U. S. NUCLEAR REGULATORY COMMISSION

REGION V

Report Nos. 50-275/89-02, 50-323/89-02

Docket Nos. 50-275, 50-323

License Nos. DPR-80, DPR-82

Licensee: Pacific Gas and Electric Company
77 Beale Street, Room 1451
San Francisco, California 94106

Facility Name: Diablo Canyon Units 1 and 2

Inspection at: San Luis Obispo, California (Diablo Canyon Site)

Inspection Conducted: January 30 - February 2, 1989

Inspectors: James F. Melfi 3/13/89
J. F. Melfi, Reactor Inspector — Date Signed

Other Accompanying Personnel
J. L. Mauck, Section Chief, SICB, NRR
R. W. Stevens, Inspector, SICB, NRR

Approved By: Stuart A. Richards 3/13/89
S. A. Richards, Chief, Engineering Section — Date Signed

Summary:

Inspection on January 30 - February 2, 1989 (Report 50-275/89-02, 50-323/89-02)

Areas Inspected: A special, announced inspection of the Anticipated Transient Without Scram (ATWS) mitigating system to the requirements of 10 CFR 50.62. This inspection assessed the conformance of the licensee's ATWS system with 10 CFR 50.62, in accordance with Temporary Instruction (TI) 2500/20. Inspection procedures 30703 and 25020 were used during this inspection.

Safety Issue Management System (SIMS) Items:

(Closed for Unit 2, Open for Unit 1) Multiplant Action (MPA) A-020, "10 CFR 50.62 Operating Reactor Reviews".

Results:

General Conclusions and Specific Findings

The licensee has installed the ATWS Mitigation System Actuation Circuitry (AMSAC) equipment adequately to meet the requirements of the ATWS rule, 10 CFR 50.62. In general, the physical arrangement and installation was done in accordance with the NRC staff Safety Evaluation Report (SER) on the system. The inspectors identified several specific items of concern as noted below.

Significant Safety Matters: None

Summary of Violations: None

Open Items Summary:

3 new items were opened. The items are as follows:

- Followup on the licensee's actions on annunciator windows.
- Followup on the licensee's actions on the separation of wires in the AMSAC cabinet.
- Verification of the first calibration of the AMSAC circuitry.

DETAILS

1. Persons Contacted

Diablo Canyon Nuclear Power Plant

*J. Townsend, Plant Manager
*J. Gisclon, Assistant Plant Manager
*J. Taggart, Quality Support Director
*D. Miklush, Maintenance Manager
*W. Coley, General Construction Supervisor
*B. Giffin, Tech. Services Manager
*M. Tresler, Project Engineer
*C. Eldridge, Quality Control Manager
*R. Webb, Senior Compliance Engineer
*C. Dougherty, QA Engineer
*R. Washington, I&C Engineer
*W. Yip, Tech. Services Engineer
*D. Tatesan, Senior Engineer
*T. Grebel, Regulatory Compliance Supervisor
*W. Kelly, Compliance Engineer
J. Blakeley, Licensing Supervisor
B. Guilbeult, Material Services Manager
J. Hefler, I&C Engineer
T. Lee, Senior Mechanical Engineer
W. Weems, Operations Training Instructor

The inspectors also held discussions with other licensee and contract personnel during the inspection. This included plant staff engineers, technicians, and administrative and clerical assistants.

2. Introduction

The purpose of this inspection was to compare the installed plant instrumentation and equipment with the commitments contained in correspondence related to the Anticipated Transient Without Scram (ATWS) issue. An ATWS event is defined as an operational transient that would be expected to trip (scram) the reactor, but a failure in the Reactor Protection System (RPS) prevents the reactor from scramming. On July 26, 1984, an amendment to the Code of Federal Regulations (CFR) was issued (10 CFR 50.62) to address the ATWS issue at all commercial light water cooled nuclear power plants. This inspection assessed whether the equipment and instrumentation installed at Diablo Canyon meets the criteria specified in the ATWS Rule and is installed as described in the NRC Safety Evaluation Report (SER). Some of the references used to assess the licensee's conformance to the ATWS rule were:

- Temporary Instruction 2500/20, "Inspection To Determine Compliance with ATWS Rule, 10 CFR 50.62," February 9, 1987.

