

ENCLOSURE

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

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License Nos.: NPF-41; NPF-51; NPF-74
Report No.: 50-528/99-15; 50-529/99-15; 50-530/99-15
Licensee: Arizona Public Service Company
Facility: Palo Verde Nuclear Generating Station, Units 1, 2, and 3
Location: 5951 S. Wintersburg Road
Tonopah, Arizona
Dates: September 13 to 17, 1999
Inspectors: L. E. Ellershaw, Senior Reactor Inspector
Engineering and Maintenance Branch
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Approved By: Dr. Dale A. Powers, Chief
Engineering and Maintenance Branch
Division of Reactor Safety

ATTACHMENT: Supplemental Information

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EXECUTIVE SUMMARY

Palo Verde Nuclear Generating Station, Units 1, 2, and 3
NRC Inspection Report No. 50-528/99-15; 50-529/99-15; 50-530/99-15

This inspection was performed to assess the adequacy of the licensee's program, procedures, and supporting documentation to ensure technical specification required surveillance testing of safety-related logic circuits was performed in an acceptable manner. The inspectors used NRC Temporary Instruction 2515/139, "Inspection of Licensee's Implementation of Generic Letter 96-01, Testing of Safety Related Logic Circuits."

Engineering

- The licensee's Generic Letter 96-01 project plan was appropriately developed to perform and complete the requested actions specified in the generic letter (Section E1.1).
- The licensee's design control process had controlled the sampled changes to systems containing logic circuits in an acceptable manner, and had ensured that required logic testing was performed (Section E2.1).
- Technical specification surveillance requirements for diesel generator load shedding and sequencing were included in the applicable surveillance procedures. Surveillance testing demonstrated that all of the logic associated with the diesel generator load shedding and sequencing were being properly tested (Section E3.1).
- The project plan review team was aggressive in their approach to reviewing industry operating experience, and had performed a thorough and in-depth evaluation of documents in order to identify issues and determine their applicability to the Palo Verde Nuclear Generating Station (Section E3.2).
- Licensee management was appropriately responsive to performing the requested actions in Generic Letter 96-01. The project plan was well formulated and the review team members were knowledgeable and well suited for their assigned tasks (Section E6.1).
- The nuclear assurance department had thoroughly evaluated the Generic Letter 96-01 project plan and its implementation (Section E7.1).
- The licensee's corrective action program was sufficient to control deficiencies identified in systems containing logic circuits. The classification and specified corrective actions for reviewed condition report/disposition requests were appropriate (Section E7.2).



Report Details

Summary of Plant Status

During this inspection, Units 1, 2, and 3 were in Mode 1.

III. Engineering

E1. Conduct of Engineering

E1.1 Generic Letter 96-01 Program Review

NRC Generic Letter 96-01 requested that all licensees complete the following: (1) review electrical schematic drawings and logic diagrams for the reactor protection system, engineered safety features actuation systems, and emergency diesel generator load shedding and sequencing systems, against existing plant surveillance test procedures to determine whether they cover all portions of the logic circuitry, and fulfill the surveillance requirements in the technical specifications; and (2) modify the procedures, as necessary, to ensure the testing complies with the surveillance requirements.

a. Inspection Scope

The inspectors reviewed the licensee's program, "Project Plan: Responding to NRC Generic Letter 96-01," which was developed to implement the actions requested in Generic Letter 96-01. The program identified scope, anticipated risks, methodology for addressing emergent issues, review process, schedule, and allocation of resources.

The inspectors also reviewed Engineering Study 13-JS-A73, "PVNGS Response to NRC Generic Letter 96-01, Testing of Safety-Related Logic Circuits," which provided the results of their Generic Letter 96-01 effort.

b. Observations and Findings

The inspectors noted that the licensee's Generic Letter 96-01 effort started during the third quarter of 1996 and was completed in February 1997. The directions in Generic Letter 96-01 stated that the requested actions were to be completed prior to startup from the first refueling outage, commencing 1 year after issuance of the letter. Thus, the licensee was to complete the review effort prior to startup from Refueling Outage U3R6 (i.e., March 1997). The inspectors determined that the licensee's program established an acceptable foundation for: (1) evaluating safety-related logic circuits; (2) comparing electrical drawings and logic circuitry against surveillance procedures to ensure that technical specification requirements were met; and (3) ensuring that emergent issues were appropriately evaluated in terms of operability, reportability, transportability, and regulatory requirements.



