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December 4, 1985
ST-HL-AE-1538
File No.: G9.17

Mr. Vincent S. Noonan, Project Director
PWR Project Directorate #5
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 Regarding
RCS Temperature Measurement

Dear Mr. Noonan:

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

The item number listed below corresponds to that 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 item which is attached to this letter is:

Attachment	Item No.*	Action Item Number	Subject
1	D7.2-2	63	RCS Temperature Measurement System including elimination of the RTD Bypass Manifold design.

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

B001 1/1 Add: Ltr & Encl
EB- Ballard
EICSB- Rosa
PSB- Gammill
RSB- Berlinger
FOB- Benaroya
J. Knight Ltr Only

L1/NRC/de

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

Very truly yours,

M. R. Wisenburg
Manager, Nuclear Licensing

CAA/yd

Attachments: See above

L1/NRC/de

cc:

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TABLE 1.1-1 (Continued)

ACRONYMS USED IN THE FSAR

SRSS	square root of the sum of the squares
SRST	spent resin storage tank
SS	stainless steel
SSD	Safe Shutdown
SSE	Safe Shutdown Earthquake
SSI	soil/structure interaction
SSPC	Steel Structure Painting Council
SSPS	Solid-State Protection System
SSS	Secondary Sampling System
STIS	South Texas Interconnected System 40
STP	South Texas Project
STPEGS	South Texas Project Electric Generating System
SWPS	Solid Waste Processing System
SWST	service water storage tank
TAMU	Texas A&M University
TAS	Temperature Averaging Scheme (RCS Loop T_{hot})
TBEG	Texas Bureau of Economic Geology
TC	thermocouple 43
TCV	temperature control valve 51
TDDU	time delay drop unit 49
TDH	total developed head
TDS	total dissolved solids
TDM	Time Division Multiplexers 49
TDWR	Texas Department of Water Resources
TEMA	Tubular (Exchanger) Manufacturer's Association
TESC	Texas Electric Service Company

TABLE 7.1-2

PLANT COMPARISON*

REACTOR TRIP SYSTEM	DIFFERENCES FROM COMANCHE PEAK NUCLEAR STATION
1. Overtemperature ΔT and Overpower ΔT Coolant Temperature Measurements (Sections 7.2, 7.3, and 7.7)	1. Comanche Peak uses N-16 power monitors and in-line T_{cold} detectors rather than the ~~bypass line~~ narrow range T_{hot} and T_{cold} ~~detectors~~ RTD's used at STP. Thus, Comanche Peak has overtemperature and overpower N-16 trips and N-16 measurements rather than overtemperature and overpower ΔT trips and ΔT measurements on STP.
2. Power Range Neutron Detectors (Sections 7.2.1.1.7 and 7.7)	2. Comanche Peak uses four-section power range neutron detectors; STP uses two-section detectors.
3. Reactor Trip on Turbine Trip (Figure 7.2-17)	3. Comanche Peak uses P-7 interlock (10 percent power); STP uses P-9 interlock (50 percent power)
4. Reactor Trip on Turbine Stop Valve Closure (Figure 7.2-17)	4. Logic is 2/4 on STP and 4/4 on Comanche Peak. 44
5. Pressurizer High Water Level Trip (Figure 7.2-6)	5. Four channels are used on STP (2/4 logic); three channels are used on Comanche Peak (2/3 logic).
6. Narrow Range Steam Generator Water Level Measurements (Figure 7.2-7)	6. Measurements are compensated for temperature effects on the reference leg fluid for STP. Measurements are not compensated on Comanche Peak.
7. Turbine Trip on Reactor Trip (Figures 7.2-2, 7.2-14, and 7.2-17)	7. Comanche Peak uses a P-4 signal to trip the turbine; STP uses P-16 signal (P-4 or reactor trip signal) to trip turbine.

*With the exception of those items listed as differences, this plant is functionally identical to the Comanche Peak Steam Electric Station.

