REGION V

Report Nos. 50-528/93-51, 50-529/93-51, 50-530/93-51

License Nos. NPF-41, NPF-51, NPF-74

Licensee: Arizona Public Service Company
P. O. Box 53999, Station 9012
Phoenix, Arizona 85072-3999

Facility Name: Palo Verde Nuclear Generating Station Units 1, 2, and 3

Inspection at: Wintersburg, Arizona

Inspection Conducted: December 6-10, 1993

Inspected by: _____ 1/3/94
L.C. Carson II, Reactor Radiation Specialist Date Signed

Approved by: _____ 1/3/94
James H. Reese, Chief Date Signed
Facilities Radiological Protection Branch

Summary:

Areas Inspected: Routine, announced inspection of the licensee's radiation protection program, and followup of items in the NRC Safety Evaluation Report (SER) dated August 19, 1993, and Inspection Report 50-529/93-37. Inspection procedures 84750, 92701, 92702 were used.

Results: The inspector determined from observations, reviews and, discussions that the licensee's programs for identifying steam generator tube leakage using radiochemical analyses and process radiation monitoring techniques were adequate for meeting the licensee's safety objectives. Four enforcement and open items were closed. No violations or deviations were identified.

DETAILS

1. Persons Contacted

Licensee

*R. Bernier, Supervisor, Nuclear Regulatory Affairs
*D. Kanitz, Sr. Engineer, Nuclear Regulatory Affairs
*H. Lesan, Sr. Technical Advisor, Radiation Monitoring Systems
*G. Mobbs, QA Specialist, Quality Auditing and Monitoring
*A. Ogurek, Consultant, Nuclear Oversight
*R. Raught, Chemistry Manager, Unit 3
*J. Scott, General Manager, Site Chemistry
*R. Sorensen, Manager, Site Chemistry
J. Wolf, Manager, Unit 2 Chemistry

Nuclear Regulatory Commission

J. Sloan, Sr. Resident Inspector

(*) Denotes the individuals who attended the exit meeting held December 10, 1993. The inspector also held discussions with other personnel during the inspection.

2. Followup of Open Items (MC 92701)

a. Item 50-529/93-37-02 (Closed): This item involved the following changes made by the licensee to emergency operating procedures (EOPs) in response to items addressed in the NRC SER:

- 41EP-1R003, Rev. 1; "Steam Generator Tube Rupture"
- 41EP-1R004, Rev. 00.08; "Excess Steam Demand"
- 41EP-1R008, Rev. 00.13; "Functional Recovery"

During this inspection the completed EOPs were reviewed, and there were no further questions regarding this matter.

3. Followup of Items of Noncompliance (MC 92702)

a. Item 50-529/93-03-01 (Closed): This involved a "Notice of Deviation" (NOD) issued to the licensee for failing to comply with NUREG-0737 requirements for performing "In-Situ" calibrations on containment high range monitors (CHRMs). On October 19, 1993, the licensee met with the NRC's Nuclear Reactor Regulation (NRR) to discuss the NOD. On November 30, 1993, NRR issued a report on the details of that meeting, which stated that:

> "The staff [NRR] agreed in principle with the licensee's approach, but stated that additional review of the calibration methodology would be necessary prior to accepting the licensee's approach for long term equivalent surveillance."

In the "Reply to the Deviation" dated November 29, 1993, the licensee stated that:

> "The technical justification for using this method will be forwarded to NRR for review prior to March 31, 1994, along with surveillance test results that correlate the performance of the CHRMs to the primary calibration (performed by the manufacturer)."

NRR will further track this matter as TAC No. M88217.

b. Item 50-529/93-29-01 (Closed): This violation involved the licensee's failure to use the steam generator (SG) downcomer lines for chemistry and radiochemistry sample points as recommended by the SG supplier. The inspector reviewed and discussed the licensee's corrective actions that were documented in the "Reply to the Violation" dated October 11, 1993, and in the NRC SER, dated August 19, 1993. The title of the NRR report was:

> "Safety Evaluation by the Office of Nuclear Reactor Regulation Related to the Startup and Operation of Palo Verde Nuclear Generation Station, Unit 2, Following the Steam Generator Tube Rupture of March 14, 1993, Arizona Public Service Company, Docket No. 50-529."

The SER addressed several corrective actions the licensee planned to implement because of the steam generator tube rupture. The inspector verified that the corrective actions had been implemented.

