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June 30, 1986

Mr. H. R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. NUCLEAR REGULATORY COMMISSION
Washington, D. C. 20555

Attention: Mr. George Lear
PWR Project Directorate 1

Gentlemen:

DOCKETS 50-266 AND 50-301
NUREG 0737 - SUPPLEMENT 1
SAFETY PARAMETER DISPLAY SYSTEM
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

NUREG 0737 - Supplement 1 requires the submittal of a safety analysis describing the basis on which the parameters selected for display on the Safety Parameter Display System, called the Safety Assessment System for Point Beach Nuclear Plant, "are sufficient to assess the safety status of each identified function for a wide range of events, including symptoms of severe accidents." The Commission's Order dated July 2, 1984, as modified January 6, 1986, requires the submittal of the analysis by June 30, 1986.

Enclosed is our safety analysis of the Safety Assessment System for Point Beach Nuclear Plant, Units 1 and 2. Included in this analysis is a discussion of the electrical isolation for the Safety Assessment System, as requested by letter dated February 28, 1986.

Should you have any questions, please contact us.

Very truly yours,

C. W. Fay
Vice President
Nuclear Power

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Enclosure

Copy to Resident Inspector

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SAFETY ANALYSIS
SAFETY PARAMETER DISPLAY SYSTEM
POINT BEACH NUCLEAR PLANT

Introduction

NUREG 0737, TMI Action Plan Item I.D.2, requires a Safety Parameter Display Console which "will display to operating personnel a minimum set of parameters which define the safety status of the plant through continuous indication of direct and derived variables as necessary to assess the plant safety status". NUREG 0696, Functional Criteria for Emergency Response Facilities, further delineates the requirements for a Safety Parameter Display System.

NUREG 0737, Supplement 1, required that the minimum information displayed on the system be sufficient to provide information to plant operators about:

i) Reactivity Control
ii) Reactor Core Cooling and Heat Removal From the Primary System
iii) Reactor Coolant System Integrity
iv) Radioactivity Control
v) Containment Conditions

The specific information displayed was to be determined by the licensee.

Point Beach Nuclear Plant Development

The Point Beach Nuclear Plant safety parameter display system is a subset of the Safety Assessment System (SAS) which is being implemented in conjunction with the new Plant Process Computer System (PPCS). The SAS is designed to provide easily understandable information from a highly reliable computer-based data acquisition system in human factors engineered formats.

Major features of the SAS include:

i) Plant mode dependent high level display of key parameters used to assess the safety status of the plant.

ii) Thirty-minute trend graphs of groups of related parameters

iii) An accident Identification and Display System (AIDS) that graphically informs the operator of the relative likelihood that each of the three major PWR accidents may be occurring: Loss of Coolant Accident (LOCA), Steam Generator Tube Rupture (SGTR), and Loss of Secondary Coolant (LOSC).

iv) A Critical Safety Function Monitor which defines conditions to assess the status of six critical safety functions.

Dedicated color CRT/keyboard combinations (display stations) provide access to either unit's SAS. The SAS display stations are located in the following areas:

i) Control Room - two displays controlled from one keyboard for each of the two units

ii) Technical Support Center - one display station

iii) Computer Room - one display station

In addition, all of the computer system PPCS display stations have access to all of the SAS displays. PPCS display stations are distributed as follows:

i) Control Room - one display station per unit and two display stations for general use as needed

ii) Technical Support Center - two display stations

iii) Computer Room - one display station

iv) Emergency Operations Facility - two display stations

A relatively large data base is used to support the operation of the SAS. All SAS inputs are directly related to input signals to reduce dependence on PPCS application programs. From this data base a reduced set of parameters are selected for continuous display to the operator during plant operation to give an overview of plant safety status. Some conditioning of data is performed using SAS algorithms to reduce the number of displays that are required without losing functions that may provide key indication of safety status. This includes combining of multiple instruments into a single value, smoothing of instrument noise and rejecting questionable data. The selection of parameters for display on SAS is based upon the Westinghouse Owners Group (WOG) Emergency Response Guidelines (ERGs), Revision 1, which were also used to develop plant specific Emergency Operating Procedures and Critical Safety Function Status Trees for Point Beach Nuclear Plant. These parameters include all Type A variables as defined in Regulatory Guide 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident," as well as selected instrumentation required for long-term operator response and assessment of core damage.