During implementation of the Generic Letter 96-01 effort, the project plan review team identified two reportable deficiencies in which existing surveillance test procedures did not fully test logic circuits in accordance with the technical specification surveillance requirements (see paragraph E7.2.b below). Following identification of these deficiencies, acceptable testing of the circuits was performed within the 24-hour time frame provided by Technical Specification 4.0.3. Corrective actions were subsequently implemented to formalize the additional test steps into the applicable surveillance test procedures.

Upon completion of the review, the project plan review team initiated Condition Report/Disposition Request 9-7-0363 to examine the results of the review effort, and take appropriate actions to communicate this information to preclude recurrence of the types of testing deficiencies identified during the review.

c. Conclusions

The inspectors concluded that the licensee's program was appropriately developed to accomplish the requested actions specified in Generic Letter 96-01. Further, the licensee implemented and completed their review effort within the time frame requested in Generic Letter 96-01.

E2 Engineering Support of Facilities and Equipment

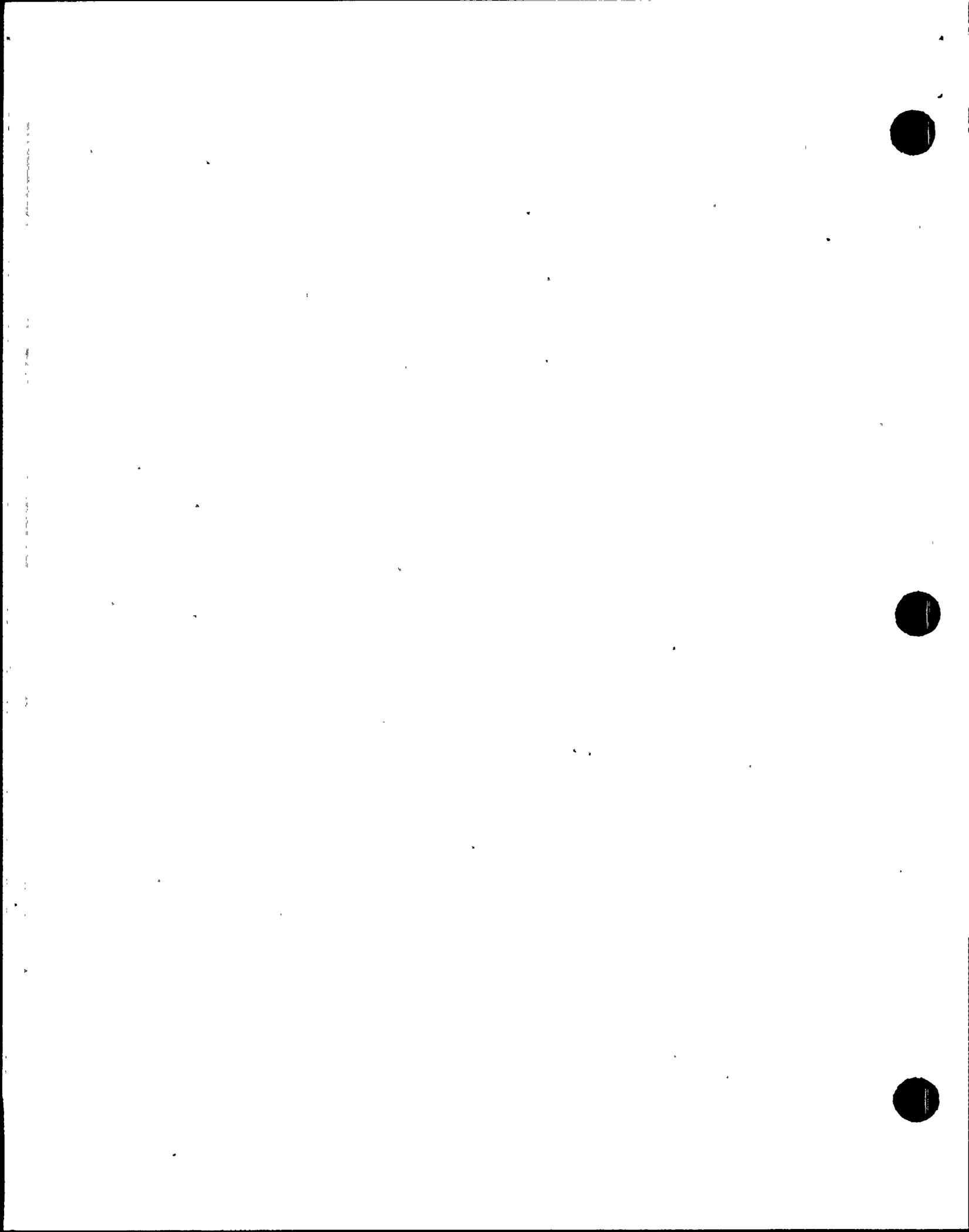
E2.1 Design Change Process

a. Inspection Scope

The inspectors reviewed the modification process to ensure that modifications to logic systems would be properly controlled. The inspectors reviewed Procedures 81DP-0EE10, "Plant Modifications," Revision 4, which provided the requirements for the plant modification process, and 73ST-1DG02, "Class 1E Diesel Generator and Integrated Safeguards Surveillance Test Train B," Revision 8. In addition, the inspectors reviewed two modifications, which were selected from a list of modifications since 1996 that affected the diesel generators, the reactor protection system, and the engineered safety features systems. The two modifications selected were Design Modification Work Orders 00704965, "Water Reclamation Facility Tripped Off-Line Upon System Degraded Voltage," dated July 26, 1996, and 00704967, "Develop a Design Modification to Modify the Containment and CEDM Fan Control Circuitry to Remove the Fans from the Sequencer," dated March 14, 1996.

