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SUBJECT: Forwards response to SER Question 222.04 re multiple control sys malfunction due to common power source, common sensor, or common instrument tap failures.

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December 30, 1982
ANPP-22623 - WFQ/MSN

Mr. T. M. Novak
Assistant Director for Licensing
Division of Licensing
Office of Nuclear Reactor Regulatory
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Palo Verde Nuclear Generating Station
(PVNGS) Units 1, 2 and 3
Docket Nos. STN-50-528/529/530
File: 82-056-026; G.1.01.10

Reference: NUREG-0857, "Safety Evaluation Report" related to the operation of Palo Verde Nuclear Generating Station Units 1, 2, and 3 dated November, 1981.

Dear Mr. Novak:

Section 7.7.2, of the referenced SER, requested a response to your Question 222.04 regarding multiple control system malfunctions due to common power source, common sensor, or common instrument tap failures. Attached is Question 222.04 and our response. We believe this additional information provides assurance that the design basis event analyses adequately bound other more credible failures that you outlined in items 1 through 4 in Question 222.04. This response to Question 222.04 will be incorporated in the PVNGS FSAR in an upcoming ammendment.

We feel this closes the portion of the open item in Section 7.7.2, of the SER, regarding Question 222.04.

Very truly yours,

E. E. Van Brunt, Jr.
APS Vice President,
Nuclear Projects
ANPP Project Director

EEVBJr/MSN/sp
Attachment

cc: E. A. Licitra L. Bernabei P. L. Hourihan A. C. Gehr

ALL WITH ATTACHMENTS

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ATTACHMENT

NRC Question 222.04

The analyses reported in Chapter 15 of the FSAR are intended to demonstrate the adequacy of safety systems at mitigating anticipated operational occurrences and accidents. Based on the conservative assumptions made in defining these design basis events and the detailed review of the analyses by the staff it is likely that they adequately bound the consequences of single control system failures.

To provide assurance that the design basis event analyses adequately bound other more fundamental credible failures, you are requested to provide the following information:

Item 1: Identify those control systems whose failure or malfunction could seriously impact plant safety.

Item 2: Indicate which if any of the control systems identified in 1 receive power from common power sources. The power sources considered include all power sources whose failure or malfunction could lead to failure or malfunctions of more than one control system and should extend to the effects of cascading power losses due to the failure of higher level distribution panels and load centers.

Item 3: Indicate which if any of the control systems identified in 1 receive input signals from common sensors. The sensors considered should include, but should not necessarily be limited to common hydraulic headers or impulse lines feeding the pressure, temperature, level, or other signals to two or more control systems.

Item 4: Provide justification that any simultaneous malfunctions of the control systems identified in 2 and 3 resulting from failures or malfunctions of the applicable common sensor or power source are bounded by the analyses in Chapter 15 and would not require action or response beyond the capability of operators or safety systems.

Response

Item 1: Table 222.04-1 identifies the control systems which were considered in the evaluation of potential impacts on plant safety due to common power source or common sensor failures. As discussed below, the consequential malfunctioning of these systems due to a common power/sensor failure has an impact on plant safety which is bound by the Chapter 15 analyses in the FSAR.

Item 2: The power source failures which would affect more than one control system, and a brief description of the impact on each control system, is provided below. Except for the loss of offsite electrical power, which is specifically addressed by the Chapter 15 analyses, no other power failures have been identified which would introduce additional control system malfunctions to those described. This is due to the degree of separation inherent in the electrical power distribution network and the availability of backup power sources within the network.

Impact Due to Loss of 120 V AC Distribution Panel E-NNN-D11

FWCS - The main feedwater pump speed will decrease to its minimum controlled speed, reducing feedwater flow. In addition, the feedwater control valves will fail as is (in the position they were in when power was lost.)

SBCS - The control system cannot generate quick open and modulate open signals to open the turbine bypass valves. In addition, control room indication of the automatic permissive signal will be lost.

RPCS - The control system will be unable to generate CEA drop demand and turbine runback signals.

PLCS - The letdown control valve closes and all charging pumps are turned on.

CEDMCS - Loss of one of two redundant power sources to the interlock relays. Therefore, CEDMCS will not be impacted.

Impact Due to Loss of 120 V AC Distribution Panel E-NNN-D12

SBCS - Inability to generate an automatic motion inhibit (AMI) signal.

RRS - Inability to generate CEA motion demand signals. Loss of CEA motion demand indication in the control room

PPCS - Pressurizer spray control valve closes and proportional heaters turn off. Pressure indication in the control room goes to zero psia.

