U. S. NUCLEAR REGULATORY COMMISSION

REGION V

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License Numbers: NPF-10, NPF-15

Licensee: Southern California Edison Company
Irvine Operations Center
23 Parker Street
Irvine, California 92718

Facility Name: San Onofre Nuclear Generating Station
Units 2 and 3

Inspection Conducted: March 16 - 20, 1991
A conference call on March 26, 1991

Inspectors: F. Gee, Reactor Inspector
J. Mauck, NRR/SICB

Approved by: Anthony A. Gody, Jr. 5/12/92
A. Gody, Acting Chief, Engineering Section — Date Signed

Inspection Summary:

Inspection during the period of March 16 through 20, 1992 (Report Numbers 50-361/92-11 and 50-362/92-11)

Areas Inspected:

The inspectors conducted an announced inspection to verify the implementation of the plant modifications for Diverse Scram System (DSS) and Diverse Emergency Feedwater Actuation System (DEFAS), as required by Title 10 of the Code of Federal Regulations Part 50.62, "Requirements for Reduction of Risk from Anticipated Transients Without Scram (ATWS) Events for Light-Water-Cooled Nuclear Power Plants." The inspectors utilized Temporary Instruction 2500/020, "Inspection to Determine Compliance with ATWS Rule, 10 CFR 50.62," Revision 2, and Nuclear Regulatory Commission (NRC) Safety Evaluation Reports (SERs) as guidance for this inspection.

Results:

General Conclusions and Specific Findings:

The inspectors concluded that the installed ATWS equipment complies with the ATWS rule with the exception of the quality classification of the motor-generator output contactors for the diverse scram system. The motor generator output contactors were used to interrupt power to the control rods.

The licensee's quality assurance classification of ATWS equipment was designated as Quality Class III/ATWS, which complied with the guidance provided in Generic Letter 85-06, "Quality Assurance Guidance for ATWS Equipment That Is Not Safety-Related." The licensee has committed to upgrade the quality class of these contactors to Quality Class III/ATWS by the next scheduled refueling outage for each unit.

Significant Safety Matters: None

Summary of Violations and Deviations: None

Open Items Summary: The inspectors closed one follow-up item and opened two follow-up items.

Details

1. Persons Contacted

*D. Axline, Engineer, Onsite Nuclear Licensing
*C. Brandt, Engineer, Quality Assurance
*D. Brevig, Supervisor, Onsite Nuclear Licensing
*M. Cabrera, Controls Engineer, Site Nuclear Engineering
*B. Carlis'n, Mechanical/Nuclear Discipline Manager, Nuclear Engineering Design Organization (NEDO)
*C. Diamond, Mechanical Engineer, NEDO
*R. Erickson, Senior Engineer, San Diego Gas & Electric Company
*K. Hara, Electrical Engineer, NEDO
*J. Jamerson, Lead Engineer, Onsite Nuclear Licensing
*N. Pillutla, Controls Engineer, NEDO
*R. Plappert, Supervisor, Technical Support & Compliance
*J. Reilly, Manager, Nuclear Engineering & Construction
*A. Thiel, Controls Discipline Manager, NEDO
*J. Thomas, Senior Engineer, Quality Assurance
*J. Vandenbroek, Supervisor, Compliance
*D. Werntz, Onsite Nuclear Licensing Engineer
*M. Wharton, Manager, NEDO
*J. Winslow, Supervisor, Station Technical

*The asterisk denotes those who attended the exit meeting on March 20, 1992.

The inspectors also held discussions with other licensee personnel during the inspection.

2. Introduction

In this inspection, the inspectors determined if the licensee's Anticipated Transients Without Scram systems (Diverse Scram System, Diverse Emergency Feedwater Actuation System, and Diverse Turbine Trip System) complied with Title 10 of the Code of Federal Regulations (CFR) Part 50.62, "Requirements for Reduction of Risk from Anticipated Transients without Scram (ATWS) Events for Light-Water-Cooled Nuclear Power Plants" (ATWS rule). In addition, the inspectors verified that the implementation of these systems was in accordance with the design details submitted by the licensee. The inspectors also conducted this post-implementation inspection in accordance with the guidelines established in NRC Temporary Instruction 2500/020, "Inspection to Determine Compliance with ATWS Rule, 10 CFR 50.62", Revision 2, dated May 4, 1990.