- Letter, C. E. Rossi (NRC) to L. D. Butterfield (WOG), "Acceptance of Referencing of Licensing Topical Report," July 7, 1986.

- Letter, R. A. Newton (WOG) to J. Lyons (NRC), "Westinghouse Owners Group Transmittal of Topical Report, WCAP-10858-P-A, Revision 1, AMSAC Generic Design Package," August 3, 1987.

- Letter, R. A. Newton (WOG) to J. Lyons (NRC), "Westinghouse Owners Group Addendum 1 to WCAP-10858-P-A and WCAP-11293-A: AMSAC Generic Design Package," February 26, 1987,

- Letter, H. Rood (NRC) to J. D. Shiffer (PGE), "Safety Evaluation of the AMSAC System, with Enclosure 1 'Safety Evaluation Report, Diablo Canyon Power Plant, Units 1 and 2, Compliance With ATWS Rule 10 CFR 50.62'," August 15, 1988.

The Westinghouse Owners Group (WOG) analyzed possible ATWS scenarios, and provided three different ATWS Mitigation System Actuation Circuitry (AMSAC) designs to mitigate the most limiting ATWS event at Westinghouse designed reactors. As noted in the July 7, 1986 letter above, the NRR staff stated that all three generic AMSAC designs would meet the requirements of the ATWS Rule (10 CFR 50.62) at Westinghouse designed reactors. This letter also stated that the staff would review the plant specific design details to assure compliance.

The licensee supplied correspondence related of their site specific installation in letters dated October 30, 1987, March 2, 1988 and April 28, 1988. The licensee submitted a letter dated August 15, 1988, requesting to delay the installation of the AMSAC until the third refueling (1989) outage, since the NRC SER had not been issued. The SER was issued on the same day, and the NRC issued a letter dated September 13, 1988 informing the licensee that the installation of the equipment could not be delayed.

As a result of the generic reviews, the NRC staff agreed with Westinghouse that the most severe ATWS scenarios requiring AMSAC to actuate were a Loss of Normal Feedwater (LONF) or a Loss of Load (LOL) event, concurrent with an ATWS. These events were analyzed for different reactor powers, and it was determined that a reactor power greater than 70% with these assumed events could lead to a reactor vessel pressure (3200 Psig) exceeding the ASME Boiler and Pressure Vessel Code C Service Limit stress criteria.

To correct this situation, the licensee elected to install option 1 of the generic AMSAC designs. To help maintain the water mass in the steam generator, this equipment is designed to isolate Steam Generator blowdown and sample valves, actuate a turbine trip, and start Auxiliary Feedwater (AFW) flow when conditions indicative of an ATWS are sensed. The AMSAC equipment senses conditions indicative of an ATWS by monitoring the narrow range steam generator water levels, and main turbine power. The steam generator water level setpoint for AMSAC initiation is set below the RPS trip setpoints, allowing the RPS to normally actuate first, start AFW and cause a turbine trip. The AMSAC equipment is prevented from actuating for 25 seconds after these conditions are sensed, to allow the RPS to fulfill its function. A turbine setpoint (C-20) was installed for the AMSAC system, which arms the AMSAC system when a turbine power greater than 40% is achieved. This setpoint was chosen to prevent

inadvertent AMSAC actuations during startup and to limit the amount of predicted voiding in the core at 70% power. The AMSAC equipment remains armed for several minutes after the turbine goes below 40% power, to assure that the AMSAC will actuate if needed. These actions will help maintain water inventory in the steam generators to maintain a heat sink for the reactor during an ATWS event.

In order to provide this diverse feature, the NRC staff realized that the AMSAC equipment has to be separate and independent from the RPS (the RPS is assumed to be failed) to minimize common cause failures. This includes being seismically and environmentally qualified to appropriate standards, the use of different isolation devices and power supplies from the RPS, and AMSAC equipment being designed and installed with good engineering practice. The equipment also has to be testable, and capable of being bypassed. The staff concluded that the AMSAC equipment does not need to be class 1E, but it did need to be procured in accordance with Generic Letter 85-06.

3. Inspection Details

The inspectors reviewed the licensee's design in accordance with the NRC Safety Evaluation Report (SER). The separate items considered in the SER are addressed below.