b. Observations and Findings

The inspectors noted that Procedure 81DP-0EE10 provided design validation testing controls, and required consultation with the system engineer during preparation of the design validation testing instructions. The procedure also provided ample information for developing testing and acceptance requirements. Modification 00704967 revised the



sequencing time of the control element drive mechanism fan onto the diesel generator from 5 to 55 seconds. This modification resulted in wiring changes in the balance-of-plant engineered safety features cabinets.

The inspectors noted that Procedure 73ST-ADG02 had been revised to incorporate the change in the sequencing time and that the new sequencing was post-modification tested. In addition, the Updated Final Safety Analysis Report (UFSAR), Table 8.3-3, was revised to reflect the revised sequencing time.

Modification 00704967 changed the design of the control logic for the 13.8 kV supply breaker to the nonsafety-related water reclamation facility such that the breaker would trip on a safety injection signal. This modification was applicable to Unit 1 only. The purpose was to provide a load margin to ensure that the grid voltage in the plant switch yard would be maintained at a level to assure the safety functions of the Class 1E buses, if a safety injection signal occurred.

c. Conclusions

The inspectors concluded the licensee's design control process had controlled the sampled changes to systems containing logic circuits in an acceptable manner, and had ensured that required logic testing was performed.

E3 Engineering Procedures and Documentation

E3.1 Safety-Related Logic Circuit Reviews

a. Inspection Scope

The inspectors selected the elementary drawings of logic circuits associated with the emergency diesel generators for load shedding and sequencing, to compare with the applicable test procedures, technical specifications, UFSAR, and other documents related to the logic circuits. The following documents were reviewed:

Technical Specification, Section 3.8.1, "AC Sources - Operating"

UFSAR, Section 8.3.1.1.3.9, "Automatic Loading and Load Shedding"

Unit 2 Procedure 73ST-2DG02, "Class 1E Diesel Generator and Integrated Safeguards Surveillance Test - Train B," Revision 9