SPDS Parameters

A list of key instrumentation used in the ERGs was developed. The key instrumentation monitors the plant variables which provide primary information required to permit the Control Room Operating staff to:

i) Perform symptom identification

ii) Take specified preplanned manually controlled action for which no automatic control is provided (R.G. 1.97 Type A variables), and

iii) Reach and maintain a safe shutdown condition.

The ERG-identified key parameters and the specific analog parameters used to generate the high-level SAS display for Point Beach Nuclear Plant is provided in Table 1. The information provided, unless otherwise noted, is identical for Units 1 and 2. This list includes parameters necessary to give early indications of potentially adverse safety conditions, necessary to monitor

proper functioning of mitigating equipment after a response to the transient is initiated, and necessary to monitor critical functions for long term operator response. These parameters were used to develop the high level SAS display illustrated in Figure 1.

RCS Pressure

ERG Assumption

The reactor coolant system (RCS) is assumed to have at least two wide range pressure transmitters connected to the residual heat removal (RHR) hot leg suction lines. The range of these channels is typically 0 to 3000 psig. This instrumentation is assumed to be subject to adverse containment conditions.

Point Beach Instrumentation

The reactor coolant system has two wide range pressure transmitters, PT420A and PT420B connected to loop A and loop B cold legs, respectively. PT420C is connected to the RHR suction leg.

Wide range pressure indications are included in the SAS. PT420A and PT420B are averaged to provide input to SAS RCS pressure indication. They also provide input to the subcooling monitor. Within SAS, RCS pressure is based on an average of the pressurizer pressures (refer to Pressurizer Pressure description) as long as any two of the four inputs are good. Otherwise, RCS pressure is based on the wide range loop pressures.

RCS Hot and Cold Leg Temperatures

ERG Assumption

Each RCS hot and cold leg is assumed to have a deep well mounted RTD to monitor wide range RCS temperature. The range of these channels is typically 0 to 700°F. Trending of temperatures is necessary for monitoring RCS natural circulation and cooldown rates.

Point Beach Instrumentation

Hot leg RTDs TE450B and TE450D, TE451B and TE451D and cold leg RTDs TE450A and TE450C, TE451A and TE451C, for loops A and B respectively are deep well mounted dual RTDs and provide input to the SAS. The range of the RTDs is 50 to 750°F. Trending of hot and cold leg temperatures is provided for the previous 30 minutes.

Reactor Vessel Water Level

ERG Assumption

A Reactor Vessel Liquid Inventory System (RVLIS) is used to measure vessel level. The RVLIS system is assumed to have design features typical of a Westinghouse-designed RVLIS, including the following three measurement indications:

a. Upper Range - A measurement that provides an indication of reactor vessel level above the hot leg pipe when the reactor coolant pump in the loop

with the hot leg connection is not operating. The indicated span of the upper range is (1) to 120 percent.

b. Full Range - A measurement that provides an indication of reactor vessel level from the bottom to the top of the reactor vessel during natural circulation. The indicated span of the full range is 0 to 120 percent.

c. Dynamic Head Range - A measurement that provides an indication of reactor core and internals pressure drop for any combination of operating reactor coolant pumps. Comparison of the measured pressure drop with the normal single phase pressure drop provides an approximate indication of the relative void content or density of the circulating fluid. This measurement monitors coolant conditions on a continuous basis during forced flow conditions. The indicated span of the dynamic head range is 0 to 120 percent.

