notes f,z)
Motor-Driven Auxiliary Feed-water Pump Status	On/Off	D2	Yes	Yes	1 per pump	1 pair of lights per pump	Core Load	1E	Yes	Yes	Conforms (Note f)
Auxiliary Feed-water Turbine Pump Status	0-~~5000 rpm~~ 3000 psig, Open/Closed	D2	Yes	Yes	1 ~~turbine speed~~ pump discharge pressure indicator, 1 per steam inlet valve	QDPS 1 meter, 1 pair of lights per valve	Core Load	1E	Yes	Yes	Conforms (Note f)
SI Pump Status	On/Off	D2	Yes	Yes	1 per pump	1 pair of lights per pump	Complete	1E	Yes	Yes	Conforms (Note f)
SI Valve Status	Open/Closed	D2	Yes	Yes	1 per valve	1 pair of lights per valve	Complete	1E	Yes	Yes	Conforms (Note f)
Essential Cooling Water Pump Status	On/Off	D2	Yes	Yes	1 per pump	1 pair of lights per pump	Complete	1E	Yes	Yes	Conforms (Note f)
CCW Pump Status	On/Off	D2	Yes	Yes	1 per pump	1 pair of lights per pump	Complete	1E	Yes	Yes	Conforms (Note f)

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TABLE 7.5-1

POST ACCIDENT MONITORING INSTRUMENTATION (Continued)

Variable	Range/Status	Type/ Category	Sensor Qualification Environ- mental	Seismic	Number of Channels	Control Room Display	Implemen- tation Date	Sensor Power Supply	EOF Indica- tion	TSC Indica- tion	Conformance to RG 1.97, Rev. #2
RHR Pump Status	On/Off	D2	Yes	Yes	1 per pump	1 pair of lights per pump	Complete	1E	Yes	Yes	Conforms (Note f)
SI Actuation Status	On/Off	D2	Yes	Yes	1 per ~~plant~~ actuation train	1 Alarm	Core Load	1E	Yes	Yes	Conforms
Containment Isolation Actuation Status	On/Off	D2	Yes	Yes	1 per ~~plant~~ actuation train	1 Alarm	Core Load	1E	Yes	Yes	Conforms
Control Room Radiation Level	10^{-1} to 10^{4} mR/hr (area)	E3	No	No	1 ~~per plant~~	CRT (RMS)	Core Load	N-1E	Yes	Yes	Note 1
	10^{-6} to 10^{-1} uCi/cc (intake air)	E2	Yes	Yes	2 ~~per plant~~	QPDS 2 meters 2 recorded	Core Load	1E	Yes	Yes	Conforms
Access Area Radiation	10^{-1} to 10^{4} R/hr	E3	Yes	No	1 per designated area	CRT (RMS)	Core Load	N-1E	Yes	Yes	Note 1
Condenser Vacuum Pump Radiation Level	10^{-6} to 10^{5} uCi/cc	E3	Yes	No	1 ~~per plant~~	CRT (RMS)	Core Load	N-1E	Yes	Yes	Note n
Concentration from Liquid Pathways											
SG Blowdown	10^{-6} to 10^{-1} uCi/cc	E2	Yes	No	1 per plant	CRT (RMS)	Core Load	N-1E	Yes	Yes	Note t
Cond. Polish	10^{-6} to 10^{-1} uCi/cc	E2	Yes	No	1 per plant	CRT (RMS)	Core Load	N-1E	Yes	Yes	Note t
Liquid Radwaste	10^{-6} to 10^{-1} uCi/cc	E2	Yes	No	1 per plant	CRT (RMS)	Core Load	N-1E	Yes	Yes	Note t
TGB Drain	10^{-6} to 10^{-1} uCi/cc	E2	Yes	No	1 per plant	CRT (RMS)	Core Load	N-1E	Yes	Yes	Note t

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TABLE 7.5-1

POST ACCIDENT MONITORING INSTRUMENTATION (Continued)

Variable	Range/Status	Type/Category	Sensor Qualification Environmental	Sensor Qualification Seismic	Number of Channels	Control Room Display	Implementation Date	Sensor Power Supply	EOF Indication	TSC Indication	Conformance to RG 1.97, Rev. #2
Effluent Path Flow Rate/Status											
SG Blowdown Flow	0-100% of span	E3	No	No	1 per plant	CRT (RMS)	Core Load	N-1E	Yes	Yes	Note q
Valve Status	Open/Closed	E2	Yes	No	1 per valve	1 pair of lights per valve	Core Load	N-1E	Yes	Yes	Notes q, w
Cond. Polish Flow	0-100% of span	E3	No	No	1 per plant	CRT (RMS)	Core Load	N-1E	Yes	Yes	Note q
Valve Status	Open/Closed	E2	Yes	No	1 per valve	1 pair of lights per valve	Core Load	N-1E	Yes	Yes	Notes q, w
Liquid Radwaste Flow	0-100% of span	E3	No	No	1 ~~per plant~~	CRT (RMS)	Core Load	N-1E	Yes	Yes	Note q
Valve Status	Open/Closed	E2	Yes	No	1 per valve	1 pair of lights per valve	Core Load	N-1E	Yes	Yes	Notes q, w
TGB Drain Flow	0-100% of span	E3	No	No	1 per plant	CRT (RMS)	Core Load	N-1E	Yes	Yes	Notes q
Valve Status	Open/Closed	E2	Yes	No	1 per plant	CRT (ERFDADS)	Core Load	N-1E	Yes	Yes	Notes q, w
Unit Vent Flow	0-100% of span	E2	Yes	No	1 ~~per plant~~	CRT ~~(RMS)~~ [ERFDADS]	Core Load	N-1E	Yes	Yes	Note w
Condenser Vacuum Pump Flow	0-100% of span	E3	No	No	1 ~~per plant~~	CRT (RMS)	Core Load	N-1E	Yes	Yes	Note v
Pump Status	On/Off	E2	Yes	No	1 ~~per plant~~ [per pump]	CRT (ERFDADS)	Core Load	N-1E	Yes	Yes	Notes v, w
Meteorological Parameters	~~N/A~~ (see table 2.3-23)	E3	No	No	15 ~~per plant~~	CRT (ERFDADS)	Core Load	N-1E	Yes	Yes	Note u, l

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TABLE 7.5-1

POST ACCIDENT MONITORING INSTRUMENTATION (Continued)

Variable	Range/Status	Type/Category	Sensor Qualification Environmental	Sensor Qualification Seismic	Number of Channels	Control Room Display	Implementation Date	Sensor Power Supply	EOF Indication (EOC)	TSC Indication	Conformance to RG 1.97, Rev. 2
Containment Sump and Atmospheric Sampling	N/A	E3	No	No	1 post accident sampling system ~~per plant~~	CRT (ERFDADS)	Core Load	N-1E	Yes	Yes	Notes d, h
Boric Acid Tank Charging Flow	----	----	----	----	----	----	----	----	----	----	Note g
Containment Atmospheric Temperature	----	----	----	----	----	----	----	----	----	----	Note i
Accumulator Tank Level	----	----	----	----	----	----	----	----	----	----	Note j
Containment Sump Water Temperature	----	----	----	----	----	----	----	----	----	----	Note k
Heat Removal by the Containment Fan Heat Removal System	----	----	----	----	----	----	----	----	----	----	Note m
Emergency Ventilation Damper Position	----	----	----	----	----	----	----	----	----	----	Note p

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TABLE 7.5-1 (Continued)

NOTES

a. Noble Gas: 10^{-6} to 10^{5} μCi/cc, Particulate: 10^{-11} to 10^{2} μCi/cc, Halogens: 10^{-11} to 10 μCi/cc.

To cover the required range of particulates and halogens, a combination of on-line detection and grab sample capability with onsite analysis is employed. These monitors are environmentally qualified, but not seismically qualified, since they are attached to a non-seismic system.

b. RCS Pressure - one qualified channel of wide range RCS pressure and two qualified channels of extended range RCS pressure are used to monitor RCS pressure for STP.

c. Containment Isolation Valve Status - STP has identified instrumentation that is necessary to assess the process of accomplishing or maintaining critical safety functions. The critical safety functions defined are equivalent to those utilized in the Westinghouse Owners Group Emergency Response Guidelines, i.e., ~~Reactivity Control~~ Subcriticality, RCS ~~Pressure Control~~ Integrity, Reactor Coolant Inventory ~~Control~~, Reactor Core Cooling, Heat Sink Maintenance, and ~~Reactor~~ Containment Environment. Containment isolation valve status is not a critical safety function. However, the containment isolation valve positions were designated variables for monitoring the actual gross breach of the containment and are therefore qualified to category 2 criteria. 40

d. The STP Post-Accident Sampling System is sufficient for obtaining samples to perform detailed analysis of RCS coolant, containment sump, and containment atmospheric activity. Offline measurement systems are considered Category 3 variables.

e. Pressurizer Heater Status - RG 1.97, Rev. 2 specified that heater current was the preferred parameter for determining heater status. For STP, heater breaker position was selected for determining pressurizer heater status due to hardware considerations. Breaker position provides adequate indication to the operator to ensure that the two pressurizer heater banks powered from the Class 1E busses are operable.