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neutron flux power-range signals above the setpoint; its absence indicates that the plant is below approximately 40 percent of full power. The block action (absence of the P-8 interlock signal) occurs when three of four neutron flux power-range signals are below the setpoint. Thus, below the P-8 setpoint, the reactor is allowed to operate with one inactive loop, and trip does not occur until two loops are indicating low flow. See Figure 7.2-4 for derivation of P-8 and Figure 7.2-5 for applicable logic. 43

The absence of the P-9 interlock blocks a reactor trip on a turbine trip signal. The P-9 signal is derived from two of four neutron flux power-range signals above the setpoint; its absence indicates that the plant is below approximately 50 percent of full power. The block action (absence of the P-9 interlock signal) occurs when three of four neutron flux power-range signals are below the setpoint. See Figure 7.2-4 for derivation of P-9 and Figure 7.2-17 for the turbine trip reactor trip logic. 43

See Table 7.2-2 for the list of RTS blocks.

INSERT A

7.2.1.1.5 Coolant Temperature Sensor Arrangement and Calculational Methodology. The hot and cold leg resistance temperature detectors are inserted into reactor coolant bypass loops. A bypass loop from upstream of the SG to downstream of the SG is used for the hot leg resistance temperature detectors, and a bypass loop from downstream of the RCP to upstream of the pump (to the same point downstream of the SG used for the hot leg RTD; see Figure 5.1-2) is used for the cold leg resistance temperature detectors. The complete bypass loop is inside the Containment. The resistance temperature detectors are located in manifolds and are directly inserted into the reactor coolant bypass loop flow without thermowells. Thermowells are not used in order to minimize the detector thermal lag. The bypass arrangement permits replacement of defective temperature elements while the plant is at hot shutdown without draining or depressurizing the reactor coolant loops. 43

Three sampling probes are installed in a cross-sectional plane of each hot leg at approximately 120-degree intervals. Each of the sampling probes, which extend several inches into the hot leg coolant stream, contains five inlet orifices distributed along its length. In this way, a total of 15 locations in the hot leg stream are sampled, providing a representative coolant temperature measurement. The 2-in.-diameter pipe leading to the resistance temperature detector manifold provides mixing of the samples to give representative temperature measurement.

Care was taken to distribute the flow evenly among the five orifices of each probe by effectively restricting the flow through the orifices. This was done by designing a smaller overall orifice flow area than that of the common flow channel within the probe. This arrangement was also applied to the flow transition from the three probe flow channels to the pipe leading to the temperature element manifold. The total flow area of these channels was therefore designed to be less than that of the 2-in. pipe connecting the probes to the manifold.

The cold leg reactor coolant flow is well mixed by the RCP, thereby eliminating any cold leg temperature spatial dependence. Therefore, the cold leg sample is taken directly from a 2-in. pipe tap off the cold leg downstream of the pump.

7.2.1.1.5 Coolant Temperature Sensor Arrangement and Calculational Methodology

The individual loop hot and cold loop temperature signals required for input to the reactor trip circuits and interlocks are obtained using RTD's installed in each reactor coolant loop.

The hot leg temperature measurement on each loop is accomplished with three fast response narrow range RTDs mounted in thermowells. The thermowells are located within the three scoops previously used for the RTD bypass manifold with a portion of the scoop removed to entirely expose the end of the thermowell to the mainstream flow. For the final insertion depth, the tip of the RTD is located at the same dimensional position as previously occupied by the third center flow hole of the scoop.

These three narrow range RTD signals per loop are input to the QDPS where a sensor quality check is first performed. First, an out-of-range check is performed on each input with any signal out of range declared invalid. The following algorithm is then computed:

$$T_{h_{ave_i}} = \sum_{j=1}^{N} T_{h_{j_i}} / N$$

where

$T_{h_{j_i}}$ = jth narrow range T_{hot} signal in loop i

N = number of valid narrow range T_{hot} signals in loop i (N = 2 or 3)

If $\left| T_{h_{ave_i}} - T_{h_{j_i}} \right| > E$, then the sensor input $T_{h_{j_i}}$ is automatically declared invalid, where

E = input parameter based upon empirical data obtained from plant measurements of the temperature distribution within the hot leg.