Point Beach Instrumentation

Point Beach Reactor Vessel Level Indication System consists of two wide range differential pressure level detectors, LT494 and LT495 which give an indication of coolant conditions under forced flow conditions, and two narrow range differential pressure detectors LT496 and LT497 which provide indication of reactor coolant level from the bottom to the top of the reactor vessel during no flow or natural circulation flow. The indicated span of wide range instrument is 20 to 145 feet of water head. The narrow range is 0 to 45 feet of water head. Both wide range and narrow range instruments provide input to the SAS.

Steam Generator Narrow Range Water Level

ERG Assumption

Each steam generator is assumed to have at least three channels of a narrow range level measurement system. The range of the narrow range measurement channels is 0 to 100 percent of span. The narrow range instruments are hot calibrated and provide level indications in the steam generators between the top of the U-tubes and the bottom of the secondary moisture separators.

Point Beach Instrumentation

Each steam generator has three narrow range level measurement systems. The range of the narrow range level measurement channels is 0 to 100 percent of span. The narrow range instruments are hot calibrated and provide level indications in the steam generators between the top of the U-tubes and the bottom of the secondary moisture separators. Steam generator A narrow range level is provided by LT461, LT462 and LT463. Steam generator B narrow range level is provided by LT471, LT472 and LT473. Narrow range steam generator level instruments are used by the operator during normal operation and provide the operator with an early indication of potentially adverse safety conditions. Narrow range indication is provided on the SAS.

Steam Generator Wide Range Water Level

ERG Assumption

Each steam generator is assumed to have at least one wide range level measure-

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(1) Plant specific, normally 64 or 70 percent

ment system. The wide range instruments are generally cold calibrated (ambient containment conditions, depressurized steam generator and secondary inventory at containment temperature conditions) and are used primarily for performing steam generator "wet layup" following plant shutdown. The instrument provides level indications in the steam generator between the tubesheet and the bottom of the secondary moisture separators.

Point Beach Instrumentation

Each steam generator has two wide range level measurement instruments. The wide range instruments are cold calibrated (ambient containment conditions, depressurized steam generator and secondary inventory at containment temperature conditions). The instrument provides level indications in the steam generator between the tubesheet and the bottom of the secondary moisture separators. The range of indication is 0 to 518 inches of water. Steam generator A wide range level is provided by LT460A and LT460B. Steam generator B wide range level is provided by LT470A and LT470B.

Both wide range level indications are provided in the form of a digital readout on the SAS. Even though the wide range level transmitters are cold calibrated, adequate indication accuracy exists to provide an early indication of potentially adverse safety conditions and to assure acceptable operator response required by the ERGs.

In addition, during normal operation the operator sees a particular wide range level that corresponds to the acceptable narrow range level and will be alert to any changes from this normal level.

Pressurizer Pressure

ERG Assumption

It is assumed that at least three pressure transmitters are connected to the pressurizer. The range of the channels is typically 1700 to 2500 psig.

Point Beach Instrumentation

There are four pressure transmitters connected to the pressurizer: PT429, PT430, PT431 and PT449. The range of the channels is 1700 to 2500 psig.

SAS RCS pressure is equal to pressurizer pressure, as long as at least two of the four pressurizer pressure indications are valid data. Otherwise RCS wide range pressure is used for SAS RCS pressure. RCS pressure is displayed on the SAS high level display.

Pressurizer Level

ERG Assumption

The pressurizer is assumed to have at least three channels of level measurement. The instruments provide level indications for approximately the total height of the pressurizer. The range of the measurement system is 0 to 100 percent of span.

Point Beach Instrumentation

The pressurizer has four channels of level measurement. LT426, LT427, and LT428 are hot calibrated and provide level indications for approximately the

total height of the pressurizer. LT433 is a cold calibrated transmitter used primarily during plant shutdown. The range of the measurement system is 0 to 100 percent of span. LT426, LT427, and LT428 provide input to the high level SAS display at normal operating temperatures and LT433 is used when cold shutdown loop temperatures are present.