f. The study performed on STP indicated that these parameters were ~~included~~ needed in the minimum set of parameters necessary to monitor the performance of:

   1. Plant safety systems employed 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 systems.

   2. Systems normally employed for attaining a cold shutdown condition.

g. Boric Acid Tank Charging Flow - For monitoring the performance of the Emergency Core Cooling System (ECCS), STP has designated Refueling Water Storage (RWST) Tank Level, High-Head Safety Injection (HHSI) Flow,

TABLE 7.5-1 (Continued)

NOTES

Low Head Safety (LHSI) Injection Flow, Containment Water Level, and ECCS Valve Status. Since the ECCS does not take suction from the Boric Acid Tank (BAT), the Boric Acid Charging Flow was not designated a key variable. If the operator uses the BAT for boration following an accident, normal charging flow and RCS sampling is used to demonstrate that the RCS is being borated.

h. Data entry is via manual keyboard.

i. Containment Atmospheric Temperature - The WOG Emergency Response indication Guidelines (ERG) do not require the operator to take an action that would result in adverse consequences if the Containment temperature was ~~indi-~~ providing ~~cating~~ an erroneous value. As such, the Containment temperature indication is considered a D3 parameter and is not specifically identified on this listing.

j. Accumulator pressure indication and valve position indication for the accumulator discharge isolation valves and accumulator vent valves provide adequate status of the accumulators.

k. Containment sump water temperature indication is not utilized by the operator to take corrective action. Other parameters were designated as STP type D variables to demonstrate that the Safety Injection System (SIS) is operating properly when taking suction from the Containment sump. 40

l. Conforms to RG 1.97, Rev. 3.

m. Heat removal by the Containment Heat Removal System (CHRS) - Other parameters were designated as STP type D variables to demonstrate that the containment heat removal systems are operating properly. These include the following:

- Containment Spray Flow
- Containment Spray System (CSS) valve status
- Containment Pressure
- Containment Water Level
- Containment Spray Pump Status
- Reactor Containment Fan Cooler (RCFC) Differential Pressure
- RCFC Status

n. Condenser Vacuum Pump Radiation Monitor - This parameter is considered to be a backup variable for the measurement of secondary side radiation.

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TABLE 7.5-1 (Continued)

NOTES

Main steamline radiation monitors are adequate to provide primary indication of this information. The condenser vacuum pump radiation monitor is environmentally qualified, but not seismically qualified, since it is attached to a non-seismic system.

o. The STP design utilizes four physically separate auxiliary feedwater lines. The four Class 1E transmitters provide the redundancy required. The requirement is to ensure flow to at least one intact steam generator post-accident. The required redundancy with a four loop plant is provided by one channel per loop. SG Level Wide Range provides a diverse backup. Total AFW flow (0-1800 gpm) is also displayed via the QDPS.

p. Emergency Ventilation Damper Position - As an alternate to monitoring ventilation damper position, STP monitors radiogas, radioparticulate, and/or radio~~halogen~~ iodine concentrations at various locations in the plant which provide information concerning the status of the ventilation system. These parameters include:

- Area radiation in locations which contain, or could contain, significant quantities of radioactive material
- Unit vent radiogas concentration
- Radiogas concentration discharged from non-headered vents
- Environs radiation
- Fuel handling building vent radiation
- Effluent path flow rate

q. Effluent Path Flow Rate/Status - Variables which provide the operator with information to estimate the magnitude of release of radioactive materials through identified pathways. Valve status is the primary variable and flow rate is a backup variable.

r. Neutron Flux - No diverse variable is required since the failure of one channel will not cause the operator to violate the required safety function.

s. Two Containment high range monitors meet the requirements of a Type A variable. These monitors are Class 1E, redundant and fully qualified to Category 1 requirements. Six area monitors are located throughout Containment with the range of 0.1 to 10,000 mR/hr that provide additional monitoring over this range. In addition, the off-scale high readings of the low range monitors provide some information to resolve ambiguity above this range. These two qualified high range radiation monitors also satisfy the requirements of NUREG-0737.

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TABLE 7.5-1 (Continued)

NOTES

t. The study performed on STP indicated that these parameters were included in the minimum set of parameters necessary to monitor for release of radioactivity via liquid effluent pathways. These monitors are environmentally qualified, but not seismically qualified since they are attached to non-seismically qualified systems.

u. Meets requirements of RG 1.23.

v. For the purpose of radiological release calculations, the conservative assumption of maximum flow will be utilized. Actual flow indication serves as a backup parameter and is designated Category 3.

w. These Category 2 sensors are environmentally, but not seismically qualified, since they are attached to a non-seismic system. 40

x. Rod position indication is provided in the CR via the digital rod position indication system light emitting diode (LED) display.

y. Instrument loops on Class 1E systems are qualified up to and including channel isolation devices.

z. These Category 2 sensors are environmentally and seismically qualified; however, they are installed in a non-seismic system and are therefore not listed as seismically qualified instruments. They are installed using mountings similar to those used for comparable seismically qualified equipment. X

DELETE (PER SAR C/R 406, ALREADY APPROVED) TABLE TO BE DELETED

TABLE 7.5-2

MAIN CONTROL BOARD INDICATORS AND/OR RECORDERS AVAILABLE TO THE OPERATOR
CONDITION IV EVENTS

Parameter	No. of Channels Available	Required	Range	Accuracy Required	Indicator/Recorder	Purpose
1. Containment Pressure	2	1	0-115% of design pressure	±10% of full scale	Both channels indicated; 1 recorded	Monitor post-LOCA Containment conditions
2. Refuleing Water Storage Tank Water Level	2	1	0-100% of span	±3% of level span	Both channels indicated; 1 recorded	Ensure that water is flowing to the Safety Injection System after a LOCA; determine when to shift from injection to recirculation mode
3. Steam Generator Water Level (narrow range)	1/SG	*	+7 to -5 ft from from nominal full load level	±10% of level span **	All channels indicated; channels used for control are recorded	Detect SG tube rupture; monitor SG water level following a steam line break
4. Steam Generator Water Level (wide range)	1/SG	*	+7 to -41 ft from nominal full load level	±20% of level span	All channels recorded	Detect SG tube rupture; montor SG water level following a steam line break
5. Steam Line Pressure	2/steam line	1/steam line	0-1,300 psig	±6% of full scale	Both channels indicated; 1/steam line recorded	Monitor steam line pressures following SG tube rupture or steam line break
6. Pressurizer Water Level	2	1	Entire distance between taps	Indicate that level is somewhere between 0 and 100% of span***	Both channels indicated; 1 recorded	Indicate that water has returned to the pressurizer following cooldown after SG tube rupture or steam line break
7. Containment Radiation Level	2	1	10^2 to 10^8 mR/hr	15%	Both channels indicated; 1 recorded	Monitor and indicate radiation in Containment
8. Containment H_2 Concentration	2	2	0 to 8%	±5%	Both indicated; 1 recorded	Monitor and indicate hydrogen concentration in Containment

* One level channel per SG (either wide or narrow range) with at least two wide-range channels for the plant.

** For the steam break, when the water level channel is exposed to a hostile environment, the accuracy required can be relaxed. The indication need convey to the operator only that water level in the SG is somewhere between the narrow-range SG water level taps.

*** Indicated water level should be above the pressurizer heaters and below 100% of span (approximately 25% of span).

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TABLE 7.5-2 (Continued)

MAIN CONTROL BOARD INDICATORS AND/OR RECORDERS AVAILABLE TO THE OPERATOR
CONDITION IV EVENTS

Parameter	No. of Channels Available	No. of Channels Required	Range	Accuracy Required	Indicator/Recorder	Purpose
9. Control Room Radiation Level	2	1	1×10^{-6} 1×10^{-1} µCi/cc	10%	Both indicated; 1 recorded	Monitor and indicate gaseous radioactive concentration in the air intake duct
10. Fuel-Handling Building Ventilation Radiation Level	2	1	1×10^{-6} to 1×10^{-1} µCi/cc	10%	Both indicated; 1 recorded	Monitor and indicate gaseous radioactivity in the ventilation exhaust