The narrow range RTD hot leg signal per loop is then calculated as follows:

$$T_{h_{ave_i}} = \sum_{j=1}^{N} T_{h_{j_i}} / N + B_i$$

where

B_i = input bias in loop i that compensates $T_{h_{ave_i}}$ upon loss of one narrow range T_{hot} input signal.

$T_{h_{ave_i}}$ for each loop is then output from the QDPS to the Reactor Trip System/ESF Actuation System (7300 process protection system).

Should more than one narrow range T_{hot} input signal per loop be invalid, the calculation is not performed and the reactor trip function that requires $T_{h_{ave_i}}$ as an input signal is alarmed on the control board and the operator must place the channel in a tripped mode in accordance with the Technical Specifications.

One fast response narrow range RTD is located in each cold leg at the discharge of the reactor coolant pump (as replacements for the cold leg RTDs previously located in the bypass manifold). Temperature streaming in the cold leg is not a concern due to the mixing action of the reactor coolant pump. These RTDs measure the cold leg temperature for use in calculation of the loop T_{ave} and ΔT_i variables.

One of the presently installed well mounted fast response RTDs used in the excessive cooldown protection logic is used as a spare for the cold leg; no new penetrations are necessary.

All fast response narrow range T_{cold} RTD signal outputs are input directly to the 7300 process protection system. The loop T_{ave_i} and ΔT_i variables are calculated in the 7300 hardware.

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7.2.1.2.1 <u>Generating Station Conditions</u>: Generating station conditions requiring a reactor trip are the following:

1. DNBR approaching the design basis limit (Chapters 4 and 15).

2. Power density (kW/ft) approaching rated value for ANS Condition II faults (see Chapter 4 for fuel design limits).

3. Reactor Coolant System (RCS) overpressure creating stresses approaching the limits specified in Chapter 5.

7.2.1.2.2 <u>Generating Station Variables</u>: The following variables are required to be monitored to provide reactor trips (see Table 7.2-1):

1. Neutron flux

2. Reactor coolant temperature

3. RCS pressure (pressurizer pressure)

4. Pressurizer water level

5. Reactor coolant flow

6. RCP operational status (voltage and frequency)

7. Steam generator water level (density compensated) |43

8. Turbine generator operational status (trip fluid pressure and stop valve position)

7.2.1.2.3 <u>Spatially Dependent Variables</u>: The reactor coolant temperature measurement is the only spatially dependent variable. ~~(see Section [illegible])~~ |43

7.2.1.2.4 <u>Limits, Margins, and Setpoints</u>: The parametric values that will require reactor trip are given in Chapter 15. Chapter 15 proves that the setpoints to be used in the Technical Specifications are conservative.

The setpoints for the various functions in the RTS were analytically determined so that the operational limits so prescribed will prevent fuel rod clad damage and loss of integrity of the RCS as a result of any ANS Condition II incident (anticipated malfunction). As such, during any ANS Condition II incident, the RTS limits the following parameters to:

1. Minimum DNBR = 1.30 |43

2. Maximum system pressure = 2,750 psia

3. Fuel rod maximum linear power for determination of protection setpoints = 18.0 kW/ft

derived by auctioneering of the four channels for automatic rod control. If any channel fails in such a way as to produce a low output, that channel is incapable of proper overpower protection but will not cause control rod movement because of the auctioneer. Two-out-of-four overpower trip logic will ensure an overpower trip if needed, even with an independent failure in another channel.

In addition, channel deviation signals in the Reactor Control System will give an alarm if any neutron flux channel deviates significantly from the average of the flux signals. Also, the control system will respond only to rapid changes in indicated neutron flux; slow changes or drifts are compensated by the temperature control signals. Finally, an overpower signal from any nuclear power range channel will block manual and automatic rod withdrawal. The setpoint for this rod stop is below the reactor trip setpoint.

