



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO AMENDMENT NO. 48 TO FACILITY OPERATING LICENSE NO. NPF-41

ARIZONA PUBLIC SERVICE COMPANY, ET AL.

PALO VERDE NUCLEAR GENERATING STATION, UNIT 1

DOCKET NO. STN 50-528

1.0 INTRODUCTION

By letter dated April 30, 1990 the Arizona Public Service Company (APS) on behalf of itself, the Salt River Project Agricultural Improvement and Power District, Southern California Edison Company, El Paso Electric Company, Public Service Company of New Mexico, Los Angeles Department of Water and Power, and Southern California Public Power Authority (licensees), requested changes to the Technical Specifications for the Palo Verde Nuclear Generating Station (PVNGS), Unit 1 (Appendix A to Facility Operating License No. NPF-41). The proposed amendment was requested on an emergency basis to prevent unnecessary delays in return to power. The proposed changes would revise surveillance requirement 4.4.1.4.2 of TS 3/4.4.1.4, "Reactor Coolant System-Cold Shutdown," by decreasing the required shutdown cooling flowrate from 4000 gpm to 2000 gpm on a one-time basis until initial entry into Mode 2 of Cycle 3, and would specify that valve CHV-183 (reactor makeup water pump outlet to charging pump suction isolation valve) be closed whenever the flowrate is below 4000 gpm.

Additional information which provided clarification to the submittal was obtained during telecons on May 2 and 3, 1990.

2.0 DISCUSSION AND EVALUATION

Surveillance requirement 4.4.1.4.2 of TS 3/4.4.1.4, "Reactor Coolant System-Cold Shutdown," currently specifies a shutdown cooling loop flowrate of at least 4000 gpm. The basis for this minimum flowrate requirement is to ensure adequate boron mixing, to prevent stratification, and to produce gradual reactivity changes during boron concentration reductions in the reactor coolant system (RCS), which would allow for reactivity change rates associated with boron reduction to be within the capability of operator recognition and control.

On April 24, 1990 a steam generator tube leak developed in Unit 1 during startup. In order to avoid unnecessary delays in startup, repair of the leak would require the plant to enter reduced RCS inventory operation.

NRC Generic Letter No. 88-17, "Loss of Shutdown Cooling," identified operational concerns during reduced RCS inventory operation and recommended various actions designed to reduce the likelihood of losing shutdown cooling

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during such evolutions, one of which was to operate the shutdown cooling pumps in a manner that would produce flowrates which would minimize vortexing (and potential air entrainment) but yet satisfy heat removal and boron mixing considerations. Consistent with the guidance of the Generic Letter, APS had been preparing a license amendment request for reduction in minimum flow requirements. However, the priority of the effort was nominal since APS had administratively committed to completely defuel the reactor vessel during refueling outages, thus obviating the need (and associated precautions) for reduced RCS operation. Therefore, APS prepared a plant-specific one-time only amendment request to reduce the minimum flow requirement from 4000 gpm to 2000 gpm, until initial entry into Mode 2 for Cycle 3.

In considering this amendment request, three issues were evaluated by the staff:

1. adequacy of decay heat removal capability,
2. adequacy of boron mixing and boron dilution considerations, and
3. integrity of the shutdown cooling pumps.

2.1 Decay Heat Removal

Unit 1 has been shut down since March 5, 1989 for a refueling and extended maintenance outage. Hence, the decay heat generation is approximately 0.8 MW(th). At the minimum flowrate of 2000 gpm, the resultant temperature rise across the core would be approximately 3°F. If shutdown cooling capability were lost during mid-loop operation, and assuming a Mode 5 temperature of 120°F, onset of boiling would occur around 2.5 hours, and would boil-off at a rate of approximately 6.5 gpm. Core uncover would not occur for more than 18 hours after loss of shutdown cooling. In addition, plant procedures require the availability of two borated RCS makeup supply paths in the event of loss of shutdown cooling, with each supply path capable of providing flowrates greater than the core boil-off rate. Therefore, sufficient time is available for operator action to provide borated makeup to the RCS in the event of loss of shutdown cooling.

Based on its evaluation, the staff concludes that a minimum flowrate of 2000 gpm is adequate for decay heat removal. It further concludes that adequate makeup can be provided in a timely manner in the event shutdown cooling becomes unavailable.