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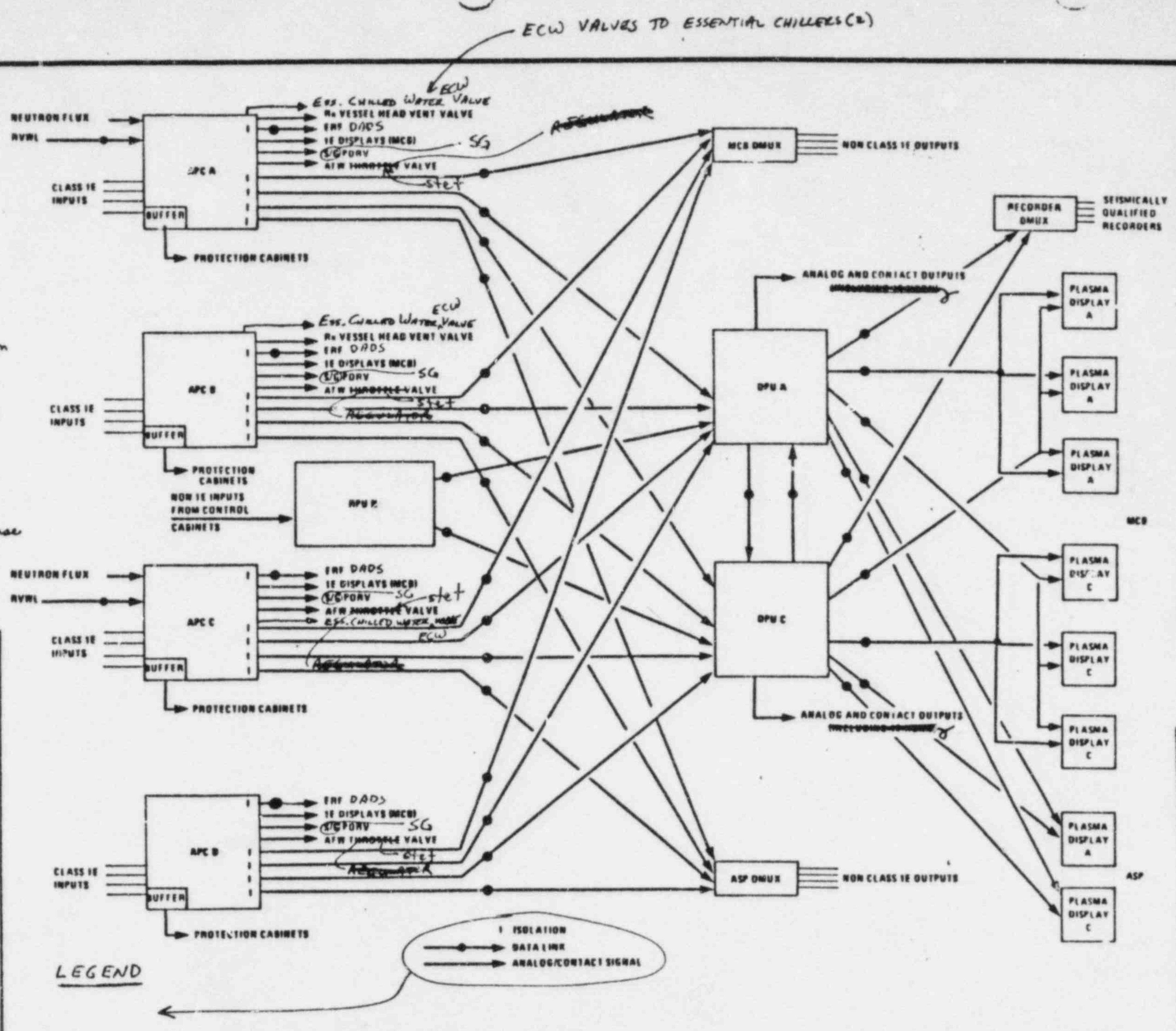

ACRONYMS

RVWL Reactor Vessel Water Level
APC Auxiliary Process Cabinet
Rx Reactor
MCB Main Control Board
ASP Auxiliary Shutdown Panel
RPU Remote Processing Unit
DPU Database Processing Unit
ERF DADS Emergency Response Facilities Data Acquisition & Display System

SOUTH TEXAS PROJECT UNITS 1 & 2

QUALIFIED DISPLAY PROCESSING SYSTEM BLOCK DIAGRAM

Figure 7.5.6-1

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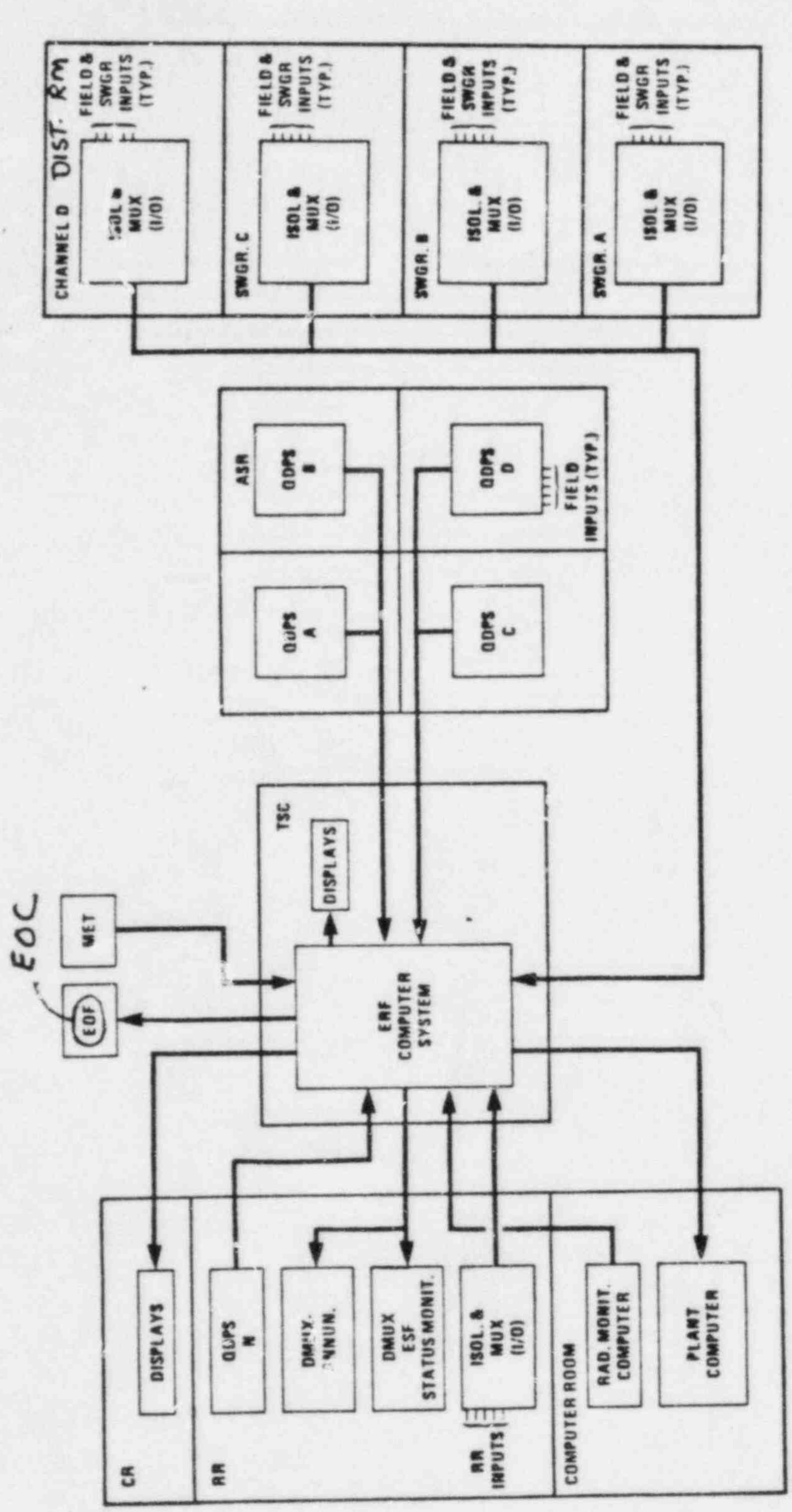

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SOUTH TEXAS PROJECT
UNITS 1 & 2

ERF DADS
CONCEPTUAL INTERCONNECTION
DIAGRAM

Figure 7.5.7-1

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Chapter 7

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Chapter 7

Appendix 7B

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Move to page 7B-i below 7B.1.3

7B.1 DISCUSSION

An analysis was conducted to develop a response to Regulatory Guide (RG) 1.97, Rev. 2. This analysis identified the appropriate variables and established appropriate design bases and qualification criteria for instrumentation employed by the control room operator during and following an accident.

This design basis establishes the key and preferred backup variables to be monitored by the control room operating staff of the South Texas Project (STP) following the initiation of an accident. The design basis recognizes the variables essential to the control room staff up to the time other Emergency Operating Facilities (EOFs) are manned as well as the information essential to the control room staff in subsequently controlling the plant and proceeding to safe shutdown conditions. Also included, to aid the system designer are criteria for determining the requirements for the instruments used to monitor these variables.

The selection of variables was integrated with the Westinghouse Owners Group (WOG) Emergency Response Guidelines (ERGs) in accordance with the guidance on integration of emergency response capability elements outlined in NUREG-0737, Supplement 1 (See Appendix 7A, Item S.3).

This was accomplished by performing a task analysis based upon the WOG ERGs to identify those variables necessary for implementation of the guidelines. The 40
Optimal Recovery Guidelines (ORGs) were reviewed to determine those Type A Q32.
variables necessary to (a) perform diagnosis, (b) take preplanned manually 18
controlled actions and (c) take actions necessary to reach and maintain a controlled condition. The Critical Safety Function (CSF) Status Trees were reviewed to determine those Type B variables necessary for the operator to determine if a Functional Restoration Guideline (FRG) should be implemented. Furthermore, the FRGs were reviewed to determine those Type B variables necessary to assess the process of accomplishing or maintaining CSFs, i.e., subcriticality, reactor core cooling, heat sink maintenance, RCS integrity, containment environment and RCS inventory. The ERGs were also reviewed to determine those Type D variables necessary for (a) monitoring those plant safety systems employed for mitigating the consequences of an accident and subsequent plant recovery and (b) other systems normally employed for attaining a cold shutdown condition. Finally, the ERGs were reviewed to determine those Type E variables necessary to (a) determine the accessability of areas at the plant following an accident and (b) continually assess the release of radioactive materials due to the accident.

