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SUBJECT: Documents discussion presented to NRC during 860206 meeting re natural circulation testing. Data collected during 860124 test will suport post-test analysis to demonstrate compliance W/Branch Technical Position RSB 5-1.

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NOTES: Standardized plant. 05000528

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Arizona Nuclear Power Project
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February 21, 1986
ANPP-35269-EEVB/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)
Natural Circulation Testing at PVNGS Unit 1
File: 86-056-026

Reference: (1) Meeting of the NRC Staff and ANPP on February 6, 1986. Subject: Natural Circulation Testing at PVNGS Unit 1.
(2) Letter from E. E. Van Brunt, Jr., ANPP, to G. W. Knighton, NRC, dated August 29, 1985 (ANPP-33282). Subject: PVNGS Unit 1 Natural Circulation Testing Program.
(3) Letter from E. E. Van Brunt, Jr., ANPP, to G. W. Knighton, NRC, dated January 31, 1985 (ANPP-31829). Subject: Natural Circulation Test Procedure.

Dear Mr. Knighton:

A meeting was held on February 6, 1986 between representatives of ANPP and the NRC Staff. The purpose of this meeting was to discuss changes that ANPP had made to the natural circulation test procedure which the NRC Staff had previously reviewed. These changes to the test procedure involved changes that were made prior to the test and deviations from the test procedure during the conduct of the test.

The purpose of this letter is to formally document the discussion that was presented to the NRC Staff during the February 6, 1986 meeting. The following differences, from the test procedure which was previously reviewed by the NRC Staff, are discussed in the attachment to this letter.

1. The difference in the test initiation method (turbine trip versus reactor coolant pump trip).

2. The use of an A-train and a B-train vent valve to establish the vent path from the reactor vessel head.

3. The use of three charging pumps during the test.

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4. The use of letdown during the depressurization portion of the test.

5. Core Protection Calculator (CPC) trip data from the January 9, 1986 reactor trip. (Not a test difference, this data is used to meet a test objective).

ANPP has concluded that the natural circulation test which was performed on January 24, 1986 was a successful test. The data that was collected during the test will support the post-test analysis to demonstrate compliance with Branch Technical Position RSB 5-1 and all of the test objectives were satisfied. If you have any additional questions on this matter, please contact Mr. W. F. Quinn of my staff.

Very truly yours,

E. E. Van Brunt

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

EEVB/BJA/dlm
Attachment

cc: E. A. Licitra (all w/a)
R. P. Zimmerman
C. Y. Liang
A. C. Gehr

ATTACHMENT

DISCUSSION OF TEST PROCEDURE DIFFERENCES

1) The difference in the test initiation method:

The test procedure which was previously reviewed by the NRC Staff contained the following sequential steps for the initiation of the test: (i) simultaneously trip all four reactor coolant pumps (RCPs), (ii) reactor trip on flow projected low DNBR, and (iii) establish natural circulation in Mode 3.

This test initiation method was changed to the following sequential steps: (i) trip the turbine, (ii) reactor trip on high pressurizer pressure, (iii) simultaneously trip all four RCPs, and (iv) establish natural circulation in Mode 3.

The change to the test initiation method was carefully reviewed prior to the change. Once it was determined that all of the test objectives could be satisfied with this change, the procedure was modified to incorporate the different test initiation method. This allowed ANPP to combine the last two trip tests (turbine trip and natural circulation trip) to reduce the number of reactor trips. This is clearly beneficial for the overall safety of the plant because of the reduction in the number of challenges to plant safety systems resulting from the reduction in the number of reactor trips.