2.2 Boron Mixing/Boron Dilution

The boron dilution accident is evaluated in Chapter 15 of the Updated Final Safety Analysis Report (UFSAR). The UFSAR analysis results stated that shutdown margin could be lost in as little as 52 minutes, and that sufficient time was available to assure detection of a boron dilution event at least 15 minutes prior to criticality.



The staff has previously reviewed the boron dilution analysis for PVNGS and found it to be acceptable (CESSAR SSER No. 1-NUREG-0852, Suppl. 1 dated March 1983).

However, APS has proposed an additional measure to prevent the addition of unborated water into the RCS, by closing valve CHV-183 (reactor makeup water pump outlet to charging pump suction isolation valve) whenever flow is less than 4000 gpm.

The staff concludes that closure of valve CHV-183 will decrease the likelihood of unborated water addition, and is, therefore, acceptable.

As stated earlier, the bases for the 4000 gpm minimum flowrate requirement is to ensure adequate boron mixing, to prevent stratification, and to produce gradual reactivity changes during boron concentration reduction evolutions. The staff found that 23 minutes for RCS loop recirculation, based on an RCS volume of 12097 ft³ and 4000 gpm was adequate to achieve the above described conditions. While in mid-loop operation, the RCS volume is approximately 4500 ft³ (as assumed in the boron dilution accident analysis). At a proposed minimum flowrate of 2000 gpm, the resulting RCS loop circulation period is approximately 17 minutes.

As such, the proposed minimum flowrate requirement at the mid-loop RCS volume ensures adequate boron mixing for operator recognition and correction of a boron dilution event, and is, therefore, acceptable. APS, however, will be required to be at or below the maximum 23 minute loop recirculation period at all times during the transient period between full RCS and mid-loop volume.

2.3 Shutdown Cooling Pump Seal Integrity

As part of APS' efforts in response to NRC Bulletin No. 88-04, "Potential Safety Related Pump Loss," Ingersoll-Rand (IR), the manufacturer of the shutdown cooling (SDC) pumps at PVNGS was requested to evaluate the minimum pump flow requirements of the SDC pumps. IR's evaluation determined that the specified minimum flow was 100 gpm, and that the minimum continuous stable flow (MCSF) was 2400 gpm. IR also stated that the useful life of the pump was limited by the life of the mechanical seals.

IR recommended the use of a mathematical formula, which considered the number of starts and stops, number of hours of operation above MCSF and number of hours of operation below MCSF. An accelerated seal life reduction factor of 12 was utilized for operation below MCSF as compared to operation at or above MCSF. This is an empirical formulation based on vibration data at low flowrates, correlated to forces and shaft deflection.

The validity of seal life based on this formula has not yet been verified by the manufacturer. However, APS' procedures require that these seals be replaced whenever the calculated remaining seal life reaches 24 percent. The remaining seal life for the Unit 1 train "A" and "B" SDC pumps is 45 percent and 54 percent, respectively.



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By letter dated October 11, 1989, the staff concluded that APS had fulfilled the reporting requirements of the Bulletin. Implicit in this conclusion is the understanding that seal life considerations were appropriately factored into the operability determinations of pumps.

Based on the remaining seal life available for each of the SDC pumps and APS' procedural requirement of replacing the seal packages when the remaining seal life reaches 24 percent, the staff concludes that the integrity of the shutdown cooling pumps will be maintained.

2.4 Generic Letter (GL) 88-17 Considerations

In response to GL 88-17, the licensee has taken additional action which includes the installation of permanent redundant channels of reactor vessel water level indication and alarms, the availability and monitoring of two core exit thermocouples, the establishment of a hot leg vent path capable of preventing pressurization of the upper plenum of the reactor vessel, and control of containment integrity during reduced RCS inventory operation.

The staff finds these actions to be acceptable as they relate to this amendment request. These actions were also found to be responsive to the Generic Letter in our letter to APS dated May 5, 1989.

