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KNIGHTON,G.W. Licensing Branch 3

SUBJECT: Forwards addl info re SPDS,for completion of review,in response to 850618 request.SPDS variable selection contains indication of flow for heat removal in ECCS & shutdown cooling modes when steam generators unavailable.

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Director of Nuclear Reactor Regulation
Attention: Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

August 19, 1985
ANPP-33235-EEVB/PGN

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
PVNGS Safety Parameter Display System (SPDS)
Docket Nos. STN 50-528(License No. NPF-41)/529/530
File: 85-056-026; G.1.01.10

Reference: Letter from G. W. Knighton, NRC, to E. E. Van Brunt, Jr., APS, dated June 18, 1985.
Subject: Request for Additional Information Concerning the PVNGS SPDS.

Dear Mr. Knighton:

The above referenced letter requested that APS provide additional information to your staff so that they may complete their review of the PVNGS SPDS. Attached is the information as requested per the referenced letter, which is also attached.

If you have any further questions, please call Mr. William F. Quinn of my staff.

Very truly yours,

E E Van Brunt Jr /VH

E. E. Van Brunt, Jr.
Executive Vice President
Project Director

EEVB/PGN/slh
Attachments

cc: A. C. Gehr
E. A. Licitra
M. E. Ley
R. Zimmerman

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To assist the staff in completing their evaluation of the PVNGS Units 1, 2 and 3 SPDS, additional information is being provided. This information has been formatted to correspond with Enclosure (1) of the Reference Letter.

A. VARIABLE SELECTION

1. At PVNGS, the Critical Safety Functions (CSF's) referenced by NUREG-0737 Supplement 1, have been categorized into the following six areas:

   Reactivity Control (RTV)
   Heat Removal (HRV)
   RCS Inventory & Pressure Control (PIC)
   Indirect Radioactive Release Control (IRR)
   Containment Integrity (CIN)
   Maintenance of Vital Auxiliaries (VAX)

   As stated in the PVNGS SPDS Safety Analysis Report (SAR), the PVNGS SPDS parameter selection was based on displaying leading parameters of information associated with the CSF groups. These leading parameters were identified as being the most useful to the control room operator when he/she uses the plant specific Emergency Operating Procedures (EOP's) during abnormal or emergency conditions.

   The relationship of the PVNGS CSF's to the CSF's in NUREG-0737 Supplement 1 is shown in Table 1 below. Parameters currently associated with each of the PVNGS CSF's are as shown in Table 2 of this attachment.

TABLE 1

RELATIONSHIP OF PVNGS CSF TO NUREG-0737 SUPPLEMENT 1 CSF
PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2 AND 3

NUREG-0737 Supplement 1 CSF	PVNGS Plant Specific CSF
Reactivity Control	Reactivity Control (RTV)
Rx Core Cooling and Heat Removal (from Primary)	Heat Removal (HRV)
Rx Coolant System Integrity	Pressure and Inventory Control (PIC)
Radioactive Control	Indirect Radioactivity Release (IRR)
Containment Integrity	Containment Integrity (CIN)
None	Maintenance of Vital Auxiliaries (VAX)

TABLE 2

SAFETY FUNCTION VARIABLES
PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2 AND 3

SAFETY FUNCTION	VARIABLE
Reactivity Control (RTV)	CEA Position Log Power Linear Power HPSI Flow to RCS LPSI Flow to RCS
Heat Removal (HRV)	Sub-Cooled Margin CET-T Hot T Hot - T Cold (Loop 1) T Hot (Loop 1) T Hot - T Cold (Loop 2) T Hot (Loop 2) Outlet Plenum Level SG-1 Level SG-2 Level SG-1 Pressure SG-2 Pressure
Pressure & Inventory Control (PIC)	Sub-Cooled Margin Vessel Head Level RCS Pressure Pressurizer Pressure Pressurizer Level HPSI Flow to RCS LPSI Flow to RCS
Indirect Radiation Release (IRR)	Plant Vent Stack Condenser Vacuum Exhaust Fuel Building Exhaust S/G 1 Blow Down Radiation S/G 2 Blow Down Radiation Essential Cooling Water Radiation Control Room Vent Radiation Nuclear Cooling Water Radiation
Containment Integrity (CIN)	Containment Isolation Verification Containment Pressure Containment Spray Flow Containment Temperature Containment Level Containment Radiation - High Refuel Pool Radiation H_2 Concentration