Utilization of this task analysis process ensures that the plant information utilized by the plant operators following an accident to implement the STP Emergency Operating Procedures (EOPs) is obtained from specially designed and qualified instrumentation as defined in this design basis.

The WOG ERGs, the results of the Control Room Design Review (see Appendix 7A, Item I.D.1), and the interpretation of RG 1.97 Revision 2, as described in this Appendix, will be used to develop STP EOPs that are human factored, function oriented, and integrated with the plant design.

The detailed methodology for the handling of displays was addressed in the design of the Qualified Display Processing System (QDPS) and in conjunction with the Control Room Design Review programs to address NUREG-0696 and NUREG-0700 (See Appendix 7A, Item S.5). Section 7B.3 describes interface criteria which must be satisfied for the display methodology to meet the intent of RG 1.97 Revision 2 and this design basis. X

7B.1.1 Planned Versus Unplanned Operator Actions 40 Q32.18

The plant safety analyses and evaluations define the design basis accident event scenarios for which preplanned operator actions are required. Accident monitoring instrumentation is necessary to permit the operator to take required actions to address these analyzed situations. However, instrumentation is also necessary for unplanned situations (i.e., to ensure that, should plant conditions evolve differently than predicted by the safety analyses, the operator has sufficient information to monitor the course of the event). Additional instrumentation is also needed to indicate to the operator whether the integrity of the fuel clad, the Reactor Coolant System (RCS) pressure boundary, or the reactor containment has degraded beyond the prescribed limits defined as a result of the plant safety analyses and other evaluations. Such additional requirements are considered by this design basis.

7B.1.2 Variables Types

Five classifications of variables have been identified. Operator manual actions identified in the operating procedures, associated with design basis accident events, are preplanned. Those variables that provide information needed by the operator to perform these manual actions are designated Type A. The basis for selecting Type A variables is given in Section 7B.2.2.1.

Those variables needed to assess that the plant critical safety functions are being accomplished or maintained, as identified in the plant safety analysis and other evaluations, are designated Type B. 40

Variables used to monitor for the significant breach or the potential significant breach of fuel clad, the RCS pressure boundary, or the reactor containment, are designated Type C. Type C variables used to monitor the potential breach of containment have an arbitrarily-determined, extended range. The extended range is chosen to minimize the probability of instrument saturation even if conditions exceed those predicted by the safety analysis. The response characteristics of Type C information display channels allow the control room operator to detect conditions indicative of significant failure of any of the three fission product barriers or the potential for significant failure of these barriers. Although variables selected to fulfill Type C functions may rapidly approach the values that indicate an actual significant 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 information display channels.

Those variables needed to assess the operation of individual safety systems and systems normally used to attain cold shutdown are designated Type D.

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The variables that are required for use in determining the magnitude of release and continually assessing any releases of radioactive materials are designated Type E.

The five classifications are not mutually exclusive in that a given variable (or instrument) may be included in one or more types. The cross-referencing of variable to type is given in Table ~~7B.9-1.~~ 7.5-1

Table ~~7B.10-1~~ 7B.1-1 identifies the instruments utilized at STP which address the recommendations of both NUREG-0737 and RG 1.97 Revision 2. The instruments identified meet the intent of the guidance provided in NUREG-0737.

7B.1.3 Design and Qualification Criteria

Three categories of design and qualification criteria have been identified. The differentiation is made in order that an importance of information hierarchy can be recognized in specifying post-accident monitoring instrumentation. Category 1 instrumentation has the highest pedigree and should be utilized for primary information which the operator should use for preplanned manual actions and determining the state of the plant. Category 2 and 3 instruments are of lesser importance in determining the status of the plant and do not require the same level of operational assurance. 40

The primary differences between category requirements are in qualification, application of the single failure criterion, power supply, and display requirements. Category 1 requires seismic and environmental qualification, the application of a single failure criterion, utilization of emergency standby power, and an immediately accessible display. Category 2 requires qualification commensurate with the required function but does not require the single failure criterion, emergency standby power, or an immediately accessible display. Category 2 requires, in effect, a rigorous performance verification for a single instrument channel. Category 3 does not require qualification, single failure criterion, emergency standby power, or an immediately accessible display.

Editors - pls put in order by section of NUREG-0737 as shown in circles for better readability

Note: Table moved from p 7B.10-1 to 7B.1-4

TABLE 7B.~~10-1~~ 1-1

NUREG-0737 CONFORMANCE (lowercase)

Applicable Section of NUREG-0737	Variable
(2) II.D.3	Pressurizer PORV and Safety Valve Status
(7) II.F.1 Attachment 4	Containment Pressure (Extended Range)
(8) II.F.1 Attachment 5	Containment Water Level (Wide Range and Narrow Range)
(9) II.F.1 Attachment 6	Containment H_2 Concentration
(10) II.F.2	Core Exit Temperature
	Reactor Vessel Water Level
	RCS Subcooling
(1) I.D.2	Emergency Response Facilities
	Data Acquisition and Display
(3) I.E.1.2	Auxiliary Feedwater Flow
(6) II.F.1 Attachment 3	Containment ~~Area~~ Radiation (High Range)
(5) II.F.1 Attachment 2	Unit Vent Sample Condenser Vacuum Pump Sample
(4) II.F.1 Attachment 1	Unit Vent ~~Activity~~
	Condens~~ate~~er Vacuum Pump ~~Effluent~~
	~~Main~~ Steamline Radiation
(11) II.K.1.5	ECCS and Other Systems Valve Status

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7B.2 DEFINITION OF VARIABLE TYPES

7B.2.1 Definitions

7B.2.1.1 Design Basis Accident Events. Design basis accident events are those events, any one of which may occur during the lifetime of a particular plant, and those events not expected to occur but postulated because their consequences would include the potential for release of significant amounts of radioactive gaseous, liquid, or particulate material to the environment. Excluded are those events (defined as "normal" and "anticipated operational occurrences" in 10CFR50) expected to occur more frequently than once during the lifetime of a particular plant. The limiting accidents that were used to determine instrument functions are: 1) LOCA, 2) Steamline Break, 3) Feedwater Line Break, and 4) Steam Generator Tube Rupture.

7B.2.1.2 Safe Shutdown (Hot Standby). The state of the plant in which the reactor is subcritical such that K_{eff} is less than or equal to 0.99 and the RCS temperature is greater than or equal to 350°F.

7B.2.1.3 Cold Shutdown. The state of the plant in which the reactor is subcritical such that K_{eff} is less than or equal to 0.99, the RCS temperature is less than 200°F, and the RCS pressure is less than or equal to 10CFR50 Appendix G limits.

7B.2.1.4 Controlled Condition. The condition that is achieved when the plant has been stabilized using the ORGs, ~~and~~ the recovery procedures are being implemented and the critical safety functions are being accomplished or maintained by the control room operator. 40

7B.2.1.5 Critical Safety Functions. Those safety functions that are essential to prevent a direct and immediate threat to the health and safety of the public. These are the accomplishing or maintaining of:

1. subcriticality
2. reactor core cooling
3. heat sink maintenance
4. RCS integrity
5. containment environment
6. RCS inventory

7B.2.1.6 Immediately Accessible Information. Information that is visually available to the control room operator, or is accessible through the execution of the EOPs.

7B.2.1.7 Primary Information. Information that is essential for the direct accomplishment of the preplanned manual actions specified in the ERGs; it does not include those variables that are associated with contingency actions.

7B.2.1.8 Key Variables. Those variables which provide the most direct measure of the information required.

7B.2.1.9 Backup Information. Backup information is that information, made up of additional variables beyond those classified as key, that provides supplemental and/or confirmatory information to the operator. Backup variables do not provide an indication which is as reliable or complete as that provided by primary variables, and they should not be relied upon as the sole source of information. Those backup variables which should be first consulted by the operator are designated as preferred backup variables.

7B.2.2 Variable Functions

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

7B.2.2.1 Type A. Type A variables are those variables that provide the primary information required to permit the control room operating staff to:

- Perform the diagnosis specified in WOG ERGs
- Take the specified preplanned manually controlled actions, for which no automatic control is provided, that are required for safety systems to accomplish their safety function in order to recover from the Design Basis Accident (DBA) Event, and 40
- Reach and maintain a safe shutdown condition.

The verification of the actuation of safety systems have been excluded from the definition of Type A. The variables which provide this verification are included in the definition of Type D.

Variables in Type A are restricted to preplanned actions for DBA events.

7B.2.2.2 Type B. Type B variables are those variables that provide to the control room operating staff information to assess the process of accomplishing or maintaining critical safety functions, i.e., subcriticality, reactor core cooling, heat sink maintenance, RCS integrity, containment environment, and RCS inventory. The WOG contingency guidelines which go beyond the design basis were reviewed for additional variables which may be utilized as variable types B, C, D, and E.