7.2.2.3.2 Coolant Temperature: The accuracy of the resistance temperature detector bypass loop temperature measurements is demonstrated during plant startup tests by comparing temperature measurements from the bypass loop resistance temperature detectors with one another as well as with the temperature measurements obtained from the resistance temperature detectors located in the hot leg and cold leg piping of each loop. The comparisons are made with the RCS in an isothermal condition. The linearity of the ΔT measurements obtained from the hot leg and cold leg bypass loop resistance temperature detectors as a function of plant power is also checked during plant startup tests. The absolute value of ΔT versus plant power is not important, per se, as far as reactor protection is concerned. Reactor Trip System setpoints are based upon percentages of the indicated ΔT at nominal full power rather than on absolute values of ΔT in order to account for loop differences which are inherent. Therefore, the percent ΔT scheme is relative, not absolute, and it provides better protective action without the expense of accuracy. For this reason, the linearity of the ΔT signals as a function of power is of importance, rather than the absolute values of the ΔT. As part of the plant startup tests, the bypass loop resistance temperature detector signals are compared with the core exit thermocouple signals.

Reactor control is based upon signals derived from RTS channels after isolation by isolation amplifiers, so that no feedback effect can perturb the protection channels.

Since control is based on the average temperature of the loop with the highest temperature, the control rods are always moved based upon the most pessimistic temperature measurement with respect to margins to DNB. A spurious low average temperature measurement from any loop temperature control channel will cause no control action. A spurious high average temperature measurement will cause rod insertion (safe direction).

In connection with the instrumentation provisions associated with the narrow-range reactor coolant temperature monitoring, individual low-flow annunciators (both audible and visual indications to operator) for each reactor coolant loop bypass flow are provided on the main control board. The annunciators provide the operator with immediate indication of a low-flow condition in the bypass loops associated with any reactor coolant loop. 43

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Local indicators are provided to monitor total flow through the resistance temperature detector bypass manifolds for each loop. The indicators are located inside the Containment but are accessible during power operations. | 43

Flow is locally monitored:

1. Prior to restoring temperature channels to normal service following reopening of bypass loop stop valves whenever a bypass loop has been out of service.

2. On a periodic basis.

3. Following any bypass loop low-flow alarm (see above).

In addition, channel deviation signals in the control system will give an alarm if any temperature channel deviates significantly from the auctioneered (highest) value. Automatic rod withdrawal blocks and turbine runback (power demand reduction) will also occur if any two of the four overtemperature or overpower ΔT channels indicate an adverse condition.

INSERT B →

7.2.2.3.3 Pressurizer Pressure: The pressurizer pressure protection channel signals are used for high- and low-pressure protection and as inputs to the overtemperature ΔT trip protection function. Isolated output signals from these channels are used for pressure control. These are used to control pressurizer spray and heaters and power-operated relief valves (PORVs). Pressurizer pressure is sensed by fast-response pressure transmitters.

A spurious high-pressure signal from one channel can cause decreasing pressure by actuation of either spray or relief valves. Additional redundancy is provided in the low pressurizer pressure reactor trip and in the logic for safety injection to ensure low-pressure protection.

Overpressure protection is based upon the positive surge of the reactor coolant produced as a result of turbine trip under full load, assuming the core continues to produce full power. The self-actuated safety valves are sized on the basis of steam flow from the pressurizer to accommodate this surge at a setpoint of 2,500 psia and an accumulation of 3 percent. Note that no credit is taken for the relief capability provided by the PORVs during this surge.

In addition, operation of any one of the (PORVs) can maintain pressure below the high-pressure trip point for most transients. The rate of pressure rise achievable with heaters is slow, and ample time and pressure alarms are available to alert the operator of the need for appropriate action.

7.2.2.3.4 Pressurizer Water Level: Four pressurizer water level channels are used for reactor trip. Isolated signals from these channels are used for pressurizer water level control. A failure in the level control system could fill or empty the pressurizer at a slow rate (on the order of 30 minutes or more).