3. Technical Evaluation

3.1 General

To meet the requirements of the ATWS rule, the licensee performed plant modifications to install new equipment for two ATWS systems, the Diverse Scram System (DSS) and the Diverse Emergency Feedwater Actuation System (DEFAS), and justified previously installed components for the Diverse Turbine Trip (DTT).

The DTT design shared all circuit components with the DSS up to, but not including, the final turbine trip device. Those components that were unique to the DTT and downstream of the final turbine trip device were the existing undervoltage relays, trip relays, master trip relays, and the master solenoid. These relays monitored the Control Element Drive Mechanism (CEDM) power bus undervoltage in a two-out-of-four logic to actuate the turbine trip circuitry. When the DSS caused denergization of the CEDM coils upstream of the CEDM power bus undervoltage relays, the undervoltage relays actuated the diverse turbine trip circuitry.

For the DSS, the licensee installed four new and diverse pressurizer pressure transmitters which shared sensing lines with the existing four transmitters. The DSS consisted of four measurement channels, four two-out-of-four trip logics, and two energized-to-trip paths. Channels 1 and 3 shared one trip path, and Channel 2 and 4 shared the other trip path. The circuit was designed such that activation of both trip paths were required to initiate a reactor trip. Once the trip was actuated, it was sealed in until manually reset at the DSS panel. The DSS trip setpoint was greater than the Reactor Protective System (RPS) high pressurizer pressure trip setpoint and less than the primary safety valve relief pressure setpoint.

For the DEFAS, the licensee utilized the existing safety-related steam generator level signals for inputs. The DEFAS outputs were interfaced with the outputs of the existing safety-related emergency feedwater system equipment which would provide emergency feedwater to the steam generators to mitigate the consequences of an ATWS event. The DEFAS initiation utilized a two-out-of-four logic trip scheme which required both a DEFAS trip signal concurrent with DSS actuation. A DEFAS initiation signal from either one of the two DEFAS initiation paths would initiate emergency feedwater flow.

The SERs stated that the staff's acceptance of the ATWS designs was subject to the following confirmatory items:

a. Control of Jumper Usage - To verify the administrative control of jumper usage in ATWS/DSS test procedures.

b. Software Verification and Validation - To verify the DEFAS software verification and validation process.

c. End-to-End Test Procedures for DEFAS - To verify that end-to-end testing of the DEFAS is conducted at each refueling outage.

In addition to the confirmatory items, the inspectors examined other aspects of the ATWS systems such as isolation device qualification, test procedures, engineering design documents, diversity, safety related interfaces, bypasses, and quality assurance.

3.2 Confirmatory Items

a. Control of Jumper Usage in ATWS/DSS Test Procedures

The overall controlling procedure on the temporary jumpers was SO123-II-15.3, "Preparation, Review, Approval and Distribution of the Temporary System Alteration and Restoration Form, SO(123) 335," which governed any temporary change to the system. The inspectors sampled the ATWS/DSS procedures, SO23-II-109, 110, 111, and 112, "Anticipated Transient Without Scram / Diverse Scram System (ATWS/DSS) Response Time Test," Revision 0, for Channel 1, 2, 3, and 4 respectively. The procedures included controls for temporary jumper usage within the procedural steps. The procedures required a second person, who was not involved with the performance of the test, to formally verify the removal of the temporary jumper. The inspectors concluded the usage of temporary jumpers in ATWS/DSS test procedures had been adequately controlled.

b. Software Verification and Validation in the DEFAS Design

The inspectors performed an audit of the software process used with the Foxboro Spec 200 Microsystem, which was the equipment used by SCE to implement the requirements of the ATWS rule. Documents provided to the inspectors were:

(1) "Foxboro Quality Assurance Laboratory Type Test Request, QOAAE03," Revision B, dated 26 October 1988.