The inspector verified that the licensee's procedure 74CH-9XC16, "Sampling and Analytical Schedule," incorporated the use of SG downcomer lines for chemistry and radiochemistry sample points. The licensee performed valve line-ups in Units 1, 2, and 3 to collect samples from the SG downcomers. The licensee re-evaluated and revised procedure 74CH-9ZZ66, "Determination of Primary to Secondary Leak Rate," to require the to use of radioactive noble gas from the condenser vacuum exhaust system and tritium in the secondary side of the SG as the preferred "quantitative" SG leak rate methods. Licensee procedure 74DP-9ZZ05, "Abnormal Occurrence Checklist," was revised to give clearer guidance to chemistry personnel on monitoring SG primary to secondary leaks.

The inspector reviewed SG test data collected by Unit-1 chemistry personnel in October 1992 that showed higher concentrations of radioactivity in the SG downcomer lines. Chemistry personnel compared the concentration of several radioiodines in the SG dowmcomer sections to that found in the SG hotleg sections. The results conclusively demonstrated that radioiodine concentrated more abundantly in the SG downcomer by a factor of 10. The inspector noted that Unit-1's findings substantiated previous licensee and supplier SG test data at PVNGS. The licensee

concluded that while the SG domncomers did concentrate radiochemicals more abundantly it may not represent the average SG radiochemical makeup.

The inspector had no further concerns in this matter.

c. Item 50-529/93-29-04 (Closed): This violation involved three examples of the licensee's failure to adhere to procedures for responding to alarming process, effluent, and area radiation monitors. The inspector reviewed and discussed the licensee's corrective actions documented in the "Reply to the Violation" dated October 11, 1993, and addressed in an NRC SER, dated August 19, 1993.

In response to the first example of the violation, the licensee issued an order to operations personnel dated September 30, 1993. The order re-emphasized the procedural requirement for operations personnel to discuss the occurrence of radiation monitor alarms with the chemistry department. The inspector verified that operations personnel signed that they received the order. Additionally, the inspector reviewed a memorandum dated May 10, 1993, which emphasized to all personnel the importance of not disabling radiation monitor alarms. Revisions to procedure 74RM-9EF41 "Radiation Monitoring System Alarm Response," were reviewed by the inspector.

In response to the second example of the violation, the licensee determined that procedure 74RM-9EF41 did not provide chemistry technicians with adequate flexibility and direction to respond to an event like the SG tube rupture. The inspector reviewed subsequent changes to procedure 74RM-9EF41, and EOPs.

In response to the third example of the violation, the licensee re-trained personnel on changing radiation monitor setpoints according to procedure 74RM-9EF42, "Radiation Monitor Alarm Setpoint Determination." The inspector reviewed the latest changes to procedure 74RM-9EF42, which were in response to the SG tube rupture event.

The inspector concluded that the licensee's corrective actions regarding the procedure adherence violation were adequate. The inspector had no further concerns in this matter.

4. Radioactive Waste Treatment, Effluents, and the Radiological Environmental Monitoring Program (MC 84750)

These inspection activities were conducted as a followup to the licensee's SG tube rupture event that occurred in March 1993 as documented in NRC reports PVNGS AIT 50-529/93-14, NRR-SER, and 50-529/93-29. During the fall of 1993, Unit-3 PVNGS had indications of RCS primary to SG secondary leakage. The inspector observed, reviewed and discussed the licensee's programs for effectively quantifying,

monitoring and controlling the amount of radioactivity associated with a primary reactor coolant system (RCS) to SG secondary system leakage.

a. Quality Assurance, Audits, Monitoring, and Self-Assessments

The inspector reviewed the following QA audits, monitoring, and self assessment reports:

* Audit Report 93-010, September 1993
* Audit Report 93-013, December 1993
* QA Monitoring Report (QAMR), 93-0520, August 1993
* QAMR 93-0588, September 1993
* QAMR 93-0589, September 1993
* QAMR 93-0596, September 1993
* QAMR 93-0618, October 1993
* QAMR 93-0719, November 1993
* QAMR 93-0721, November 1993
* QA Deficiency Document, 93-013, November 1993
* Chemistry RMS/Effluent Self-Assessment, May 1993
* Chemistry Laboratory Analytical Control Self-Assessment, July 1993

Based on interviews with QA personnel and reviews of documents, the inspector concluded that the licensee's QA coverage appeared comprehensive regarding radiation monitoring and SG chemistry operations. The activities identified above for QA audits, monitoring, and self-assessment provided licensee management an indication of performance in the areas SG primary to secondary leak detection, radiation monitoring, and chemistry. The inspector had no concerns in this area.

b. Training and Qualification

The inspector observed and reviewed the licensee's training programs that were implemented to correct deficiencies identified in the Unit-2 steam generator tube rupture (SGTR) and radiation monitor system (RMS) event.

