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KNIGHTON,G.W. Licensing Branch 3

SUBJECT: Forwards addl info re Test Procedure 42.7, "Natural Circulation Boron Mixing & Cooldown Test." Info justifies use of vol control tank for water makeup & CRD mechanism fans during test.

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JAMES D. SHIFFER
VICE PRESIDENT
NUCLEAR POWER GENERATION

February 25, 1985

PGandE Letter No.: DCL-85-078

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

Re: Docket No. 50-275, OL-DPR-80
Diablo Canyon Unit 1
Natural Circulation Boron Mixing and Cooldown Test

Dear Mr. Knighton:

PGandE letter DCL-84-337, dated October 26, 1984, provided information to the NRC Staff regarding Diablo Canyon Test Procedure No. 42.7, Natural Circulation Boron Mixing and Cooldown Test. PGandE letter DCL-84-354, dated November 21, 1984, submitted the revised Pretest Report and Test Procedure No. 42.7.

The enclosure to this letter provides additional information requested by the NRC Staff regarding the Natural Circulation Boron Mixing and Cooldown Test. PGandE believes that the enclosed information justifies: (1) use of the Volume Control Tank for water makeup during the test, (2) a delay in tripping the Reactor Coolant Pumps until plant stability has been achieved, and (3) use of the Control Rod Drive Mechanism Fans during the test.

Kindly acknowledge receipt of this material on the enclosed copy of this letter and return it in the enclosed addressed envelope.

Sincerely,

JDShiffer

Enclosure

cc: J. B. Martin
H. E. Schierling
Service List

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ENCLOSURE

NATURAL CIRCULATION BORON MIXING AND COOLDOWN TEST

The NRC Staff has requested additional information to complete evaluation of Diablo Canyon Test Procedure No. 42.7 relating to the Natural Circulation Boron Mixing and Cooldown Test. The NRC questions and request for information are listed below; each question is followed by PGandE's response.

NRC QUESTION 1

Why is PGandE not using the Refueling Water Storage Tank for Reactor Coolant System makeup during the test? Justify the use of the Volume Control Tank.

PGandE Response

Dissolved Oxygen Considerations

The reasons for using the Volume Control Tank (VCT) and not the Refueling Water Storage Tank (RWST) during the test are to reduce the possibility of excessive corrosion and to maintain dissolved oxygen concentration below Technical Specification values.

The RWST contains high levels of dissolved oxygen due to the nature of the tank's construction (vented to atmosphere). The oxygen concentration of the RWST is approximately 9 ppm (air saturated) and the blender concentration would be approximately 0.06 ppm. The RWST is normally used exclusively for refueling water makeup while the reactor coolant system is cold (below $200^{o}F$) where oxygen content is of no concern.

The makeup water during the test will be added through the normal charging system which can take suction from either the RWST or the VCT. The VCT makeup comes from the blender which controls the boron concentration blended from the

boric acid storage tank and the primary water storage tank. A high local concentration of oxygen at the point of injection to the Reactor Coolant System (RCS) at hot conditions above 200°F will cause excessive corrosion to take place at the nozzle and RCS piping connections. Additionally, use of the RWST may result in exceeding the technical specification oxygen concentration limit of 0.1 ppm. This in turn could present a significant problem when steam generator maintenance is performed due to the higher radiation levels present caused by the activated corrosion products. The NRC request to use the RWST is in direct conflict with the NRC requirements of ALARA for limiting radiation exposure to plant workers. Use of the VCT and blender would minimize localized corrosion concerns and result in oxygen concentrations within the technical specification limit.

Since the choice of source water for RCS cooldown will not affect the thermal or hydrodynamic conditions of the test, use of the VCT and blender is the preferred source to minimize corrosion and dissolved oxygen.

Boron Concentration Considerations

Once natural circulation conditions have been established, and just prior to the boration phase of the test, the boron concentration in the VCT will be adjusted to approximately 1200 ppm (870 ppm initial RCS boron concentration at 100% power plus 300 ppm increase due to boration). This concentration will prevent additions from the VCT from masking any data taken during the boron mixing test.

After boron mixing has been verified and prior to cooldown, the makeup control to the VCT will be increased to 2000 ppm and maintained at this concentration until Cold Shutdown conditions have been established.

In summary, PGandE and Westinghouse do not believe that the use of the RWST for RCS makeup will provide benefits of a sufficient magnitude to offset the identified disadvantages.

NRC QUESTION 2

What is the rationale for not tripping the Reactor Coolant Pumps as soon as possible ("in the order of one to two minutes") following the reactor trip? Provide justification for the delay.

PGandE Response

As specified in RSB 5-1, the test requirements are to "(a) confirm that adequate mixing of borated water added prior to or during cooldown can be achieved under natural circulation conditions and permit estimation of the times required to achieve such mixing, and (b) confirm that the cooldown under natural circulation conditions can be achieved within the limits specified in the emergency operating procedures."

The delay in tripping the Reactor Coolant Pumps (RCPs) is to ensure that plant stability has been achieved. Establishing stability prior to tripping the RCPs will allow the operator time to determine that the plant is in a safe condition so that the test can be properly conducted. Also, during the time the RCPs are operating, plant stability is achieved much more quickly.