7B.2.2.3 Type C. Type C variables are those variables that provide the control room operating staff information (1) to monitor the extent to which variables which indicate the potential for causing a significant breach of a fission product barrier have exceeded the design basis values and (2) that the fuel clad, the reactor coolant system pressure boundary (RCPB) or the reactor containment may have been subject to significant breach. Excluded are those associated with monitoring of radiological release from the plant which are included in Type E.

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

7B.2.2.4 Type D. Type D variables are those variables that provide to the control room operating staff sufficient information to monitor the performance of:

1. Plant safety systems employed for mitigating the consequences of an accident and subsequent plant recovery to attain a safe shutdown condition. (These include verification of the automatic actuation of safety systems). 40

2. Systems normally employed for attaining a cold shutdown condition.

7B.2.2.5 Type E. Type E variables are those variables that provide to the control room operating staff information to:

1. Monitor the habitability of the control room,

2. Monitor plant areas where access may be required to service equipment necessary to monitor the progress of or mitigate the consequences of an accident,

3. Estimate the magnitude of release of radioactive materials through identified pathways, and continually assess such releases, and

4. Monitor radiation levels and radioactivity in the environment surrounding the plant (via portable monitors).

7B.3 CRITERIA

7B.3.1 General Requirements

The following design and qualification criteria are applied to instrumentation for Type A, B, C, D and E variables. These are summarized in Tables 7B.3-1 and 7B.3-2.

7B.3.2 Equipment Design and Qualification Criteria.

The qualification requirements of the Type A, B, C, D, and E accident monitoring instrumentation are subdivided into three categories (1, 2, 3). Descriptions of the three categories are given below. Table 7B.3-2 briefly summarizes the design and qualification requirements of the three designated categories.

7B.3.2.1 Design and Qualification Criteria - Category 1.

7B.3.2.1.1 Selection Criteria - Category 1: The selection criteria for Category 1 variables have been subdivided according to the variable type. For Type A, those key variables used for diagnosis or providing information for necessary operator action have been designated Category 1. For type B, those key variables which are used for monitoring the process of accomplishing or maintaining critical safety functions have been designated Category 1. For Type C, those key variables which are used for monitoring the potential for breach of a fission product barrier have been designated Category 1. X 40

7B.3.2.1.2 Qualification Criteria - Category 1: The instrumentation is environmentally and seismically qualified as discussed in ~~accordance with FSAR~~ Sections 3.11 and 3.10, respectively. Instrumentation continues to read within the required accuracy following but not necessarily during a seismic event. At least one instrumentation channel~~s~~ is qualified from sensor to display. For the balance of instrumentation channels, qualification applies up to and including the channel isolation device. (Refer to Section 7B.3.3 in regard to extended range instrumentation qualification). X X

7B.3.2.1.3 Design Criteria - Category 1:

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 condition of or result from a specific accident, prevents the operator from being presented the required information. Where failure of one accident monitoring channel results in information ambiguity (e.g., the redundant displays disagree), additional information is provided to allow the operator to analyze the actual conditions in the plant. This is accomplished by providing additional independent channels of information of the same variable (addition of an identical channel), or by providing independent channels which monitor different variables which bear known relationships to the multiple channels (addition of a diverse channel(s)). Redundant or diverse channels are electrically independent and physically separated from each other, to the extent practicable with train separation, and from equipment not classified as ~~non~~safety-related in accordance with RG 1.75. X

For situations such as isolation valves in series, the intent is generally to verify the isolation function. In such a situation a single indication on each valve is sufficient to satisfy the single failure criterion if those indications are from different trains (i.e., unambiguous indication of isolation).

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

2. The instrumentation is energized from station emergency standby power sources, battery backed where momentary interruption is not tolerable, as ~~provided in~~ required by RG 1.32.

3. 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.

4. 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 generating station shutdowns, a capability for testing during power operation is provided. 40

5. Whenever means for removing channels from service are included in the design, the design facilitates administrative control of the access ~~of~~ to such removal means.

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

7. The monitoring instrumentation design utilizes human-factored displays to minimize indications potentially confusing to the operator.

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

9. 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.

10. Periodic checking, testing, calibration, and calibration verification are in accordance with the applicable portions of RG 1.118.

11. The range selected for the instrumentation encompasses the expected operating range of the variable being monitored to the extent that saturation does not negate the required action of the instrument in accordance with the applicable portions of RG 1.105.

7B.3.2.1.4 <u>Information Processing and Display Interface Criteria - Category 1</u>: The interface criteria specified here provide~~s~~ requirements implemented in the establishment of the design basis for processing and displaying of the information.

1. The operator has immediate access to the information from redundant or diverse channels in the units familiar to the operator (e.g., for a temperature reading, degrees not volts). Where two or more instruments are needed to cover a particular range, overlapping of instrument spans are provided.

INSERT A

2. ~~A historical record of a minimum of one instrumentation channel for each process variable is maintained.~~ A recorded pre-event history for these channels is required for a minimum of one hour and continuous recording of these channels is required following an accident until such time as continuous recording of such information is no longer deemed necessary. This recording is available when required, but need not be immediately accessible. One hour was selected based on a representative slow transient which is bound (bounded) by this time requirement. A one-half inch equivalent break area Loss-of-Coolant Accident (LOCA) was selected since trip occurs at approximately fifty minutes after break initiation. Where direct and immediate trend or transient information is essential for operator information or action, the recording is immediately accessible.

7B.3.2.2 Design and Qualification Criteria - Category 2.

7B.3.2.2.1 Selection Criteria - Category 2: The selection criteria for Category 2 variables are subdivided according to the variable type. For Types A, B, and C, those variables which provide preferred backup information are designated Category 2. For Type D, those key variables that are used for monitoring the performance of safety systems, are designated Category 2. For Type E, those key variables to be monitored for use in determining the magnitude of the release of radioactive materials and for continuously assessing such releases, are designated Category 2. 40

7B.3.2.2.2 Qualification Criteria - Category 2: Category 2 instrumentation is qualified from the sensor up to and including the channel isolation device for at least the environment (seismic and/or environmental) in which it must operate to serve its intended function. Instrumentation associated with those safety-related systems that are required to operate following a Safe Shutdown Earthquake (SSE) to mitigate a consequential plant incident are seismically qualified in accordance with IEEE-344-1975. Category 2 instrumentation is environmentally qualified in accordance with IEEE-323-1974.

7B.3.2.2.3 Design Criteria - Category 2:

1. Category 2 instrumentation associated with those safety-related systems that are required to operate following an SSE to mitigate a consequential plant incident are energized from a ~~seismically qualified~~ (highly reliable) power source, not necessarily the emergency standby power, which is battery-backed where momentary interruption is not tolerable. ~~Otherwise the instrumentation is energized from a highly reliable on site power source, not necessarily the emergency standby power, which is battery backed where momentary interruption is not tolerable.~~

2. 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.

INSERT 'A'

2. The Qualified Display Processing System (QDPS) provides control room indication via plasma display units which meet the category 1 qualification requirements. Displays of category 1 variables are immediately accessible to the operator via a single pushbutton action on the QDPS plasma display units. These variables will be displayed when needed by the operator through execution of the Emergency Operating Procedures. The information displayed on the plasma display units is the single "most probable value" based on automated signal limit checks and redundant sensor algorithms, which relieve the operator of the burden of valid data selection. Individual sensor values are available on lower level displays.

3. In addition to the QDPS plasma display units, seismically qualified recorders provide continuous indication and a historical record for at least one channel of each category 1 variable. These recorders are located in the control room.

(continue now with mat'l on p. 7B.3-3)

7B.3.2.3.3 Design Criteria - Category 3:

1. 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 generating station shutdowns, a capability for testing during power operation is provided.

2. Whenever means for removing channels from service are included in the design, the design facilitates administrative control of the access to such removal means.

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

4. The monitoring instrumentation utilizes human-factored displays to minimize indications potentially confusing to the operator.

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

6. 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.

7B.3.2.3.4 Information Processing Display, Interface Criteria - Category 3: The interface criteria specified here provide requirements considered in the establishment of the design basis for processing and displaying of the information. 40

The instrumentation signal is, as a minimum, processed for display on demand. Recording requirements are variable specific and are determined on a case-by-case basis.

