

ENCLOSURE

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Report No.: 50-275/99-16
50-323/99-16

Licensee: Pacific Gas and Electric Company

Facility: Diablo Canyon Nuclear Power Plant, Units 1 and 2

Location: 7 1/2 miles NW of Avila Beach
Avila Beach, California

Dates: October 18-22, 1999

Inspector: J. Blair Nicholas, Ph.D., Senior Radiation Specialist
Plant Support Branch

Approved By: Gail M. Good, Chief, Plant Support Branch
Division of Reactor Safety

Attachment: Supplemental Information

EXECUTIVE SUMMARY

Diablo Canyon Nuclear Power Plant, Units 1 and 2
NRC Inspection Report No. 50-275/99-16; 50-323/99-16

This routine, announced inspection reviewed the radiation protection program focusing on Refueling Outage 2R9 activities. Areas reviewed included: external exposure controls; internal exposure controls; control of radioactive material and contamination, surveying and monitoring; shutdown chemistry control; temporary shielding program; hot spot reduction program; source inventory program; high radiation area key controls; and quality assurance oversight.

Plant Support

- The external exposure control program met regulatory requirements. Appropriate radiological controlled area access controls were maintained. Radiation workers used the personnel contamination monitors in accordance with station procedures. Radiation, contamination, high, and locked high radiation areas were properly controlled and posted. The personnel dosimetry program was properly maintained. Personnel contamination events during the 2R9 refueling outage showed a 50 percent reduction from the number experienced during the previous 1R9 refueling outage. Radiation protection job coverage of work observed, including the removal of the steam generator nozzle dams, was appropriate and professionally conducted. The total dose for the nozzle dam installation and removal of 7.3 man-rem was 3.2 man-rem less than the estimated 10.5 man-rem for the total job (Section R1.1).
- An effective internal exposure control program was implemented. The use and positioning of air sampling equipment within the Unit 2 radiological controlled areas were appropriate for monitoring radiological airborne conditions. Proper total effective dose equivalent/as low as is reasonably achievable evaluations for respirator use were performed. Whole body counting systems were calibrated and performance checked in accordance with station procedures. Internal dose assessments were performed in accordance with station procedures (Section R1.2).
- Good controls were in place to prevent the spread of radioactive contamination. Radiological postings were in compliance with station procedures and regulatory requirements. Portable radiation protection survey instrumentation was calibrated and source response checked in accordance with station procedures. Effective radioactive source inventory and leak testing programs were in place (Sections R1.3).
- The 2R9 refueling outage dose goal of 120 person-rem was challenging and the lowest outage dose goal ever established in the operating history of the station. The collective outage dose status were tracked and trended daily for each radiation work permit and station organization. As of October 20, 1999, the 2R9 refueling outage collective dose was under the projected outage dose goal by approximately 2 person-rem. Effective chemistry reactor shutdown plans and controls were implemented significantly reducing the outage source term and personnel exposure. Temporary shielding installed during

the outage reduced personnel exposure approximately 30 - 50 person-rems. The hot spot reduction program was properly monitored (Section R1.4).

- An effective nuclear quality assessment program was implemented. The nuclear quality assessments provided management with a good overall evaluation of the station's performance during the 2R9 refueling outage and specifically the observed improvement in radiation worker practices and implementation of the ALARA program (Section R7).

Report Details

Summary of Plant Status

During the inspection Diablo Canyon Nuclear Station, Unit 2, was in the fourth week of refueling outage 2R9.

IV. Plant Support

R1 Radiological Protection and Chemistry Controls

R1.1 External Exposure Controls

a. Inspection Scope (83750)

Radiation protection personnel involved in the external exposure control program were interviewed. Several tours of the radiological controlled areas in the Unit 2 auxiliary and reactor containment buildings were performed. The following areas were inspected:

- Radiological controlled area access/egress controls
- Control of high radiation areas and locked high radiation areas
- Issuance and control of locked high radiation area keys
- Personnel dosimetry
- Personnel contamination events
- Job coverage by radiation protection personnel and radiation worker performance, including steam generator nozzle dam removal

b. Observations and Findings

The inspector observed personnel process in and out of the access/egress areas established for the radiological controlled areas in the Unit 2 auxiliary building and the Unit 2 containment. The inspector noted that station workers used the computerized log-in/out and personnel contamination monitoring equipment properly. Radiation protection personnel at the access/egress control points provided appropriate and timely guidance to station workers who alarmed the personnel contamination monitors or needed assistance using the computerized log-in/out equipment. The inspector noted that the layout of the personnel contamination monitors at the exit points from the two radiological controlled areas indicated above were properly positioned to provide an efficient flow of personnel traffic and prevent the possibility of cross contamination of personnel and/or the unmonitored release of radioactive material from the radiological

controlled area. Observed radiation workers wore their dosimetry properly. When questioned by the inspector, workers knew to leave their work area and contact radiation protection personnel if their electronic dosimeter alarmed.

During tours of the radiological controlled areas in the Unit 2 auxiliary and containment buildings, the inspector performed independent radiation measurements to confirm that area radiological postings were in compliance with station procedures and regulatory requirements. The inspector observed that radiation areas, contamination areas, high radiation areas, and locked high radiation areas were controlled and posted in accordance with station procedures and regulatory requirements. Radiological survey maps correctly indicated general area radiological conditions. The survey maps were clearly posted at the personnel access control points to the radiological controlled areas in the Unit 2 auxiliary building and containment and at various locations throughout the Unit 2 containment. The inspector noted that ALARA low dose waiting areas were appropriately established and clearly identified with signs throughout the Unit 2 radiological controlled areas in the auxiliary building and containment. The inspector verified that selected Technical Specification required locked high radiation doors were locked and properly posted. Housekeeping throughout the radiological controlled area in the Unit 2 auxiliary building was good. The inspector noted that work areas were free of debris, and tools and equipment staged for work in-progress were properly stored.

The inspector reviewed the locked high radiation key control program and determined that keys for locked high radiation areas were properly controlled by the radiation protection department. The inspector reviewed the key issue logs maintained for the Unit 2 auxiliary building and containment and verified that the issuance of locked high radiation keys was properly controlled. The inspector verified that a high radiation area key inventory was performed by the radiation protection foreman at the close of each shift. Keys for locked high radiation areas were issued and controlled in accordance with station procedures.

Personnel thermoluminescent dosimeters (TLDs) were processed by the licensee on site. The inspector toured the laboratory used for processing the TLDs and reviewed the calibration and quality control programs implemented for processing the personnel TLDs. A recently performed National Voluntary Laboratory Accreditation Program on-site assessment of the personnel TLD program found no deficiencies. The inspector noted that the licensee's personnel TLD processing program was National Voluntary Laboratory Accreditation Program accredited in all categories. The inspector also noted that the electronic dosimeter dose results used for accounting daily dose estimates were conservative with regard to the thermoluminescent dosimeter results.

From a review of personnel contamination logs, the inspector determined that there were, at the time of the inspection, 102 personnel contamination events recorded during the 2R9 refueling outage. This was approximately a 50 percent decrease from the 209 personnel contamination events experienced during the 1R9 refueling outage. Four of the 102 personnel contamination events resulted in an evaluation in accordance with station procedure criteria of 8,000 counts for hot particle contamination and 50,000 counts for distributed contamination. Two of the four personnel contamination events evaluated were from hot particles. The resulting exposures to the skin of the whole

body for the two hot particle contaminations were 206 millirems and 83 millirems. The other two personnel contamination events were evaluated as distributed contamination on areas of the whole body. The resulting exposure from one of these personnel contaminations was 41 millirems to the skin of the whole body. The results from the other distributed personnel contamination evaluation were pending.

