

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of)
SACRAMENTO MUNICIPAL UTILITY DISTRICT) Docket No. 50-312 SP
(Rancho Seco Nuclear Generating Station))

AFFIDAVIT OF ERNEST D. SYLVESTER

I Ernest D. Sylvester being duly sworn, depose and state that:

1. I am an employee of the U. S. Nuclear Regulatory Commission (NRC). My present position is Senior Auxiliary Systems Engineer (Nuclear), Auxiliary Systems Branch, Division of Systems Integration within the Office of Nuclear Reactor Regulation. A copy of my professional qualifications is attached.
2. The purpose of my affidavit is to respond to Item No. 2 of the Atomic Safety and Licensing Appeal Board Memorandum and Order dated October 7, 1981 (ALAB-655). Item No. 2 requests the following information:
"Status reports from SMUD and the staff on SMUD's commitments to improve AFW reliability, as described in CEC Exhibit 21 (Enclosure 2)."
3. By letter (CEC Exhibit 21) dated February 26, 1980, the staff responded to SMUD letters which provided the auxiliary feedwater system (AFWS) reliability study and the proposed AFWS upgrade action plan for staff review. Enclosure 1 to CEC Exhibit 21 provided the results of the staff review of the licensee's reliability study and action plan, and Enclosure 2 established an implementation schedule for completing all necessary actions with respect to the continued upgrade of the timeliness and reliability of the Rancho Seco AFW system.

Enclosure 1 to CEC Exhibit 21 is divided into four parts: Part A provided staff comments on the Rancho Seco AFWS reliability analysis and identified areas of the reliability report which need to be revised; Part B identified staff positions and requests for additional information on the AFWS outstanding items; Part C identified concerns regarding the Rancho Seco AFWS related to Section 10.4.9 of the Standard Review Plan and requested certain additional information; and Part D identified our generic concerns regarding the design basis for AFWS flow requirements. The action items in Enclosure 1 were summarized in Enclosure 2 to CEC Exhibit 21 and requested implementation dates were provided for the action items identified in Parts A through D of Enclosure 1. SMUD has responded to the positions and requests of CEC Exhibit 21 by submittals to the staff from March 18, 1980 to the present as noted below in the discussion of each item. The last SMUD submittal, dated September 8, 1981, provides a final design description of the design concepts for portions of the upgraded AFWS and a preliminary design description for other portions of the system. A staff review of the final design details provided in the September 8, 1981 submittal is currently underway. The staff review for the remaining portions of the system upgrade (not finalized in the September 8, 1981 letter) will be performed subsequent to submittal of final design details for these items currently scheduled for January 1, 1982. The status of each of the required actions identified in Enclosure 2 to CEC Exhibit 21 is provided below.

PART A: NRC COMMENTS ON RANCHO SECO RELIABILITY ANALYSIS

1. Revise success criterion defined in Section 1.5 and associated figures.

The staff requested that the AFWS mission success criterion be modified to reflect the requirement that AFW flow should be delivered to the steam generators prior to steam generator dryout. The staff also requested that the reliability report be clarified to indicate that the high pressure injection system would not be available to mitigate the effects of loss of main feedwater in conjunction with a loss of all A. C. power.

SMUD responded to this item in a letter dated May 14, 1980 in which they agreed to clarify the report relative to high pressure injection availability during a loss of all A. C. power. However, SMUD maintained their position that mission success for the AFWS is the attainment of flow to at least one steam generator in time to support decay heat removal from the core and that preventing steam generator dryout is of secondary importance. SMUD stated that adequate core cooling can be attained even if AFWS actuation is delayed beyond steam generator dryout. In a meeting with the staff on September 4, 1980, the licensee committed to perform a new reliability analysis to verify the adequacy of the AFWS as upgraded by proposed modifications. This meeting was reported by an NRC letter dated September 30, 1980. The staff will report on the adequacy of the revised reliability study after receipt of this analysis from SMUD. An acceptable revised reliability analysis should be based on a mission success criterion which includes the requirement to deliver the AFW flow to the steam generator before the steam generator boils dry. The revised reliability analysis is scheduled to be submitted January 1, 1982 at which time the staff will review the adequacy of the analysis.

2. Revise Section 2.4.2 and AFWS procedures with regard to AFW pump suction and discharge pressure instrumentation

The staff noted that, contrary to the discussion in Section 2.4.2 of the licensee's reliability report, there is no indication of AFW pump suction and discharge pressure in the control room. The staff requested that SMUD verify that this discrepancy does not affect the reliability study results and that there are no AFWS procedures that are dependent on such instrumentation.