The test initiation method did not compromise the test objectives. The initial concern of the NRC Staff regarding the change in the test initiation method was that operating the RCPs following the reactor trip would substantially cool the Reactor Vessel Upper Head (RVUH) and prevent the formation of a void in the head. In discussions with Combustion Engineering prior to the natural circulation test, it was identified that other phenomena would dominate the long-term upper head temperatures during the period of time spent at hot standby conditions. Results from the San Onofre natural circulation test (refer to CEN-259) show that the temperature in the upper head reached a steady state condition during hot standby. The steady state was initiated when the heat loss from the RVUH was balanced by the heat input from the reactor (decay heat). ANPP and CE concluded that a similar situation would occur at Palo Verde at the end of the hot standby period, and this steady state would not be affected by the short period of forced circulation flow after the reactor trip.

Preliminary review of the Palo Verde natural circulation test data supports this conclusion. Figure 1 shows that the temperatures in the upper head stabilize soon after the hot leg temperature stabilized. This indicates initiation of a steady state condition in the upper head as was predicted based on the San Onofre natural circulation test results. Figure 2 shows the approximate locations of the RVUH thermocouples at Palo Verde.

Based on the discussions presented above, the following conclusions can be made:

(1) During natural circulation conditions at hot standby, upper head temperatures are largely a function of loop temperatures and upper head cooling effects (CEDM ACUs).

(2) Since cold leg temperatures were held relatively constant by the reactor operators during the period when the plant was held in hot standby conditions, hot leg temperatures during hot standby are a function of decay heat.

(3) RVUH temperatures (driven by the loop temperature and CEDM ACUs) at the end of hot standby were not effected by operating the RCPs for 9 minutes after reactor trip.

(4) Indication of a void in the RVUH was observed during the depressurization portion of the test. The fact that a void was observed provides additional support to the conclusion that head temperatures were not affected by operation of the RCPs.

At the request of the NRC Staff, the following additional data has been provided. Figure 3 shows the Palo Verde hot leg temperatures for the January 9, 1986 turbine trip test and the January 24, 1986 natural circulation test. In the January 9 test, failure of the fast-transfer of non-essential station loads to the offsite power resulted in loss of power to the RCPs. This data was requested to show the system response to a reactor trip initiated by a loss of flow event. This data shows that the hot leg temperature remains below the full power temperature at all times following the reactor trip. It should be noted that hot leg temperatures during the January 9, 1986 event reflect a slight overcooling of the reactor coolant system initially following the trip. When the hot leg temperatures are corrected for the overcooling, the actual plant response is still bounded by the existing safety analyses.

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Figure 1 - Natural Circulation Test Data