TABLE 2
(Continued)

SAFETY FUNCTION	VARIABLE
Maintenance of Vital Auxiliaries (VAX)	HPSI Flow to Loop 1
	HPSI Flow to Loop 2
	LPSI Flow to Loop 1
	LPSI Flow to Loop 2
	CS Flow A
	CS Flow B
	Aux. Feed Flow to SG1
	Aux. Feed Flow to SG2
	Steam Flow - Feed Flow 1
	Steam Flow - Feed Flow 2

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2. Neutron Flux (Source Range)

The PVNGS SPDS contains two neutron flux power range indications as indicated in Table 1. These two parameters indicate, by bar length, the relative power in the following ranges:

Log Power : 2.0E-8% to 2.0E2%

Linear Power : 0% to 2.0E2%

The range for these two variables presently exceeds the R.G. 1.97, Table 2 requirements of 1.0E-6% to 1.0E2% by 2.5 decades of range. The combination of these two variables provides a wide dynamic range of neutron flux indication. This wide range will provide the neutron flux information necessary to assist the plant operator in the detection of plant CSF deviations and accomplishment of emergency and abnormal event mitigation.

In addition, the PVNGS SPDS variable selection is based upon selecting the plant specific CSF groups (Table 1) with their leading associated parameters (Table 2) that will aid in the execution of the EOP's for detecting and mitigating abnormal conditions. The PVNGS EOP requirements for neutron flux encompass two basic setpoints:

Setpoint A: 1.0E-4% power level and stable

- Required by the PVNGS EOP Functional Recovery Procedure (FRP) 41 RO 1ZZ10 in the following areas:

  ° Reactivity Safety Function assessment flow chart to verify shutdown.

  ° Safety Function success criteria for Reactivity Control in the success paths for automatic reactor trip and CEA drive-in.

Setpoint B: Decreased to 1.0E-6% power level

- Required by the following EOP FRP's:

  ° 41 RO 1ZZ01, Appendix A&B, Section 3.1
  ° 41 RO 1ZZ02, Appendix A&B, Section 4.1
  ° 41 RO 1ZZ03, Appendix A&B, Section 5.1
  ° 41 RO 1ZZ04, Appendix A&B, Section 3.1
  ° 41 RO 1ZZ05, Appendix A&B, Section 6.2
  ° 41 RO 1ZZ06, Appendix A&B, Section 3.1
  ° 41 RO 1ZZ07, Appendix A&B, Section 5.2
  ° 41 RO 1ZZ08, Appendix A&B, Section 5.1
  ° 41 RO 1ZZ09, Appendix A&B, Section 3.3

In conclusion, the ranges provided for "Log Power" and "Linear Power" on the PVNGS SPDS as described above are adequate to monitor the required neutron flux indication range.

3. Cold Leg Temperature

Currently under the Heat Removal (HRV) CSF, variables for "THot - TCold" and "THot" for both Loops 1 and 2 are displayed. Due to space limitation on each of the SPDS display pages, only eleven parameters can be displayed without cluttering the display and introducing a human factors discrepancy. Since "Delta T" and "T-Hot" provide operator action points in the PVNGS EOP's, these two variables were primarily selected in lieu of "T-Cold".

With the use of these two selected variables, the operator can readily determine either the Loop 1 or Loop 2 "TCold" for brittle fracture consideration. This determination can be accomplished by observing the difference of the "Delta T" and "THot" variable bar lengths.