(2) "SCE Quality Class II & Quality Class III/ATWS Foxboro Spec 200 Micro Configurations File Units 2 & 3," dated March 14, 1990, document number 90045.

(3) "SCE QC II & QC III/ATWS Foxboro Spec Micro Configuration," dated October 1, 1990.

(4) "SCE Foxboro Spec 200 Microsystem Verification and Control," dated April 30, 1990.

The fourth document provided the instructions for the functional verification of the Spec 200 Micro components and the program configurations. The document included detailed procedures, restoration, objectives, prerequisites, and precautions.

The first document provided quarterly procedures used by the development teams, and made a comparison of those procedures to the guidance of ANSI/IEEE Standard 730, "Software Quality Assurance Plans," 1984. The Foxboro document was the software verification and validation report for the Spec 200 Micro development project.

The inspector concluded the verification and validation program for the non-safety related Foxboro Spec 200 micro modules was acceptable, based on the above documentation and on previous NRC staff review.

The inspector noted that in an identical installation of these modules at the Haddem Neck facility, Foxboro performed the module configuration and included this as part of their commitment to IEEE 7.4.3.2, "American National Standard Application Criteria for Programmable Digital Computer System in Safety Systems of Nuclear Power Generating Station." The SONGS-2&3 ATWS system module configuration was being performed by SCE personnel. The inspector observed that the licensee did not adhere to any software standards. Moreover, the licensee did not have a formal verification and validation program that controlled the configuration and modifications to this configuration.

Although ATWS is a non-safety system, 10 CFR 50.62 requires it be reliable and to have a quality that is commensurate with the guidance provided by Generic Letter 85-06. There was evidence in Station Technical Procedure SO123-V-4.70, "Software Modification and Verification," that a formal software modification and verification program, that complied with IEEE 7.4.3.2, was being applied to the software associated with the multiplexing of the DSS signals to the Critical Functions Monitoring System (CFMS). The licensee indicated that this procedure was used only for the CFMS by Station Technical personnel. Although the licensee's ATWS system module configuration for DEFAS was not identified as a deviation from GL 85-06, the inspectors observed that the licensee did not apply the same level of review to the configuration of the Spec 200 Micro modules utilized in DEFAS as applied to the CFMS DSS signals.

c. End-to-End Testing of DEFAS

The licensee installed the DEFAS in the last refueling outage and performed an end-to-end test of the system during pre-operational testings. At the time of the inspection, the licensee did not have the refueling end-to-end test procedures ready for review. The licensee indicated that the test procedures will be available for the next refueling outage, and will be similar to the pre-operational test procedures. The review of these test procedures is an open item (Inspector Follow-up Item 50-361, 50-362/89-11-01).

3.3 Other Considerations

a. Isolation Device Qualification Tests

The licensee used two types of electrical isolation device in the DEFAS. Foxboro voltage-to-current converters, Type 2AO-VAI, isolated the steam generator level instruments from DEFAS. Potter-Brumfield MDR relays, Model MDR-134-1-SCE-0, isolated the DEFAS actuation signal from the Class 1E logic circuits.

Foxboro Type Test Report, QOAAB44, "2AO-VAI Custom (ECEP 9206), Style A CS-N/SRC, Voltage-To-Current Converters," Revision A, stated that the converter maintained its isolation capabilities and structural integrity during the seismic tests when tested in a 2ANU-D nest.

Nutherm test report, "Maximum Credible Fault Testing, Potter-Brumfield MDR Relays," SCE-3882MFT, Revision 1, verified that the relays maintained coil-to-contact isolation when they were subjected to maximum credible fault conditions.

