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SUBJECT: Forwards response to 860708 request for addl info on 860109 reactor trip at facility. Design of sys precludes possibility of out phase reenergization of reactor coolant pump buses.

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July 29, 1986
ANPP-37623-JGH/BJA/98.05

Director of Nuclear Reactor Regulation
Attention: Mr. George W. Knighton, Project Director
PWR Project Directorate #7
Division of Pressurized Water Reactor Licensing - B
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Palo Verde Nuclear Generating Station
Unit 1
Docket No. STN 50-528 (License No. NPF-41)
NRC Request for Additional Information on the
January 9, 1986, Reactor Trip at PVNGS Unit 1
File: 86-E-056-026

References: (1) Letter from E. E. Van Brunt, Jr., ANPP, to U. S. Nuclear Regulatory Commission, dated February 10, 1986 (ANPP-34972). Subject: Licensee Event Report 86-006-00.
(2) Letter from E. A. Licitra, NRC, to E. E. Van Brunt, Jr., ANPP dated July 8, 1986. Subject: Request for Additional Information - Palo Verde Unit 1 LER No. 86-006.

Dear Mr. Knighton:

Reference (1) submitted Licensee Event Report 86-006-00 concerning a reactor trip which occurred at PVNGS Unit 1 on January 9, 1986. The NRC review of Reference (1) has identified the need for more information on this reactor trip. Therefore, the NRC has requested additional information that the NRC requires in order to complete their review of this reactor trip. The purpose of this letter is to provide the requested additional information to the NRC. The attachment to this letter contains the ANPP responses to each of the NRC questions.

If you have any questions, or require additional information on this matter, please contact Mr. W. F. Quinn of my staff.

Very truly yours,

JG Haynes

J. G. Haynes
Vice President
Nuclear Production

JGH/BJA/dlm
Attachment

cc: E. E. Van Brunt, Jr. (all w/a)
E. A. Licitra
R. P. Zimmerman
A. C. Gehr

A001
1/1

ATTACHMENT

RESPONSES TO NRC QUESTIONS

1. NRC QUESTION: What is the coastdown rate of the RCPs assumed in the FSAR and what are the factors or assumptions on which this value is based?

   ANPP RESPONSE: Two different Reactor Coolant Pump (RCP) coastdown rates are used in the safety analyses for PVNGS. Figure 1 of this attachment shows the assumed RCP flow coastdown utilized for the total loss of reactor coolant flow accident analysis (refer to CESSAR Section 15.3.1). This flow coastdown curve used for the total loss of reactor coolant flow accident analysis is a best estimate curve based on how the RCPs were expected to perform in the coastdown mode. The total loss of reactor coolant flow accident analysis is the only PVNGS accident analysis that uses the best estimate flow coastdown curve. For any of the other PVNGS accident analyses, the assumed RCP coastdown is conservatively fast since only 90 percent of the RCP rotational inertia is assumed. This equates to a conservatism in the coastdown flow rates which varies from about 1 percent faster coastdown at 1 second into the coastdown to about 5 percent faster coastdown at 10 seconds. Thus, the only accident analysis which was potentially affected by the faster than expected coastdown rate was the total loss of reactor coolant flow analysis.

2. NRC QUESTION: How much faster was the coastdown recorded on January 9, 1986 compared to the coastdown in the SAR? What were the safety implications as determined by APS? Discuss the consequences on each transient and accident analyzed in FSAR that is affected by the faster flow coastdown.

   ANPP RESPONSE: Figure 2 shows the predicted RCP speed coastdown versus the RCP speed coastdown that was measured during the January 9, 1986, reactor trip at PVNGS Unit 1. It should be noted that the predicted RCP speed coastdown curve of Figure 2 corresponds to the flow coastdown curve of Figure 1. The maximum difference between the measured and predicted RCP speeds is less than 1 percent. As discussed in the ANPP response to NRC Question #3 below, this measured RCP speed coastdown does not reduce plant safety since the existing CESSAR analysis for the total loss of reactor coolant flow analysis is still the bounding analysis.

3. NRC QUESTION: What are the proposed corrective actions to assure that this deviation of the RCP coastdown rate will not result in an unreviewed safety question?

   ANPP Response: The accident analysis affected by the faster than predicted RCP coastdown was reanalyzed assuming the faster RCP coastdown. The faster RCP coastdown results in an earlier reactor trip than assumed in the analysis. This earlier reactor trip leads to results that are less severe than the present accident analysis because the earlier reactor trip compensates for the faster coastdown rate.