A. Procurement

As noted in correspondence with the licensee, the NRR staff concluded that AMSAC equipment does not need to be class 1E, with the QA requirements imposed on class 1E systems, but did need to have the QA requirements for procurement noted in Generic Letter 85-06. The staff asked questions on the QA requirements that the licensee used for the AMSAC system.

The licensee responded to the staff specific questions on the QA requirements on this system in their letter dated March 2, 1988. The QA measures that the licensee implemented on the procurement and installation of the AMSAC equipment are discussed below.

The inspector reviewed purchase order 756844, dated March 12, 1987 and verified that the purchase order was consistent with the technical design and the licensee's plan for implementing the ATWS rule. Receipt inspection, identification and storage controls were applied in accordance with the licensee's procedures. The licensee performed vendor inspections to verify the quality of the AMSAC equipment. The inspector verified that the AMSAC equipment for unit 1 (which is not yet installed) was marked and stored in a partitioned area. The utility was using the latest installation specifications, drawings, and procedures. The licensee had put the AMSAC equipment on the 'Q' list, and would purchase spare parts for the AMSAC equipment to the committed standards.

During the installation of the equipment, the licensee used the QA controls appropriate for this installation.

B. Diversity

Diversity is required between the AMSAC system and the RPS to minimize common cause failures. The licensee provided a response to the issue of diversity in their plant specific submittal dated October 30, 1987. The licensee's response confirmed that the microprocessor-based AMSAC logic circuits have analog inputs provided by isolation amplifiers. This logic is diverse from the discrete digital logic circuits of the RPS in the areas of design, equipment, and manufacturing. The final actuation devices which initiate AMSAC are isolated by Struthers Dunn relays, which are different from the relays used by the RPS.

The NRC staff previously concluded that the equipment is diverse from the RPS, as noted in the SER.

C. Logic Power Supplies

As noted in the SER, the logic power supplies are not required to be class 1E, but must be capable of performing the design function on a loss of offsite power. The use of RPS batteries and inverters was not considered acceptable by the NRC staff, since it was not independent from the RPS.

The inspectors verified that the licensee powers the AMSAC equipment off of the chemistry lab and counting room inverter. This inverter can be powered from non-RPS power supplies. The inverter has its own set of batteries for continued operation in the event of a loss of AC power. The logic power supplies were found to be in accordance with the SER.

D. Safety-Related Interface

The SER required that existing RPS continue to meet all applicable safety criteria regarding its interface with the AMSAC.

The inspectors verified that the existing Class 1E Steam Generator Water Level instrumentation and Turbine First Stage Pressure instrumentation inputs into the AMSAC were adequately isolated. The output to start the AFW pumps were also verified to be adequately isolated.

E. Maintenance and Operating Bypasses

In the NRC SER, the NRC staff stated that the maintenance bypass status and operating bypasses should be continuously indicated in the control room. The staff also noted that the independence of the C-20 permissive should be addressed.

The licensee provided information to the staff stating that the maintenance bypass and operational bypass status would be provided in the control room through the use of status lights and annunciation.

During documentation review and inspection of the control room status indication, a concern surfaced related to the adequacy of the annunciation associated with the AMSAC system. Two annunciator windows [PK12-13 ("AMSAC ARMED/BYPASSED") and PK08-15 ("AMSAC TROUBLE/TRIP")] are currently provided on the control room annunciator panels. The AMSAC status signal output and light coordination design is currently such that the illumination of both lights represents any one of two completely opposite operating conditions, either tripped or bypassed. Discussions with plant operating personnel supported the inspector's concern that the current scheme does not clearly or adequately represent the AMSAC system operational status and is potentially misleading to plant operators.

The inspector verified that there is a single distinct AMSAC status output signal for the tripped/actuated condition, which is currently used as an input into the same window associated with the trouble signals. Thus, it is the inspectors position that, in conjunction with this signal, a dedicated (third) annunciator window should be incorporated into the plant design to aid in the distinction that the AMSAC has actually produced a trip/actuation signal. The inspector considered that with the incorporation of a three AMSAC annunciator window combination, the control room operators will be able to accurately diagnose in a timely (rapid) manner the operational status of AMSAC at any given point in time without reliance on other means. The licensee's response to this issue on annunciation will be followed up in a future inspection report (50-323/89-02-01).