Drawing 01-E-MAA-002, "Unit Single Line Diagram," Revision 5

Drawing 02-E-PBB-002, Sheet 1 of 2, "Elementary Diagram 4.16 kV Class 1E Power System Switchgears 2E-PBA0S03 & 2E-PBB-S04 4.16 kV Alternate Supply Breakers," Revision 5



Drawing 02-E-HJB-006, "Elementary Diagram HVAC-Control Bldg System ESF SWGR Room ESS AHU A&B," Revision 2

Drawing 02-E-PEB-001, Sheet 2, "Elementary Diagram Stand-By Generation System Diesel Generator 2E-PEB-G02 4.16 kV Breaker"

Drawing 02-E-SIB-001, Sheet 2, "Elementary Diagram Safety Injection & Shutdown Clg System HP Safety Injection Pump 2M-SIB-P02," Revision 3

Drawing 02-E-CHB-025, "Elementary Diagram Chemical & Volume Control System Charging Pump 2," Revision 6

Drawing 02-E-PCB-001, "Elementary Diagram Fuel Pool Cooling & Cleanup System Fuel Pool Cooling Pumps 1 & 2," Revision 5

Drawing 02-E-PBB-002, Sheet 2, "Elementary Diagram 4.16kV Class 1E Power System Switchgears 2E-PBA-S03 & 2E-PBB-S04 4.16 kV Alternate Supply Breakers," Revision 4

Drawing 02-E-PBB-001, Sheet 2, "Elementary Diagram 4.16kV Class 1E Power System Switchgear 2E-Pbb-004 4.16 kV Normal Supply Breaker," Revision 5

Drawing 02-E-HJB-002, "Elementary Diagram HVAC-Control Bldg System Control Room Essential AHU Fan," Revision 8

Drawing 02-E-HCB-004, "Elementary Diagram HVAC-Containment Bldg System Containment Normal ACU Fans A & D," Revision 5

Drawing 02-E-HCB-005, "Elementary Diagram HVAC-Containment Bldg System Containment Normal ACU Fans B & C," Revision 4

Drawing 02-E-HCB-002, "Elementary Diagram HVAC-Containment Bldg System CEDM Normal ACU Fans C & D," Revision 8

Drawing 02-E-AFB-001, "Elementary Diagram Auxiliary Feedwater System Auxiliary Feedwater Pump & Thermocouples," Revision 3

Drawing 02-E-HCB-001, "Elementary Diagram HVAC-Containment Bldg System CEDM Normal ACU Fans A & B," Revision 7

b. Observations and Findings

The inspectors reviewed the surveillance requirements in Technical Specification 3.8.1 and determined that there were three surveillance requirements that tested the logic circuits of the diesel generator load shedding and load sequencing. The three surveillance requirements were: (1) Surveillance Requirement 3.8.1.11, which verified that on a simulated loss of offsite power that the loads were shed from the emergency



buses, the diesel generator started, and emergency loads were auto-connected through the automatic load sequencer; (2) Surveillance Requirement 3.8.1.12, which verified on a simulated engineered safety features actuation signal without a loss-of-offsite power that the diesel generator auto started, permanently connected loads remained energized from the offsite power system, and emergency loads were auto-connected through the automatic load sequencer to the offsite power system; and (3) Surveillance Requirement 3.8.1.19, which verified that on a loss-of-offsite power, in conjunction with an engineering safety features actuation, that the loads were shed from the emergency buses, the diesel generator started, and emergency loads were auto-connected through the automatic load sequencer.

The inspectors verified, step-by-step, that the three surveillance requirements were included in Surveillance Procedure 73ST-2DG02 for the Class 1E diesel generator and integrated safeguards test. In addition, the inspectors reviewed UFSAR, Section 8.3.1.1.3.10, "Automatic Loading and Load Shedding," and verified that there were no discrepancies between the UFSAR and the technical specification requirements.

The inspectors verified that all of the components in the logic circuits for load shedding and load sequencing on the elementary electrical diagrams were properly tested. Prior to testing the load shedding capability, all equipment to be shed was placed in the "ON" position in accordance with the surveillance procedure. By using installed instrumentation, control board indication, and local light indication, the licensee's personnel verified that the equipment was properly shed, following the opening of the 13.8 kV feeder breaker to the engineered safety features bus under test. The inspectors noted that the surveillance procedure contained a list of all breakers required to open along with a signoff line to verify that each breaker had opened.