SMUD responded to this item in a letter dated May 14, 1980 stating that the reliability analysis had been revised to delete any reliance on pump suction or discharge pressure indication with the result that the system unavailability increased by seven percent. In addition, by letter dated November 30, 1981 SMUD has verified that there are no AFWS procedures that are dependent on such instrumentation. As noted in Item A.1 above, a revised reliability study will be submitted and subsequently the staff will report on the adequacy of the analysis. An acceptable revised reliability analysis should reflect the actual instrumentation and controls that will be available after AFWS upgrade.

3. Discussion of ICS-NNI power supply as a potential single failure source

The staff requested that SMUD explain why Sections 3.3.1, 3.3.2 and 3.3.4 of the reliability study do not identify the integrated control system non-nuclear instrumentation (ICS-NNI) power supply as a potential single failure source which can fail to open the AFW flow control valves upon

demand. In a letter dated May 14, 1980 SMUD provided an explanation of the use of ICS-NNI failure in the fault trees. Because the NRC has specified an unavailability value (7×10^{-3} per demand) to be assigned to each separate actuation and control train, it was implicitly assumed that this value included all related actuation and control failures including power supply failures. As noted in Item A.1 above, a revised reliability study will be performed for the upgraded AFWS system. Since the upgraded system will include a safety-grade AFW automatic initiation and control system which is independent of the ICS, the staff considers Item A.3 to be closed.

PART B: NRC STAFF POSITIONS/REQUEST FOR ADDITIONAL INFORMATION ON AFWS
OUTSTANDING ITEMS

1.a AFW Automatic Initiation and Control System

In CEC Exhibit 21, Enclosure 2 the staff required that the proposed safety-grade automatic initiation and control system for the Rancho Seco AFWS be installed and operational by January 1, 1981 with design details submitted for staff review by August 1, 1980. NUREG-0737, sent to the licensee by letter dated October 31, 1980, changed the required implementation date to July 31, 1981. By letter dated November 17, 1980, SMUD provided a design concept for a major system upgrade for the AFWS which includes installation of the safety-grade initiation and control system. SMUD stated in a letter dated December 15, 1980 that implementation of the major system upgrade will be done during the first extensive outage following the 1982 delivery of equipment for the modifications.

The staff approved the preliminary design in a letter dated January 22, 1981 and requested that SMUD provide a schedule for submittal of design information. The SMUD letter of March 6, 1981 stated that the final design would be submitted for staff review and approval by January 1, 1982 and that the equipment for the upgraded AFWS is scheduled for delivery in August 1982. Additional information on the design of the safety grade automatic initiation and control system was provided by the SMUD letter of September 8, 1981. Final design details are still scheduled for submittal by January 1, 1982 at which time the staff will review the adequacy of the design.

1.b Actuate AFW valves FV-20527 and FV-20528 and implement periodic testing procedure for automatic initiation circuitry of AFW pumps

The staff required that AFW flow control valves (FV-20527 and FV-20528) be actuated using existing design control signals during the refueling outage underway at the time CEC Exhibit 21 was sent to SMUD. The staff also requested that periodic testing procedures be implemented to perform channel functional tests of the existing automatic initiation circuitry. SMUD committed to these actions by letter dated March 18, 1980. By letter dated November 30, 1981, SMUD verified that the valves were actuated and that procedures are in place to perform the tests at least every 31 days as required. The staff considers Item B.1.b to be closed.

1.c Submit test results and analyses which support automatic loading of Pump P-319 on Nuclear Service Bus

SMUD had proposed that provisions be made for automatic loading of AFW pump P-319 on the emergency bus in the event of a loss of offsite power. The staff requested that, before implementing this proposed

modification, SMUD should provide test results and analyses for staff review to demonstrate that automatic sequencing does not adversely affect diesel generator performance and associated safety system actuations and functions. By letter dated March 18, 1980, SMUD referred the staff to a SMUD letter of February 18, 1980 for the requested information. Subsequently, the upgraded AFW preliminary design description, provided by the SMUD letter of November 17, 1980, noted that two additional diesel generators will be included in the upgraded plant design modifications. In the same letter, SMUD proposed that the automatic loading provisions for both AFW pumps be delayed until the new diesel generators are installed. Consequently, the staff has not reported on the adequacy of the existing on-site power system relative to automatic loading of the AFW pump. The staff will evaluate the acceptability of the provisions for automatic loading of both AFW pumps on the new diesel generators after receipt of the final design description of the proposed emergency power system modifications.