Steam Generator Pressure

ERG Assumption

Each steam generator is assumed to have at least three pressure transmitters located in its main steam line upstream of the main steam line isolation valve. This instrumentation is not assumed to be subject to adverse containment conditions. Typically, these pressure transmitters are located outside containment in the auxiliary building or steam tunnel area. The range of these instruments is typically 0 to 1300 psig.

Point Beach Instrumentation

Each steam line has three channels of pressure measurement upstream of the main steam line isolation valve. These pressure transmitters are located outside containment in the auxiliary building. Steam Generator A pressure is indicated by PT468, PT469, and PT482. Steam Generator B pressure is indicated by PT478, PT479, and PT483. The range of these instruments is 0 to 1400 psig.

All of these steamline pressure channels provide input to the SAS display.

Core Exit Temperature

ERG Assumption

Core exit thermocouple (CET) temperatures are necessary for providing an indication of inadequate core cooling and an input in the determination of RCS subcooling. Several of the thermocouples should be located to monitor the most probable highest temperature area of the core. Also, several of the core exit thermocouples should be located in the vicinity of the vessel hot leg nozzle outlets. The range of the core exit thermocouple temperature readout should be from plant cold shutdown conditions to the maximum core temperature following a design basis LOCA. A typical readout range is 100 to 2200°F.

Point Beach Instrumentation

The CET system has 39 thermocouples positioned to measure fuel assembly outlet coolant temperatures at preselected core locations including probable highest temperature areas and the vicinities of the hot leg nozzles. The range of the CET temperature readout is 50 to 1600°F.

All CETs provide input to the SAS and to the subcooling monitor.

RCS Subcooling

ERG Assumption

RCS subcooling can either be computed manually using a steam table or using a computer-based algorithm. The pressure input can be supplied by RCS wide

range pressure and pressurizer pressure. Generally, the pressure value used for determining the system saturation temperature is an auctioneered low value of the RCS hot leg temperatures and core exit thermocouple temperatures. The temperature value used in the ERGs to determine RCS subcooling is typically the core exit thermocouple temperatures.

Point Beach Instrumentation

Core subcooling within SAS is based on an average core exit temperature and compared to a saturation temperature that is determined using the RCS pressure (pressurizer pressure or wide range loop pressure) and steam table algorithms. Subcooling indication is provided on the high level SAS display.

Auxiliary Feedwater Flow

Assumption

The auxiliary feedwater (AFW) supply lines to each steam generator have at least one auxiliary feedwater flow measurement indicated in the control room. If each steam generator is supplied with auxiliary feedwater flow from more than one auxiliary feedwater pump, the flow measuring device indicates total flow to each steam generator. Total auxiliary feedwater flow to all steam generators is determined by adding the auxiliary flow to each of the steam generators.

Point Beach Instrumentation

AFW flow to each steam generator can be provided by a motor driven auxiliary feedwater pump which is shared between units or one steam driven auxiliary feedwater pump per unit which supplies both steam generators for that unit. AFW flow indication to the A steam generator is provided by FT4036. AFW flow indication to the B steam generator is provided by FT4037. The AFW flow indicates the sum of the flows from the motor and steam driven pumps. AFW flow to each steam generator is provided on the high-level SAS display. The range of measurement is 0 to 300 gpm.

RWST Level

ERG Assumption

At least two channels of level measurement system are available to monitor the refueling water storage tank (RWST). The instruments provide level indications for at least the minimum required water supply to the SI pumps following a LOCA and key the switchover from the injection to the recirculation mode. The range of the measurement system is 0 to 100 percent of span.

Point Beach Instrumentation

Two channels of level measurement are available to monitor the RWST. LT972 and LT973 provide level indications for 0 to 100 percent of span. Both of these level channels provide input to SAS but are not an early indication of potentially adverse safety conditions and are not displayed on the high level SAS display. They can be monitored on lower level displays to assure adequate SI pump water supply and to monitor the switchover from the injection to the recirculation mode.