The inspectors reviewed the data in these two reports and concluded that the test data appeared to be adequate for the application at SONGS-2&3.

b. Test Procedures

The licensee performed a channel check daily to ensure the four ATWS channels (pressurizer pressure for the DSS and steam generator level for DEFAS) were within the same acceptance criteria as the four existing indications. The licensee also performed a functional test at 92-day intervals to verify the alarm actuation setpoints and logic. During each refueling outage, the licensee performed a channel calibration and a functional end-to-end trip test, using a simulated sensor input to verify expected alarms and indications.

The inspectors reviewed the following test procedures:

(1) Procedure S023-II-1.115, "Diverse Emergency Feedwater Actuation System (DEFAS) Functional Test," Revision 0, dated November 6, 1991.

(2) Procedure S023-II-1.107, "Anticipated Transient Without Scram Diverse Scram System Functional Test," Revision 1, dated January 16, 1991.

(3) Procedure S023-II-1.108, "Anticipated Transient Without Scram/Diversified Scram System (ATWS/DSS) Calibration and Test," Revision 0, dated November 8, 1991.

The inspectors concluded that the procedures appeared to be adequate.

c. Training Program

The inspectors also reviewed the training records of operational personnel on the DEFAS and DSS. The personnel appeared to be adequately trained under the requalification training program. The licensee estimated the ATWS equipment at the simulator will be operational in approximately one year.

d. Locations and Uses of Controls, Indicators and Alarm Points

There were two common trouble annunciation windows with reflash capability on the main control board in the control room, one for "ATWS/DSS Trouble" and the other for "ATWS/DEFAS Trouble." All alarms, trip indications, and

testing conditions were available on the Critical Functions Monitoring System (CFMS) in the control room. The CFMS displayed the normal condition in white and alarm condition in flashing magenta. System lineup, controls, alarms, indications, and bypasses for DSS and DEFAS were also available on the respective local panels. The inspectors concluded the systems were adequately configured in these areas.

e. Human Factors Engineering Review

The licensee designed the ATWS panels to meet the human factors criteria of the SONGS-2&3 Control Room Design Review (CRDR). During the plant walkdown, the physical layout of the controls, indications and alarms on the ATWS panels appeared to be consistent with the CRDR and adequate.

f. Means of Bypassing

Local panels of DSS and DEFAS provided bypass switches and continuous bypass status indications to facilitate system testing. The CFMS provided continuous bypass switch position status in the control room. There were no automatic bypasses. The licensee allowed the usage of temporary jumpers and the lifting of leads during refueling testing. The licensee's administrative controls on jumper usage appeared adequate.

g. Environmental Qualification

The ATWS system panels were located in a mild environment with the exception of the four pressurizer pressure transmitters of the DSS. The licensee purchased these four transmitters for safety related containment service, and they were qualified as such. The licensee utilized maintenance and surveillance procedures to control the testing and replacement of compone. required to maintain ATWS systems operability. The inspectors concluded that the environmental qualification of the ATWS system was acceptable.

h. Completion of Mitigative Action

During the review of the associated design change package for DSS and DEFAS and the system walkdown, the inspectors concluded that once initiated, the mitigative action went to completion and that deliberate operator action was required to reset or return the actuated systems to normal operating conditions.

i. Completed Work

The engineering design documents appeared to be complete and represented the as-built condition of the ATWS systems. The sampled procurement documents appeared to be complete and called for the procurement of equipment with a safety grade equal to or better than that assigned to the ATWS components.

j. Diversity

The inspectors concluded that adequate diversity existed between ATWS systems and the RPS, and that existing maintenance procedures and guidelines would assure that diversity was maintained over the lifetime of the systems.

k. Safety Related Interfaces

The DSS was independent from the existing RPS except that the DSS shared the same pressurizer pressure sensing lines.

The DEFAS was electrically independent from the existing RPS up to the Engineered Safety Feature Actuation System (ESFAS) cabinets. The non-safety related circuits of DEFAS were electrically isolated from the safety related circuits at the Foxboro Spec 200 Microsystem equipment cabinets and at the final actuation devices in the ESFAS cabinet.

