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SUBJECT: Forwards addl info re 851009 Proposed Change 200 to Tech Specs, reducing max concentration of boric acid stored in makeup tanks, per NRC request. CEN-316(s), "Boric Acid Makeup Tank Concentration...," encl.

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February 11, 1986

Director, Office of Nuclear Reactor Regulation
Attention: Mr. George W. Knighton, Director
PWR Project Directorate No. 7
Division of PWR Licensing - B
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
San Onofre Nuclear Generating Station
Units 2 and 3

Southern California Edison Company's (SCE) letter dated October 9, 1985 submitted a proposed change to the San Onofre Nuclear Generating Station (SONGS) Units 2 and 3 Technical Specifications. The proposed change, NPF-10/15-200 (PCN-200), would revise borated water source requirements for SONGS 2 and 3. Specifically, the proposed change would reduce the maximum concentration of boric acid to be stored in the boric acid makeup tanks.

The Staff requested additional background information relating to PCN-200 to facilitate their review. Supporting information for PCN-200 is found in CEN-316(S), "Boric Acid Makeup Tank Concentration Reduction Effort Technical Basis and Operational Analysis" (Enclosure 2). A copy of this report was provided to the Staff by SCE on January 17, 1986. In subsequent conversations, the Staff raised several questions relating to specific aspects of this report. Responses to these questions are provided in Enclosure 1.

If you require any additional information to complete your review of PCN-200, please call me.

Very truly yours,

M. O. Medford

Enclosures

cc: Harry Rood, NRC Project Manager (to be opened by addressee only)
F. R. Huey, USNRC Senior Resident Inspector, Units 1, 2 and 3

A001 1/1

BORIC ACID MAKEUP CONCENTRATION REDUCTION EFFORT
RESPONSE TO NRC REVIEW QUESTIONS

Question 1: What are the uncertainties and conservatisms associated with the two curves shown in Figure 2-5 of CEN-316(S)?

Response to Question 1:

The lower curve in Figure 2-5 of CEN-316(S) represents an upper bound on the concentration required to be present in the reactor coolant system for a 5.15% shutdown margin at the indicated temperatures. In the computer analysis that was performed to generate this curve, appropriate analytical and measurement uncertainties as well as appropriate conservatisms were included to ensure that an upper bounding curve was obtained. The major uncertainties and conservatisms that were factored into the 5.15% shutdown curve of Figure 2-5 are as follows:

1. Initial scram is assumed to take place from the hot full power PDIL (power dependent insertion limit) to all rods in, with the worst case rod stuck in the full out position.

2. Scram worth(1): -4% bias, ± 9% uncertainty,

3. Moderator cooldown uncertainty(2)(3): ± 10%,

4. Doppler cooldown uncertainty(2)(3): ± 15%, and

5. Boron measurement uncertainty(4): ± 50 ppm boron.

6. The time constant for xenon decay at 26 hours is chosen to be conservatively large.

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(1) CEN-266-P-A, "The ROCS and DIT Computer Codes for Nuclear Design," April 1983

(2) M. O. Medford (SCE) to G. W. Knighton (NRC), Docket No. 50-361 and 50-362, "Reload Analysis Report, San Onofre Nuclear Generating Station, Units 2 and 3," September 28, 1984

(3) Safety Evaluation, Amendment No. 32 to NPF-10 and Amendment No. 21 to NPF-15, Docket Nos. 50-361 and 50-362

(4) Bases 3/4.9.1 of the San Onofre Nuclear Generating Station Units 2 and 3 Technical Specifications

Since appropriate analytical and measurement uncertainties as well as appropriate conservatisms associated with the analysis were factored into the lower curve in Figure 2-5, it is not necessary to factor any additional uncertainties or conservatisms directly into the upper curve shown in that figure. Although no additional uncertainties were included in the upper curve, the cooldown scenario was specifically chosen to be conservative such that the actual concentration curve in Figure 2-5 in effect represents a lower bound on the boron concentration that can be achieved given a certain boric acid makeup tank (BAMT) level and boron content. Specifically, conservatisms in the cooldown scenario were ensured in two ways. First, the cooldown was conducted assuming a constant pressurizer level, i.e., charging to the reactor coolant system only as necessary to makeup for coolant contraction. Therefore, boron concentration in the reactor coolant system can be increased above the upper curve in Figure 2-5 by over charging during the cooldown process, i.e., charge in excess of the makeup required for coolant contraction by allowing pressurizer level to increase. Second, five hundred (500) gallons was added to the BAMT volumes obtained in Table 2-6 through Table 2-29 of CEN-316(S) with these values then rounded up to the nearest 50 gallons in order to give the final results shown in Table 2-30. Boron concentration in the reactor coolant system, therefore, can be increased further since more inventory is available in the BAMT's than that used to generate the actual concentration curve in Figure 2-5.