CLCS - Inability to generate condensate storage tank control valve opening signal. The valve will remain in its normally closed state.

CEDMCS - Loss of one of two redundant power sources to the interlock relays. Therefore, CEDMCS will not be impacted.

Impact Due to Loss of 125 V DC Load Center E-NKN-M45

SBCS - Inability to actuate turbine bypass valve quick open or permissive solenoids. Loss of quick open indication in the control room.

PPCS - De-energization of the proportional heaters and loss of all the non-IE backup heaters.

CLCS - Inability to open condensate storage tank control valve due to solenoid de-energization.

MSRCS - Inability to isolate the extraction lines from the high and low pressure turbines to the feedwater heaters.

MFTPCS - Inability to automatically trip main feedwater pumps or use pump logic. Manual trip is still available.

Item 3: Table 222.04-2 identifies the control systems which share a common sensor or instrument tap. No other common sensors/taps have been identified.

Item 4: As discussed below the consequences of common power source, common sensor, and common instrument tap failures are bound by CESSAR FSAR Chapter 15.

Part A: EVALUATION OF COMMON POWER SOURCE FAILURES

Panel E-NNN-D11 Failure

The FWCS will initiate a decrease in feedwater flow at the time the distribution panel loses power. In addition, the PLCS will reduce letdown flow to 0 gpm, and initiate charging flow from all three charging pumps, resulting in a net mass addition to the primary system. The SBCS and RCPS are unable to automatically respond to any challenges.

This event scenario is bound by the loss of feedwater flow event qualitatively presented in Section 15.2.7 of the CESSAR FSAR with respect to peak RCS pressure and fuel performance. The event in the FSAR assumes a total loss of feedwater flow at time zero which is more severe than the flow degradation due to the distribution panel failure. In addition, the SBCS and RPCS are assumed to be in the manual mode of operation and do not, therefore, serve to mitigate the event consequences. The failure of the PLCS is the only consequence of the panel malfunctions not addressed in the FSAR analysis. However, the rate of RCS inventory addition is small and will not appreciably affect the peak RCS pressure or fuel performance aspects of this event. In addition, sufficient time exists for the operator to take action to prevent the pressurizer from filling.

Panel E-NNN-D12 Failure

The loss of this panel will result in the loss of automatic pressurizer pressure control except through use of the backup heaters. The condenser hotwell level may decrease due to the inability to automatically control it. In addition, the RRS and SBCS will behave as if they were in their manual mode of operation.

Partial loss of the pressurizer heaters allows the RCS pressure to drift down to the actuation setpoint for the backup heaters which will then maintain pressure within the allowed operating range (Table 15.0-5, CESSAR FSAR). A total loss of feedwater flow (LOFW) due to the condenser hotwell level decrease may occur. However, the LOFW event presented in Section 15.2.7 of the CESSAR FSAR assumed that the PPCS, SBCS, and RRS are in the manual mode of operation, unable to automatically respond to challenges. Therefore, the FSAR event bounds the panel failure event.

Load Center E-NKN-M45 Failure

Failure of this load center effectively results in the SBCS, CLCS, and MFTPCS being placed in the manual mode of operation. In addition, pressurizer pressure control will be hindered, but not

defeated, due to de-energization of all the non-IE heaters. Consequently, RCS pressure may drift below the backup heater actuation setpoint but will be mantained there by the IE backup heaters. The resulting RCS pressure remains within the allowed operating limits. Therefore, this panel failure is not of concern with respect to peak RCS pressure, fuel performance, or radiological releases.

Part B: EVALUATION OF COMMON SENSOR FAILURES

RCS Cold Leg Temperature Sensor (CEDMCS, RRS, PLCS)

The PLCS receives a average reactor coolant temperature (Tavg) signal from the RRS based on either loop or both loop cold leg and hot leg temperatures (Tcold and Thot) measurements. The measured Tavg determines the programmed pressurizer level. If a Tcold channel fails such that Tavg (indicated) does not agree with Tavg (actual) then the PLCS will adjust charging and letdown to change the pressurizer level to the new programmed level within the normal operating band.

The RRS and CEDMCS have several features which protect against inadvertent CEA motion following failure of Tcold channel. These include; Input Channel Deviation Alarm, Automatic Motion Inhibit, and Automatic Withdrawal Prohibit. In addition, the consequences of inadvertent CEA insertion (withdrawal) resulting from indicated Tcold failing higher (lower) than actual Tcold in combination with pressurizer level variations within the control band are bound by the CEA Withdrawal event described in Section 15.4.2 of the CESSAR FSAR.