Load sequencing was also performed under the integrated safeguards procedure. The loss-of-offsite power function for the sequencer was demonstrated by opening the 13.8 kV breaker to each safety train engineered safety features bus transformer. The inspectors noted that the downstream undervoltage relays sensed the loss-of-power and sent a signal to the balance of plant engineered safety features logic. The load sequencer entered the proper mode of operation for the signal generated.

The inspectors noted that testing of the load sequencer was performed to demonstrate that its different modes of operation were performed properly to show that it was capable of starting the loads in a sequential manner. The inspectors found that verification of the proper actuation of the equipment for each mode was performed by using installed instrumentation and control room indications. The procedure contained data sheets listing the equipment to be sequenced on, with a required entry for actual equipment loading time. The inspectors determined that the test demonstrated that all of the logic associated with the auto-start functions controlled by the load sequencer for each component were being properly tested.



c. Conclusions

The inspectors determined that the technical specification surveillance requirements for the diesel generator load shedding and sequencing were included in the surveillance procedures. In addition, the inspectors verified that there were no discrepancies between the technical specifications and UFSAR for diesel generator load shedding and sequencing. The inspectors determined that the surveillance test demonstrated that all of the logic associated with the diesel generator load shedding and sequencing were being properly tested.

E3.2 Industry Operating Experience Review

a. Inspection Scope

The inspectors evaluated the licensee's efforts to review various industry operating experience reports pertaining to Generic Letter 96-01 issues, including NRC information notices, licensee event reports, and other industry operating experience reports.

b. Observations and Findings

The project plan review team had examined the information notices (listed in the Attachment) identified in the "Background" Section of Generic Letter 96-01. In addition, the project plan review team reviewed approximately 130 licensee event reports and 20 operating experience reports, all related to Generic Letter 96-01 issues. These reviews were documented in a matrix identified as "Industry Events Related to GL 96-01." The project plan review team had essentially performed a line-by-line review of each document to identify the issues and determine their potential applicability to the Palo Verde Nuclear Generating Station.

The inspectors' review of the matrix determined that the project plan review team had performed a thorough and in-depth review of the identified issues, and had clearly determined whether the issues were applicable to the site.

c. Conclusions

The inspectors concluded that the project plan review team was aggressive in their review of industry operating experience, and had performed a thorough and in-depth evaluation of each document in order to identify issues and determine their applicability to the Palo Verde Nuclear Generating Station.

E6 Engineering Organization and Administration

E6.1 Project Plan Review Team

a. Inspection Scope

The inspectors reviewed the composition and assigned responsibilities of the project plan review team.



b. Observations and Findings

Licensee management determined that a concerted effort was required to implement the actions specified in Generic Letter 96-01. The Instrumentation Design Engineering Team was designated as the lead group for organizing and coordinating this effort. In mid-1996, seven engineering personnel from various engineering departments were assembled as a full-time team, with the understanding that their effort could take as much as 6 months to complete. After partitioning the scope of review, they were tasked with the following:

- Review testing criteria, as specified in applicable regulatory commitments and industry standards
- Perform initial reviews of the logic circuits and associated surveillance testing for assigned area
- Prepare documentation packages to summarize the results of each assigned initial review
- Address any emergent issues or deficiencies encountered, and coordinate any corrective actions
- Perform independent verification of initial review packages prepared by other team members

During the inspectors' discussions and general interfacing with various project plan review team members, it became apparent that all were knowledgeable and well suited for the assigned tasks.

c. Conclusions

The inspectors concluded that licensee management was appropriately responsive to performing the requested actions specified in Generic Letter 96-01. The project plan was well formulated and the review team members were knowledgeable and well suited for the assigned tasks.