CST Level

ERG Assumption

At least two channels of a level measurement system are available to monitor the level in each condensate storage tank (CST) which provides the primary water source to the auxiliary feedwater pumps. The instruments should provide level indications for at least the minimum required water supply for the auxiliary feedwater system. The range of the measurement system is 0 to 100 percent of span.

Point Beach Instrumentation

Two channels of level measurement are available to monitor the level in the condensate storage tanks which provide the primary water source to the auxiliary feedwater pumps through a common supply line. The instruments, LT4038 and LT4040 for Tank A and LT4039 and LT4041 for Tank B, provide level indications for 0 to 100 percent of span (0-21 ft) for each tank. These instruments are not unit specific. Condensate storage tank level is not a parameter which gives direct indication of safety status or impending adverse safety conditions. It is a parameter used during recovery from a plant transient. CST level is monitored on lower level SAS displays.

Containment Pressure

ERG Assumption

At least two channels of containment pressure are available to monitor the containment. The instruments must extend over the range from normal conditon containment pressure to containment design pressure. For a dry containment, this range is typically 0 to 65 psig.

Point Beach Instrumentation

Eight channels of containment pressure are available to monitor the containment. The instruments extend over the range from normal condition containment pressure to three times containment design pressure. PT945, PT947, PT949 measure -6 to 54 psig. PT946, PT948 and PT950 measure 0 to 90 psig. PT968 and PT969 measure -5 to 195 psig. All but the last two instruments listed above are inputs to SAS and are combined to provide containment pressure found on the trend displays. High containment pressure will cause an indication on the CONTAINMENT Critical Safety Function.

Containment Water Level

ERG Assumption

At least two channels of a level measurement system are available to monitor the water level in the containment building. The bottom tap of the measurement system should be located in the cavities or sumps in which water resulting from a loss of reactor or secondary coolant would initially collect. The top tap should be at the maximum expected flood level in the containment building. In some instances, due to the large span of the required level measurement, two channels of narrow range are implemented which only provide an indication of water level in the reactor cavity or sump. Two channels of a wide range level system are then utilized for determining containment flood level. The range of the measurements systems is 0 to 100 percent of span.

Point Beach Instrumentation

Containment water level is measured by float-type, magnetic reed switch devices LT958 and LT959 for Sump A (reactor cavity sump) and LT960 and LT961 for Sump B (lowest containment level). The ranges of the level indicators overlap and provide continuous level indication equivalent to 0 to 350,000 gallons which exceeds the maximum available water inventory. These overlapping instruments are combined in SAS to furnish a single indication of containment water level which is provided on the high level display.

Containment Radiation Level

ERG Assumption

At least two channels of radiation detectors are assumed to be available for containment radiation monitoring. The radiation monitor is capable of providing an indication of radiation levels from background levels to a postulated total integrated dose (TID) release. As in the case of the containment water level system, a narrow and wide range monitoring system may be installed to increase the sensitivity at the lower radiation levels.

Point Beach Instrumentation

Three channels of radiation detectors available for containment area radiation monitoring provide input to the SAS. The radiation monitors are capable of providing an indication of radiation levels from background levels to a postulated TID release. RE126, RE127, RE128 have a range of 10^{0} to 10^{8} R/hr.

Secondary Radiation Level

ERG Assumption

At least two channels of a measurement system for detecting secondary radiation are assumed to be available to the operator. Several means of implementing this monitoring function are available. These may include dedicated steam line radiation monitors, condenser air ejector radiation monitors, and steam generator blowdown radiation monitors. Factors that impact the ultimate decision for determining the plant-specific means of monitoring secondary radiation include location of monitoring instrumentation, qualification of installed instrumentation, and alternate uses of installed instrumentation (e.g., calculation of effluent release). The radiation monitoring system adopted must be capable of providing an indication of radiation levels from those levels existing in the secondary side during normal operation with maximum Technical Specification leakage to the level expected following a design basis steam generator tube rupture.