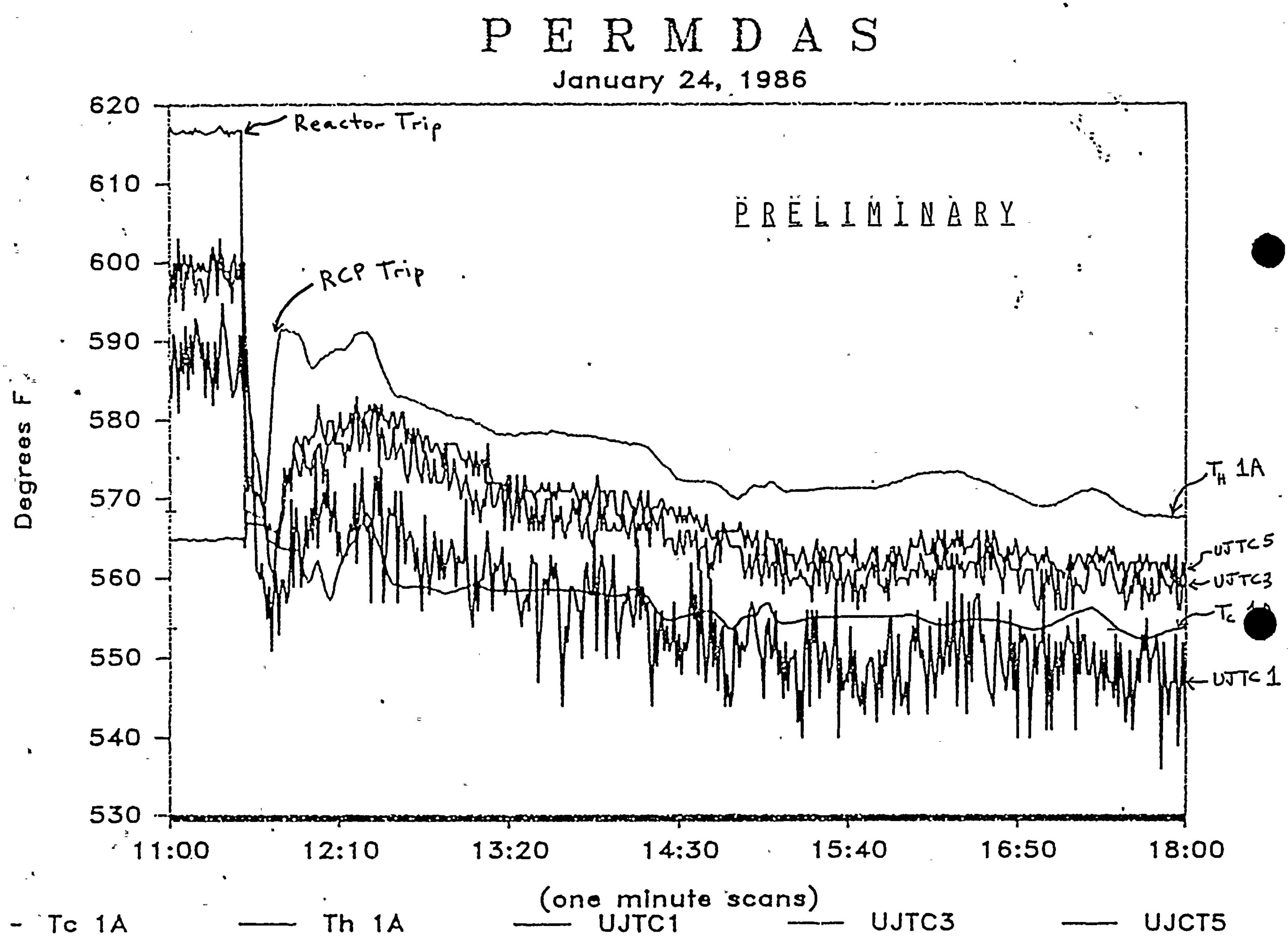


Figure 2 - Thermocouple Locations

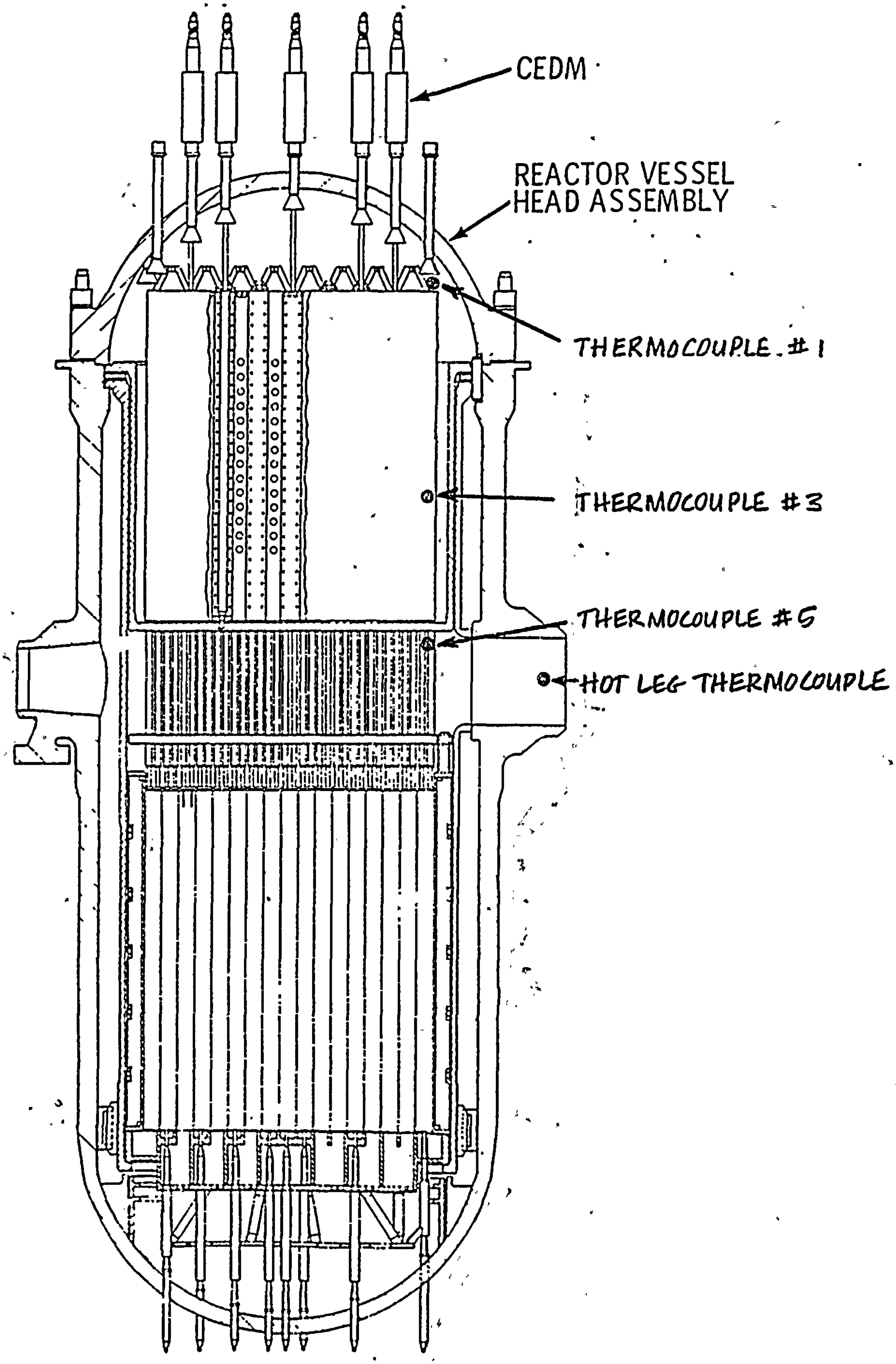