7B.3.3 Extended Range Instrumentation Qualification Criteria

The qualification environment for extended range information display channel components are based on the design basis accident events, except the assumed maximum of the value of the monitored variable is the value equal to the specified maximum range for the variable. The monitored variable is assumed to approach this peak by extrapolating the most severe initial ramp associated with the DBA Events. The decay for this variable is considered proportional to the decay for this variable associated with the DBA Events. No additional qualification margin needs to be added to the extended range variable. The environmental envelopes, except that pertaining to the variable measured by the information display channel, are those associated with the DBA Events. The environmental qualification requirement for extended range equipment does not account for steady-state elevated levels that may occur in other environmental parameters associated with the extended range variable. For example, a sensor measuring containment pressure must be qualified for the measured process variable range (i.e., 3 times design pressure for concrete

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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. ~~of the FSAR.~~ The extended range requirement is to ensure that the equipment will continue to provide information if conditions degrade beyond those postulated in the safety analysis. Since extended variable ranges are nonmechanistically determined, extension of associated parameter levels is not justifiable and is therefore not required. 40

Table 7B.3-1

Summary of Selection Criteria

TYPE	CATEGORY 1	CATEGORY 2	CATEGORY 3
A	KEY variables that are used for diagnosis or providing information for necessary operator action.	Variables which provide PREFERRED BACKUP information.	None
B	KEY variables that are used for monitoring the process of accomplishing or maintaining critical safety functions.	Variables which provide PREFERRED BACKUP information.	Variables which provide BACKUP information.
C	KEY variables that are used for monitoring the potential breach of a fission product barrier.	Variables which provide PREFERRED BACKUP information.	Variables which provide BACKUP information.
D	None	KEY variables which are used for monitoring the performance of plant systems used to attain a controlled plant condition or a safe shutdown condition.	Variables which provide PREFERRED BACKUP information ~~which are used~~ for use in monitoring the performance of plant systems used to attain a controlled plant condition or a safe shutdown condition.
E	None	KEY variables to be monitored for use in determining the magnitude of the release of radioactive materials and for continuously assessing such releases.	Variables to be monitored which provide PREFERRED BACKUP information for use in determining the magnitude of the release of radioactive materials and for continuously assessing such releases.

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Table 7B.3-2

Summary of Design, Qualification, and Interface Requirements

all caps

Qualification	Category 1	Category 2	Category 3
Environmental	Yes	As appropriate (1)	No
Seismic	Yes	As appropriate (1)	No
Design			
Single Failure	Yes	No	No
Power Supply	Emergency Standby	Reliable	As Required
Channel out of Service	Technical Specifications	Technical Specifications	No
Testability	Yes	Yes	As Required
Interface			
Minimum Indication	Immediately Accessible	Demand	Demand
Recording	Yes	As Required	As Required
Quality Assurance			
Program Requirements	10CFR50 Appendix B	~~Graded Program~~ Per (2)	Not Applicable

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(1) Category 2 instrumentation shall be qualified from the sensor up to and including the channel isolation device for at leas the environment (seismic and/or environmental) in which it must operate to serve its intended function

(2) The quality assurance requirements that are implemented should provide control over activities affecting quality to an extent consistent with the importance to safety of the instrumentation.

7B.4 TYPE A VARIABLES

7B.4.1 Introduction

Type A Variables are defined in Section 7B.2.2.1. They are the variables which provide primary information required to permit the control room operating staff to:

1. Perform the diagnosis specified in the WOG ERGs
2. Take specified preplanned manually controlled actions, for which no automatic control is provided, that are required for safety systems to accomplish their safety function to recover from the DBA Event (Verification of actuation of safety systems is excluded from Type A and is included as Type D); 40
3. Reach and maintain a safe shutdown condition

Key Type A variables have been designated Category 1. These are the variables which provide the most direct measure of the information required.

No Type A Variables have been designated Category 2 or 3.

The Type A variables are listed in Table 7B.4-1.

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TABLE 7B.4-1 lower case

SUMMARY OF TYPE A VARIABLES

		Category
1.	RCS Pressure (Wide Range)	A1
2.	Hot Leg Reactor Coolant Temperature (Wide Range T_{hot})	A1
3.	Cold Leg Reactor Coolant Temperature (Wide Range T_{cold})	A1
4.	Wide Range Steam Generator Water Level	A1
5.	Narrow Range Steam Generator Water Level	A1
6.	Pressurizer Water Level	A1
7.	~~Primary Reactor~~ Containment Pressure	A1
8.	Steamline Pressure	A1
9.	Refueling Water Storage Tank (RWST) Water Level	A1
10.	Containment Water Level (Wide Range)	A1
11.	Containment Water Level (Narrow Range)	A1
12.	Auxiliary Feedwater Storage Tank (AFST) Water Level	A1
13.	Auxiliary Feedwater Flow	A1
14.	High Range Containment Radiation Level	A1
15.	RCS Pressure (Extended Range)	A1
16.	Steam Generator Blowdown Radiation Level ~~Monitor~~	A1
17.	Steamline Radiation Level ~~Monitor~~	A1
18.	Core Exit Temperature	A1
19.	RCS Subcooling	A1

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7B.5 TYPE B VARIABLES

7B.5.1 Introduction

Type B variables are defined in Section 7B.2.2.2. They are the variables that provide to the control room operating staff information to assess the process of accomplishing or maintaining critical safety functions, i.e.,

1. Subcriticality

2. Reactor Core Cooling

3. Heat Sink Maintenance

4. Reactor Coolant System (RCS) Integrity 40

5. Containment Environment

6. Reactor Coolant System (RCS) Inventory

Variables which provide the most direct indication (i.e., KEY variables) to assess each of the 6 critical safety functions have been designated Category 1. Preferred backup variables have been designated Category 2. These are listed in Table 7B.5.1. All other backup variables have been designated Category 3.

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Table 7B.5-1

Summary of Type B Variables

				Category
Subcriticality	Key:	a.	Neutron Flux (Extended Range)	B1
		b.	Neutron Flux Startup Rate	B1
	Preferred Backup:	a.	Wide Range T_{Hot}	B2
		b.	Wide Range T_{Cold}	B2
Reactor Core Cooling	Key:	a.	Core Exit Temperature	B1
		b.	Reactor Vessel Water Level	B1
		c.	RCS Subcooling	B1
		d.	AFST Level	B1
		e.	RWST Level	B1
	Preferred Backup:	a.	Wide Range T_{Hot}	B2
		b.	Wide Range T_{Cold}	B2
		c.	RCS Pressure (WR)	B2
Heat Sink Maintenance	Key:	a.	Narrow Range S/G Level	B1
		b.	Wide Range S/G Level	B1
		c.	Auxiliary Feedwater Flow	B1
		d.	AFST Level	B1
		e.	Steamline Pressure	B1
		f.	Core Exit Temperature	B1
		g.	Wide Range T_{Hot}	B1
		h.	Wide Range T_{Cold}	B1
	Preferred Backup:	a.	Main Steamline Isolation Valve Status	B2
		b.	Main Steamline Isolation Bypass Valve Status	B2
Reactor Coolant System Integrity	Key:	a.	RCS Pressure (WR)	B1
		b.	RCS Pressure (Extended Range)	B1
	Preferred Backup:	a.	Containment Pressure	B2
		b.	High Range Containment Radiation Level	B2
		c.	Narrow Range SG Level	B2
		d.	S/G Blowdown Radiation Level	B2
		e.	Steamline Radiation Level	B2
		f.	Pressurizer PORV Status	B2
		g.	Pressurizer Safety Valve Status	B2

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Table 7B.5-1 (Continued)

Summary of Type B Variables

			Category
~~Reactor~~ Containment Environment	Key:	a. Containment Pressure	B1
		b. High Range Containment Radiation Level	B1
		c. Containment Water Level (~~WR~~ Wide Range)	B1
		d. Containment Hydrogen Concentration	B1
	Preferred Backup:	None	
Reactor Coolant System (RCS) Inventory	Key:	a. Pressurizer Water Level	B1
		b. Reactor Vessel Water Level	B1
	Preferred Backup:	a. Containment Water Level (~~WR~~ Wide Range)	B2
		b. Containment Water Level (~~NR~~ Narrow Range)	B2
		c. Wide Range Steam Generator Water Level	B2

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7B.6 TYPE C VARIABLES

7B.6.1 Introduction

Type C variables are defined in Section 7B.2.2.3. Basically, they are the variables that provide to the control room operating staff information to monitor the potential for breach or actual significant breach of:

1. Fuel Clad;
2. Reactor Coolant System (RCS) Boundary; or
3. ~~Reactor~~ Containment Boundary.

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

Those Type C key variables which provide the most direct measure of the POTENTIAL for breach of one of the 3 fission product boundaries have been designated Category 1. Backup information indicating potential for breach is designated Category 2. Variables which indicate actual breach have been designated as preferred backup information and have been designated to Category 2. All other backup variables have been designated Category 3.

Table 7B.6-1 summarizes the selection of Type C variables.