The independence of the C-20 permissive signal was noted in the SER to be maintained for a time period consistent with revision 1 to WCAP-10858-P-A. It was identified during the inspection that the time delay associated with the AMSAC C-20 permissive was set at 240 seconds instead of the 360 seconds recommended by Revision 1 to WCAP 10858-P-A. The licensee subsequently provided copies of information dated February 12, 1988 and February 2, 1989 to verify that a study was performed for Diablo Canyon by Westinghouse to confirm the adequacy of setting the C-20 time delay at 240 seconds. Based on this information, the setting is appropriate.

F. <u>Manual Initiation</u>

Manual initiation capability of the AMSAC mitigation function was required. The licensee discussed in their October 30, 1987 submittal how a manual turbine trip and AFW actuation are accomplished by the operator. These manual start procedures are outlined in the licensee's Emergency Procedure FR-S.1, "Response to Nuclear Power Generation/ATWS." The inspectors reviewed the procedure and concluded that the capability for manual initiation is adequate.

G. Electrical Independence

As noted in the SER, independence is required from the sensor output to the final actuation device, at which point nonsafety-related circuits must be isolated from the safety-related circuits by qualified Class 1E isolators.

The inspectors verified that the licensee had provided the required isolation devices and that they were tested to Class 1E electrical equipment requirements. The inspectors also reviewed the qualification package for the isolators. The AMSAC equipment appears to be electrically independent.

H. Separation from the Existing Reactor Protection System (RPS)

The NRC SER noted that the implementation of the AMSAC system must be such that the separation criteria applied to the existing RPS are not violated. The SER also stated the the licensee would continue to meet the original plant separation criteria.

During a physical inspection of the AMSAC microprocessor logic cabinet, the inspectors identified that adequate separation apparently was not maintained between the AMSAC analog input signal wiring (steam generator low level and main turbine impulse pressure) obtained from the existing reactor protection system (RPS) Class IE analog process cabinets. Within each channelized Class IE analog protection process rack, the AMSAC signal wiring from the output (downstream) side of the qualified isolator becomes associated (physically bundled together) with the respective Class IE channel wiring before being routed in separate channelized conduit to the AMSAC cabinet. The wiring exiting each conduit associated with (common to) each of the four independent and redundant Class IE protection sets was found to be physically bundled together in the bottom of the subject AMSAC cabinet. The inspectors considered that the cable routing observed inside the AMSAC logic cabinet may violate the RPS separation criteria (FSAR Section 8.3.1.4) approved by the NRC during original plant licensing. The configuration is not consistent with the separation guidance of Regulatory Guide 1.75 and IEEE 384 pertaining to "Associated" circuits. A failure inside the AMSAC non-Class IE cabinet could potentially negate required protective actions due to lack of physical separation between the inputs and outputs of the isolators and result in loss of the protective function, although this possibility appears small considering the low energy of the circuits involved.

During an NRC review of the original plant design prior to initial plant licensing, a similar situation was identified. SER Section 7.2.3 (October 16, 1974) states that a separation violation to IEEE 279-1968 and IEEE 279-1971 was discovered related to the wiring routed from the protection system process analog racks to the non-safety related control racks. The situation was resolved subsequent to the NRC staff's approval of noise and fault voltage tests. It is the NRC staff's understanding that such a method was viable in that case because of space restrictions within the

protection system analog process cabinets and the control racks. However, such an approach for the AMSAC situation does not appear to be appropriate as it appeared from inspection that sufficient open space exists within the subject AMSAC logic cabinet to allow the licensee to implement an approved method of physical separation to maintain independence between the redundant circuits associated with the Class IE analog process rack wiring. Thus, the licensee should provide a minimum physical separation of six inches where possible and provide approved barriers/wrapping where required between the associated redundant wiring within the AMSAC logic cabinet. The licensee's actions regarding the separation of wires within the AMSAC cabinet, and the applicability of noise and fault voltage testing to this situation, will be reviewed in a future inspection (50-323/89-02-02).

I. Seismic Qualification

The AMSAC equipment is not required to be seismically qualified by the NRC staff. The occurrence of an ATWS with a seismic event was not deemed credible. The licensee did qualify AMSAC cabinets to resist the worst case loads in the cable spreading room where the cabinet is located. This was done to prevent interaction with the other cabinets in the room per the licensee's Seismic Interaction Program (SIP).