FIGURE 1

(FROM CESSAR FIGURE 15.3.1-7)

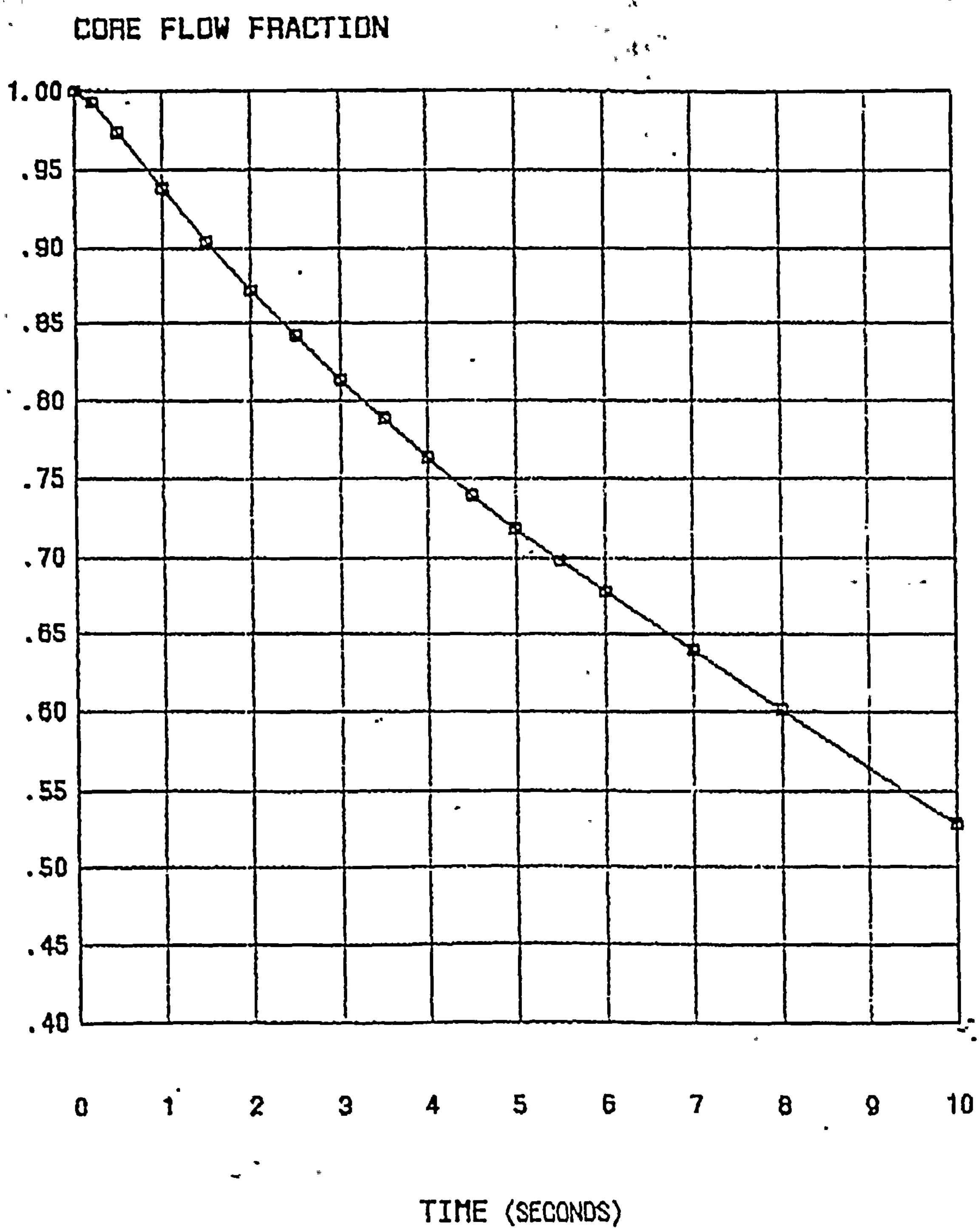