In a letter dated December 15, 1980, SMUD stated that the new diesel generators will not be operational until late 1983. However, in a meeting with the staff on November 16, 1981, SMUD indicated that the current refueling schedule does not include an outage in 1983 and therefore the new diesel generators will not be installed until the 1984 refueling outages. Because of this extended schedule, SMUD is currently considering a resubmittal of their original proposal to load an AFW pump on the existing diesel generator power system until the new diesel generators are installed. The acceptability of such an interim modification will be evaluated by the staff if proposed.

2.a AFW Flow Indication

Enclosure 2 to CEC Exhibit 21 required that the proposed modification to provide safety-grade AFW flow indication be implemented by January 1, 1981 and that a design description be submitted for staff review by September 1, 1980. NUREG-0737 changed the required implementation date to July 1, 1981. In the letter dated November 17, 1980, SMUD stated that the work on this item is being done independently of the overall system upgrade and would be completed before implementation of the overall system modifications. Subsequently in a letter dated December 15, 1980, SMUD stated that the safety grade flow indication would be installed during the 1982 refueling outage (presently scheduled to begin in September 1982). Although equipment for this modification was scheduled to be delivered by January 1982, SMUD did not believe that a shutdown in January would be advisable due to the large power demand in Northern California at that time. SMUD provided a final design description for this modification in a letter dated September 8, 1981. The staff review of the adequacy of the safety-grade AFW flow indication is currently in progress.

2.b Implement periodic testing procedure for performing tests on AFW flow and steam generator level indication

By Enclosure 2 to CEC Exhibit 21, the staff required SMUD to institute interim test procedures on existing equipment until the safety-grade AFW flow indication of Item B.2.a above is installed. By letter dated March 18, 1980, SMUD committed to establish and implement a procedure for performing channel functional tests of the AFW flow indication and channel checks of the steam generator level indication channels at least every 31 days. By letter dated November 30, 1981, SMUD verified

that these test procedure are in place. The staff considers the Item B.2.b to be closed.

3. System Modification for Periodic AFW Pump Testing

In a letter dated September 17, 1979, SMUD proposed AFW modifications to improve system reliability when performing periodic pump tests. A manual valve (FWS-055) in the test flow path would be replaced by a motor operated valve operable from the control room and system piping would be changed so that one AFW train can be tested without affecting the availability of the other train. In CEC Exhibit 21, the staff approved the proposed modifications and required the following verifications be provided:

- a. confirmation that the motor operated valve position will be indicated in the control room;
- b. confirmation that upon completion of the modification, the pump full flow test procedure will be changed to accommodate the modified system;
- c. a commitment to provide a revised P&ID reflecting the final design;
- d. a commitment to continue to station an operator at valve FWS-055 during pump surveillance testing until the system modifications for full-flow testing are implemented.

By letters dated March 18, 1980 and May 14, 1980, SMUD committed to the above requirements. The SMUD letter of December 15, 1980 stated that these modifications will be implemented during the 1982 refueling outage. The P&ID for the system modification for full-flow testing was provided as an attachment to the SMUD letter of September 8, 1981. The staff considers this response to be acceptable pending staff review of the P&ID.

4. Review procedures and verify that they are adequate for supplying water from both the canal and plant reservoirs

This action required the licensee to verify that procedures are in place and are adequate for obtaining water for the AFWS from sources other than the condensate storage tank (the primary source). SMUD, in a letter dated 3/18/80, committed to ensure that procedures are available or would be revised to adequately describe how to obtain water from the alternate AFW sources. By letter dated November 30, 1981, SMUD verified that the procedures have been revised to describe methods for obtaining water from the Folsom South Canal or the Plant Reservoir. In particular the procedures address operation of the canal pumping station pumps as requested by the staff.

5. Submit Technical Specification modification on AFWS flow path verification

By CEC Exhibit 21, the staff required the following modification to the AFWS technical specifications:

"Prior to startup following a refueling shutdown or any cold shutdown of longer than 30 days duration, conduct a test to demonstrate that the motor-driven AFW pumps can pump water from the CST to the steam generators."

By letter dated April 30, 1980, SMUD submitted proposed Amendment 64, Revision 2 to the Rancho Seco Technical Specifications which incorporates the above modification. The modifications to the Technical Specifications was approved by the staff and issued as Amendment 31 by letter dated March 27, 1981.

6. Condensate Storage Tank Level Indication and Alarm

The staff by CEC Exhibit 21, approved the licensee's commitment to install safety grade condensate storage tank (CST) level indication and alarm. However, SMUD was required to confirm that the design will include:

- a. Redundant sensors, detectors readouts and alarms from the CST to the control room, including power supplies; and
- b. Use of Class 1E circuitry, equipment and power supplies.