The licensee installed the cabinets to rigid supports as noted in Design Change Notice (DCN) DC2-EC-40065. The licensee designed the supports as noted in Calculation Number SQE-31, dated 3/28/88. As noted in the calculation, the cabinets and supports were designed to the worst case floor acceleration in the room. Westinghouse also provided the qualification of the AMCO cabinet and Hoffman relay enclosure in WCAP 8687, dated May, 1988. The licensee verified that the AMSAC equipment met the design spectra in calculation SQE-32, dated 6/14/88.

The DCN and calculation appeared complete, with appropriate sign-offs. The inspector verified that the supports were installed as designed during a walkdown of the system. The seismic qualification seems appropriate.

J. Environmental Qualification

The AMSAC equipment is required to be environmentally qualified for the environment where the equipment is located. As noted in the licensee's October 30, 1987 submittal on the site specific design, all of the AMSAC equipment is located in the cable spreading room of the auxiliary building. This area is a mild environment. The AMSAC equipment is designed to operate from 5 to 50 ^{o}C and 0 to 95% humidity (non-condensing). The AMSAC design is qualified for the cable spreading room, since the design conditions are more extreme than the conditions expected in the cable spreading room.

The licensee purchased the equipment to an appropriate environmental specification. Based on the staff review, the environmental qualification seems adequate.

K. Testing

The AMSAC equipment was required (as noted in the SER) to be capable of being tested periodically at power. The testing could be performed in the bypass mode. It was also noted that the licensee would perform a post-installation startup test.

The inspectors reviewed test documentation to verify that the system was capable of being tested at power and to confirm that preoperational testing had been accomplished for AMSAC. During the preoperational testing of the AMSAC system, it was identified that the main steam blowdown and sample valves failed to close upon AMSAC actuation. The AFW pump also inadvertently started. It was found by investigation by they licensee that the circuit wiring was incorrect for the subject valves. The licensee stated that the situation was corrected by Field Change Notice 11948. The inspectors reviewed the electrical schematics to verify the correct situation. The licensee subsequently wrote Licensee Event Report (LER) 88-018 to document the above situation and also to document poor communication between the site and corporate engineering. The LER was closed out in the last resident inspectors' report.

The inspectors were informed that administrative procedures for at-power testing and refueling outage end-to-end testing were not complete/finalized. The licensee stated that the at-power test procedure (STPI-92A) would be completed by March 2, 1989 and that the 18 month test procedure (STPI-92B) would be completed by the refueling outage following initial implementation of the AMSAC system. Also, the staff was informed that the AMSAC test procedures will be incorporated as part of the plant recurring task schedule (RTS) with a priority one or two assigned to it. The completion and adequacy of these respective efforts will be followed up in a later inspection (50-323/89-02-03).

The staff did confirm through design documentation review and inspection that sufficient capability does exist to allow for appropriate AMSAC testing during both power operation and while the plant is shut down.

L. Training

The inspectors discussed training with the control room operators and training instructors, to verify that the operators had been trained on the new AMSAC installation. The inspectors also toured the simulator to verify the implementation of the AMSAC modification on the simulator. The training was verified by the inspectors to be completed by 11/16/88 for all the operators. Based on the discussions held with the licensee's staff and review of the lesson plan, the operators were found to be trained on the new AMSAC modification.

M. Completion of Mitigative Action

The licensee was required to verify that (1) the protective action, once initiated, goes to completion and (2) the subsequent return to operation requires deliberate operator action.

Based on the review of the test results, and system design, the AMSAC system should complete its action once initiated. The subsequent return to operation also requires deliberate operator action.

N. Technical Specifications

The plant specific submittal was to address the technical specification requirements for AMSAC.

The licensee stated that no technical specification action was proposed with respect to the AMSAC system at this time and that normal administrative controls were sufficient to ensure AMSAC operability.

The NRC staff is presently reviewing ATWS requirements to determine whether and to what extent technical specifications are appropriate. The NRC staff will provide guidance to the licensee for the AMSAC system at a later date.

4. Exit Interview

The inspectors met with the licensee representatives identified in paragraph 1 on February 2, 1989. The scope of the inspection and the findings up to that date were discussed.