ARIZONA PUBLIC SERVICE COMPANY
PALO VERDE NUCLEAR GENERATING STATION
ANNUAL ENVIRONMENTAL OPERATING REPORT
FOR 1990

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I. INTRODUCTION

The Palo Verde Nuclear Generating Station (PVNGS) is located in Maricopa County, Arizona, approximately 50 miles west of the Phoenix metropolitan area. The PVNGS site comprises approximately 4050 acres. Site elevations range from 890 feet above mean sea level at the southern boundary to 1030 feet above mean sea level at the northern boundary. The station consists of three pressurized water reactor electrical generating units with a nominal generating capacity of 1270 MWe per unit.

PVNGS was issued low power operating licenses NPF-34, NPF-46 and NPF-65 for Units 1, 2 and 3 by the United States Nuclear Regulatory Commission (NRC) on December 31, 1984, December 9, 1985, and March 25, 1987, respectively. The Unit 1 full power operating license NPF-41 was issued June 1, 1985. The Unit 2 full power operating license NPF-51 was issued April 24, 1986. The Unit 3 full power operating license NPF-74 was issued November 25, 1987. Appendix B to these operating licenses is entitled the "Environmental Protection Plan (Non-Radiological)". The Environmental Protection Plans (EPP) of each of the current operating licenses are identical.

The EPP has as its stated purpose the "protection of environmental values during construction and operation of the nuclear facility." In conjunction with this general purpose, the EPP also has the principal objectives to:

(1) Verify that the station is operated in an environmentally acceptable manner, as established by the FES (Final Environmental Statement) and other NRC environmental impact assessments.

(2) Coordinate NRC requirements and maintain consistency with other Federal, State and local requirements for environmental protection.

(3) Keep NRC informed of the environmental effects of facility construction and operation and of actions taken to control those effects.

This report is intended to satisfy the requirements of section 5.4.1 of the EPP regarding the submittal of an Annual Environmental Operating Report to the Commission. This report describes the activities during the year 1990 related to the PVNGS EPP. For purposes of this report, reference to the EPP is considered to be the EPP of NPF-41, NPF-51 and NPF-74 unless otherwise specified.

II. ENVIRONMENTAL MONITORING SUMMARIES AND ANALYSIS

A. Cultural Resources

Section 4.2.1 of the EPP requires that an archaeological survey be performed when final alignment of the PVNGS-to-Saguaro transmission line is completed. As of the date of this report, plans for this transmission line have been placed on indefinite hold. Therefore, there has been no further activity in this area of the EPP.

B. Terrestrial Ecology Monitoring

Section 4.2.2 of the EPP requires that the provisions of the Salt Deposition and Impact Monitoring Plan (Revision 4, May 1985) be implemented by the onset of commercial operation of the first unit. The EPP further stipulates that the monitoring plan continue for a minimum of three full years after the onset of operation of all three units or until shown to not be necessary. Unit 3 (the last unit licensed at PVNGS) began commercial operation in November 1987. Therefore the minimum required monitoring period was satisfied as of November 1990. However, APS has elected to continue the Salt Deposition Monitoring Program for an additional year.

The enclosed report, Annual Report for PVNGS Salt Deposition Monitoring Program, January - December 1990 (NUS-5340) describes the results of the salt drift monitoring activities during 1990. The report concludes that PVNGS cooling tower operations had no significant effects on the off site environment during 1990. However, there were clear indications of the effects of cooling tower emissions from the results of sampled media from monitoring sites close to the cooling towers. The measured off site salt deposition is well under the levels anticipated to produce any significant adverse environmental impact. A proposal to reduce the scope of the Salt Deposition Monitoring Program is being prepared for submittal to the NRC for approval in 1991.

III. PLANT DESIGN AND OPERATION CHANGES

Section 3.1 of the EPP allows changes in station design or operation or the performance of tests or experiments affecting the environment provided that such changes, tests or experiments do not constitute an unreviewed environmental question and do not require a change to the EPP. Changes, tests or experiments in which all measurable nonradiological effects are confined to the on-site areas previously disturbed during site preparation and plant construction or in which the environment is not affected are exempt from the evaluation and reporting requirements of Section 3.1. Section 3.2 of the EPP also exempts changes, tests, or experiments which are required to comply with other Federal, State or local environmental regulations.