During tours of the Unit 2 containment, the inspector noted that radiation protection job coverage was appropriate for radiological work observed. In addition, the inspector observed by video camera the removal of the steam generator nozzle dams from all four steam generators. The nozzle dam removal was well planned, controlled, and efficiently performed. The inspector observed that the personnel involved in monitoring and performing the nozzle dam removal were well trained. Notable performance was achieved during the installation and removal of the steam generator nozzle dams. The steam generator "jump teams" received the lowest ever dose of 4.1 man-rems during the nozzle dam installation. The steam generator "jump teams" received 2.1 man-rems during nozzle dam removal, which was about 1 man-rem less than the estimated 3.2 man-rem for the nozzle dam removal. The total dose for the nozzle dam installation and removal of 7.3 man-rems, including dose received by support personnel, was 3.2 man-rems less than the estimated 10.5 man-rems for the total job. These lower personnel doses were the result of lower steam generator bowl dose rates due to improved chemistry reactor shutdown controls and the incorporation of lessons learned from the 2R8 refueling outage. These lessons learned included no whole body jumps to clean and inspect the steam generator bowls. The estimated dose savings was 500 millirems.

c. Conclusions

The external exposure control program met regulatory requirements. Appropriate radiological controlled area access controls were maintained. Radiation workers used the personnel contamination monitors in accordance with station procedures. Radiation protection personnel stationed at the exits from the radiological controlled areas provided appropriate guidance to station workers who alarmed the personnel contamination monitors. Radiation, contamination, high, and locked high radiation areas were properly controlled and posted. Radiation workers wore their dosimetry properly and knew the proper response to electronic dosimeter alarms. The personnel dosimetry program was properly maintained. Personnel contamination events during the 2R9 refueling outage showed a 50 percent reduction from the number experienced during the previous 1R9 refueling outage. Radiation protection job coverage of work observed, including the removal of the steam generator nozzle dams, was professionally conducted. The total dose for the nozzle dam installation and removal of 7.3 man-rems was 3.2 man-rems less than the estimated 10.5 man-rems for the total job.

R1.2 Internal Exposure Controls

a. Inspection Scope (83750)

Radiation protection personnel involved with the internal exposure control program were interviewed. The following items were reviewed:

- Air sampling program
- Respiratory protection program
- Whole-body counting program
- Internal dose assessment program

b. Observations and Findings

The use and positioning of continuous air monitors within the radiological controlled areas were appropriate for monitoring radiological airborne conditions in the work areas and limiting radiation worker's airborne exposures. All continuous air monitors observed in the radiological controlled areas had current calibration dates and were response checked in accordance with station procedures.

Five tasks required respiratory equipment for radiological work during the 2R9 refueling outage. The inspector reviewed the control and issue programs for this equipment. The inspector noted that a non-cited violation had been issued in NRC Inspection Report 50-275/99-15; 50-323/95-15 for two examples of the issuance and use of a wrong size respirator. Additionally, the inspectors reviewed the total effective dose equivalent/as low as is reasonably achievable (TEDE/ALARA) evaluations for the five outage tasks, which were performed to ensure compliance with the requirements of 10 CFR Part 20, Subpart H, and concurred with the licensee's conclusions that respiratory protection equipment satisfied TEDE/ALARA principles.

The inspector noted that the licensee utilized two types of whole body counting systems. These systems included a sodium iodide "bed" type whole body counting system and a standup "Quicky" fast-scanning whole body counting system. In general, the inspector determined that the calibration and quality control programs for the whole body counting systems were implemented in accordance with station procedures. However, two action requests (A0492830 and A0493224) were recently written concerning the performance of the quality control program. No violations were identified. The inspector verified that the whole body counting systems were calibrated annually by the vendor using an appropriate phantom and standards traceable to the National Institute of Standards and Technology, and quality control checks, including energy calibrations, were performed daily prior to use.

The inspector reviewed the internal dose assessment program and noted that, during the 2R9 refueling outage to date, 26 diagnostic whole body counts had been performed. The licensee recorded internal dose at an action level of 10 millirem. No committed effective dose equivalent dose was assigned to any individual as a result of a diagnostic whole body count.

c. Conclusions

An effective internal exposure control program was implemented. The use and positioning of air sampling equipment within the radiological controlled areas and Unit 2 containment were appropriate for monitoring radiological airborne conditions. Proper total effective dose equivalent/as low as is reasonably achievable evaluations for respirator use were performed. Whole body counting systems were calibrated and performance checked in accordance with station procedures. Internal dose assessments were performed in accordance with station procedures.