3.0 FINDING ON EXISTENCE OF EMERGENCY SITUATION

In their submittal of April 30, 1990, APS explains that an unanticipated steam generator tube leak developed during the startup of Unit 1. The repair to the steam generator tube could be accomplished either with the reactor vessel defueled, or with fuel in the core but RCS inventory at reduced levels. The licensees stated that off-loading the reactor in order to effect the necessary repairs would result in at least a 35-day delay in startup over the time required to enter mid-loop and repair the tube(s). The need for this amendment request was unforeseen, since the TS minimum flow requirement was moot in view of the licensee practice of off-loading the core during refueling outages. APS also stated that operation of the shutdown cooling system at the current minimum flow requirement could potentially result in the loss of the SDC system since Unit 1 test data indicated that vortex formation occurs in the 3600 gpm to 4100 gpm range, depending upon the coolant level of the RCS.

The staff has reviewed the licensees' request and concludes that failure to act in a timely manner would result in an unnecessary delay of plant startup, and that compliance with the current minimum flow requirement could potentially result in a loss of shutdown cooling during mid-loop operation. Also, the licensee made a timely application for amendment after identifying the steam generator tube leak. Accordingly, the Commission is issuing this amendment in accordance with 10 CFR 50.91(a)(5).

4.0 FINAL SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

The Commission's regulations in 10 CFR 50.92 state that the Commission may make a final determination that a license amendment involves no significant



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hazards considerations, if operation of the facility in accordance with the amendment would not:

- (1) Involve a significant increase in the probability or consequences of any accident previously evaluated; or
- (2) Create the possibility of a new or different kind of accident from any accident previously evaluated; or
- (3) Involve a significant reduction in a margin of safety.

This amendment has been evaluated against the standards in 10 CFR 50.92. It does not involve a significant hazards consideration based on the following discussion:

The previously evaluated accidents of concern that are effected by this amendment are the boron dilution accident and the loss of shutdown cooling. The amendment still requires the plant to conform to the original design basis requirements for the boron dilution event in that the maximum RCS loop recirculation interval of 23 minutes as specified in the Technical Specification Bases is maintained when the shutdown cooling flowrate is decreased to 2000 gpm while at the mid-loop RCS volume. The amendment also permits the plant to operate in a manner that would decrease the probability of losing shutdown cooling in that the reduction in the minimum flowrate requirement is consistent with the guidance provided by GL 88-17, "Loss of Shutdown Cooling." Therefore, this amendment does not involve a significant increase in the probability or consequences of any accident previously evaluated.

This amendment does not permit plant operations in a configuration or condition that has not been previously evaluated. The amendment lowers the minimum shutdown cooling flowrate requirement to a value that continues to maintain the facility within its licensing basis in that the acceptance criteria for boron mixing and boron dilution remain unaltered, and that adequate decay heat removal capability is maintained, with adequate time for corrective action by operators in the event shutdown cooling is lost. Therefore, this amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

Reduction of the minimum shutdown cooling flowrate requirement for mid-loop operation to its specified value of 2000 gpm is acceptable with respect to boron dilution and boron mixing concerns in that the resulting loop recirculation interval of 17 minutes is less than the maximum allowed interval of 23 minutes as stated in the Bases of the Technical Specifications. Furthermore, reduction of the shutdown cooling flow requirement, which is consistent with the staff's guidance in GL 88-17, decreases the likelihood of losing shutdown cooling by increasing the operating margin from onset of vortex formation and subsequent potential air entrainment in the RCS. Therefore, this amendment does not involve a significant reduction in a margin of safety.



Accordingly, the Commission has determined that this amendment involves no significant hazards considerations.

5.0 CONTACT WITH STATE OFFICIAL

The Arizona Radiation Regulatory Agency was advised on May 4, 1990 of the proposed issuance of the amendment. No comments were received.

6.0 ENVIRONMENTAL CONSIDERATION

The amendment involves changes in the surveillance requirements of facility components located within the restricted area as defined in 10 CFR Part 20. The staff has determined that the amendment involves no significant increase in the amount, and no significant change in the type, of any effluent that may be released offsite and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has made a final no significant hazards consideration finding with respect to this amendment. Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need to be prepared in connection with the issuance of the amendment.

7.0 CONCLUSION

The staff has concluded, based on the considerations discussed above, that (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public. We, therefore, conclude that the proposed changes are acceptable.

Principal contributor: T. Chan

Dated: May 4, 1990



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