The following change in station design was evaluated during 1990 and was found not to involve any unreviewed environmental issues.

A design change to replace the rubberized asphalt/hypalon lining system on the PVNGS Evaporation Pond #1 with a high density polyethylene liner was evaluated. The replacement liner system will provide lower permeability rates than those of the existing system. This design change is projected to be implemented in 1991.

IV. EPP NONCOMPLIANCES

There were no instances of noncompliance with the EPP identified during 1990.

V. NONROUTINE REPORTS

There were no nonroutine reports required by Section 5.4.2 of the EPP submitted during 1990.

VI. ENCLOSURE

NUS-5340, NUS Corporation, Annual Report for PVNGS Salt Deposition Monitoring Program, January - December 1990, April 1991.

NUS-5340

Annual Report for PVNGS Salt Deposition Monitoring Program

January - December 1990

Prepared for

Arizona Public Service
Phoenix, Arizona

April 1991

By

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Abstract

The PVNGS salt deposition and impact monitoring program began operation in May 1983. It is intended to meet the commitment to a monitoring program called for in the PVNGS Environmental Report, Construction Permit Stage and required by the operating license. This annual report describes the results of the sampling activities conducted during January through December 1990 and presents an analysis of these data. The media sampled include air, cooling tower basin water, deposited soluble and insoluble minerals (salt), soils, and vegetation (indigenous and cultivated).

Results for the various media sampled in the 1990 PVNGS drift monitoring program have been compared with corresponding preoperational values. There are clear indications of the effects of cooling tower emissions, particularly in the deposition samples from close-in monitoring sites. The 1989 results, as presented in last year's annual report, produced similar findings; 1990 PVNGS operations appear not to have extended the range of influence of PVNGS cooling tower drift emissions beyond that observed in 1989.

Only one cultivated site had significant changes in the same parameter (analyte) for all media sampled: calcium at site 13, 3.2 miles north-northwest of the plant, increased in deposition, soil, and crop tissue samples. The 1990 cooling tower operations at PVNGS had no significant effects on the offsite environment.

As a result of these findings, a recommendation for reduction of the scope of the monitoring program has been presented to APS (NUS, 1991b).

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1 Introduction

NUS Corporation is conducting a salt deposition and impact monitoring program in the vicinity of the Palo Verde Nuclear Generating Station (PVNGS) for Arizona Public Service (APS). The objective of this monitoring program is to determine the environmental impact of salt drift emissions from the operation of the PVNGS round mechanical draft cooling towers.

This annual report presents the results of laboratory analyses of samples collected from January through December 1990 and an assessment of their significance. The media sampled include agricultural crops, indigenous vegetation, soil, drift deposition, particulates collected by low-volume air filters, and cooling tower basin water. Also presented is a comparison of the 1990 data collected during plant operation with those collected during a preoperational period (1983 through 1985), as required by the PVNGS Units 1, 2, and 3 Environmental Protection Plans, Sections 4.2.2 and 5.4.1 (Appendix B of Facility Operating Licenses NPF-41, NPF-51, and NPF-74). The preoperational data, which exclude data for sites 16, 20, 80, 81, and 83 for 1985, are derived from a previous study (NUS, 1987a).

Specific assessments in this report include (1) the levels of airborne soluble and insoluble deposits, (2) the chemistry of surficial soils, (3) the salt concentrations in leaf tissue of agricultural crops and indigenous plants, and (4) the yield of cotton crops. Interrelationships observed between the measurements are also presented.

Additionally, this report provides a description, in the form of a climatological summary, of the area meteorology as measured at the PVNGS meteorological tower during the report period, and a modeling assessment of drift deposition during the period using actual cooling tower operating data and site meteorological data. Included as appendixes are tabulations of the plant operating data as well as the data bases upon which the assessments are based. Meteorological data summaries for 1990 are presented in another report (NUS, 1991).

2 Monitoring Program Summary

The salt deposition and impact monitoring program began in May 1983. It is intended to meet the commitment to a monitoring program called for in the Environmental Report, Construction Permit Stage (ER-CP) (PVNGS, 1974, Section 6.2.5), and to satisfy the requirements of the PVNGS Units 1, 2, and 3 Environmental Protection Plans, Sections 4.2.2 and 5.4.1 (Appendix B of Facility Operating Licenses NPF-41, NPF-51, and NPF-74).