Note to Typist: heading changes apply to both pages of table. Potential for Breach has a Category column associated with it; so does Actual Breach. (C1, C2, C3)

Please Remove ( ) Throughout the table

TABLE 7B.6-1

Summary of Type C Variables

	POTENTIAL FOR BREACH (Category)	ACTUAL BREACH (Category)
IN-CORE FUEL CLAD	Key: Core Exit Temperature (C1) Backup: ~~Preferred~~ Reactor Vessel Water Level (C2)	Backup: RCS Sampling (C3)
RCS BOUNDARY	Key: RCS Pressure (C1) (Extended Range) RCS Pressure (C1) (Wide Range)	Preferred Backup: RCS Pressure (Wide Range) (C2) Containment Pressure (C2) Containment Water Level ~~(WR)~~ Wide Range (C2) Containment Water Level ~~(NR)~~ Narrow Range (C2) Steamline Radiation Level (C2) ~~S/G~~ SG Blowdown Radiation Level (C2) High Range Containment Radiation Level (C2)
CONTAINMENT BOUNDARY	Key: Containment Pressure (Extended Range) (C1) Containment Pressure ~~(Wide Range)~~ (C1) Containment Hydrogen Concentration (C1)	Preferred Backup: Unit Vent Radiation Level (C2) Fuel Handling Building Exhaust Radiation Level (C2) Containment Isolation Valve Status (C2) Containment Pressure (Extended Range) (C2)

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TABLE 7B.6-1 (Continued)

Summary of Type C Variables

POTENTIAL FOR BREACH	Category	ACTUAL BREACH	Center	Category
CONTAINMENT BOUNDARY (Cont'd)		Backup: Site Environmental Radiation Level (Portable Monitoring) (C3)*		4
		Adjacent Building Area Radiation Level (C3)		4

7B.7 TYPE D VARIABLES

7B.7.1 Introduction

Type D variables are defined in Section 7B.2.2.4. Basically, they are those variables that provide sufficient information to the control room operating staff to monitor the performance of:

1. Plant safety systems employed 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 systems; and

2. Other systems normally employed for attaining a cold shutdown condition.

Type D KEY (lowercase) variables are designated Category 2. Preferred backup information is designated Type D Category 3. X

The following systems have been identified as requiring Type D information to be monitored:

1. Pressurizer Level and Pressure Control (assess status of RCS following return to normal pressure and level control under certain post-accident conditions)

2. Chemical and Volume Control System (CVCS) (normally employed for attaining a safe shutdown under certain post-accident conditions) 40

3. Secondary Pressure and Level Control (employed for restoring/maintaining a secondary heat sink under post-accident conditions)

4. Emergency Core Cooling System (ECCS)

5. Auxiliary feedwater X

6. Containment Systems

7. Component cooling water (CCW) X

8. Essential Cooling Water (ECW)

9. Residual Heat Removal (RHR) System (normally employed for attaining a cold shutdown condition) Y

10. Heating, ventilation, and air conditioning (HVAC) if required for Engineered Safety Features operation

11. Electric power to vital safety systems

12. Verification of automatic actuation of safety systems

Table 7B.7-1 lists the key variables identified for each system listed above and specifies the seismic and environmental qualification for each variable.

For purposes of specifying seismic qualification for Type D Category 2 variables, it is assumed that a seismic event and a break in Category I piping will not occur concurrently. As a result, the limiting event is an unisolated (single failure of a main steam isolation valve (MSIV)) break in non-Category I main steam piping. Instrumentation associated with the safety systems which 40
are required to mitigate and monitor this event should be seismically qualified instrumentation. Similarly, the environmental qualification for Type D Category 2 variables depends on whether the instrumentation is subject to a high energy line break (HELB) when required to provide information.

TABLE 7B.7-1

Summary of Type D ~~Key~~ Variables

System Designation	~~Key~~ Variable ~~Instrumentation~~	Seismic	Environmental	Category
1. Pressurizer Level and Pressurizer Control	Pressurizer PORV Status	Yes	HELB	D2
	Pressurizer PORV Block Valve Status	Yes	HELB	D2
	Pressurizer Safety Valve Status	Yes	HELB	D2
	Pressurizer Spray Valve Status	No	Ambient	D2
	Pressurizer Heater Breaker Position	No	Ambient	D2
	Pressurizer Water Level	Yes	HELB	D2
	Reactor Vessel Water Level	Yes	HELB	D2
	RCS Pressure ~~(WR)~~ wide Range	Yes	HELB	D2
	Pressurizer Pressure	Yes	HELB	D2
	RCP Status	No	Ambient	D2
2. CVCS	Charging Flow	No	Ambient	D2
	Letdown Flow	No	Ambient	D2
	VCT Water Level	No	Ambient	D2
	RCP Seal Injection Flow	No	Ambient	D2
	Valve Status	Yes (Isolation valves only)	Ambient	D2
	Charging Pump Status	Yes	Ambient	D2
	BAT Pump Status	Yes	Ambient	D2
3. Secondary Pressure and Level Control	SG ~~S/G~~ PORV Status	Yes	HELB*	D2
	Main Steamline Isolation Valve Status	Yes	HELB*	D2
	Main Steamline Bypass Valve Status	Yes	HELB*	D2
	SG ~~S/G~~ Safety Valve Status	Yes	HELB*	D2
	Steamline Pressure	Yes	HELB*	D2
	MFW Control Valve Status	Yes	HELB*	D2
	MFW Control Bypass Valve Status	Yes	HELB*	D2
	MFW Isolation Valve Status	Yes	HELB*	D2
	MFW Isolation ~~Valve~~ Bypass Valve Status	Yes	HELB*	D2

*These systems must be qualified to the worst case environment in which they must function (including HELBs inside and outside containment).

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TABLE 7B.7-1 (Continued)

Summary of Type D ~~Key~~ Variables

System Designation	~~Key~~ Variable ~~Instrumentation~~	Seismic	Environmental		
3. Secondary Pressure and Level Control (Cont'd)	MFW Flow	No	Ambient	D2	
	Auxiliary Feedwater Flow	Yes	HELB*	D2	
	SG ~~S/G~~ Water Level ~~(WR) and (NR)~~ (Wide Range and Narrow Range)	Yes	HELB	D2	X
	SG ~~S/G~~ Blowdown Isolation Valve Status	Yes	~~Ambient~~ HELB*	D2	X
	SG ~~S/G~~ Blowdown Sample Isolation Valve Status	Yes	~~Ambient~~ HELB*	D2	X
4. ECCS	RWST Water Level	Yes	Ambient	D2	X
	~~Total~~ HHSI Flow	Yes	HELB**	D2	X
	~~Total~~ LHSI Flow	No	HELB**	D2	X
	Containment Water Level (Wide Range and Narrow Range) ~~(WR) and (NR)~~	No	HELB	D2	X
	Pump and Valve Status	Yes	HELB**	D2	
	Accumulator Pressure	Yes	HELB	D2	
5. Auxiliary Feedwater	Auxiliary Feedwater Flow	Yes	HELB*	D2	X
	Pump and Valve Status	Yes	HELB*	D2	X
	Auxiliary Feedwater Storage Tank Water Level	Yes	Ambient	D2	
6. Containment Systems	Containment Spray Flow	No	HELB**	D2	
	Containment Water Level (Wide Range and Narrow Range) ~~(WR) and (NR)~~	No	HELB	D2	X
	Spray System Pump and Valve Status	No	HELB**	D2	X
	~~RCB~~ Reactor Containment Fan Cooler Differential Pressure/Status	No	HELB	D2	X
	Containment Pressure	No	HELB	D2	
	Containment Isolation Valve Status	Yes	HELB*	D2	
	Containment Ventilation ~~Damper~~ Valve Status	Yes	HELB*	D2	X

*These systems must be qualified to the worst case environment in which they must function (including HELBs inside and outside containment).

**These systems may see radiation from components in the recirculation path.

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TABLE 7B.7-1 (Continued)

Summary of Type D ~~Key~~ Variables

System Designation	~~Key~~ Variable ~~Instrumentation~~	Seismic	Environmental	Category
7. ~~CCW~~ Component Cooling Water	Pump Discharge Pressure	Yes	Ambient	D2
	Header Temperature	Yes	Ambient	D2
	Surge Tank Water Level	Yes	Ambient	D2
	Flow to ESF Components	Yes	HELB*	D2
	Pump and Valve Status	Yes	Ambient/HELB	D2
8. Essential Cooling Water ~~System~~	Flow to ESF Components	Yes	Ambient	D2
	Pump and Valve Status	Yes	~~HELB~~ Ambient	D2
9. RHR System	Heat Exchanger Discharge Temperature	No	HELB**	D2
	Flow	No	HELB**	D2
	Pump and Valve Status	No	HELB**	D2
	RCS Pressure ~~(WR)~~ Wide Range	Yes	HELB	D2
10. HVAC	ESF Environment Temperature	Yes	HELB**	D2
	ESF Cubicle Fan/cooler Status	YES	HELB**	D2
11. Electric Power	Standby Power and Emergency Source Status	Yes	Ambient	D2
	Other Safety-Related Energy Sources	Yes	Ambient	D2
12. Verification of Automatic Actuation of Safety Systems	Reactor Trip Breaker Position	Yes	HELB*	D2
	Turbine Governor Valve Position	No	No	D2
	Turbine Stop Valve Position	No	No	D2
	Auxiliary Feedwater Pump Status (turbine)	Yes	HELB*	D2
	Auxiliary Feedwater Pump Status (motor driven)	Yes	HELB*	D2
	SI Pump and Valve Status	Yes	~~Ambient~~ HELB**	D2

*These systems must be qualified to the worst case environment in which they must function (including HELBs inside and outside containment).