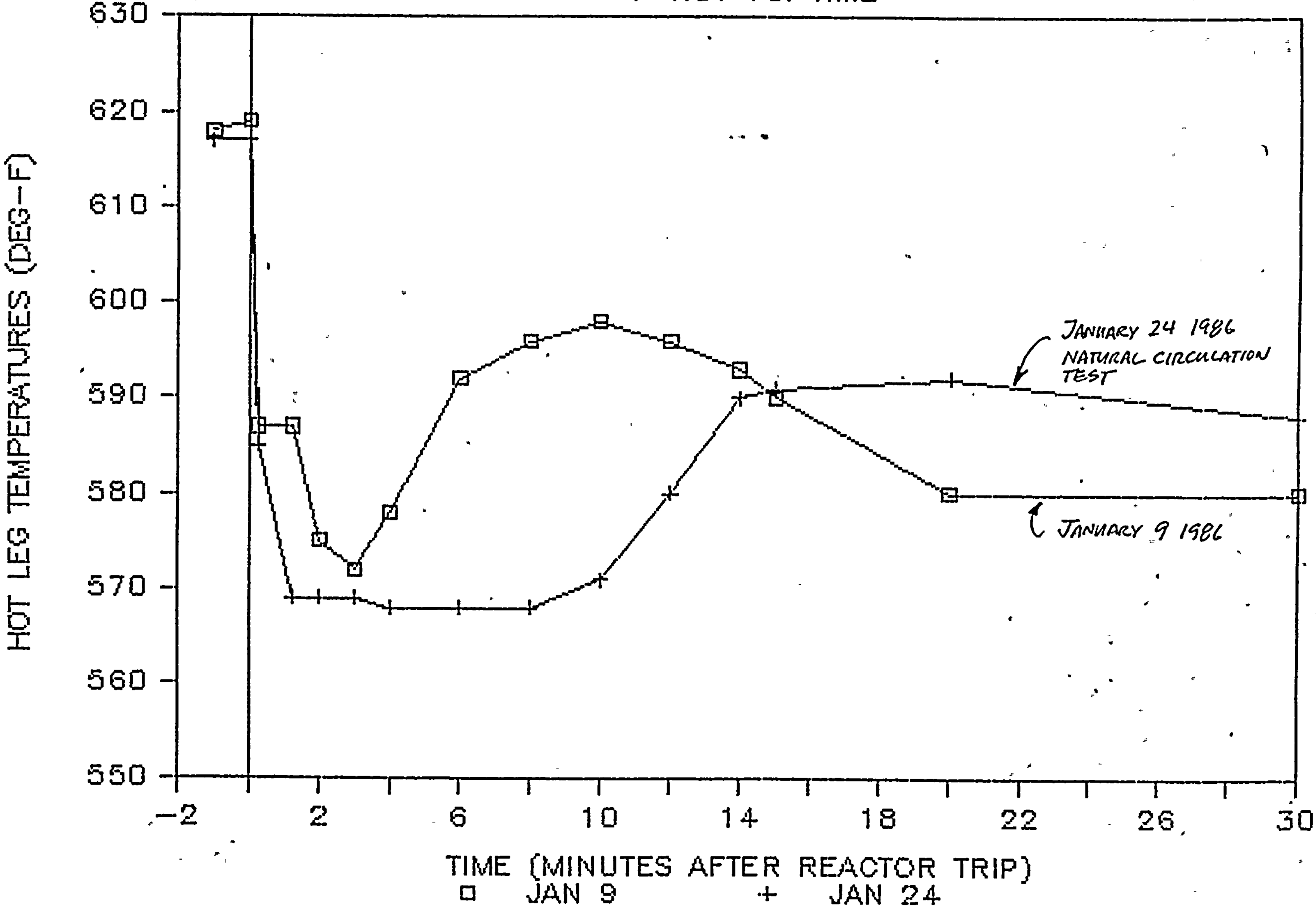