Point Beach Instrumentation

Several channels of a measurement system for detecting secondary radiation are available to the operator. These include dedicated steam line radiation monitors RE231 and RE232 (10^{-1} to 10^{3} uCi/cc), condenser air ejector radiation monitor RE215 (.01 to 100 mr/hr), and a steam generator blowdown radiation monitor RE219 (10 to 10^{6} CPM). RE225 and RE226 (0.01 to 100 mr/hr and 0.01 to 100 R/hr respectively) also provided for low and high range condenser air ejector radiation monitoring for Unit 1 and 2 combined.

RE215, RE231, and RE232, the monitors expected to give the primary indication of potentially adverse safety conditions, provide input for the digital indication on the high level SAS display.

Neutron Flux

ERG Assumption

At least two channels of instrumentation are assumed to be available to monitor core neutron flux. The instrumentation is capable of monitoring neutron flux from source range levels to the maximum expected core return to power levels due to excessive RCS cooldown. Several installed instruments are capable of monitoring the required range. These include the source, intermediate, and power range detectors.

Point Beach Instrumentation

Neutron flux instrumentation consists of two Source Range channels, N31 and N32 (10^{0} to 10^{6} CPS), two Intermediate Range channels, N35 and N36 (10^{-11} to 10^{-3} AMPS), and four Power Range channels, N41, N42, N43, and N44 (0 to 120 percent of power). These neutron flux channels are not monitored on the Normal Operation or Heatup/Cooldown high level SAS displays. Source, Intermediate, and Power Range channels provide input to lower level SAS displays. Source Range instruments provide input to the Cold Shutdown high level display.

Return to power while the reactor is tripped would be indicated by an abnormal condition for the SUBCRITICALITY Critical Safety Function.

Trend Displays

Lower level SAS displays consist of 30-minute trend displays. There are two types of 30-minute trends available within SAS: 1) AIDS bar height trends and 2) group parameter trends. The AIDS bar height trends provide 30-minute histories of AIDS bars for the selected plant operating mode (Normal Operation or Heatup/Cooldown). The current value, direction of trend, and AIDS bar height contribution for all of the inputs to the AIDS bar in question are also provided on these displays. The group parameter trends each contain a predefined set of up to four related parameters. The current value, a bar, and a 30-minute trend of each parameter are displayed. Two group trends can be displayed at one time.

Data Storage and Retrieval

The Plant Process Computer System (PPCS) is capable of storing and retrieving all measured inputs and Radiation Monitoring System values including all inputs to the SAS. Data is stored on hard disk at five second intervals for forty-eight hours and at ten-minute intervals for two weeks. Either set of data can be stored on magnetic tape.

Electrical Isolation

The SPDS is required to be suitably isolated from electric or electronic interference with equipment and sensors that are in use for safety-related systems. Electrical isolation is a function of the safety-related instrumentation independent of the SAS/PPCS. Typically, outputs from the instrument racks to the computer multiplexers are isolated by isolation devices