Pressurizer Level Sensor (PPCS, PLCS)

In response to a high indicated pressurizer level (Lpzr) the PLCS will decrease charging flow and increase letdown flow resulting in a slow decrease in RCS inventory and pressurizer level. If the indicated Lpzr is high enough, a High Level Alarm will be generated, the normally running charging pump will be secured and an Insufficient Charging Alarm will be generated. In addition, if the pressurizer level error (Lpzr (indicated) - Lpzr (programmed) is large enough, the PLCS will signal the PPCS to energize pressurizer heaters. The high indicated Lpzr will disable one of two channels of heater cutout. Normally, however one channel is sufficient to activate the heater interlock and generate a low Lpzr alarm. Also, under the conditions of maximum letdown flow and minimum charging flow, it would require in excess of 30 minutes for pressurizer level to drop from the full power programmed level to the level corresponding to the top of the heaters. This time interval would allow the operator to arrest the level transient prior to heater uncovery.

The thermalhydraulic effects of the slow decrease in RCS inventory are bound by the Double-Ended Break of a Letdown Line as described in Section 15.6.2 of the CESSAR FSAR.

If the indicated Lpzr fails low, the PLCS would increase charging and decrease letdown. This would result in a slow increase in RCS inventory. If the indicated Lpzr fails low enough, a Low Level Alarm would be activated as would the heater interlock in the PPCS thus preventing pressurizer heater operation. The effects of this transient are bounded by the PLCS Malfunction event described in Section 15.5.2 of the CESSAR FSAR.

Pressurizer Pressure Sensor (PPCS, SBCS)

Failure of a pressurizer pressure (Ppzr) sensor cannot result in inadvertent operation of the SBCS. The SBCS has two independent circuits (main circuit and permissive circuit) both of which must be activated in order to generate either a Turbine Bypass Valve (TBV) modulation signal or quick open signal. Failure of a Ppzr sensor, therefore, can only affect the PPCS. Failures in single control systems have already been considered in the CESSAR FSAR Chapter 15 safety evaluation.

Main Steam Flow Sensor (FWCS, SBCS)

Similarly, failure of a main steam flow (Fms) sensor cannot result in inadvertent operation of the SBCS. Failure of a Fms sensor, therefore, can only affect the FWCS. Failures in single control systems have been considered in the CESSAR-F Chapter 15 safety evaluation.

Part C: EVALUATION OF COMMON INSTRUMENT TAP FAILURES

Tap for Pressurizer Pressure and Level Sensors (PPCS, PLCS, SBCS)

As previously indicated the SBCS utilizes two independent circuits, therefore, the SBCS will not open bypass valve due to the instrument tap failure. The response to the tap failure is limited to various combinations of PPCS and PLCS malfunctions which can cause slow pressurizer pressure and level increases or decreases. The evaluation is similar to that provided above in Part B for the Pressurizer Level Sensor failure. The potential consequences of this instrument tap failure are bound by the PLCS Malfunction event and the Double-Ended Break of a Letdown Line event described in Section 15.5.2 and 15.6.2, respectively, of CESSAR FSAR.

TABLE 222.04-1

| Control System | Acronym |
|---|---|
| Reactor Regulating System | RRS |
| Control Element Drive Mechanism Control System | CEDMCS |
| Reactor Power Cutback System | RPCS |
| Boron Control System | BCS |
| Steam Bypass Control System | SBCS |
| Turbine Generator Control System | TGCS |
| Moisture Separator Reheat Control System | MSCRS |
| Feedwater Control System | FWCS |
| Main Feedwater Turbine Pump Control System | MFTPCS |
| Condenser Level Control System | CLCS |
| Pressurizer Level Control System | PLCS |
| Pressurizer Pressure Control System | PPCS |

TABLE 222.04-2

Control Systems Sharing a Common Sensor

| | Sensor | Control Systems |
|---|---|---|
| 1) | RCS Cold Leg Temperature | CEDMCS, RRS, PLCS |
| 2) | Pressurizer Level | PLCS, PPCS |
| 3) | Pressurizer Pressure | PPCS, SBCS |
| 4) | Main Steam Flow | FWCS, SBCS |

Control Systems Sharing a Common Instrument Tap

| | Sensors Sharing Tap | Control Systems |
|---|---|---|
| 5) | Pressurizer Level | PPCS, PLCS |
| | and | |
| | Pressurizer Pressure | PPCS, SBCS |