(1) Industry Events: Steam Generator Tube Rupture

The licensee presented classroom training on the Unit-2 SGTR as an industry event. The inspector observed some of the training presentations on the SGTR event, and reviewed the SGTR lesson plan and personnel attendance roster. The lesson plan included lessons learned from the SGTR event as documented in NRC inspection report 50-529/93-29. Two of the main topic areas were procedure 74CH-9ZZ66, "Determination of Primary-to-Secondary Leak Rate," and properly responding to radiation monitoring system (RMS) alarms and trends. During this inspection, the licensee's chemistry department completed the SGTR training.

(2) Radiation Monitoring System

The inspector noted that half of the licensee's operators had completed the RMS re-training, and the other half were scheduled to complete RMS training by April 1994. Operator training emphasized RMS procedures during normal, abnormal, and emergency operations. Particular emphasis was placed on RMS procedure and design changes that occurred because of the SGTR event. PVNGS RMS training required that the operators pass a written examination. According to the PVNGS training records reviewed by the inspector, all the operators passed the training.

The inspector concluded that the licensee's corrective actions regarding SGTRs and RMS operations training were adequate. The inspector had no further concerns in this area.

c. Changes in ODCM, PCP, and Radwaste System Design and Operation

The inspector examined design, procedure, and operations changes on the licensee's RMS. The inspector held discussions with licensee personnel on RMS changes, and conducted field inspections of the RMS changes.

(1) Nitrogen-16 Radiation Monitors

The inspector observed the licensee's prototype nitrogen-16 (N-16) process RMS that was installed in the Unit-2 mainsteam (MS) lines. The RMS system engineer and chemistry staff explained the calibration and operation of the N-16 "qualitative" SGTR leak detection RMS. The inspector reviewed the licensee's Temporary Modification Request (TMR) and 10CFR50.59 assessment of the N-16 RMS. The licensee was in process of installing new 3"x 3" sodium iodine N-16 detectors in all three units as RU-142. The inspector examined the shielded housings for the new N-16 monitors. It was estimated that the N-16 monitors could detect SG leakage as low as 5 gallons per day (GPD) [13 cubic centimeters/minute (cc/min)]. The inspector noted that the current process MS, steam generator blowdown (SGBD), and condenser vacuum exhaust (CVE) RMSs had less sensitive detection limits of approximately 12 GPD [32 cc/min].

The licensee's 10CFR50.59 review for the N-16 design change was adequate. The inspector concluded that the licensee's N-16 RMS would be an enhancement to the licensee's SG leak detection and process RMS capabilities.

(2) Design Change Package - 065

DCP-065 eliminated the condenser vacuum exhaust (CVE) system effluent pathway from all three units at PVNGS by re-routing the CVE to the main plant ventilation ducts. DCP-065 also eliminated the interdependency between radiation monitors RU-141 and RU-142 by eliminating the need for the high range monitor RU-142. DCP-065 also allowed the removal from service of effluent RMS RU-141 and RU-142 as off-line monitors by converting RU-141 to in-line monitors. RU-142 will be the RMS designation for the new N-16 monitors that were discussed in Section C(1) of this report. The inspector toured the areas and equipment affected by DCP-065, and reviewed the 10 CFR 50.59 evaluation. The inspector found that the licensee's 10CFR50.59 evaluation for DCP-065 was adequate.

(3) Design Change Package - 066

DCP-066 eliminated the interdependence of the two plant vent particulate and iodine monitors RU-143 (normal radiation range) and RU-144 (high radiation range) for all three units at PVNGS. The licensee installed bypass sample lines which allow either the RU-143 or RU-144 monitors to be worked on for more than 72 hours without declaring plant vent effluent RMS inoperable. The inspector found the licensee's 10CFR50.59 evaluation for DCP-066 was adequate.