FIGURE 3

T-HOT VS. TIME



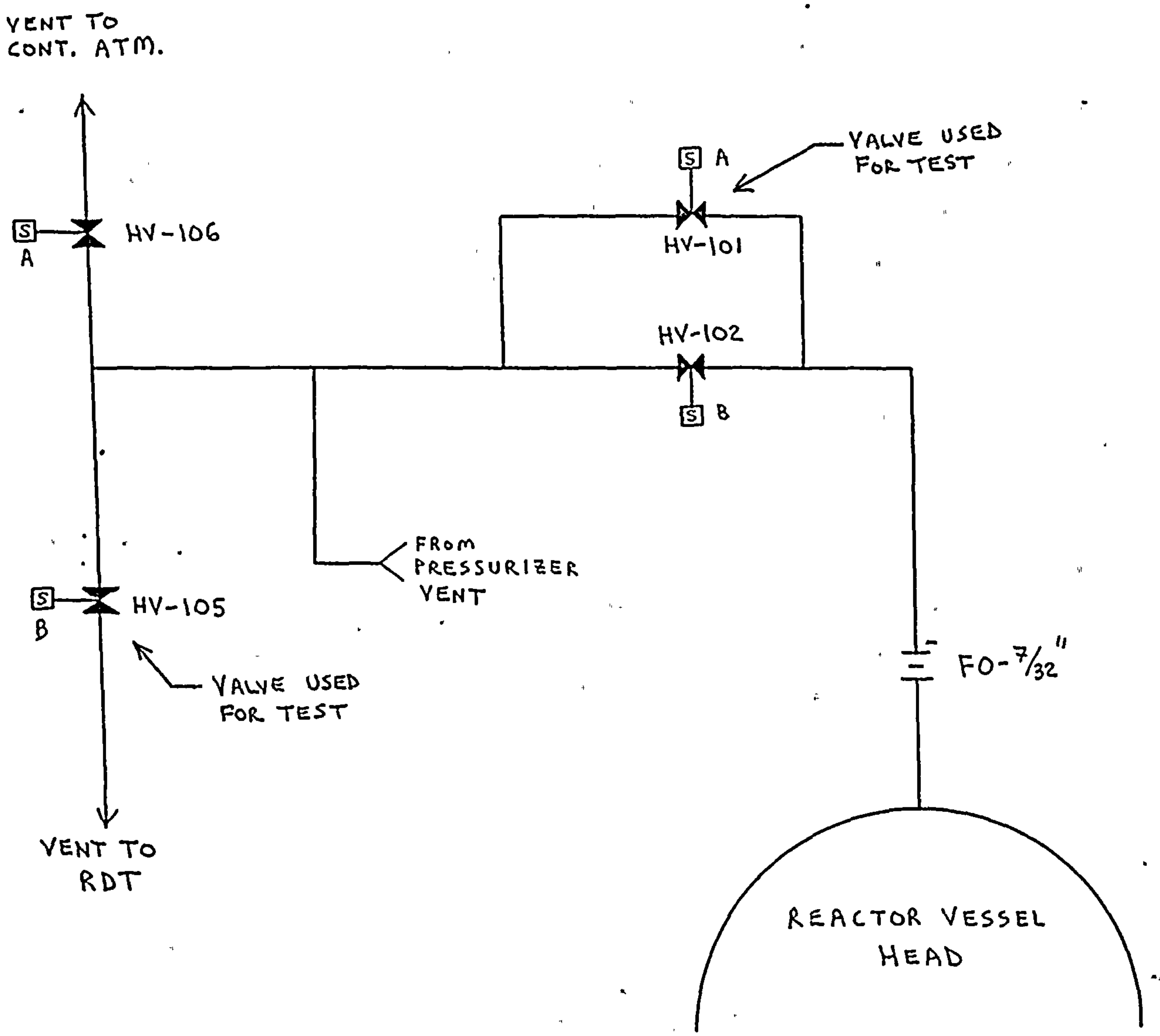
2) The use of an A-train and a B-train vent valve to establish the vent path from the reactor vessel head:

Reference (2) submitted certain test procedure changes to the NRC Staff for review. One of these changes was a commitment to change the test procedure to assume the most limiting single failure (i.e., the failure of one diesel generator). The test procedure was modified to assume the failure of the A-train diesel generator. Thus, only B-train safety related equipment was to be relied upon during the test. Therefore, the use of the A-train vent valve (RCA-HV-101) during the test was not in accordance with the commitment made to the NRC Staff.

This change, to make use of the A-train vent valve, was made to satisfy a separate licensing commitment which is documented in the response to question 5A.22 of the PVNGS FSAR. This FSAR commitment was made for safety purposes and it states, "to minimize the possibility of a common mode failure of solenoid operated valves to shut when de-energized, the operation procedure for the RCS gas vent system will require that when both Trains A and B are available that one valve powered from Train A and one valve powered from Train B will be used to complete a vent path."

For the purposes of this natural circulation test and to ensure plant safety, the FSAR commitment was complied with and one A-train valve and one B-train valve was used. Had this been an actual loss of forced circulation event under the assumptions of BTP RSB 5-1, the reactor vessel head vent path could have been completed using only B-train components (refer to the attached system diagram). This would not have resulted in any differences in system performance characteristics from those observed during the natural circulation test.