The high water level trip setpoint provides sufficient margin so that the undesirable condition of discharging liquid coolant through the safety valves is avoided. Even at full-power conditions, which would produce the worst thermal expansion rates, a failure of the water level control would not lead

Insert B

Section 4.7 of IEEE 279-1971 and GDC 24 requirements concerning Control and Protection Systems Interaction are satisfied, even though control signals are derived from protection sets, because 2/4 voting coincidence logic of the protection sets is maintained. Where a single random failure can cause a control system action that results in a condition requiring protective action and can also prevent proper action of a protective system channel designed to protect against the condition, the remaining three redundant protection channels are capable of providing the protective action even if degraded by a second random failure.

TABLE 7.2-3

REACTOR TRIP SYSTEM INSTRUMENTATION

	Reactor Trip Signal	Typical Range	Typical Trip Accuracy	Typical Time Response (sec)
1.	Power-range high neutron flux	1 to 120% full power	1% of full power	0.2
2.	Intermediate-range high neutron flux	8 decades of neutron flux overlapping source range by 2 decades	±5% of full scale ±1% of full scale from 10^{-4} to 50% full power (1)	0.2
3.	Source-range high neutron flux	6 decades of neutron flux (1 to 10^{6} counts/sec)	±5% of full scale (1)	0.2
4.	Power-range high positive neutron flux rate	+15% of full power	±5% (1)	0.2
5.	Power-range high negative neutron flux rate	-15% of full power	±5% (1)	0.2
6.	Overtemperature ΔT:	T_H 530 to 650°F T_C 510 to 630°F T_{avg} 530 to 630°F P_{PRZR} 1,700 to 2,500 psi f_1 (ΔΦ) -50 to +50 ~~ΔT setpoint 0 to 100°F~~	~~±3.2°F~~ (later)	~~6.0 (including transport time)~~ (later)

|43

(1) Reproducibility (see definitions in Section 7.1)

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TABLE 7.2-3 (Continued)

REACTOR TRIP SYSTEM INSTRUMENTATION

	Reactor Trip Signal	Typical Range	Typical Trip Accuracy	Typical Time Response (sec)	
7.	Overpower ΔT	T_H 530 to 650°F T_C 510 to 630°F T_{avg} 530 to 630°F ~~ΔT setpoint 0 to 100°F~~	(later)	(later)	43
8.	Pressurizer low pressure	1,700 to 2,500 psig	±18 psi (compensated signal)	2.0	43
9.	Pressurizer high pressure	1,700 to 2,500 psig	±18 psi (noncompensated signal)	2.0	43
10.	Pressurizer high water level	Entire cylindrical portion of pressurizer (distance between taps)	+2.3% of full range ΔP between taps at design temperature and pressure	1.2	
11.	Low reactor coolant flow	0 to 120% of rated flow	±2.5% of full flow within range of 70% to 100% of full flow (1)	1.0	43
12.	RCP bus undervoltage	0 to 100% rated voltage	±1%	1.5	43
13.	RCP bus underfrequency	50 to 65 Hz	±0.1 Hz	0.6	43

(1) Reproducibility (see definitions in Section 7.1)

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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. Temperature Averaging Scheme for narrow range T_{hot} Signal per loop.

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 I equipment design and qualification criteria defined in Appendix 7B.

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3. Open-loop control and position indication for the reactor vessel head vent valves.

The SG PORV control equipment provides hardware to meet the requirements for full 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 bi-stable output signals, low and high limit, to the valve controller. These signals maintain auxiliary FW 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 station.

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 Level Compensation and Display - The Steam Generator Narrow Range Water Level Compensation system automatically compensates the SG 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 level signals, the required increase in the low-low SG 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 levels are displayed on the QDPS plasma displays and on main control panel indicators. For additional information, refer to Section 7.2.