(4) Steam Generator Blowdown Monitors (RU-4 & RU-5)

The inspector evaluated and discussed with licensee chemistry RMS personnel Condition Report/Disposition Request (CRDR) 2-3-0557. This CRDR addressed that the Unit-2 steam generator blowdown (SGBD) radiation monitors RU-4 and RU-5 had a contamination problem. Contamination caused the monitors to have background level 10-20 times higher than the actual secondary side SG radioactivity. Antimony (Sb)-124 and cesium (Cs)-134 were the primary contaminants in the SGBD sample lines. The inspector found that CRDR 2-3-0557 thoroughly explained the licensee's background information, problem history, action plan, evaluation, and results. The inspector noted that the licensee tried many reasonable corrective actions to resolve the problem. However, the main problem was that the RU-4 and RU-5 contamination interfered with Unit-2's ability to detect SG tube leaks. The normal lower level of sensitivity for the SGBD monitors was 17 GPD, but the contamination level correlated to a SG leakage of 130 GPD. The SGBD monitors were used for alerting the licensee's chemistry and operations staff to sudden and abnormal high radiation levels indicative of SG tube leakage. The licensee came to following resolutions regarding SGBD monitor contamination:

* Install N-16 RMSs on the MS lines.

* MS line RMS (RU-139 & RU-140) setpoints were lowered to alarm at 1.6 millirem/hour (mr/hr).

* Continually decontaminating the SGBD sample lines was not cost effective, because recontamination occurred every three days.

* Radioactivity levels would eventually decay off, because of Sb-124's 60 day half-life.

* Perform a design change to replace the SGDB sample lines with a larger tubing to increase the sample flowrate, and decrease the likelihood of contaminants plating out in the sample lines.

The inspector concluded from observing the operation of the N-16 RMS, mainsteam line RMS alarm setpoint change, and the extensive nature of corrective actions in CRDR 2-3-0557 that the licensee's SG leak detection program evaluation was adequate, because it was not solely dependent on the SGBD RMS.

The inspector concluded the licensee's changes to the RMS were appropriate and adequate to increase the reliability of the RMS, regarding SG tube leakage. The inspector had no further concerns in this matter.

d. Steam Generator Primary to Secondary Leak Rate Determination

(1) Unit-2 Operations

The inspector toured Unit-2's chemistry facilities to determine the level of SG tube leakage awareness that RMS and chemistry technicians exhibited. Licensee chemistry personnel gave the inspector a memorandum dated September 7, 1993, which outlined the chemistry department's increased Unit-2 SG tube leakage monitoring frequency. The licensee's monitoring requirements were as follows:

* SG primary to secondary leak rate calculations were to be performed every shift using RU-141 gas grab analysis. If the results indicated less than detectable activity, determine the minimum leak rate sensitivity.

* SG isotopic analyses were to be performed daily, with emphasis on short lived isotopes such as antimony, iodine and fission gases.

* Evaluate RU-4, RU-5, and RU-141 alarm setpoints each shift to ensure they remained within the range specified in procedure 74RM-9EF42.

* RU-4, RU-5, and RU-141 ten minute and hourly RMS trend data were being evaluated twice per shift. If the trends indicated increases by a factor of 1.5 times the daily average sample, then main steam samples would be analyzed for tritium and other isotopes.

The inspector reviewed and held discussions with chemistry personnel about the RMS/Effluent Shift Log, SGBD chemistry data, RMS trending data, and the Chemistry Action Documents. The inspector found that the licensee was continuing to implement the requirements of the increased SG tube leakage monitoring memorandum. The inspector noted that chemistry personnel were very aware and knowledgeable about the new SG leakage detection program.

The inspector concluded that Unit-2 chemistry personnel adequately implemented the SG leakage detection program. The inspector had no further concerns in this matter.

(2) Unit-3 Operations

On November 29, 1993, Unit-3 shutdown to investigate a SG tube leakage. From August through November 1993 Unit-3 chemistry and RMS data revealed an increasing trend that a very small SG tube leak existed. During this inspection, the licensee's monitoring and analysis process was evaluated. Discussions were held with licensee chemistry supervision about the implementation of the SG leak rate procedure 74CH-9ZZ66. The inspector reviewed RMS and chemistry data, and verified SG leak rate calculations used in procedure 74CH-9ZZ66.