In addition, the "Delta T" for each loop may be considered by the control room operator for assessing the status of natural circulation as a mode of heat removal rather than "TCold" by itself or with manual calculation of "Delta T".

As discussed above, the PVNGS SPDS does provide alternate added variables that aid the plant operator in accomplishing detection and mitigation of CSF deviations.

4. Steam Generator (SG) Pressure

Currently under the Heat Removal (HRV) CSF, parameters have been added for SG-1 and SG-2 pressure. The addition of these two variables were a result of the PVNGS SPDS Verification and Validation (V&V) Program which demonstrated that these two parameters were required in order to address the PVNGS CSF's when the operator uses the plant specific EOP's (documented in the PVNGS Safety Analysis Report Appendix A; SPO 24).

5. Steam Generator Radiation

Currently under the Indirect Radiation Release (IRR) CSF, parameters for "SG-1 Blowdown Radiation" and "SG-2 Blowdown Radiation" and "Condenser Vacuum Exhaust" exist. The two SG Blowdown Radiation parameters, along with Condenser Vacuum Exhaust will provide a rapid assessment of plant radiation status in the secondary system (steam generator and steamline). Once the affected steam generator and its steamline are isolated, the operator will be able to rapidly assess on the SPDS a decrease in radiation. This decrease will assist the operator during accidents and abnormal operating conditions by providing him with the

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information that the affected steam generator has been isolated. Therefore, radiation in the secondary system (steam generator and steamline) has been isolated and is not being released to the environment.

6. Shutdown Cooling Flow

PVNGS may use either the LPSI pumps or Containment Spray (CS) pumps for shutdown cooling. The "Maintenance of Vital Auxiliaries" (VAX) display contains indications of flow from each of the four pumps via individual train flow and indication.

The ranges of these indications are:

LPSI Flow: 0 - 10,000 GPM
CS Flow: 0 - 5,000 GPM

Per the PVNGS "Shutdown Cooling Procedure" the desired flow values are approximately 4500 GPM for the LPSI pump and approximately 4000 GPM for the Containment Spray pump.

It should be noted that the "LPSI Flow" indication also can indicate the Containment Spray flow as the "LPSI flow", since the flow element is located downstream of the tie point of the LPSI pump discharge piping and the Containment Spray pump discharge piping for the specific train. In operating and emergency modes where both the Containment Spray Pump and LPSI pumps are simultaneously operating, the SPDS "LPSI Flow" bar indicates total injection flow to the cold leg for the specific train.

Additionally, a summation of the Train A and Train B "LPSI flow" values are provided on the "Reactivity Control" (RTV) display to aid the operator in the implementation of EOP actions.

Therefore, the PVNGS SPDS variable selection does contain indication of flow for heat removal in the ECCS and Shutdown Cooling modes when the steam generators are not available.

B. VARIABLE VALIDATION

1. The PVNGS SPDS validation did include the evaluation of the SPDS variable relationship to the PVNGS CSF's by a walk-thru of selected transients and accidents.

As stated in the PVNGS SPDS SAR, this method consisted of a dynamic SPDS programmed with plant specific transient data and accident data which was used to simulate CSF deviations on the SPDS display. This walk-thru was performed while the operator utilized the SPDS and plant specific EOP's to detect plant CSF deviations from normal plant operating conditions.

During the validation, the SPDS variable relationship to plant CSF's was addressed using criteria as follows:

- Could the operator detect proper plant deficiencies as postulated in the simulated transients and accidents?

- Did the variable selection provide sufficient or correct leading variables for each of the CSF groups?

- Is the system responsive enough to allow the operator time to evaluate the discrepancy as postulated and to formulate further action in a timely manner?

Therefore, as mentioned above, consideration was given to walk-thru of plant specific transients and accidents during the validation of the PVNGS SPDS. This walk-thru did address the relationship of the selected variables to the plant specific CSF's.