As described in Salt Deposition and Impact Monitoring Plan, Revision 5 (NUS, 1987c), the monitoring program was designed to (1) determine levels of airborne salt deposition; (2) define physical and chemical properties of surficial soils; (3) estimate species richness and cover and measure the salt loading of agricultural crops and indigenous plant communities in the vicinity of PVNGS; and (4) estimate cotton crop yield. Several background locations that would not be affected by the operation of the PVNGS cooling towers were established as control sites. These sites were selected to give an indication of any long-term natural changes.

The following sections provide a brief summary of the sampling activities conducted during January through December 1990 that together constitute the PVNGS salt deposition and impact monitoring program. The media sampled included air, cooling tower basin water, deposited soluble and insoluble minerals (salt), soils, and vegetation (indigenous and cultivated). A description of salt emission and deposition modeling of the PVNGS area, which involved the use of actual plant operating and meteorological data for this period, is also presented in Section 2.2 of this report.

2.1 ONSITE METEOROLOGICAL MEASUREMENTS PROGRAM

The onsite meteorological measurements program at the site, which began on August 13, 1973, is described in the Environmental Report, Operating License Stage (ER-OL) (PVNGS, 1979). The measurement instruments are deployed at two heights (35 and 200 feet) on a guyed tower in the northwestern portion of the site.

Digital meteorological data have been recorded by the upgraded PVNGS meteorological system since October 1985. Before October 1985, such data were manually reduced from analog strip charts.

Monthly and annual statistics on all meteorological parameters collected at PVNGS were processed and compared with historical data. The results of these programs for calendar year 1990 are discussed in more detail in Section 3.

2.2 COOLING TOWER EMISSIONS AND MODELING

2.2.1 Cooling Tower Basin Water

Cooling tower basin water was sampled during all months in which cooling towers were operated in 1990. The chemical composition of the cooling tower basin water (and drift) was compared with that of deposits (dustfall jars) and suspended airborne materials (particulates collected on low-volume filters) to identify any changes in salt composition associated with cooling tower operation. A summary of cooling tower operation for the period January through December 1990 is presented in Section 4.

The cooling tower basin water samples were analyzed for the major constituents identified in Table 3.6-1 of the ER-OL to determine the composition of the drift. These constituents include total dissolved solids (TDS), calcium, magnesium, potassium, chloride, sodium, nitrate, sulfate, and silica. Minor constituents were also quantitatively assessed to the extent feasible.

2.2.2 Emissions Modeling

The NUS FOG code was used to calculate the deposition of dissolved solids (salt) emitted as drift by the round mechanical draft cooling towers of PVNGS Units 1, 2, and 3. Input to the FOG code consisted of sequential hourly meteorological data for 1990, which were obtained from the PVNGS meteorological tower system, as well as daily plant operating data--i.e., the number of fans in operation; the circulating water flow rate; the heat release rate; the TDS concentration; and the drift rate and droplet size

distribution as determined from emission tests of the towers. These emission tests were performed in 1983 (ESC, 1983) and again in 1990 (ESC, 1990).

2.3 SALT DEPOSITION MEASUREMENTS

The measurement of salt deposition was accomplished through the collection of drift deposition samples, which were then analyzed for dissolved mineral content and suspended solids. Sampling was accomplished by placing, at selected monitoring locations, pairs of open jars containing demineralized water. The jars were 6 inches in diameter and 18 inches deep. The 18-inch-deep jar recommended by the American Society for Testing and Materials (ASTM) was used for drift collection. This jar is regarded as the most suitable vessel for sampling in a desert environment; it requires less frequent checking of the water level than other, shallower jars. Two jars were placed at each sampling location to provide for an estimate of sampling precision.

The jars were elevated approximately 3 feet above the ground surface on stands, and a bird ring was placed around the edge of each jar to prevent birds from perching and contaminating the sample. This height was used instead of the minimum height of 8 feet recommended by the ASTM (1970) to permit the collection of drift deposition that occurs at typical plant crown height. A chemically inert 1- to 2-millimeter conical screen was suspended above the maximum water level in the jars to keep out potential contaminants such as those attributable to insects and birds. At least 1 inch of water was maintained in the jars to prevent collected drift from being blown out.