SMUD provided confirmation of the above in a letter dated March 18, 1980 except that qualified Class 1E alarm annunciators would not be provided because they are not available. We agree that qualified Class 1E annunciators are not available for commercial reactor plant application and we, therefore, conclude that the SMUD response of March 18, 1980 is acceptable.

7. Submit requested information on AFW endurance test

In CEC Exhibit 21, SMUD was requested to provide additional information from the endurance test performed on the AFW pumps. Guidelines were provided for the format and content of the requested endurance test report. The staff also requested that an explanation be provided for the rising temperatures for the east and west turbine bearings of pump P-318 which occurred during the latter part of the test run. SMUD transmitted the requested report by letter dated May 14, 1980. SMUD attributed the rising bearing temperature indication to an increasing gland seal steam leakage from the turbine driver which heated the pyrometer probe, causing it to read higher than the actual bearing temperature. SMUD planned to perform follow-up testing to verify

this assumption. Follow-up testing was performed in June 1980 with more accurate test instrumentation. Bearing temperatures were measured for eight hours during which time the west end turbine bearing temperature stabilized at 214°F which is less than manufacturer's acceptance criteria of 240°F. The east end bearing stabilized at a lower temperature. The staff concludes that this matter has been acceptably resolved.

8. Periodic Testing of AFW Motor-Operated Valves

CEC Exhibit 21 did not require further action on this item. It was considered to be acceptably resolved.

9. AFWS operation during loss of all A.C. power

By CEC Exhibit 21, SMUD was required to do the following:

- a. Verify that procedure A.51 (1) requires an operator to be stationed at the AFW flow control valves at all times when A.C. power is not available and (2) provides for adequate lighting and communication with the control room independent of A.C. power for two hours. (To be done prior to startup from the refueling outage underway at that time).
- b. Modify the AFWS design so that the control room operator can control AFWS operation and steam generator level from the control room for two hours independent of A.C. power (To be implemented by January 1, 1981, or later if justifiable).

By letter dated March 18, 1980, SMUD committed to the requirements noted above. In a subsequent letter dated April 14, 1980, SMUD withdrew their commitments of March 18, 1980, noting that Rancho Seco was designed to a single active failure of the power supplies and that

an implication that the plant can be safety shutdown with two active failures (i.e., loss of both diesel generators) would be imprudent. The staff has concluded that the SMUD position does not meet the guidelines of Standard Review Plan 10.4.9 regarding diversity of motive power sources for the AFWS and is, therefore, unacceptable. Although an event involving the loss of all A.C. power was not considered in the design of Rancho Seco, precursors to this event have occurred at other facilities* which have led the staff to conclude that an adequate heat sink must be provided under such circumstances. The staff has advised licensees of operating PWRs of the need to provide such capability. The staff believes that an upgraded AFWS should be provided which incorporates provisions to enable the control room operator to control AFWS operation and steam generator level from the control room for two hours independent of all A.C. power.

10. Submit revision to proposed Technical Specifications for AFW limiting condition for operation

By CEC Exhibit 21, SMUD was required to revise Technical Specifications to provide AFWS Limiting Conditions for Operation to read as follows:

- a. When two independent 100% capacity flow paths are not available, capacity should be restored within 72 hours or the plant placed in a cooling mode not relying on steam generator cooling within the next 12 hours.
- b. When at least one 100% capacity flow path is not available, the plant shall be made subcritical within one hour and the facility placed in a shutdown cooling mode which does not rely on steam generators for cooling within 12 hours.

* See, NUREG-0611, "Generic Evaluation of Feedwater Transients and Small Break Loss-of-Coolant Accidents In Westinghouse-Designed Operating Plants", p. III-10, (January, 1980).

By letter dated April 30, 1980, SMUD committed to the suggested wording for Item 1 but suggested that for Item 2, the wording require that "the plant shall be made subcritical within four hours...".

SMUD believes that fast shutdown, within the one hour limit, could result in tripping the main feedwater pumps resulting in a loss of all feedwater capability. SMUD believes that a four hour shutdown is more reasonable, in that the shutdown would proceed in a more orderly manner with less risk to plant safety. The modifications to the Technical Specifications proposed by SMUD were approved by the staff and issued as Amendment 31 by letter dated March 27, 1981.