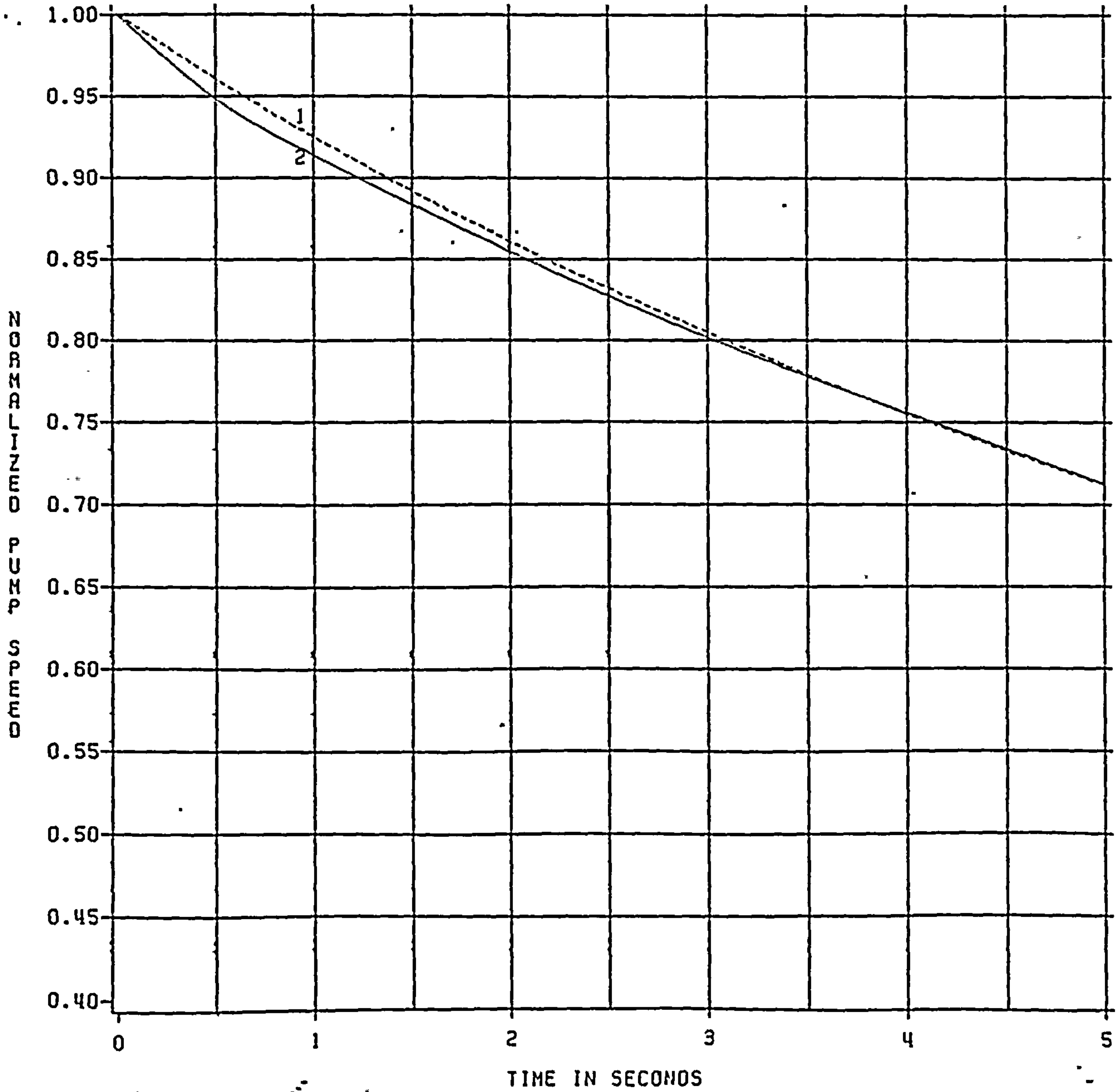