The inspector concluded that ATWS system independence appeared acceptable.

l. Physical Separation

During the system walkdown, the inspectors observed that in Panel L122 (typical of the four panels: L122, L126, L130, and L134), the Class 1E input and the non-class 1E output cables of the voltage-to-current modules were routed together in the panel. The licensee stated that low-energy non-class 1E cables were permitted to be routed with one (and only one) Class 1E separation group under Section 8.3.3.3.3 , control boards and other panels, of the San Onofre FSAR. The inspectors reviewed the FSAR section and concluded that the licensee's caable routing in this instance was acceptable.

m. Quality Assurance

10 CFR 50.62, (c)(2) requires licensees of selected plant designs to have a diverse scram system from the sensor output to the interruption of power to the control rods. The diverse scram system must be designed to perform its function in a reliable manner and be independent from the existing reactor trip system (from sensor output to interruption of power to the control rods). The individual components are required to be designed to quality affecting requirements consistent with Generic Letter 85-06, "Quality Assurance Guidance for ATWS Equipment That Is Not Safety-Related," dated April 16, 1985.

SONGS-2&3 classified the ATWS equipment under its quality classification (QC) QC-III/ATWS, which was in compliance with Generic Letter 85-06. The inspectors identified that the motor-generator set output contactors of the diverse scram system, which were used to interrupt power to the control rods, were not classified as QC-III/ATWS by the licensee. On March 26, 1992, the licensee committed to upgrade the quality class of such contactors from non-safety related class to QC-III/ATWS by the next scheduled refueling outage for each unit. If upgrade of the existing contactors was not

possible, the licensee committed to replace the contactors with QC-III/ATWS qualified components. This issue is an open item (Follow-up Item 50-361, 50-362/92-11-02).

With the one exception noted, the inspector concluded the licensee had incorporated the quality assurance requirements of the ATWS systems into the procurement documents, system designs and plant procedures by the appropriate identification and control of components and procedures.

4. Conclusion

The inspectors concluded that the installed ATWS equipment complied with 10 CFR 50.62 and the NRC SERs with the exception of the quality classification of the motor-generator output contactors for the diverse scram system. The motor generator output contactors were used to interrupt power to the control rods. The licensee's quality assurance classification of ATWS equipment was designated as Quality Class III/ATWS, which complied with the guidance provided in Generic Letter 85-06, "Quality Assurance Guidance for ATWS Equipment That Is Not Safety-Related." The licensee has committed to upgrade the quality class of these contactors to Quality Class III/ATWS by the next scheduled refueling outage for each unit.

No violations or deviations from NRC requirements were identified.

5. Quality of Engineering Work

In the 1989-1990 period, the licensee revised the design change process. Under the new program and in the 1991 period, design engineering performed the work of the design change for the Unit 3 DEFAS modification. The inspectors reviewed this design change package and concluded that the quality of the engineering design work was improved by the implementation of this design change process. The number of Field Interim Design Change Notices (FIDCNs) was small.

6. (Closed) Follow-up Item 50-206/90-39-01: Completion of the Procedural Changes Per Design Change Modification on Unit 1 ATWS Systems

In addressing this follow-up item, the licensee documented the completion of revisions to sixteen procedures affected by the Unit 1 ATWS system Design Change Package (DCP) 3407. The inspector reviewed two of the revised procedures, SO1-II-1.74, "Surveillance Requirement Auxiliary Feedwater System Channel Calibration," Revision 8, and SO1-II-1.76, "Surveillance Requirement Auxiliary Feedwater System Channel Test," Revision 7. The inspector concluded the procedural changes had been adequately revised. This follow-up item is closed.

7. Exit Meeting

The inspector conducted an exit meeting on March 20, 1992, with members of the licensee staff as indicated in Section 1 and a conference call with your staff on March 26, 1992. During the exit meeting, the inspector summarized the scope of the inspection activities and reviewed the inspection findings as described in this report. The licensee acknowledged the concerns identified in the report and the commitments as described herein.