E7 Quality Assurance in Engineering Activities

E7.1 Nuclear Assurance Overview

a. Inspection Scope

The inspectors reviewed three nuclear assurance evaluation reports that pertained to the licensee's Generic Letter 96-01 project. The three evaluation reports (ER96-0702, dated October 31, 1996, ER96-0831, dated December 23, 1997, and ER 99-0258, dated June 1, 1999) documented assessments performed by Nuclear Assurance Department personnel.



b. Observations and Findings

Nuclear Assurance Evaluation Report.ER96-0702 included the project scope, review process, inclusion of industry experience, training, and methodology established for responding to emergent deficiencies. This report concluded that the project plan was adequate to address the concerns of Generic Letter 96-01. The report also identified an engineering strength, in that, the scope of the project plan review included the devices to be actuated rather than stopping the review at the sub-group relay contacts.

The scope of Nuclear Assurance Evaluation Report ER96-0831 was to determine if the project plan's committed review and independent verification of each engineered safety features actuation signal sub-system had been implemented. This report evaluated the recirculation actuation signal circuitry and identified three minor errors that indicated a need to improve attention to detail. The report concluded, however, that the project plan review team's review and independent verification efforts were sufficiently thorough to ensure that testing would identify any malfunctions, the tested circuits would ensure that the technical specification functions were being met, and that the actuated devices would go to their safety-related positions.

The scope of Nuclear Assurance Evaluation Report ER99-0258 included a verification, through inspection of procedures and supporting documentation using the guidance contained in NRC Inspection Procedure TI 2515/139, that the requested actions of Generic Letter 96-01 had been implemented. The nuclear assurance evaluation team selected the variable overpower trip logic circuit of the reactor protection system to perform a detailed review. The report concluded that the project plan team had implemented the requirements of Generic Letter 96-01.

c. Conclusions

The inspectors concluded that the nuclear assurance department had thoroughly evaluated the Generic Letter 96-01 project plan and its implementation.

E7.2 Corrective Action Process

a. Inspection Scope

The inspectors reviewed the licensee's corrective action process to ensure that identified deficiencies to logic systems would be properly controlled and that each deficiency was corrected and properly integrated into the applicable surveillance test procedure. This included a review of Procedure 90DP-0IP10, "Condition Reporting," Revision 7, which provided a process for the identification and resolution of conditions that had the potential to adversely affect the safety of the plant. In addition, the inspectors were informed of the following 17 condition report/disposition requests (CRDRs) that were initiated for conditions related to the project plan review team's Generic Letter 96-01 efforts:

CRDR 9-6-1276, testing of auxiliary feedwater actuation signal lockout relays, dated November 19, 1996

CRDR 9-6-1379, testing of reactor trip switchgear shunt and undervoltage logic, dated December 4, 1996

CRDR 9-6-1404, testing of essential chiller bypass logic, dated December 11, 1996

CRDR 9-6-1425, testing of diesel generator loss of offsite power override logic, dated December 18, 1996

CRDR 9-6-1426, testing of core protection calculator, dated December 19, 1996

CRDR 9-6-1440, inconsistencies in surveillance test procedure notations, dated December 20, 1996

CRDR 9-7-0046, testing of containment purge isolation actuation signal logic, dated January 16, 1997

CRDR 9-7-0059, some conditions were identified where operators must override an automatic ESFAS signal in order to reposition a component, dated January 17, 1997

CRDR 9-7-0074, technical errors identified on key electrical and I&C drawings, dated January 22, 1997

CRDR 9-7-0078, deficiencies identified in procedures, dated January 23, 1997

CRDR 9-7-0231, deficiencies identified in the UFSAR, dated February 26, 1997

CRDR 9-7-0232, deficiencies identified in various design basis manuals, dated February 26, 1997