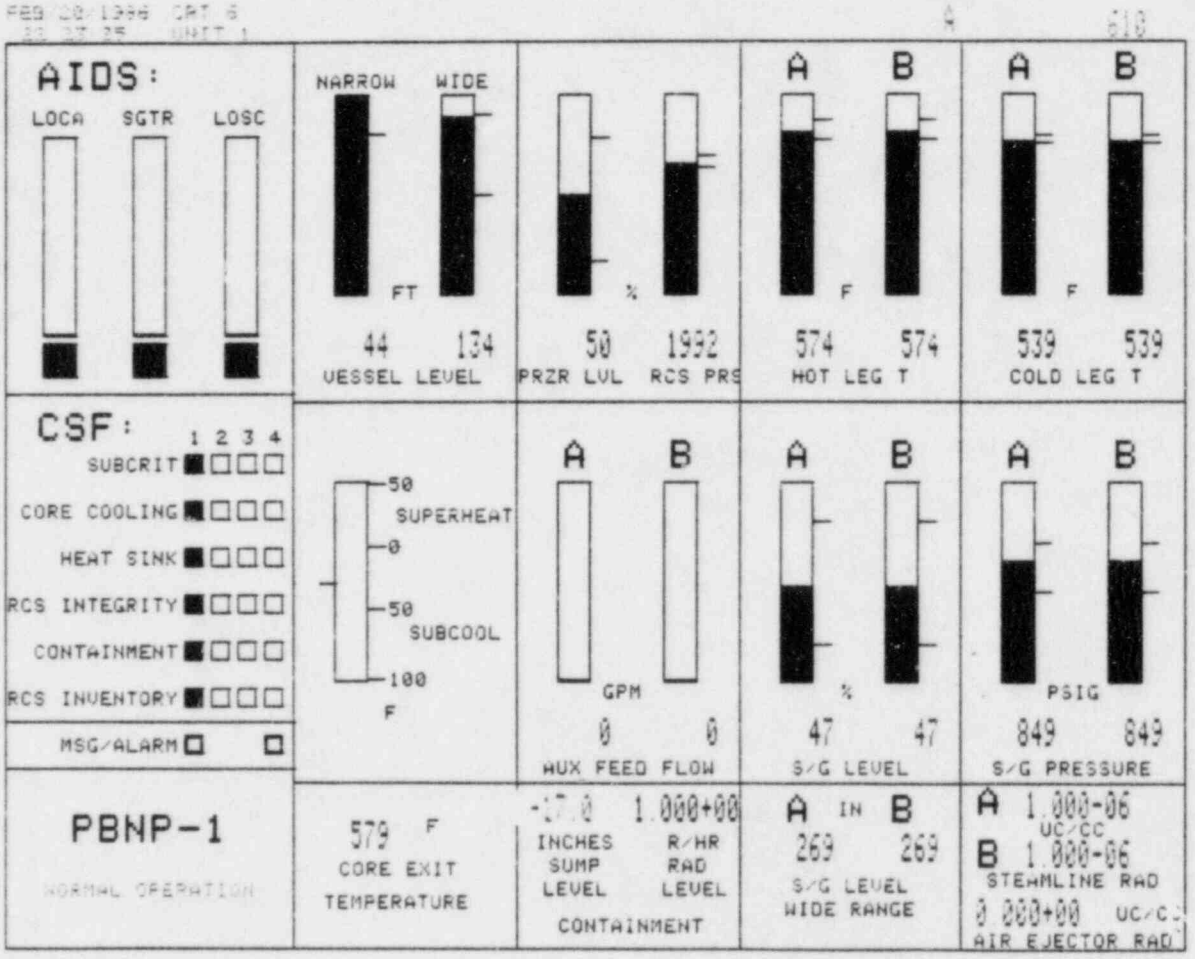
which are part of the instrument loop. In addition, the multiplexers are electrically isolated from the computer central processing unit, with data transmission between the multiplexers and CPU by fiber optic data links.

Instrument racks for safety-related equipment are either Foxoboro H-Line or Spec. 200. Outputs are isolated from the instrument loops by current to current and voltage to current isolation devices, respectively. These types of devices have been tested by Foxboro to insure that a fault on the device output will not affect the instrumentation.

All safety-related instrumentation, and therefore the isolation device comply with appropriate seismic and environmental qualification standards. The multiplexers are also seismically qualified.

FIGURE 1

SAS HIGH LEVEL DISPLAY



Note: This figure for illustration purposes only.