The inspector reviewed Unit-3 RMS trending data for RU-4, RU-5, RU-139, RU-140, and RU-141 from November to December 1993. The inspector found that the MS line RMS RU-139 and RU-140 showed no trends for that period. The SGBD RMS RU-4 increased to a peak of about 2.2E-6 microCuries/cubic centimeters (uCi/cc), while RU-4 decreased to about 9.2E-7 uCi/cc. The CVE monitor RU-141 remained steady at approximately 9.7E-7 uCi/cc.

The inspector determined that RU-5 data indicated that Unit-3's SG#2 had a possible tube leak, but RU-4 gave no such indication for SG#1. Licensee chemistry personnel concurred with the inspector's assessment. The inspector used procedure 74CH-9ZZ66 to evaluate the RU-141 CVE RMS data. Using a gamma isotopic analysis of a CVE grab sample dated November 24, 1993, and procedure 74CH-9ZZ66, the inspector

calculated the lower limit of SG leakage detection for xenon (Xe)-133. For Xe-133 the minimum detectable activity using the gamma isotopic system was 8.84E-8 uCi/cc, which calculated to 12 GPD quantitative SG leakage detection ability.

The inspector noted from reviews of SG chemistry and CVE data that Xe-133 radioactivity was below the minimum detectable activity. Chemistry personnel stated that while a lack of Xe-133 in RU-141 CVE samples was a positive indication of good fuel integrity, it had a negative affect on the SG leakage detection method of preference in procedure 74CH-9ZZ66. This fact made it necessary for the chemistry department to use another radioisotope for quantifying SG tube leakage.

The licensee used the stable tritium leak rate method in Appendix C of procedure 74CH-9ZZ66. The inspector examined graphical data and verified licensee's tritium calculation methods. From August and November 1993 tritium in the secondary side of the Unit-2 SG indicated a steady increasing leak of between 0.2 GPD and 0.8 GPD. Discussions were held with Unit-3 chemistry supervision about reactor coolant system (RCS) and SG chemistry data. On October 3, 1993, tritium activity peaked to 0.75 uCi/cc while the SG activity was 8.9E-6 uCi/cc, which was equivalent to 0.4 GPD (1cc/min) SG leak. However, on November 17, 1993 the RCS tritium activity was 0.3 uCi/cc while the SG activity was 6.3E-6 uCi/cc, which was equivalent to 0.73 GPD (2.0 cc/min) leak. The inspector noted that the appearance of an increasing SG tube leak using the procedure 74CH-9ZZ66 "quantitative" calculation for tritium may have been false. Licensee chemistry personnel were aware that the calculation required that the RCS tritium activity be at a steady state. Licensee personnel explained that prior to shutting down Unit-3 the RCS boron concentration was diluted, which reduced the RCS tritium activity. The inspector noted that reducing the RCS boron concentration and reactor power level reduced the production process for RCS tritium. The lower RCS tritium concentration value was placed in the denominator of the tritium leak rate equation, which caused the resultant SG leak rate to increase. The inspector concluded that the licensee performed SG primary to secondary leak rate determinations in accordance to procedure 74CH-9ZZ66.

The inspector asked the chemistry supervision if they were used an alternative radiochemistry methods for identifying potential SG tube leak. The licensee gave the inspector the results of volumetric filtration samples. The inspector found that the licensee detected SG radioactivity (iodine and cesium) down to 5.0E-10 uCi/cc range by running a 100

cc/min sample flowrate through a filter for 24 hours, and then counting the filter by gamma isotopic analysis.

The inspector concluded that the licensee was fully capable of detecting and monitoring both small and large SG tube leaks. During this inspection, the licensee revealed that they found one Unit-3 leaky SG tube plug. However, it must be noted that the licensee's preferred radiochemical methods of qualifying and quantifying SG tube leaks were limited to 5-10 GPD. The inspector had no further concerns in this matter.

The inspector concluded that the licensee was fully capable of meeting its safety objectives regarding SG primary to secondary leakage determination. No violations or deviations were identified.

5. Exit Interview

The inspector met with members of licensee management at the conclusion of this inspection on December 10, 1993. The scope and findings of the inspection were summarized. Some material presented to the inspector was identified as proprietary, however, the material was reviewed and returned to the licensee. The licensee acknowledged the inspector's observations.