R1.3 Control of Radioactive Materials and Contamination; Surveying and Monitoring

a. Inspection Scope (83750)

Areas reviewed included:

- Control of radioactive material
- Portable instrumentation calibration and performance check programs
- Radioactive source control and leak testing programs

b. Observations and Findings

The licensee provided good controls to prevent the spread of radioactive contamination. During tours of the Unit 2 radiological controlled areas in the auxiliary building and containment, the inspector noted that all observed radioactive material containers were labeled, posted, and controlled in accordance with station procedures and regulatory requirements. Contaminated areas were clearly identified and properly posted. Trash and laundry barrels were maintained to prevent the spread of radioactive contamination. Step-off pads were placed at the exits from contaminated areas and the Unit 2 containment radiological controlled area. The inspector observed radiation worker performance while exiting contaminated areas and the Unit 2 containment and noted that personnel used proper health physics practices during the removal of potentially contaminated protective clothing.

The inspector determined that an adequate supply of portable instrumentation was operable and available. All portable radiation protection survey instruments observed in Unit 2 were calibrated and source response checked in accordance with station procedures.

The inspector reviewed the radioactive source inventory and leak testing records for the last 12 months. The inspector noted that the radioactive source inventories were performed quarterly, and the leak tests of sealed radioactive sources were performed every 6 months in accordance with station procedures. The inspector randomly selected 10 radioactive sources from the licensee's source inventory record to determine their accountability. The inspector found all 10 radioactive sources in their designated storage location.

c. Conclusions

Good controls were in place to prevent the spread of radioactive contamination. Radiological postings were in compliance with station procedures and regulatory requirements. Portable radiation protection survey instrumentation was calibrated and source response checked in accordance with station procedures. Effective radioactive source inventory and leak testing programs were in place.

R1.4 Maintaining Occupational Exposure As Low As is Reasonably Achievable (ALARA)

a. Inspection Scope (83750)

The inspector interviewed the ALARA radiation protection engineer and reviewed the following areas:

- Outage exposure goal establishment and status
- Reactor shutdown chemistry controls
- Temporary shielding program
- Hot spot reduction program

b. Observations and Findings

Outage Exposure Goals

The inspector noted that originally the licensee had estimated a dose goal of 140 person-rems for the 2R9 refueling outage but finally approved an aggressive goal of 120 person-rems. This goal was 190 person-rems less than the collective exposure of 310 person-rems experienced during the previous 1R9 refueling outage and the lowest outage dose goal ever established in the operating history of the station. From discussions with the licensee, the inspector determined that the 2R9 refueling outage dose goal was established using past Unit 2 performance, lessons learned from the previous 1R9 refueling outage, and industry experience. The inspector noted that there was good participation by ALARA committee members and department managers in the development and approval of the 2R9 outage dose goal. The 2R9 collective outage dose status was tracked and trended daily by the ALARA radiation protection engineer and tabulated for each radiation work permit and station organization. The collective outage dose status was listed in the outage plan of the day and distributed daily to station department managers. A review of the ALARA dose report for October 21, 1999, (day 25 of the outage) revealed that the collective outage dose was less than the projected outage dose goal for that date by approximately 2 person-rems. The inspector noted that based on the current outage dose trend the licensee will probably meet the established dose goal for the 2R9 refueling outage.

Reactor Shutdown Chemistry Controls

During discussions with chemistry personnel, the inspector determined that management support for shutdown chemistry controls was excellent. The shutdown

chemistry controls were effective in reducing residual heat removal piping and steam generator bowl dose rates. This was accomplished as a result of the following chemistry controls:

- reactor coolant system activity remained 95 percent soluble during the shutdown process, which minimized the potential for plate-out on system piping;
- chemical volume control system filters were changed frequently, which improved the removal of the soluble activity from the reactor coolant system;
- preheating the residual heat removal piping prior to flushing to remove oxygen and particulates reduced the temperature delta and minimized the thermal plate-out of particulate activity on the residual heat removal piping walls; and
- zinc addition during the Unit 2 operating cycle displaced the cobalt activity and kept it from plating out on system surfaces.