To quantify the discussion presented in the last paragraph, the actual concentration at 52 hours in Figure 2-5 is recalculated assuming a slightly different and less conservative cooldown scenario. Specifically, 250 gallons more water will be taken from the boric acid makeup tank prior to switching to the refueling water storage tank as indicated in Table 2-6. (Note that a total of 6154.2 gallons (5904.2 + 250) will be used and that this is less than the minimum Technical Specification volume required in Table 2-30). Further, in the cooldown to 200 degrees following the switch to the refueling water storage tank, the reactor coolant system will be charged such that pressurizer level will be allowed to increase by exactly 10%. Following this less conservative scenario, the concentration at 52 hours in Figure 2-5 can be increased from 715.1 ppm to 742.0 ppm for a total increase of 26.9 ppm boron. The actual concentration curve in Figure 2-5, therefore, represents a lower bound since higher reactor coolant system concentrations can be achieved within the boric acid makeup tank limits of Table 2-30 by following a less conservative cooldown scenario.

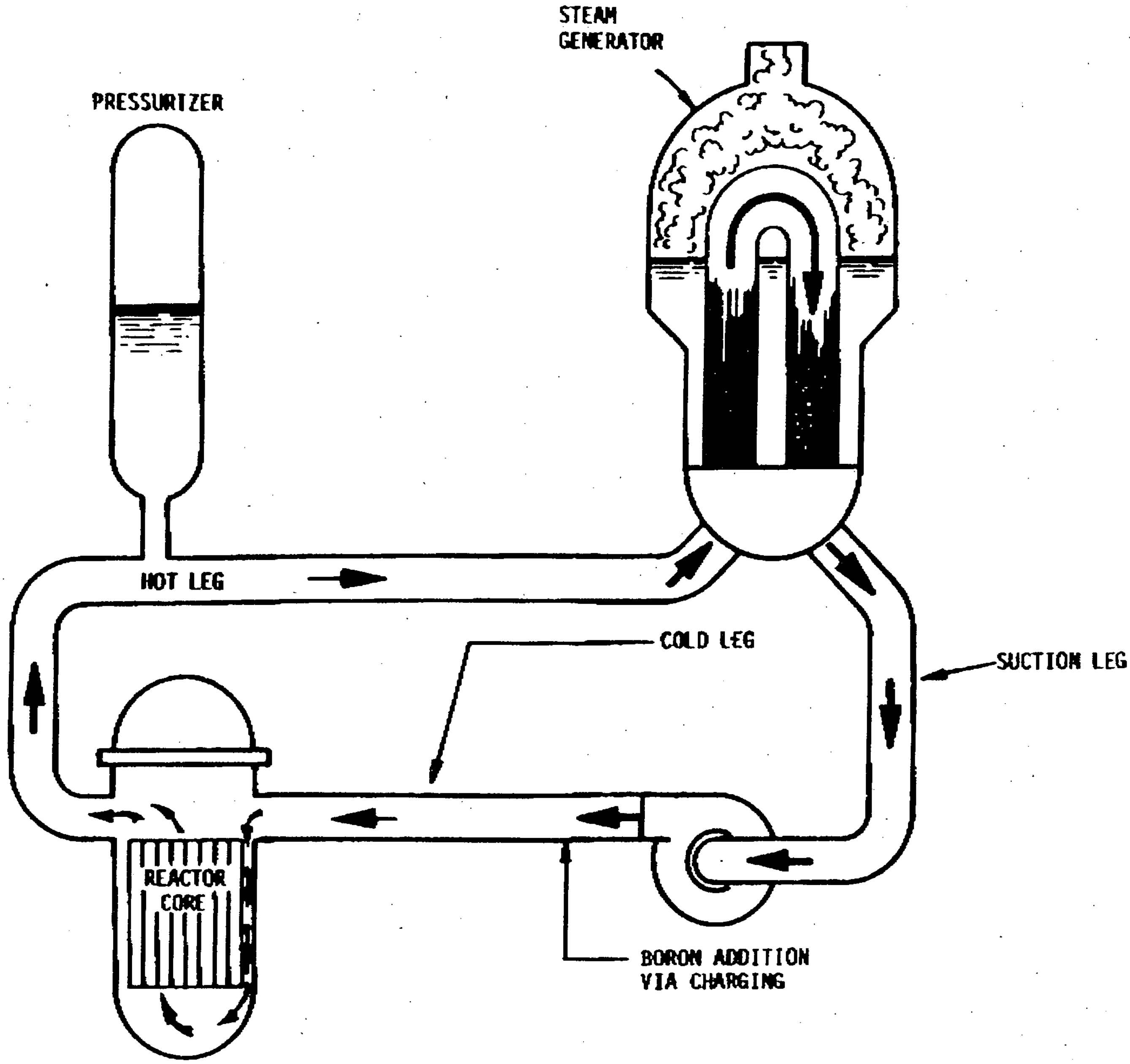
Question 2: Under natural circulation conditions, how fast does boron mix in the RCS?

