U. S. NUCLEAR REGULATORY COMMISSION

REGION V

Reports 50-528/91-13, 50-529/91-13, and 50-530/91-13

Licenses NPF-41, NPF-51, and NPF-74

Licensee: Arizona Public Service Company
P. O. Box 52034
Phoenix, Arizona 85072-3999

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

Inspection location: Wintersburg, Arizona

Inspection duration: March 25 - 29, 1991

Inspected by: _____ 4-15-91
L. L. Coblentz, Radiation Specialist — Date Signed

Approved by: G. P. Yuhas _____ 4-15-91
G. P. Yuhas, Chief — Date Signed
Reactor Radiological Protection Branch

Summary:

Areas Inspected: Routine, unannounced inspection of occupational exposure during extended outages, followup items, followup of written reports of nonroutine events, in-office review of periodic reports, and liquids and liquid wastes. The inspector used inspection procedures 83729, 92701, 92700, 90713, and 84723.

Results: The licensee's programs for control of occupational exposure during periods of extended outage appeared adequate in meeting the licensee's safety objectives. Review of maintenance work orders associated with radioactive gaseous effluent monitors revealed several potentially unaddressed causes contributing to monitor inoperability. No violations of NRC requirements were identified.

DETAILS

1. Persons Contacted

Licensee

J. Albers, Radiation Protection (RP) Manager, Site Operations
T. Albrigo, Supervisor, Operations Computer Services (OCS) Engineering
B. Berthlett, Manager, OCS
T. Bradish, Manager, Compliance
P. Coffin, Engineer, Compliance
R. Flood, Plant Manager, Unit 2
R. Fountain, Deficiencies Coordinator, Quality Assurance (QA)
D. Fuller, General Manager, Site Chemistry, Acting
R. Hazelwood, Supervisor, QA
W. Ide, Plant Manager, Unit 1
S. Kanter, Site Representative, Owner Services
T. Murphy, Supervisor, Radiation Monitoring Services/Chemistry
K. Roberson, Senior Engineer, Reporting, Compliance
R. Rouse, Supervisor, Compliance
F. Semper, Engineer, OCS
R. Sorensen, Manager, Chemistry Technical Services
J. Sills, RP Technical Services Manager
W. Wattson, Engineer, OCS
R. Zering, Manager, Facilities Maintenance

Non-APS Personnel

W. Barley, Bartlett Nuclear, Inc., Acting Technical Services Manager, Site RP
R. Henry, Salt River Project, Site Representative

NRC

R. Ringwald, Resident Inspector
J. Sloan, Resident Inspector

The individuals listed above attended the exit meeting on March 29, 1991. The inspector met and held discussions with additional members of the licensee's staff during the inspection.

2. Occupational Exposure During Outages (83729)

The inspector reviewed this program area by interviewing cognizant personnel, reviewing pertinent records and procedures, and observing work in progress. Areas examined included refueling tasks, radiation exposure permits (REPs), and hot particle exposure control.

Refueling Tasks: The inspector observed performance of the reactor head lift and interviewed personnel concerning related work on the upper guide structure (UGS). The inspector noted the following items:

* Surveys of radiological conditions associated with the reactor head lift were adequate to assess and control personnel exposure. Radiation protection technicians (RPTs) performed beta/gamma radiation surveys, contamination surveys, and personnel hot particle surveys, and took airborne radioactivity samples for particulates, iodines, noble gases, and tritium.

* While preparations were in progress to lift the UGS, a revision to the UGS lift procedure was brought into Containment. Supervisory review of the revision delayed performance of the procedure. During this delay, personnel were already in place to perform the UGS lift, wearing respirators, plastic suits, and other protective clothing, waiting in areas of radiation exposure. The inspector noted that additional dose received by these personnel could have been avoided by proper planning and work control. The licensee acknowledged the inspector's observation.