These chemistry controls implemented during Unit 2 reactor operation and shutdown contributed significantly to the reduction of the residual heat removal piping and steam generator bowl dose rates. The 2R9 average steam generator bowl dose rate (7.8 rem per hour) was approximately 40 percent lower than experienced during the 2R8 refueling outage (13.3 rem per hour) and was the lowest experienced during a Unit 2 refueling outage. The shutdown chemistry controls were effective in removing a large amount of cobalt-58, cobalt-60, and zinc-65 activity from the Unit 2 reactor coolant system, which significantly reduced the outage source term and personnel exposure.

Temporary Shielding Program

The inspector determined that there were 17 long-term shielding packages currently installed throughout both units. The inspector noted that each of the long-term shielding installations was evaluated and inspected on a 6-month frequency in accordance with station procedure. The inspector reviewed 10 of the 40 temporary shielding packages evaluated and installed during the 2R9 refueling outage. The inspector noted that the temporary shielding packages contained an ALARA review and exposure reduction evaluation, pre- and post-radiological shielding surveys of the area/component shielded, an estimate of dose to install the shielding, a drawing or photograph of the shielding installation, and an appropriate engineering evaluation. From discussions with the ALARA radiation protection engineer, the inspector determined that the installation of the 40 temporary shielding packages involved the use of 64,335 pounds of lead and resulted in an estimated dose savings of approximately 30 to 50 person-rems. A very good temporary shielding program was implemented.

Hot Spot Reduction Program

Forty-one hot spots were currently located throughout the radiological controlled areas in both units. From review of records and radiation survey maps, the inspector determined that the hot spots were tracked and the radiation levels trended by the

ALARA radiation protection engineer in accordance with station procedures. From discussions with the ALARA radiation protection engineer, the inspector determined that most of the hot spots were located in less frequented areas in the plant and did not contribute significantly to personnel dose. Therefore, there was not an aggressive program for reducing or eliminating the hot spots located in these areas in the auxiliary building. However, hot spots identified in the Unit 2 containment during 2R9 refueling outage were aggressively flushed and reduced to minimize personnel exposure during the outage. No problems were identified during the review of the hot spot reduction program.

c. Conclusions

The 2R9 refueling outage dose goal of 120 person-rem was challenging and the lowest outage dose goal ever established in the operating history of the station. The collective outage dose status were tracked and trended daily for each radiation work permit and station organization. As of October 21, 1999, the 2R9 refueling outage collective dose was under the projected outage dose goal by approximately 2 person-rem. Effective chemistry reactor shutdown plans and controls were implemented significantly reducing the outage source term and personnel exposure. Temporary shielding installed during the outage reduced personnel exposure approximately 30 - 50 person-rem. The hot spot reduction program was properly monitored.

R7 Quality Assurance Program

a. Inspection Scope (83750)

The following items were reviewed:

- Quality assurance assessments performed since September 1, 1999
- Radiological action requests written since September 1, 1999

b. Observations and Findings

Nuclear Quality Services conducted good assessments of radiation protection activities during the 1999 Unit 2 refueling outage. Two nuclear quality assessments were performed since September 1, 1999. The inspector determined that the first assessment evaluated the station's overall performance during the first 2 weeks of the 2R9 refueling outage including a general assessment of contamination and access control, radiation control and ALARA practices, radworker practices, and chemistry shutdown controls for reactor coolant system cleanup.

The second assessment focused specifically on the licensee's implementation and management of the ALARA program and radiological work practices during the third week of the 2R9 refueling outage. The following assessment observations were made. The station's 2R9 refueling outage dose performance was within the outage man-rem goal. Notable low dose performance was achieved in the area of Steam Generator nozzle dam installation. The number of personnel contamination incidents increased

during the first two weeks of the 2R9 refueling outage and were higher than that same time period in the previous three outages. However, the personnel contamination incidents showed a marked improvement during the third week of the outage.