The monthly sampling procedure followed the ASTM method for the collection of dustfall. At the end of each month the jars were collected and a clean set of jars installed. The collected sample from each jar is first transferred to a graduated cylinder. The jar is rinsed to extract any residue, and the rinsate is transferred to the cylinder. The sample is then transferred to a shipping bottle, labeled, and sent to a laboratory for analysis.

Figure 2-1 shows the locations of the 44 sites where drift deposition samples were collected. In addition to the 44 sites committed in the Monitoring

Plan, APS established 4 interim drift-deposition-only onsite sampling locations in May 1985. These locations, sites 80-83 (not shown in Figure 2-1), were established close to the cooling towers to provide unambiguous indications of drift deposition above the background level. Table 2-1 lists the approximate distances (miles) and directions (sectors) from the centroid of the PVNGS Unit 2 cooling tower array of all 48 monitoring sites.

The laboratory analyzed the collected drift deposition samples for total suspended solids and for the most significant dissolved components of the cooling tower drift as identified in Table 3.6-1 of the ER-OL.

2.4 SOILS MEASUREMENTS

At each of the 44 monitoring locations depicted in Figure 2-1, soil samples were collected in April (following the 1990 wet season) and in July (following the dry season). Collections were also made at all 13 agricultural sites after cotton defoliation (November). The samples were drawn from the upper and lower fractions of five cores on each of two transects. Sampling was in accordance with the methods described by the U.S. Department of Energy's Environmental Measurements Laboratory Procedures Manual (DOE, no date). A soil auger was used to collect 8-centimeter-diameter core samples to depths of 30 centimeters, which were divided into upper (0- to 15-centimeter) and lower (15- to 30-centimeter) segments. The upper and lower segments for each transect were separately combined to form four composites, one for each depth segment for each of the two transects. From each composite two samples were taken and labeled. The labeled samples were then taken to the analytical laboratory, where one composite sample was analyzed and the other retained in storage.

Soil samples were each analyzed for soluble sodium, calcium, potassium, magnesium, sulfate, nitrate, chloride, fluoride, carbonate, bicarbonate, ammonium, phosphate, boron, exchangeable sodium, exchangeable calcium, exchangeable potassium, exchangeable magnesium, pH, and electrical conductivity.

2.5 VEGETATION MEASUREMENTS

2.5.1 Agricultural Crops

At 5 of the 13 agricultural monitoring sites (Figure 2-2), agricultural crops were sampled twice each growing season (July and August) before defoliation (or harvest) for the estimation of leaf tissue salt loading. (Eight of the sites--7, 12, 24, 25, 28, 31, 32, and 45--were fallow during the 1990 growing season.) Cotton yield was estimated by collecting and weighing the seed and fiber (boll) from randomly selected cotton plots. This sampling occurred during the months of September, October, and November 1990.

Agricultural crop samples were sent to a laboratory for chemical analysis. The samples were oven-dried at 70°C for 24 hours, dry-weighed, ground in a blender, and stored in Kraft paper bags. The dried samples were analyzed for total sodium, calcium, potassium, magnesium, phosphate, soluble sulfate, nitrate, chloride, and fluoride.

2.5.2 Indigenous Vegetation

Representative native plant communities, which have been identified and monitored since 1976 to determine baseline conditions, were sampled semi-annually (March and October). The locations of the eight indigenous vegetation sites are depicted in Figure 2-2.

Two indigenous plant communities, one dominated by creosote bush and the other by salt bush, occur on and in the vicinity of PVNGS. Associated with these are mesquite and several species of cacti. The indigenous vegetative sampling conducted within each of the existing sites included measurement of species richness and relative cover and measurement of the salt concentration in leaf tissues of the dominant flora (other than cacti).

After collection, native vegetation samples were sent to a laboratory for chemical analysis. These samples were oven-dried at 70°C for 24 hours, dry-weighed, ground, and stored in Kraft paper bags. The dried samples were

analyzed for total sodium, phosphate, calcium, potassium, magnesium, soluble sulfate, nitrate, chloride, and fluoride.

2.5.3 Aerial Photography/Remote Sensing

Indigenous vegetation and agricultural crops were monitored by aerial (color infrared) photography. The principal crops grown in a 5-mile radius of PVNGS were photographed near the time of peak productivity (September).