REPs: The inspector reviewed REP 3003, "Reactor Head and USG Removal and Storage." The inspector noted that reactor head preparatory tasks were covered by REP 3001, but that no REP was listed for USG preparatory tasks. Discussion with a central maintenance supervisor revealed that USG preparatory tasks had been performed on REP 3001, even though this work was not within the scope of REP 3001.

The inspector mentioned this discrepancy to the Radiation Protection Manager for Site Operations (RPMSO). The RPMSO stated that, as originally planned, all USG work was to be performed under REP 3003; however, further review had indicated that less radiation exposure would be incurred if preparatory USG tasks were performed prior to the reactor head lift. The preparatory USG tasks had been assigned, therefore, to REP 3001, because it more accurately described radiological conditions prior to reactor head lift.

The RPMSO stated, further, that failure to revise the scope of REP 3001 to include preparatory USG tasks had been an oversight, and would be corrected.

Hot Particle Exposure Control: The inspector reviewed circumstances surrounding exposure of a licensee employee to a discrete radioactive particle. The licensee reconstructed the sequence of events leading to the exposure, estimated the time of contact, and performed a gamma spectrum analysis of the particle. The licensee calculated that a dose of 13.9 rad was delivered to the skin of the individual's left knee over an area of one square centimeter. The inspector noted the following items:

* The particle was apparently brought into contact with the skin when the individual leaned against a pipe support in the 2B reactor coolant pump bay inside Containment.

* Surveys of the work area had been performed prior to commencing work, and had not indicated the presence of hot particles; however,

the surveys appeared to be adequate for the level of radiological hazard expected.

* More intensive surveys performed after the incident identified several additional discrete radioactive particles in the general work area. The area was subsequently posted as a Hot Particle Control Area.

* The personal statements initially recorded by the employee and by the RPT performing initial decontamination were ineffective in reconstructing events, and in determining the point of initial skin contact with the particle.

* The licensee's subsequent investigation, however, was well-developed and technically sound. Specifically, the investigation was conservative in estimating the time of skin contact, deriving assumptions for particle makeup, and considering other possible points from which the particle could have originated.

The inspector noted that 13.9 rad delivered over one square centimeter of the skin of the left knee constituted an exposure in excess of the limits of 10 CFR 20.101. However, based on the guidance given in NRC Information Notice 90-48, "Enforcement Policy on Hot Particle Exposures," the inspector had no additional questions regarding this event.

3. Onsite Followup of Licensee Event Reports (LERs) and Special Reports (SRs) (92700)

Item 50-528/90-12-LO (Closed): This LER concerned source checks of radioactive gaseous effluent monitors. In December 1990, the licensee realized that these source checks were being performed using an installed light-emitting diode (LED) light source instead of a radioactive source as required by Technical Specification (TS) 1.32. The inspector noted the following items:

* The licensee's engineering evaluation EER 90-SQ-094 had determined that no credible failure of the monitors would be detected by a radioactive source which would not also be detected by an LED.

* The licensee routinely performed cross-checks between effluent grab sample results and monitor readings, and used these cross-checks as additional verification of monitor accuracy.

* The licensee was in the process of submitting a TS amendment for NRC approval of LED use, and was using radioactive source checks as required by existing TS in the interim.

The inspector had no further questions in this matter.

Item 50-529/88-09-Y5 (Open): This fifth supplement to a 1988 SR informed NRC that a radioactive effluent monitor design change package (DCP) development date had been extended. The original SR had concerned spurious output pulses, or "spiking," generated by the detectors. The

licensee's investigation had determined the cause to be "ground looping" (i.e., original design allowed noise on the plant ground to couple with the detector preamplifier along a capacitive feedback path, forcing the preamplifier into oscillation). Discussions with the system engineer revealed the following items:

* Temporary modifications installed on nine monitors had effectively eliminated the spiking by removing the capacitive feedback path.

