



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATING TO THE NATURAL CIRCULATION COOLDOWN TEST

SOUTHERN CALIFORNIA EDISON COMPANY

SAN ONOFRE NUCLEAR GENERATING STATION UNITS 2 & 3

DOCKETS NOS. 50-361 & 50-362

Branch Technical Position RSB 5-1 (BTP RSB 5-1), "Design Requirements of the Residual Heat Removal (RHR) System", requires that test programs for PWRs shall include tests with supporting analysis 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 the cooldown under natural circulation conditions can be achieved within the limits specified in the emergency operating procedures. In addition, the plant design is to be such that the reactor can be taken from normal operating conditions to cold shutdown using only safety-grade systems. Comparison with performance of previously tested plants of similar design may be substituted for these tests.

In NUREG-0712, "Safety Evaluation Report for San Onofre, Units 2 and 3", the staff required a natural circulation test to be performed at San Onofre Nuclear Generating Station, Unit 2 (SONGS 2) to demonstrate compliance with BTP RSB 5-1. The staff also concluded that because it was necessary to leave the control room to align the shutdown cooling system (SCS), the design did not comply with implementation of BTP RSB 5-1. Although SONGS 2 is a "class 2" plant (which requires only partial implementation of BTP RSB 5-1), the licensee agreed to make the necessary design modifications by the end of the first refueling outage. The SONGS 2 SCS was modified at its first refueling outage for full remote initiation capability.

By letter dated January 6, 1983 Southern California Edison (SCE) submitted the documentation for the SONGS2 natural circulation test program. In addition, the staff was informed that the SONGS3 SCS would be separately tested to demonstrate that the design of SONGS2 would be in compliance with RSB BTP 5-1.

The staff approved a SONGS2 partial demonstration to the point of cut-in of the SCS provided that the remainder of the test be demonstrated on SONGS3 after its SCS modification was completed. By phone conversations of September 5 and 10, 1984 the staff requested that the SONGS3 natural circulation test report be submitted after the test.

8803090138 880224  
PDR ADOCK 05000361  
P PDR

By letter dated JULY 2, 1984, the licensee submitted documentation relating to natural circulation cooldown testing performed at SONGS2 on July 27, 1983. By letter dated December 27, 1985, SCE provided a report on tests performed at SONGS3 on September 16 and 17, 1985 to demonstrate the plant cold shutdown process after reaching the cut-in point of the SCS.

The SONGS2 & 3 testing alone was not sufficient to demonstrate compliance with RSB BTP 5-1. During the SONGS2 test some non-safety grade equipment and systems were used because the plant operators did not want to risk damage to any of the equipment. These included the pressurizer heaters, letdown system and control element drive mechanism (CEDM) fans. The SONGS3 SCS testing also utilized the CEDM fans to prevent equipment damage. However, after initiating the SCS testing, which demonstrated a cold leg cooldown rate of about 60F/hr, the licensee observed that the corresponding cooling of the steam generators was very slow. Thus the licensee completed the remainder of the cooldown using the reactor coolant pumps which forced additional cooling water through the steam generators. This is acceptable since the SCS design function was demonstrated during the early part of the cooldown process (60F/hr), prior to the restarting of the reactor coolant pumps.

The staff was assisted by its contractor, Brookhaven National Laboratory (BNL) in evaluation of the natural circulation cooldown tests. BNL reviewed the natural circulation cooldown test and the remote initiation of shutdown cooling test which were performed at SONGS2 & 3. The results of that review are given in the attached Technical Evaluation Report (TER). Based on test results, analysis and engineering judgement, BNL concluded:

- a) That adequate natural circulation was established and the plant was capable of removing the decay heat by natural circulation using only safety-grade equipment.
- b) That adequate boron mixing could be achieved in less than one hour by the natural circulation within the main flow path of the RCS using only safety grade equipment.
- c) That cooling of the upper head without the CEDM fans could take about 38 hours.
- d) That without the CEDM fans, a sufficient supply of safety grade cooling water was available to support the plant cooldown.
- e) During a prolonged period of upper head cooling without pressurizer heaters, the pressurizer level would have to be maintained at 60% or higher to prevent steam bubble formation.

- f) That without letdown, pressure control could be difficult. A strategy to form steam bubbles to cool the upper head such as using the reactor head vents may have to be considered. The staff considers a controlled voiding in the upper head during the cooldown as acceptable as long as sufficient natural circulation is maintained in the reactor coolant system.
- g) That the atmospheric dump valves could be manually operated in the event the nitrogen supply to these valves should become depleted.

The staff has reviewed the TER and we are in agreement with its conclusions. With respect to item f, we suggest that the licensee review the TER and consider the need to include the use of the reactor head vents as a supplementary method of cooldown. Our conclusion is that SONGS2 &3 has demonstrated full compliance with the requirements of BTP RSB 5-1.

Principal Contributor: D. Katze

Dated: February 24, 1988