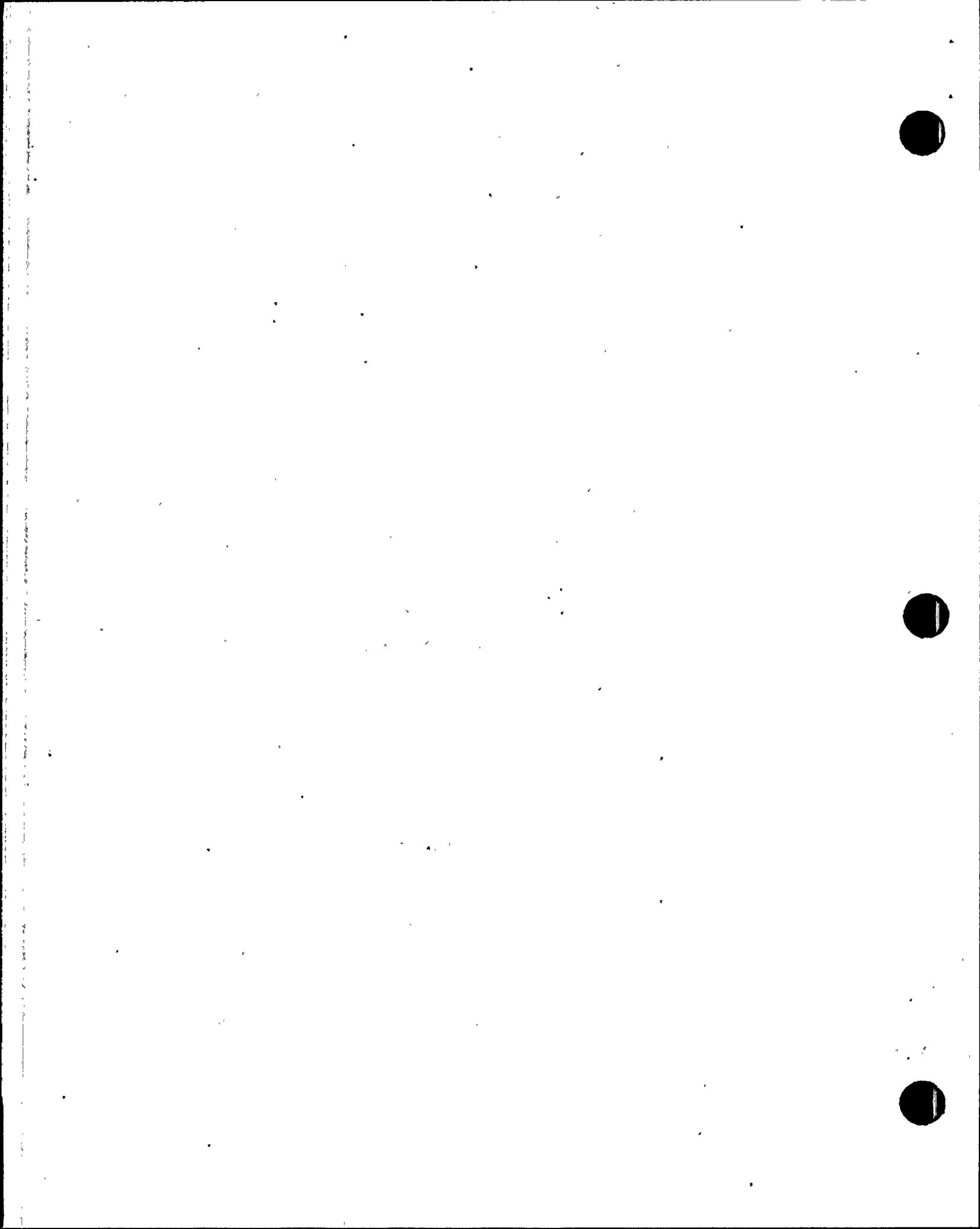
CRDR 9-7-0363, evaluated the results of the project plan review effort, dated March 13, 1997

CRDR 9-7-0369, not periodically testing power trip test interlock in the excore neutron monitoring safety system, dated March 18, 1997

CRDR 9-9-0161, testing of diesel generator output breaker relay trip bypasses, dated July 30, 1999

CRDR 9-9-1077, surveillance test procedure deficiency, dated August 31, 1999

CRDR 100706, inadequate surveillance test procedure, dated September 1, 1999



b. Observations and Findings

The inspectors noted that Procedure 90DP-01P10 provided sufficient guidelines for determining when a CRDR was required and its classification. Condition report/disposition reports were reviewed and classified by a review committee comprised of personnel from operations, maintenance, engineering, nuclear assurance, and nuclear regulatory affairs. For a significant CRDR, a root-cause investigation was required to identify the root cause and implement corrective actions to prevent recurrence. For all CRDRs, the procedure requires that the generic implications of the adverse condition should be evaluated. The inspectors determined that the licensee's corrective action procedure was sufficient to control deficiencies identified in systems containing logic circuits.