Insert

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 C

Insert C

7.5.6.1.1.5 T_{hot} Temperature Averaging Scheme and Display

The T_{hot} Temperature Averaging Scheme (TAS) is used for calculating the narrow range hot leg RTD average temperature per loop. (This averaged signal replaces the signal previously derived from the hot leg bypass RTD.) In addition to calculating a hot leg temperature average per loop, the three narrow range hot leg RTDs per loop are subjected to a sensor quality check that automatically rejects any ailed sensor and incorporates a bias to compensate for the loss of any one sensor in a loop. Should the sensor quality check detect more than one failed sensor per loop, the protective channels that have the T_{hot} average signal as an input must be placed in partial trip. This partial trip is indicated on the control board. (See also Section 7.2.1.1.5.)

and temperature averaging scheme (SGWLCS/TAS)

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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 (GDGs) are indicated below. 49

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

7.5.6.2.2 Single-Failure Criterion: The QDPS is designed to provide edundant instrument channels for each safety-grade function as described in 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 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 49 40

7.5.6.2.3 Quality of Components and Modules: 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 Equipment Qualification: The QDPS is seismically and environmentally 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. 40 49

7.5.6.2.5 Channel Integrity: 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 Channel Independence: Channels that provide signals for the same function are electrically independent and physically separated to accomplish decoupling of the effects of unsafe environmental factors, electric transients, and physical accident consequences. The system is designed to minimize the potential for interactions between channels during maintenance 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 display units. The design meets the requirements of GDC 22. 49 40 49 40 49

7.5.6.2.7 Control and Protection System Interaction: The only subsystem that is used for both protective and control functions is SGWLCS/TAS. 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 49 channel from meeting minimum performance requirements.

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

This design meets the requirements of GDC 24. 40

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

7.5.6.2.9 Capability for Sensor Checks: The QDPS has built-in diagnostics for checking the operational availability of each system input sensor 40 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.

7.5.6.2.10 Capability for Test and Calibration: The SGWLCS HAS 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 49 requirements of GDC 21.

stet 7.5.6.2.11 Channel Bypass or Removal from Operation: The SGWLCS HAS subsystems ~~is~~ are 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 49 of the SGWLCS/TAS subsystem ~~has~~ have been deliberately rendered inoperable in the QDPS hardware, the action will result in the partial trip of the respective channel.

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7.5.6.2.14 Access to Means for Bypassing: The design of the QDPS allows administrative control of the means for manually bypassing channels associated with the ESF qualified controller.

7.5.6.2.15 Multiple Setpoints: There are no multiple actuation setpoints associated with the QDPS.

7.5.6.2.16 Completion of Protective Action Once It Is Initiated: The SGWLCS subsystem of the QDPS is designed such that, once initiated, a protective action goes to completion.

7.5.6.2.17 Manual Initiation: The QDPS design does not include any means for manual initiation of a protective function at the system level. System level initiation is included as part of the Reactor Trip System (RTS) and the ESF Actuation System, with which the QDPS is integrated.

7.5.6.2.18 Access to Setpoint Adjustments, Calibration, and Test Points: The QDPS design permits access to all setpoints, data constants and module calibration adjustments via a portable terminal which can be connected to the system through a serial port. Access to the cabinets is administratively controlled. 49

7.5.6.2.19 Identification of Protective Actions: Protective actions initiated wholly or in part within the QDPS (SGWLCS, TAS and ESF controllers) are indicated on the control board.

7.5.6.2.20 Information Read-Out: The QDPS is designed to provide the operator with accurate, complete, and timely display information pertinent to its own status and the status of plant variables. Through the use of cross channel checking, the design minimizes the development of conditions which would cause meters, annunciators, recorders, alarms, etc., to give inconsistent or erroneous indications which could be confusing to the operator.

The response time of the QDPS is based upon the response time of the monitored systems and the utilization of the process variables being monitored. The design meets the requirements of GDC 13 and 19.

7.5.6.2.21 System Repair: The QDPS is designed to facilitate the recognition, location, replacement, repair, or adjustment of malfunctioning components or modules.

7.5.6.2.22 Identification: The QDPS and associated hardware has been distinctively identified as safety-related equipment.

7.5.7 Emergency Facilities Data Acquisition and Display System

7.5.7.1 Description. The ERFDADS is an integrated system that performs the following functions: 40

1. Implementation of the Safety Parameter Display System (SPDS) as described in NUREG-0696 and supplement 1 to NUREG-0737.