TABLE 1
ERG / WEPCO SAS CROSSREFERENCE

EMERGENCY RESPONSE GUIDELINE ASSUMED INSTRUMENTATION	POINT BEACH SAFETY ASSESSMENT SYSTEM INSTRUMENTATION				
INSTRUMENT	ANALOG OUTPUT PARAMETERS		DISPLAYED RANGE		INPUT INSTRUMENT POINT ID NUMBER.
1. RCS Pressure 2. Pressurizer Pressure	RCS PRESSURE (1) Wide Range Loop Pressure (or) Pressurizer Pressure		0 - 3000 1700 - 2500	PSIG PSIG	PT420A, PT420B PT429, PT430, PT431, PT449
3. RCS Hot and Cold Leg Temp.	RCS Wide Range Cold Leg Temp Loop A RCS Wide Range Cold Leg Temp Loop B		50 - 750 50 - 750	DEGF DEGF	T450A, T450C T451A, T451C
	RCS Wide Range Hot Leg Temp Loop A RCS Wide Range Hot Leg Temp Loop B		50 - 750 50 - 750	DEGF DEGF	T450B, T450D T451B, T451D
4. Reactor Vessel Level*	Reactor Vessel Level - Wide Range Reactor Vessel Level - Narrow Range		20 - 145 0 - 45	FEET FEET	LI494, LI495 LI496, LI497
5. Steam Generator Level (Narrow Range)	Steam Generator A Narrow Range Level Steam Generator B Narrow Range Level		0 - 100 0 - 100	PCNT PCNT	LT461, LT462, LT463 LT471, LT472, LT473
6. Steam Generator Level (Wide Range)	Steam Generator A Wide Range Level Steam Generator B Wide Range Level		0 - 518 0 - 518	INCH INCH	LT460A, LT460B LT470A, LT470B
7. Pressurizer Level	Pressurizer Level	Normal Operation Cold Calibrated	0 - 100 10 - 85	PCNT PCNT	LT426, LT427, LT428 LT433
8. Steamline Pressure	Steam Generator A Pressure Steam Generator B Pressure		0 - 1400 0 - 1400	PSIG PSIG	PT468, PT469, PT482 PT478, PT479, PT483
9. Core Exit Temp.	Core Exit Thermocouples		50 - 1600	DEGF	TA07-TM06 (39 total)
10. RCS Subcooling	RCS Subcooling (2)		200 - -50	DEGF	Calculated
11. Auxiliary Feed Flow**	Steam Generator A Auxiliary Feedflow Steam Generator B Auxiliary Feedflow		0 - 300 0 - 300	GPM GPM	FT4036 FT4037
12. RWST Level**	RWST Level (3)		0 - 100	PCNT	LT972, LT973
13. CST Level**	Condensate Storage Tank level (3)	CST A CST B	0 - 252 0 - 252	INCH INCH	LT4038, LT4040 LT4039, LT4041
14. Containment Pressure	Containment Pressure (3)		8.7 - 105	PSIA	PT945, PT947, PT949 PT946, PT948, PT950
15. Containment Water Level	Containment Sump Level -	Sump Level A Sump Level B	-17 - 190	INCH	LT958, LT959 LT960, LT961
16. Containment Radiation Level	Containment Radiation Level		1E 0 - 1E 8	R/HR	RE126, RE127, RE128
17. Secondary Radiation Level	Steam Line A Radiation Level Steam Line B Radiation Level Air Ejector Radiation		0 - 2E 3 0 - 2E 3 0 - 1E-2	uC/CC uC/CC uC/CC	RE231 RE232 RE215
18. Neutron Flux	Neutron Flux (3)(4)	Source Range Intermediate Range Power Range	1 - 1E 6 1E-3 - 1E-11 0 - 120	CPS AMPS PCNT	N31, N32 N35, N36 N41, N42, N43, N44

ERG NOTES:

* Optional Instrumentation. Emergency Response Guidelines have been prepared both with and without reactor vessel level.

** These parameters are not required to give an early indication of potentially adverse safety conditions but are used to monitor the proper functioning of mitigating equipment or to assist in long term operator response.

SAS NOTES:

(1) Pressurizer pressures are used for RCS pressure unless they are out of range, in which case, wide range loop pressures are used.

(2) Subcooling is based on the RCS pressure (see note 1) plus containment pressure and an average of the 39 core exit TC's.

(3) Parameter is not available on the normal operation or heatup/cooldown high level displays but is available on a lower level SAS display.

(4) Source range is available on the high level cold shutdown SAS display.