2.6 AIRBORNE SALT MEASUREMENTS

Airborne salt concentrations were measured by collecting particles on a low-volume particulate sampler. Samples were taken from the existing low-volume air samplers at six locations (Figure 2-1) being used as part of the PVNGS radiological monitoring program. The filters were collected weekly for radiological analysis and composited monthly for chemical analysis. The composite filters were analyzed for calcium, chloride, iron, fluoride, potassium, magnesium, sodium, nitrate (as nitrogen), sulfate, and phosphate (as phosphorus). To date, these data have not contributed any information related to understanding and defining the drift deposition at PVNGS.

Table 2-1. Distance and direction of 48 drift deposition monitoring sites from centroid of PVNGS Unit 2 cooling towers (sheet 1 of 2)

Site	Distance (miles)	Direction (sector)	Site type	Onsite vs. offsite	Sample
1	1.3	NE	Native	Onsite	DF, S, NV
2	1.5	NE	Native	Onsite	DF, S, NV
3	0.6	NNW	Native	Onsite	DF, S, NV
4	2.2	SSE	Native	Onsite	DF, S, NV
5	2.0	S	Native	Onsite	DF, S
6	1.8	S	Native	Onsite	DF, S, NV
7	5.1	ENE	Agricultural	Offsite	DF, S, AG
8	2.1	N	Native	Offsite	DF, S, LVA
9	1.8	NNE	Native	Offsite	DF, S, LVA
10	1.6	NE	Native	Onsite	DF, S, LVA
11	2.0	NW	Agricultural	Offsite	DF, S, AG
12	4.8	NW	Agricultural	Offsite	DF, S, AG
13	3.2	NNW	Agricultural	Offsite	DF, S, AG
14	1.0	NE	Native	Onsite	DF, S
15	5.0	N	Native	Offsite	DF, S
16	0.6	NNE	Native	Onsite	DF, S
17	4.0	W	Native	Offsite	DF, S
18	2.8	W	Native	Offsite	DF, S
19	2.3	W	Native	Offsite	DF, S
20	0.4	WSW	Native	Onsite	DF, S, LVA
21	3.1	E	Native	Offsite	DF, S, LVA
22	4.8	E	Native	Offsite	DF, S
23	2.3	SW	Agricultural	Offsite	DF, S, AG
24	4.0	N	Agricultural	Offsite	DF, S, AG
25	19.0	WNW	Agricultural control	Offsite	DF, S, AG
26	5.0	NE	Native	Offsite	DF, S
27	2.3	S	Native	Onsite	DF, S, LVA
28	3.7	SW	Agricultural	Offsite	DF, S, AG
30	3.9	SSW	Agricultural	Offsite	DF, S, AG
31	3.5	SSE	Agricultural	Offsite	DF, S, AG

Table 2-1. Distance and direction of 48 drift deposition monitoring sites from centroid of PVNGS Unit 2 cooling towers (sheet 2 of 2)

Site	Distance (miles)	Direction (sector)	Site type	Onsite vs. offsite	Sample
32	3.9	SE	Agricultural	Offsite	DF, S, AG
33	5.3	SE	Native	Offsite	DF, S
34	6.7	NE	Native	Offsite	DF, S
35	9.9	NE	Native	Offsite	DF, S
36	12.8	NE	Native	Offsite	DF, S
37	15.0	NE	Native	Offsite	DF, S
38	10.0	SW	Native	Offsite	DF, S
39	11.5	SW	Native	Offsite	DF, S
40	18.2	WNW	Native control	Offsite	DF, S, NV
41	2.8	NE	Native	Offsite	DF, S
42	16.6	SSE	Native control	Offsite	DF, S, NV
43	15.0	SSE	Agricultural control	Offsite	DF, S, AG
44	6.6	NW	Native	Offsite	DF, S, NV
45	5.1	SW	Agricultural	Offsite	DF, S, AG
80	0.5	NE	Supplemental	Onsite	DF
81	0.2	NNW	Supplemental	Onsite	DF
82	0.5	SSW	Supplemental	Onsite	DF
83	0.3	ESE	Supplemental	Onsite	DF

Key: DF, dustfall; S, soils; NV, native vegetation; AG, agricultural crops; LVA, air by low-volume air sampler.