The inspectors noted that the project plan review team identified two specific instances in which full logic testing had not been performed to satisfy the surveillance requirements in the technical specifications (i.e., auxiliary feedwater actuation signal lockout relays, and actuation of the redundant shunt and undervoltage trip functions for the reactor trip circuit breakers). These were documented in CRDRs 9-6-1276 and 9-6-1379, and reported in Licensee Event Report 96-007. The inspectors noted that the licensee tested the circuits within the 24-hour time frame allowed by Surveillance Requirement 4.0.3. NRC Inspection Report 50-528; -529; -530/98-06 documented the results of the NRC followup on this subject.

Subsequent to the project plan review team's Generic Letter 96-01 efforts, licensee personnel identified and documented in CRDR 1-9-0161, that the emergency diesel generator output breaker relay trip bypasses were not being tested in accordance with technical specification requirements. Licensee personnel determined that this condition was reportable, and initiated Licensee Event Report 99-002. This subject was currently being reviewed by the NRC resident inspectors.

In order to determine whether corrective actions had been properly implemented, the inspectors selected five CRDRs (each of which contained as many as seven corrective action items) and verified that each identified corrective action item (i.e., changes to surveillance test procedures, UFSAR sections, and elementary electrical drawings and logic diagrams) had been performed.

c. Conclusions

The inspectors determined that the corrective action procedure was sufficient to control deficiencies identified in systems containing logic circuits, that the classification of the reviewed CRDRs was proper, and that the licensee's corrective actions were appropriate for the CRDRs reviewed. All reviewed corrective action items had been properly implemented.

Further, the inspectors concluded that licensee personnel appropriately determined reportable deficiencies, and properly reported them in a timely fashion.

V. Management Meetings

X1 Exit Meeting Summary

The inspectors presented the inspection results to members of licensee management on September 17, 1999. The licensee personnel acknowledged the findings presented. The inspectors asked licensee personnel whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

ATTACHMENT

SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee

M. Banks, Communications Representative, Owner Services
S. Bauer, Licensing Section Leader, Regulatory Affairs
M. Burns, Department Leader, Maintenance Engineering
D. Fan, Department Leader, Design Engineering
F. Gowers, Site Representative, El Paso Electric Company
S. Hall, Senior Engineer, Instrumentation & Controls, Design Engineering
R. Henry, Site Representative, Salt River Project
D. Lamontagne, Section Leader, Nuclear Assurance Engineering
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P. Paramithas, Section Leader, Instrumentation & Controls, Design Engineering
M. Winsor, Director, Nuclear Engineering
R. Younger, Department Leader, Nuclear Assurance Engineering

NRC

D. Carter, Resident Inspector
D. Corporandy, Resident Inspector

INSPECTION PROCEDURES USED

Temporary Instruction (TI) 2515/139 Inspection of Licensee's Implementation of Generic Letter 96-01, Testing of Safety Related Logic Circuits

LIST OF DOCUMENTS REVIEWED

Information Notices

88-83	Inadequate Testing of Relay Contacts in Safety-Related Logic Systems
91-13	Inadequate Testing of Emergency Diesel Generators (EDGs)
92-40	Inadequate Testing of Emergency Bus Undervoltage Logic Circuitry
93-15	Failure to Verify the Continuity of Shunt Trip Attachment Contacts in Manual Safety Injection and Reactor Trip Switches
93-38	Inadequate Testing of Engineered Safety Features Actuation Systems
95-15	Inadequate Logic Testing of Safety-Related Circuits
96-15	Inadequate Post-Modification Testing of Logic Circuits

Generic Letters

GL 91-18 Operability Determinations