As discussed in Section R1.1, the overall outage results showed that the number of personnel contamination incidents documented during the 2R9 refueling outage were approximately 50 percent less than the number personnel contamination incidents experienced during the previously worst 1R9 refueling outage. New chemistry controls resulted in the most successful clean-up of the reactor coolant system. The nuclear quality assessments also identified an improvement in radiation worker practices and numerated 10 examples of good ALARA practice performance. In addition, the assessments listed seven observations where opportunities to reduce dose needed improvement.

The inspector reviewed a summary of radiological action requests written since September 1, 1999, and randomly selected 10 of these action requests for a more in depth review. These action requests revealed that licensee personnel conscientiously used this reporting system at a proper sensitivity to identify radiological problems during the 2R9 refueling outage and provided management with a good tool to evaluate the radiation protection program. The reviewed action requests provided appropriate corrective actions. No new programmatic negative trends were identified.

c. Conclusions

An effective nuclear quality assessment program was implemented. The nuclear quality assessments provided management with a good overall evaluation of the station's performance during the 2R9 refueling outage and specifically the observed improvement in radiation worker practices and implementation of the ALARA program. Action requests identified radiological issues at the proper threshold to provide management with an overview of the radiation protection program.

R8 Miscellaneous Radiological Protection and Chemistry Issues

R8.1 (Closed) Inspection Followup Item 50-275/9911-02; 50-323/9911-02: Decline in radiation worker practices

The inspectors' observed improved radiation worker practices during refueling outage 2R9 (discussed in NRC Inspection Reports 50-275/99-15; 50-323/99-15 and 50-275/99-16; 50-323/99-16) and noted that the licensee had completed its implementation of corrective actions initiated by Action Request A0484208 to address the negative performance trend of radiation work practices. No additional regulatory issues were identified that had not already been dispositioned in NRC Inspection Reports 50-275/99-11; 50-323/99-11 and 50-275/99-15; 50-323/99-15.

V. Management Meetings

X1 Exit Meeting Summary

The inspector presented the inspection results to members of licensee management at an exit meeting conducted on October 22, 1999. The licensee acknowledged the findings presented. No proprietary information was identified.

ATTACHMENT

SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee

J. Albers, Technical Assistant, Radiation Protection
J. Becker, Manager, Operations Services
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J. Gardner, Acting Director, Chemistry and Environmental
R. Gray, Director, Radiation Protection
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B. Terrell, Acting Director, Nuclear Quality Services

NRC

D. Proulx, Senior Resident Inspector
D. Acker, Resident Inspector

INSPECTION PROCEDURE USED

IP 83750 Occupational Radiation Exposure

ITEMS OPENED, CLOSED, AND DISCUSSED

Closed

50-275/9911-02 Decline in radiation worker practices (Section R8.1).
50-323/9911-02

LIST OF DOCUMENTS REVIEWED

NUCLEAR QUALITY SERVICES ASSESSMENT REPORTS

Nuclear Quality Assessment Report, "2R9 Performance Windows 1 and 2," September 27 to October 7, 1999

Nuclear Quality Assessment Report 992950005, "2R9 ALARA and Radiological Work Practice," (Draft)

PROCEDURES

- RCP D-220 "Control of Access to High, High-High, and Very High Radiation Areas," Revision 15
- RCP D-240 "Radiological Posting," Revision 8
- RCP D-310 "Dosimetry Access Control," Revision 16
- RCP D-351 "Operation of the PC Based Helgeson "Quicky 3" in Vivo Whole Body Counter," Revision 3
- RCP D-362 "Operation of the PC Based Helgeson "Do-It-Yourself" NaI In Vivo Whole Body Counter," Revision 0A
- RCP D-370 "Evaluation of Internal Deposition of Radioactive Material," Revision 3
- RCP D-500 "Radiation and Contamination Surveys," Revision 14
- RCP D-600 "Personnel Decontamination and Evaluation," Revision 16
- RP1.DC4 "Radiological Hot Spot Identification and Control Program," Revision 0
- RP1.ID2 "Use and Control of Temporary Radiation Shielding," Revision 3
- RP1.ID3 "Respiratory Protection Program," Revision 4