2a. The useability of the SPDS was demonstrated by ensuring that the selected transients and accidents that were simulated exercised the variables on the SPDS to their fullest extent possible, with exceptions as shown on Table 3. Variables not exercised for a given scenario were those deemed unapplicable for the detection and mitigation of that specific scenario. Based on computer models of the specific scenarios, the variables were exercised (as practicable) to their appropriate maximum representations during the walk-thru. Due to the inherent design of the PVNGS SPDS, once the variables surpassed the alarm limit, any increase of the variable beyond the design range does not provide additional information to the operator, since most displayed variables have compressed ranges.

2b. The scenarios simulated during the walk-thru for SPDS validation covered the instrument setpoints for system actuations and operator actions. This is due to the method used in selecting the alarm limits for the SPDS. The alarm limits were selected based on Tech. Spec. setpoints (system actuation) and EOP values (operator actions) required to protect the safety of the plant and public. Therefore, the useability of the SPDS was demonstrated by exercising the selected variables beyond their specific alarm setpoints via the simulator walk-thru method.

TABLE 3

SPDS VARIABLES EXERCISED DURING SIMULATED TRANSIENTS AND ACCIDENTS PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2 AND 3

	SMALL BREAK LOCA	POWER FAIL	LARGE SLB	LARGE SGTR
CEA Position	X	X	X	X
Log Power	X	X	X	X
Linear Power	X	X	X	X
HPSI Flow to RCS	X	X	X	X
LPSI Flow to RCS	X			
Sub-Cooled Margin	X	X	X	X
CET-THot	X	X	X	X
THot-TCold (Loop 1)	X	X	X	X
THot-TCold (Loop 2)	X	X	X	X
THot (Loop 2)	X	X	X	X
Outlet Plenum Level	X			
SG-1 Level	X	X	X	X
SG-2 Level	X	X	X	X
SG-1 Pressure	See Note 1	See Note 1	See Note 1	See Note 1
SG-2 Pressure	See Note 1	See Note 1	See Note 1	See Note 1
Vessel Head Level	X			
RCS Pressure	X	X	X	X
Pressurizer Pressure	X	X	X	X
Pressurizer Level	X	X	X	X
Plant Vent Stack	See Note 2	See Note 2	See Note 2	See Note 2
Condenser Vacuum Exhaust				X
Fuel Building Exhaust	See Note 2	See Note 2	See Note 2	See Note 2
SG-1 B/D Rad	See Note 2	See Note 2	See Note 2	See Note 2
SG-2 B/D Rad				X
Ess Cooling Water Rad	See Note 2	See Note 2	See Note 2	See Note 2
C.R. Vent Rad	See Note 2	See Note 2	See Note 2	See Note 2
Nuc. Cooling Water Rad	See Note 2	See Note 2	See Note 2	See Note 2
Containment Iso. Verif	X	X	X	X
Containment Pressure	X		X	
Containment Spray Flow			X	
Containment Temp.	X	X	X	
Containment Level	X			
Containment Rad. Hi	X			
Refuel Pool Rad.	X			
H_2 Concentration	X	X	X	X
HPSI Flow to Loop 1	X			
HPSI Flow to Loop 2	X	X	X	X
LPSI Flow A to Loop 1	X			
LSPI Flow B to Loop 2	X			
CS Flow A			X	
CS Flow B			X	
Aux Feed Flow to SG 1		X	X	X
Aux Feed Flow to SG 2		X	X	X
Stm Flow-Feed Flow 1	X	X	X	X
Stm Flow-Feed Flow 2	X	X	X	X

Note 1: These variables were added as a result of the validation effort.

Note 2: The intent of the PVNGS SPDS validation using the walk-thru method was not to exercise every parameter displayed to its fullest extent. The purpose was to demonstrate that the operator can identify, while using the EOP's, plant transients and accidents when those parameters that provide leading indication for the CSF's are deviated from their normal plant operating condition. Therefore, those parameters were not simulated during the scenarios.