FIGURE 2

RCP COASTDOWN



LEGEND:

1. Predicted
2. Measured (January 9, 1986)

Additional corrective actions were taken to improve the fast transfer system. The existing synch. check relay was replaced with a new high speed, solid state, Beckwith relay. This new high speed relay is better suited for this application than the old electro-mechanical relay.

4. NRC QUESTION: What are the other station electrical loads on the RCP buses that caused a faster coastdown of RCPs?

ANPP RESPONSE: The following table presents a list of the electrical loads connected to the 13.8 kV bus E-NAN-S01. This bus is normally fed from the unit auxiliary transformer. It should be noted that the loads on bus E-NAN-S01 are approximately the same as the loads on the other 13.8 kV bus E-NAN-S02.

Major Loads on E-NAN-S01	Normal Load In kVA
Reactor Coolant Pump - 1A	8,076
Reactor Coolant Pump - 2A	8,076
Circulating Water Pump - 1A	3,851
Circulating Water Pump - 1B	3,851
Total 480V Load Centers	9,550
4.16 kV Bus E-NBN-S01 (includes Nuclear Cooling Water Pump, Turbine Cooling Water Pump, Plant Cooling Water Pump, Heater Drain Tank Pump, Condensate Pumps, Normal Chiller)	7,482
Total (at 0.888 pf) =	40,886

5. NRC QUESTION: Loss of power to the RCP's can occur as a result of a fast transfer failure, from the trip of the RCP bus input breaker or from the trip of a RCP breaker. Does the coastdown analysis in the SAR consider the worst case condition of loss or degradation of power supply to the RCP's?

ANPP RESPONSE: As discussed previously, the affected accident analysis was reperformed to address the case where the RCPs remain tied to the bus following a loss of power to the bus. This would be the condition of the RCPs following a failure to fast transfer or the tripping of the input breakers to 13.8 kV buses E-NAN-S01 and S02. The reanalysis proved that the existing FSAR accident analysis (free wheeling coastdown representing the tripping of RCP bus input breakers) still represents the bounding case. Thus, the existing accident analysis bounds the different cases where power to the RCPs is lost.

6. NRC QUESTION: Will the synch-check relay function be modified as a result of the January 9 event? If so, how will it be changed?

ANPP RESPONSE: The synch. check relay function was modified as discussed in the ANPP response to NRC question #3.

7. NRC QUESTION: Do the revised calculations for the RCP coastdown rate include all loads on the RCP buses or just a few selected loads?

ANPP RESPONSE: The estimated electrical load on each of the 13.8 kV buses (E-NAN-S01 and E-NAN-S02) during the January 9, 1986, reactor trip was 35,400 kVA. A full load potential was conservatively established at 42,000 kVA for each of the buses. This higher electrical load could increase the initial deceleration rate of the RCPs. For analysis purposes, this faster initial deceleration rate is conservatively estimated to increase the 1 percent maximum flow deficit to 2 percent. The flow deficit is reduced as the RCP coastdown proceeds. This worst case RCP coastdown was used in the reanalysis and found to be less severe than the existing accident analysis.

8. NRC QUESTION: Even if the fast transfer is successful, there is a period of time in cycles (Hz) during which RCP buses will be disconnected from the source of power (due to difference in time between breaker tripping and closing). During this time, the decaying voltage undergoes a phase shift. Quantify this phase shift. Is this phase shift of the residual voltage a potential for out of phase re-energization of the RCP buses when fast transfer completes?

ANPP RESPONSE: The design of the system precludes the possibility of an out of phase re-energization of the RCP buses. The following table presents the calculated frequency and phase angle differences for the period of time from when the unit auxiliary transformer breaker opens until after the fast transfer completion. (Note that the unit auxiliary transformer breaker opens at time = 0.0 sec.).

TIME	FREQUENCY DIFFERENCE (Hz)	PHASE ANGLE DIFFERENCE (DEGREES)
0 cycles = 0.0 sec.	0.00	0.00
1 cycle = 0.01667 sec.	0.13	0.38
5 cycles = 0.08335 sec.	0.63	9.47
10 cycles = 0.16670 sec.	1.26	37.48
14 cycles = 0.23338 sec.	1.77	74.23

The synch. check relay at PVNGS is conservatively set at a 35 degree angle difference to protect plant equipment. Thus, if the phase angle difference is greater than 35 degrees, then the fast transfer will be blocked by the synch. check relay because the phase angle difference exceeds the setpoint. It should be noted that this 35 degree setpoint is conservative as the maximum allowable phase angle to ensure a safe transfer has been calculated to be 83 degrees. Additionally, the relay has a built in timer that will allow the fast transfer to occur only during the first 10 cycles after the opening of the unit auxiliary transformer breaker.

9. NRC QUESTION: Did the CE evaluation of the January 9 event result in recommendations to reduce the penalty factor that was added in COLSS by APS?

ANPP RESPONSE: When reanalysis by the NSSS vendor showed that the faster than expected RCP coastdown was less severe than the existing accident analysis, the NSSS vendor recommended the removal of the penalty factor in PVNGS Unit 1. It should be noted that faster RCP free wheeling coastdown rates were observed in PVNGS Unit 2 during the post-core hot functional testing phase. To address the PVNGS Unit 2 faster RCP coastdown rates, constants were changed in COLSS and CPCs prior to initial criticality of the unit.