* The DCP called for "Kapton," a plastic wiring insulation used for strong resistance to breakdown in high radiation fields. The DCP had been considerably delayed by difficulties in obtaining Kapton which met commercial grade dedication requirements. The licensee had considered modifying the DCP to use standard electrical tape instead of Kapton; however, at the time of the inspection, approval of the DCP was still on hold to redetermine the availability of Kapton.

Item 50-528/90-06-Y1 (Closed): This SR supplement extended the completion date for investigation into material and procedural problems encountered in replacing a failed blower fan in the Containment atmosphere radiation monitor (RU-1). The inspector reviewed the licensee's investigation and associated records. The material and procedural problems had been appropriately addressed.

Item 50-528/90-07-Y0 (Closed): This SR concerned RU-1 being inoperable greater than 72 hours. RU-1 was declared inoperable on December 18, 1990, due to high flow conditions caused by failure of the flow totalizer. Replacement of the flow totalizer was delayed and monitor inoperability extended due to vendor questions addressing seismic qualification of the component. The inspector had no further questions in this matter.

Item 50-528/91-01-Y0 (Closed): This SR concerned the fuel building ventilation high range noble gas radioactivity monitor (RU-146) being inoperable for a period greater than 72 hours. The inspector made the following observations:

* Maintenance was performed on both RU-145 (low-range monitor) and RU-146. Since the two monitors operate in tandem, RU-146 must be declared inoperable if RU-145 is out of service.

* Technical Specification (TS) 3.3.3.8, Action Statement 42b requires, when RU-146 is inoperable greater than 72 hours, that the licensee submit an SR "... outlining the action(s) taken, the cause of the inoperability, and the plans and schedule for restoring the system to OPERABLE status."

* The licensee's report stated, under "Cause of Event":

> The length of time to complete the 18 month STs [surveillance tests] and perform the corrective maintenance (i.e., replace

the power supply and the hexadecimal display board) exceeded the 72 hour period allowed by TS.

* The inspector noted that the licensee's internal investigation report identified several additional factors as extending the time of RU-146 inoperability:

  + While waiting to replace a faulty power supply discovered on RU-145, testing began on RU-146. This decision extended the time of RU-146 inoperability because the RU-146 surveillance test could have been postponed (i.e., restricting the maintenance to include only RU-145 would have reduced the time required to restore RU-146 inoperability).

  + The hexidecimal display board was replaced; however, an incorrect class/item number on the work order caused the wrong part to be delivered from the warehouse, adding to the time of inoperability.

  + Miscommunication between the I&C shop and work control caused an added delay in delivery of the second hexidecimal display board.

  The inspector noted that these items were not included in the SR as contributing to the cause of inoperability.

The inspector examined the compliance group's files for SRs submitted in 1990 involving radiation monitor inoperability for greater than 72 hours. In the instance of 2-SR-90-05, 18-month surveillance tests had been performed on the plant vent low range effluent monitor (RU-143) and the high range effluent monitor (RU-144). Work began on July 16, 1990, and the monitors were returned to service July 29, 1990. The inspector noted the following items:

* Under "Cause of Event," the SR stated, in part:

  > Because of the length of the surveillance test procedure, the surveillance could not be completed within 72 hours.

  No other contributing causes are identified in the SR.

* The following statements are excerpted from the corresponding work order (WO #00433559):

  7/18 During calibration monitor would randomly reset. Stopped ST and entered CMWO #421348 to correct problem. Found problem and corrected same under CMWO.

  7/18 Completed thru Step 8.1.6.85. Am unable to find a hook gauge at this time.

  7/19 Stopped ST - Step 8.1.12.7 - M&TE is bad - Only available replacement is in the RP Cal facility.

7/20 Unable to obtain flowmeter for RU-143 at this time. Started testing RU-144. Stopped testing at Step 8.2.4.1.10 due to sources are in use at this time. Obtained flowmeter standard for RU-143. Added retest pages 50 & 51 to reperform flow section RU-143.