RCS HEAD VENTS



3) The use of three charging pumps during the test:

Reference (2) submitted certain test procedure changes to the NRC. One of these changes was a commitment to utilize only two of the three available charging pumps during the natural circulation test. The actual test used three charging pumps for limited periods of time during the test.

The reasons for using all three charging pumps during the test are as follows:

i) The third charging pump was used to compensate for the water which was being removed from the reactor coolant system (RCS) by letdown and RCP seal bleedoff during the cooldown portion of the test. Thus, the net charging flow into the RCS during this time was approximately equal to two charging pumps (88 gpm). It should be noted that letdown was maintained during the cooldown in order to make use of the boronometer in the letdown line for RCS boron concentration measurements. This use of letdown is in accordance with the previously reviewed test procedure.

ii) A target cooldown rate of 75°F/hour was selected during the natural circulation cooldown portion of the test. In order to maintain this selected cooldown rate, a net charging flow equal to two charging pumps (approximately 88 gpm) was needed for limited periods of time to supply makeup for system contraction during the cooldown. The advantage of maintaining this cooldown rate was that it would allow a more expedient system cooldown with less heat loss from the reactor coolant upper head region. Thus, the more expedient cooldown would provide a greater probability of forming a void in the upper head during system depressurization. For test purposes, it was desirable to form a void in the upper head region in order to demonstrate the capability to handle the voiding. Had this been an actual loss of forced circulation event under the assumptions of BTP RSB 5-1, the cooldown would have been slowed to the point where one charging pump would have been capable of compensating for system contraction during cooldown. The post-test analysis report will address the capability of one charging pump for the BTP RSB 5-1 scenario.

4) The use of letdown during the depressurization portion of the test:

In accordance with the commitment made in Reference (2), the test procedure was changed to secure letdown during the depressurization portion of the test when the auxiliary pressurizer spray system (APSS) was in use. It should be noted that letdown was used at all other times during the test in order to make use of the boronometer in the letdown line for RCS boron concentration measurements.

During the actual performance of the test, letdown was secured prior to initiating the depressurization in accordance with the previous commitment. However, after depressurizing approximatley 700 psi, letdown was utilized to reduce the pressurizer level. After the level was reduced, the depressurization was re-initiated with letdown secured. The depressurization continued until a void was formed in the reactor vessel upper head region.

Letdown was used to reduce pressurizer level to ensure the safety of the plant during this test. A void was expected to be formed in the reactor vessel upper head region during the depressurization portion of the test. This was the first upper head void formation on a System 80 NSSS and the operators were careful to approach the void formation in a safe and deliberate manner. Thus, the pressurizer level was reduced by using letdown in order to ensure that the pressurizer could accommodate the largest expected void without losing the ability to control RCS pressure.

Had this been an actual loss of forced circulation event under the assumptions of BTP RSB 5-1, the depressurization could have been accomplished without the use of letdown. This would have involved the formation of smaller voids in the upperhead region and the use of several void formation and collapse cycles rather then the single cycle which was used during this test.

5) Core Protection Calculator (CPC) trip data from the January 9, 1986 reactor trip.

The inclusion of this item for discussion in this letter is not due to the fact that this is a test procedure difference. This data is included at the request of the NRC Staff in order to verify that PVNGS fulfilled all of the test objectives for the natural circulation test.

One of the natural circulation test objectives was to measure the plant response to a total loss of forced reactor coolant system (RCS) flow. This objective was satisfied during the January 9, 1986 reactor trip at PVNGS Unit 1 instead of during the natural circulation test. During the January 9, 1986 reactor trip, power was lost to the reactor coolant pumps (RCP's) while the reactor was operating at approximately 100% power. This resulted in a loss of forced RCS flow. Consequently, the CPC's functioned as designed to trip the reactor on flow projected low DNBR. The CPC low DNBR trip was received on Channel "D" at approximately 266 milliseconds after the event was initiated by simulating a fault on the main generator. The plant response following the event was determined to be acceptable for the purpose of fulfilling this natural circulation test objective.