PART C: AFW SYSTEM STANDARD REVIEW PLAN - SECTION 10.4.9

The staff reviewed the Rancho Seco AFWS against the guidelines for auxiliary feedwater systems in Standard Review Plan Section 10.4.9 and the associated Branch Technical Position 10-1. The staff review indicated that further evaluations of the AFWS are required relative to the capability to mitigate the effects of postulated breaks in main feedwater, main steam and AFW piping. By CEC Exhibit 21, SMUD was requested to evaluate these postulated pipe breaks and (1) determine any AFW system design changes or procedures necessary to detect and isolate the break and direct the required feedwater flow to the intact steam generator(s) before they boil dry or (2) describe how the plant can be brought to a safe shutdown condition by use of other systems which would be available following such postulated events (assuming no operator action for 10 minutes).

By letters dated November 17, 1980 and September 8, 1981, SMUD provided a description of the proposed upgraded AFWS relative to NRC guidelines indicating that the AFWS guidelines would be met. We will report on the adequacy of the AFWS design relative to pipe breaks after receipt of the final design description of the upgraded system. The final design description is scheduled to be submitted by January 1, 1982 at which time the staff will review the adequacy of the design.

PART D: DESIGN BASIS FOR AFW SYSTEM FLOW REQUIREMENTS

SMUD was required, by CEC Exhibit 21, to provide an evaluation to show that the AFWS flow capacity is adequate to meet system requirements.

The information required from the licensee regarding AFWS design basis flow was described in Attachment B to CEC Exhibit 21. By letter dated May 14, 1980, SMUD stated that this evaluation was being prepared by B&W and was scheduled for completion on June 1, 1980. SMUD committed to provide the evaluation to the staff upon receipt of the submittal from B&W. The evaluation was submitted to the NRC by letter dated November 30, 1981 and is currently under review by the staff.

The above statements and opinions are true and correct to the best of my personal knowledge and belief.

Ernest D. Sylvester

Ernest D. Sylvester

Subscribed and sworn to before
me this 4th day of December 1981.

Judy L. Butta, Notary Public
My Commission Expires: July 1, 1982

STATEMENT OF PROFESSIONAL QUALIFICATIONS
ERNEST D. SYLVESTER

I have been with the U. S. Nuclear Regulatory Commission (NRC) since December 1976. Since September 1980 I have been a member of the Auxiliary Systems Branch, Division of Systems Integration. As a Senior Auxiliary Systems Engineer, I am responsible for performing technical reviews and evaluations of the functional capability of auxiliary systems and components as described in applications for construction permits and operating licenses for nuclear power plants, and as required for operating plants, to assure public health and safety and protection of the environment. I performed the operating license review of the Comanche Peak auxiliary systems designs. My current assignments include reviews of the McGuire safe shutdown capability in the event of postulated fires, proposed modifications to the Palisades auxiliary feedwater system and auxiliary system designs for Millstone Unit 1 for the Systematic Evaluation Program.

I have a M. S. Degree (1965) in Mechanical Engineering from Rensselaer Polytechnic Institute and a B. S. Degree (1960) in Mechanical Engineering from Michigan State University. I have completed NRC courses in boiling water and pressurized water reactor technology, radiation protection and reliability estimation.

From December 1976 to September 1980 I served as a senior systems engineering analyst in the Plant Systems Branch, Division of Operating Reactors, NRC. I performed reviews of the fire protection programs at 10 operating plants relative to ensuring safe shutdown capability in the event of postulated fires.

I prepared guidance documents for NRC staff use in evaluating fire protection programs and assisted in the development of fire protection regulations.

From August 1969 to December 1976, I served as an engineer at the Knolls Atomic Power Laboratory of the General Electric Company. I performed analyses to support the design of reactor systems for shipboard Naval reactor plants. I also developed and wrote casualty procedures for emergency core cooling systems and containment systems and operating procedures for other reactor plant systems.

From November 1965 to August 1969, I was a heat transfer engineer for the General Electric Company at their Valley Forge Space Power Division. I performed analyses and developed test programs for various nuclear space power systems and their components. I was responsible for the thermal design analysis and analytical support for testing of the SNAP-27 Lunar Module fuel cask (the container and re-entry shield for the SNAP-27 radioisotope fuel capsule) considering normal operation, possible re-entry abort and launch-pad fire ball situations.

From April 1964 to November 1965, I was an analytical engineer in the Missile Division of the Chrysler Corporation. I provided analytical support to NASA on a design study of the transient phenomena occurring in the chilldown operation for orbital restart of rocket engine systems using cryogenic liquid propellants. I was responsible for developing an extensive computer program for this study.

From October 1960 to December 1963, I was an analytical engineer for Pratt and Whitney Aircraft. My responsibilities included heat transfer and fluid flow analyses for liquid metal cooled reactors and auxiliary systems for aircraft and space power plant applications.