7/20 Step 8.1.17.34.2 unsat; RU-144 did not return to standby mode ... Wrote WR #386812 to troubleshoot/correct problem ... Step 8.1.17.65 unsat ... Monitor (RU-144) did not return to standby mode when RU-143 was re-energized. Ref. WR #386812 ... Could not obtain necessary sources from Unit 3 for RU-144 cal. - "In Use".

7/21 Obtained source set for one shift from Unit 3 after lunch; could not locate set #115 or set #118 8.0 microcurie source ... [the source sets were subsequently located.]

* A note on the 7/22 entry identifies a procedural deficiency. Wires lifted on one step caused an apparent fault during a later step (see second entry, 7/20). As a result, WR #386812 was cancelled and applicable portions of the procedure were reperformed.

* Entries on 7/24, 7/26, and 7/27 identify several equipment problems, including unexpected alarm light responses and a detector requiring replacement.

The inspector concluded that equipment problems, unavailability of measuring and test equipment (M&TE), and other factors may have extended RU-144 inoperability.

In perusal of the WO associated with 2-SR-90-04, the inspector noted similar factors which may have extended inoperability of RU-146 in June 1990. Although delays were recorded involving M&TE unavailability, conflicts with other operations, and necessary retesting due to dropping a piece of M&TE, the "Cause of Event" in the SR was given as follows:

> The TS channel calibration, installation of the temporary modification, and detector replacement required approximately 13 days to complete and could not be completed within 72 hours.

Under "Corrective Actions," the SR then stated:

> Based on the cause of this event, no additional corrective actions are required.

The inspector noted that oversimplification of the causes of monitor inoperability might result in failure to address existing deficiencies which would impact future maintenance. These deficiencies might include inadequate M&TE availability, imprudent scheduling of work, difficulty in procuring replacement parts, procedural deficiencies, personnel error, components prone to failure, lack of priority assigned to monitors, or technician unfamiliarity with procedures and equipment.

The inspector noted that Inspection Report (IR) 50-528/90-28 addressed the licensee's apparent reluctance to clearly characterize all causal factors in LERs to NRC. This IR reviewed Item 50-528/90-08-LO, which identified procedural inadequacy as the cause of a main steam isolation. The licensee's internal investigation of this event identified inappropriate operator action, and outlined corrective actions to correct personnel performance; however, the licensee had omitted this information from the LER.

The inspector discussed the SRs delineated above with members of the licensee's compliance group. The Manager, Compliance stated that an internal investigation would be performed to determine adequacy of the SRs described above. The licensee's investigation will be examined during a future inspection (50-529/91-13-01).

4. Followup (92701)

Item 50-528/90-43-04 (Closed): This item concerned the post-accident high range monitors RU-142 (condenser vacuum pump/gland seal monitor), RU-144, and RU-146. The licensee's Final Safety Analysis Report (FSAR), Section 11.5, describes the monitors as having isokinetic sampling flow, and the licensee had submitted an update to the FSAR to amend this description. The inspector reviewed the licensee's evaluation of sampler configuration and sample line design. The inspector noted the following items:

* Licensee calculations addressed sample line losses based on projected values of relative humidity, particle size distribution, chemical form, particle shape and density, radioactive transport method, and sampling system operation. Assumptions included in the calculations appeared reasonable.

* Licensee justification of fixed flow rate addressed not only anisokinetic sampling errors, but also errors associated with plateout of particulates and iodines. Licensee calculations demonstrated that errors associated with plateout (particularly iodine plateout) were more significant than errors due to anisokinetic sampling, and therefore should be given more weight in designing the samplers.

* The licensee's evaluation concluded that operating the monitors in a fixed sample flowrate mode was actually preferable to operating in an automatic proportional (isokinetic) mode.

The inspector had no further questions in this matter.

5. Review of Periodic Reports (90713)

The inspector conducted an in-office review of the timely Semi-Annual Radioactive Effluent Release Report (SARERR) for July - December 1990. The inspector noted that average Lower Limits of Detection (LLDs) for gaseous effluents given in Table A1 were the same as those given in the SARERR for January - June 1990.