At the suggestion of the NRC, the time between reactor trip and the RCP trip has been shortened from 2.5 hours to approximately 30 minutes to simulate in a safe manner more realistic plant conditions.

The NRC's additional concern that a delay of tripping the RCPs will reduce the upper head temperature and thus not realistically simulate a plant cooldown is not valid for the following reasons.

a. At the request of the NRC, the test has a hold at hot conditions under natural circulation mode for four hours.

b. In the scenario of reactor trip followed by an immediate RCP trip, the upper head temperatures will drop slowly until the heat provided by the core in natural circulation is balanced by the heat being removed by the cooling fans. This is expected to take approximately two hours for the equilibrium to be established.

c. In the scenario of reactor trip, system stability, then RCP trip, the upper head temperatures will drop due to the forced circulation cooling and then rise once the RCPs are tripped. Again equilibrium is expected at the same conditions and to take approximately two hours after the RCP trip.

d. The upper head fluid temperature response to natural circualtion is graphically demonstrated in the Sequoyah Unit 1 Special Low Power Test

Report and by the data acquired by PGandE during the Diablo Canyon natural circulation testing performed in May 1984. Data obtained during the DCPP Unit 1 test showed that the plant reached stable natural circulation conditions in 15 to 20 minutes and that the core Delta T was 35-40^{O}F at 3% reactor power. This response is essentially the same as Sequoyah Unit 1 and other Westinghouse plants that have performed the natural circulation tests. Additionally, four special in-core thermocouples indicated that the upper head fluid temperature was 10-15^{O}F cooler than core exit fluid.

In summary, tripping the RCPs immediately following the reactor trip is essentially a dynamic simulation of the Loss of Flow Accident. Because of the potential for equipment malfunctions or automatic actions that would require operator action and/or maintenance where not otherwise required, PGandE and Westinghouse feel that from a prudent testing standpoint, the present test methodology is consistent with a conservative testing approach and at the same time fulfills the test requirement of RSB 5-1. Since the conditions of the plant are essentially identical at the time the cooldown phase is initiated, there are no compelling reasons to challenge the plant equipment in this manner.

NRC QUESTION 3

Provide criteria for plant stabilization prior to Reactor Coolant Pump trip to initiate natural circulation.

PGandE Response

Criteria for plant stabilization prior to tripping the RCPs and initiating natural circulation are as follows:

RCS Temperature		544 to 550°F
Steam Generator Pressure	SG1	980 to 1030 psig
	SG2	980 to 1030 psig
	SG3	980 to 1030 psig
	SG4	980 to 1030 psig
Pressurizer Level		19% to 25%
Pressurizer Pressure		2210 to 2260 psig
Steam Generator Level	SG1	33% to 44%
(narrow range)	SG2	33% to 44%
	SG3	33% to 44%
	SG4	33% to 44%

PGandE estimates that the plant should be stabilized within approximately 30 minutes. The RCPs will be tripped after the plant has met the stabilization criteria.

NRC QUESTION 4

Provide information on the Reactor Vessel upper head region cooldown rate with and without the Control Rod Drive Mechanism (CRDM) Fans in operation.

PGandE Response

The effect on Reactor Vessel head cooldown rates with and without CRDM fans for a known RCS cooldown rate is documented in the Background Document Westinghouse Owners Group Emergency Response Guidelines, ES-0.2.

This report indicates that for an RCS natural circulation cooldown rate of 25°F/hr that the following upper head region cooldown rates occur as a function of RCS temperature and CRDM fan operation:

UPPER HEAD COOLDOWN RATE

CRDM FAN	RCS TEMPERATURE (°F)	
	600°F	350°F
ON	31°F/hr	21°F/hr
OFF	10°F/hr	10°F/hr

To prevent damage to CRDM coils, CRDM cooling fans will be in service until the vessel head metal temperature is less than 350°F. However, upper head fluid temperatures and reactor vessel metal temperatures will be monitored throughout the test and the natural circulation cooldown rates can be determined from this data. Emergency Operating Procedures do specify the actions to be taken if CRDM fans are not available.

NRC QUESTION 5

Provide information on the use of pressurizer pressure and level control systems.

PGandE Response

During natural circulation conditions pressurizer pressure will be maintained by using the vital-powered pressurizer heaters only. These heaters have manual ON/OFF control.

Prior to establishment of natural circulation conditions, letdown will be isolated and remain so unless pressurizer level has to be decreased. During the four-hour stabilization period at Hot Standby conditions, pressurizer level is expected to increase due to continuous RCP seal injection flow.

If, at that time, pressurizer level is too high, letdown flow will be initiated by the operator until the pressurizer level is at an acceptable level and so noted in the post-test report. Once cooldown has been initiated, charging flow will have to increase to compensate for RCS water volume shrinkage, therefore, letdown will be isolated. Pressurizer level will be manually controlled during the test.

The test procedure and the pretest report will be revised to reflect manual operation of pressurizer level.