**These systems may see radiation from components in the recirculation path.

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TABLE 7B.7-1 (Continued)

Summary of Type D ~~Key~~ Variables

System Designation	~~Key~~ Variable ~~Instrumentation~~	Seismic	Environmental	Category
12. Verification of Automatic Actuation of Safety Systems (Cont'd)	CCW Pump and Valve Status	Yes	Ambient/HELB	D2
	ECW Pump and Valve Status	Yes	~~HELB~~ Ambient	D2
	Containment Spray Pump and Valve Status	Yes	~~Ambient~~ HELB**	D2
	Neutron Flux (Extended Range)	Yes	HELB*e	D2
	Neutron Flux Startup Rate	Yes	HELB*ne	D2
	Containment Isolation ~~Valve Status~~ Valve	Yes	HELB*	D2
	Containment Ventilation ~~Damper~~ Valve Status	Yes	HELB*	D2
	RCB Fan Cooler Differential Pressure/ Status	No	HELB	D2
	SI Actuation Status	Yes	Ambient	D2
	Containment Isolation Actuation Status	Yes	Ambient	D2
	Control Rod Position Indication (Backup)	No	Ambient	D3

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*These systems must be qualified to the worst case environment in which they must function (including HELBs inside and outside containment).

**These systems may see radiation from components in the recirculation path.

7B.8 TYPE E VARIABLES

7B.8.1 Introduction

Type E variables are defined in Section 7B.2.2.5. They are those variables that provide the control room operating staff with information to:

1. Monitor the habitability of control room,
2. Monitor plant areas where access may be required to service equipment necessary to monitor or mitigate the consequences of an accident, 40
3. Estimate the magnitude of release of radioactive materials through identified pathways and continually assess such releases, and
4. Monitor radiation levels and radioactivity in the environment surrounding the plant via portable monitors.

Key Type E variables are qualified to Category 2 requirements. Preferred backup Type E variables are qualified to Category 3 requirements. Table 7B.8-1 lists the Type E variables.

TABLE 7B.8-1a

SUMMARY OF TYPE E VARIABLES (lower case)

	Category
1. Control Room Habitability	
Control Room Radiation Level	E2
2. Post Accident Access	
Area Radiation	
Post Accident Sampling Station	E3*
Technical Support Center	E3*
Operational Support Center	E3*
Emergency Operations ~~Facility~~ Center	E3*
Unit Vent Monitoring Station	E3*
3. Release Pathways	
High Range Containment Radiation Level	E2
Steamline Radiation Level & Relief Valve Status	E2
Unit Vent Radi~~oactivity~~ation Level and Vent Flow	E2
Condenser Vacuum Pump Radiation Level & Flowrate/~~Flow Status~~ ~~Pump~~	E3
Condenser Vacuum Pump Pump Status	E2
FHB ~~Vent~~ Exhaust Radiation Level	E2
Containment Sump & Atmospheric Sampling	E3
~~Steam Generator Radiation Level & Blowdown Flow Rate Status~~	~~E2~~
~~Condensate Polish Radiation Level & Flow Rate/Flow Status~~	~~E3~~
Liquid Radwaste Radiation Level & ~~Flow Rate/Flow~~ Valve Status	E2
Liquid Radwaste Flow Rate	E3
~~TGB Drain Radiation Level & Flow Rate/Flow Status~~	~~E2~~

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*Category 3 per Regulatory Guide 1.97, Revision 3

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TABLE 7B.8-1 (Continued)

lower case

SUMMARY OF TYPE E VARIABLES

	Category
4. Site Environmental Radiation Level	
Area Monitors (Portable)	E3*
Meteorological Parameters	E3*

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*Category 3 per Regulatory Guide 1.97, Revision 3

TABLE DELETED
SEE TABLE 7.5-1

SECTION 7B.9

Table 7B.9-1

~~Summary of Variables and Categories~~
~~(Excluding Selection of D-3)~~

Variable	Type and Category				
	Type A	Type B	Type C	Type D	Type E
RCS Pressure (Wide Range)	1	1,2	1,2	2	
Wide Range T hot	1	1,2			
Wide Range T cold	1	1,2			
Wide Range S/G Level	1	1,2		2	
Narrow Range S/G Level	1	1,2		2	
Pressurizer Level	1	1		2	
Containment Pressure	1	1,2	1,2	2	
Steamline Pressure	1	1		2	
RWST Level	1	1		2	
Containment Water Level (WR)	1	1,2	2	2	
Containment Water Level (NR)	1	2	2	2	
Auxiliary Feedwater Storage Tank Level	1	1		2	
Auxiliary Feedwater Flow	1	1		2	
High Range Containment Radiation Level	1	1,2	2		2
S/G Blowdown Radiation Level	1	2	2		2
Steamline Radiation Level	1	2	2		2
Core Exit Temperature	1	1	1		
RCS Subcooling	1	1			
Neutron Flux (Extended Range)		1		2	
Neutron Flux Startup Rate		1		2	

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Delete

Table 7B.9-1 (Continued)

Summary of Variables and Categories
(Excluding Selection of D-3)

Variable	Type and Category				
	Type A	Type B	Type C	Type D	Type E
Containment Hydrogen Concentration		1	1		
Reactor Vessel Water Level		1	2	2	
Main Steamline Isolation Valve Status		2		2	
Main Steamline Bypass Valve Status		2		2	
Control Rod Position Ind.				3	
Pressurizer Pressure				2	
RCP Status				2	
Pressurizer Spray Valve Status				2	
Containment Pressure (Extended Range)			1,2		
RCS Pressure (Extended Range)	1	1	1		
Containment Isolation Valve Status			2	2	
Unit Vent Radiation Level			2		2
RCS Sampling (Primary Coolant Activity)			3		
Fuel Handling Bldg. Radiation Level			2		
Adjacent Building Area Radiation Level			3		
Site Environmental Radiation Level			3		3
Pressurizer PORV Valve Status		2		2	
Pressurizer PORV Block Valve Status				2	
Pressurizer Safety Valve Status		2		2	
Pressurizer Heater Breaker Position				2	
Charging System Flow				2	

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Delete

Table 7B.9-1 (Continued)

Summary of Variables and Categories
(Excluding Selection of D-3)

Variable	Type A	Type B	Type C	Type D	Type E
Letdown Flow				2	
VCT Level				2	
CVCS Valve Status				2	
RCP Seal Injection Flow				2	
S/G Atmospheric PORV Status				2	
S/G Safety Valve Status				2	
Main Feedwater Control Valve Status				2	
Main F/W Control Bypass Valve Status				2	
Main F/W Isolation Valve Status				2	
Main Feedwater Flow				2	
S/G Blowdown Isolation Valve Status				2	
S/G Blowdown Sample Isolation Valve Status				2	
Charging Pump Status				2	
Main Feedwater Isolation Valve Bypass Valve Status				2	
Auxiliary Feedwater Isolation Valve Status				2	
Containment Ventilation Damper Status				2	
Total HHSI Flow				2	
Total LHSI Flow				2	
ECCS Valve Status				2	
ECCS Accumulator Pressure				2	

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Delete

Table 7B.9-1 (Continued)

Summary of Variables and Categories
(Excluding Selection of D-3)

Variable	Type A	Type B	Type C	Type D	Type E
Aux F/W Valve Status				2	
AUX F/W Motor Driven Pump Status				2	
Aux F/W Turbine Driven Pump Status				2	
Turbine Stop Valve Position				2	
Turbine Governor Valve Position				2	
Containment Spray Flow				2	
Containment Spray Pump Status				2	
Containment Spray System Valve Status				2	
RCB Fan Cooler Differential Pressure/Status				2	
CCW Pump Discharge Pressure				2	
CCW Header Temperature				2	
CCW Surge Tank Level				2	
CCW Flow to ESF Components				2	
CCW Valve Status				2	
CCW Pump Status				2	
RHR Pump Status				2	
Essential Cooling Water System Flow				2	
Essential Cooling Water System Valve Status				2	
Essential Cooling Water System Pump Status				2	
RHR Heat-exchanger Discharge Temp				2	
RHR Flow				2	

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Delete

Table 7B.9-1 (Continued)

Summary of Variables and Categories
(Excluding Selection of D-3)

Variable	Type A	Type B	Type C	Type D	Type E
RHR Valve Status				2	
ESF Environment				2	
SI Actuation Status				2	
SI Pump Status				2	
SI Valve Status				2	
Containment Isolation Actuation Status				2	
Boric Acid Transfer Pump Status				2	
Standby Power and Emergency Power Source Status				2	
Other Safety Related Energy Sources				2	
Reactor Trip Breaker Position				2	
Control Room Radiation					2
Access Area Radiation					3
FHB Vent Radiation					2
Meteorological Parameters					3
Condenser Vacuum Pump Effluent Radiogas Concentration					3
Effluent Path Flow Rate					
Steam Generator Blowdown					3
Condensate Polish					3
Liquid Radwaste					3

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Delete

Table 7B.9-1 (Continued)

Summary of Variables and Categories
(Excluding Selection of D-3)

Variable	Type and Category Type A	Type B	Type C	Type D	Type E
TGB Drain					3
Unit Vent					2
Condenser Vacuum Pump					3
Concentration From Liquid Pathways					
Steam Generator Blowdown					2
Condensate Polish					2
Liquid Radwaste					2
TGB Drain					2
Effluent Pathway Status					
Steam Generator Blowdown Valve Status					2
Condensate Polishing Valve Status					2
Liquid Radwaste Valve Status					2
TGB Drain Valve Status					2
Condenser Vacuum Pump Status					2
Containment Sump & Atmospheric Sampling					3

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