During the inspection, the inspector asked the Radiation Monitoring Services (RMS) Supervisor how frequently these LLDs were determined. The supervisor stated that the LLDs had been reevaluated early in 1990, but were not required to be evaluated at a specific frequency.

The inspector noted that significant differences existed between LLD values reported in 1989 and 1990 for some radionuclides (e.g., Xenon-138). Using equations provided in the licensee's Offsite Dose Calculation Manual, the inspector attempted to determine whether the licensee's program for measuring offsite dose from gaseous effluents was of sufficient sensitivity to meet the requirements of 10 CFR 50, Appendix I, Section IV.A. Discussions with the RMS supervisor revealed the following items:

* The licensee had evaluated the effectiveness of their program in audits performed internally and by a vendor. Calculations assuming 1989 LLD concentrations of fission product gases indicated a potential offsite gamma air dose of 11.1 mRad/year; however, several factors rendered this potential dose implausible:

    + In the calculation described, Xenon-138 contributed over 90% of the hypothetical gamma air dose.

    + Assuming average transport time and a Xenon-138 half-life of approximately 30 minutes, a substantial dose reduction would occur between the plant vent monitor point and the site boundary.

    + More significantly, Xenon-138 accounts for a very small portion of the licensee's normal reactor coolant radionuclide mix. Assuming a normal mix, in which Xenon-133 accounts for over 90% of activity released as gaseous effluent, the licensee's detection of gaseous effluents would be much more sensitive than the 1989 Xenon-138 LLD.

The inspector concluded that the licensee's program, as described, was of sufficient sensitivity to meet the requirements of 10 CFR 50, Appendix I, Section IV.A.

6. <u>Liquids and Liquid Wastes (84723)</u>

During the inspection period, NRC management learned of detectable levels of I-131 in plant circulating water, and inquired as to the significance of the I-131 levels. A regional inspector reviewed the licensee's surveillance and evaluation of I-131 in plant circulating water. Levels during the inspection period ranged from 50 to 100 pCi/liter. No other fission or activation products were identified in circulating water.

The licensee obtained plant makeup water from the 91st Avenue and Tolleson water treatment plants in the city of Phoenix. The treated sewage effluent was piped to the Palo Verde site, treater further, and held in a storage reservoir for plant use.

The licensee had monitored radioactivity in the treated sewage influent and reservoir since 1979, and in circulating water since June, 1987. Radioiodine in treated sewage ranged from a baseline of 5-10 pCi/liter to nearly 100 pCi/liter. Based on approximately 44,000 gallons/minute full-power site makeup at 10 pCi/liter concentration, approximately 800 millicuries of iodine would be expected to arrive onsite annually, equivalent to four significant therapeutic iodine administrations excreted to city sewage. Such doses were not unusual in medical practice.

The inspector examined several plots of I-131 specific activity in sewage influent, reservoir water and cooling tower circulating water. The reservoir I-131 concentration followed the sewage influent concentration during the period 1987 to 1990, albeit at a lower overall level due to decay and decontamination factors. Comparative measurements of reservoir I-131 concentrations by the licensee's contractor and the State of Arizona agreed.

The cooling tower basin concentration was typically between 50 and 200 pCi/liter, demonstrating the reconcentration effect of cooling tower evaporation. The cooling tower concentration trend followed the treated sewage influent activity in each operating plant, while cooling tower I-131 activity fell during outages.

The licensee and the inspector agreed that I-131 in treated municipal water was the predominant source of radioiodine in circulating water. The licensee conducted thorough onsite monitoring for I-131 in unrestricted area waters. The inspector had no further questions in this matter.

7. Exit Interview

The inspector met with licensee management at the conclusion of the inspection on March 29, 1991. The scope and findings of the inspection were summarized. The licensee acknowledged the inspector's observations.