Response to Question 2:

Reference 4.3 of CEN-316(S) presented the results of two tests performed at San Onofre in order to demonstrate the ability to rapidly and completely mix boron in the reactor coolant system (RCS) under natural circulation conditions. A discussion of these tests as well as a summary of the various mechanisms that contribute to boron mixing are contained in Section 3.0 of that reference. Note, as presented in Reference 4.3 of CEN-316(S), a slug of concentrated boron added to the reactor will require approximately 30 minutes to completely mix with the entire volume in the RCS with approximately 80% of that mixing taking place in the first ten minutes. Also note that these same test results demonstrated the ability to rapidly borate the reactor coolant system concurrently with a plant cooldown.

The thirty minute mixing time discussed above is based upon a static mixing situation where a single slug of boron is added to the reactor coolant system and then monitored until complete mixing takes place. In contrast, a dynamic situation exists in the RCS for the case where the plant is being cooled and concentrated boron is being added as part of inventory makeup due to coolant contraction. In the dynamic situation, the boron concentration in the reactor vessel surrounding the core will actually be higher than indicated for the actual concentration curve at each time increment in Figure 2-5. This is true because of two conservatisms that were used to generate the actual concentration curve in that figure. The first conservatism is the assumption of complete and instantaneous mixing between all fluid added via the charging nozzles and the fluid in the RCS loops. In the dynamic situation that exists during an actual cooldown, concentrated boron would be continuously added to the RCS cold leg via the loop charging nozzle. The flow from the charging nozzle is directly into the vessel such that the concentrated boron would mix with the contents of the cold leg first and then mix with the contents of the reactor vessel. (See attached figure.) Therefore, the actual concentration that would exist within the vessel would be higher in the dynamic situation than shown in Figure 2-5 since complete and instantaneous mixing was assumed not only with the contents of the cold leg and the reactor vessel, but also with the contents of the hot leg, steam generator and suction leg.

The second conservatism that results in the concentration in the reactor vessel being higher than that indicated for the actual concentration curve at each time increments in Figure 2-5 is the assumption of complete and instantaneous mixing between all fluid added via the charging nozzle with the contents of the pressurizer. During a cooldown where an operator is charging only as necessary to makeup for coolant contraction, the driving force for mixing between the RCS and the pressurizer is small. This is the direct result of the fact that the surge line connecting the pressurizer to the hot leg is long, approximately 55 feet. As a result, instantaneous mixing with the pressurizer is a conservatism that results in calculated boron concentrations that are lower than would be seen for an actual cooldown.



Note: As discussed in Section 3.0 of CEN-259, boron added to the cold leg via charging will be 90% mixed prior to entering the reactor vessel downcomer.

Question 3: What are the implications of a reduction in boric acid makeup tank concentration with respect to plant emergency procedures and Combustion Engineering's Emergency Procedure Guidelines?

Response to Question 3:

As stated in Section 3.2 of CEN-316(S), credit is not taken for boron addition to the reactor coolant system from the boric acid makeup tanks for the purpose of reactivity control in the accidents analyzed in Chapter 15 of the plant's Final Safety Analysis Report. The response of an operator, therefore, to such events as steam line break, overcooling, boron dilution, etc., will not be affected by a reduction in BAMT concentration. In particular, the action statements associated with Technical Specification 3.1.1.1 and Technical Specification 3.1.1.2 require that boration be commenced at greater than 40 gallons per minute using a solution of at least 1720 ppm boron in the event that shutdown margin is lost. Such statements are conservatively based upon the refueling water storage tank concentration and are therefore independent of the amount of boron in the BAMT's.

Similar to the Technical Specification action steps in the event of a loss of shutdown margin, the operator guidance in Combustion Engineering's Emergency Procedure Guidelines (EPG's), CEN-152, Rev. 2, are also independent of specific boron concentrations within the boric acid makeup tanks. Specifically, the acceptance criteria developed for the reactivity control section of the Functional Recovery Guidelines of CEN-152 are based upon a boron addition rate from the chemical and volume control system of 40 gallons per minute without reference to a particular boration concentration. The reduction in boron concentration within the boric acid makeup tanks, therefore, has not impact on, and does not change, the guidance contained in the EPG's.

Question 4: What is the minimum temperature expected in the building containing the BAMU tanks?

Response to Question 4:

The BAMU tanks are located in the Radwaste area of the Auxiliary Building. FSAR Table 9.4-4 identifies a design temperature range for the radwaste area of 50°F to 104°F. The maximum BAMU tank boric acid concentration allowed by PCN-200 is 3.5 wt%. The corresponding saturation temperature for this concentration is 50°F.

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