

Salt Deposition and Impact Monitoring Plan for
The Palo Verde Nuclear Generation Stations
Units 1, 2, and 3

(Rev. 4)

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Note: Changes to this document are noted in the margins on each page with identifying numbers representing the revision. The original issue was in February 1983; a Revision 1 was prepared but never issued, being superseded by Revision 2, dated April 1983.

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1.0 INTRODUCTION

This document presents the design of an environmental monitoring program to determine the environmental impact, if any, due to salt drift from operation of the PVNGS mechanical draft cooling towers. It is designed to meet the commitment for a monitoring program contained in the Environmental Report, Construction Phase. Table 1-1 is a summary of this commitment.

Table 1-1. Salt Monitoring Program for PVNGS^a

Plant System Inducing Change	Predicted Physical Change	Physical Parameter to be Monitored	Biotic Indicator to be Monitored	Duration and Periodicity of Study	
				Preoperation Period	Operation Period
Drift from cooling tower salt	Foliar deposition of salt	Airborne salt	Salt sensitive plant species	Baseline seasonal data one year prior to opera- tion	Seasonal data until level of impact determined

^aEnvironmental Report - Construction Permit Stage, Section 6.2.5.

The monitoring program (1) determines levels of airborne salt deposition, (2) defines physical and chemical properties of surficial soils, (3) estimates species richness and cover and measures salt loading of the indigenous natural plant communities, and (4) measures salt loading and yield of cotton.

Comparisons of these parameters are made at sampling locations between the period prior to operation and the period during operation of one, two, and three units. There are also several control sites, which are used as background locations not affected by operation of the cooling towers, that give an indication of any long term changes.

2.0 MONITORING PROGRAM DESIGN

This section presents a description of the program design and includes a discussion of the selection of monitoring locations, sampling methods and equipment, laboratory sample analyses, data review and report preparation, and quality assurance.

2.1 Selection of Monitoring Locations

The monitoring program is conducted both onsite and offsite out to approximately 20 miles from the cooling towers. Most of the sampling locations are at distances of five miles or less from the cooling towers. This 5-mile distance corresponds to that beyond which salt deposition is not predicted to exceed about one pound per acre per year. Five control sites are included in the monitoring program to measure background levels of salt deposition at distances unlikely to be significantly affected by PVNGS emissions.

Factors considered for the selection of these control site areas included an examination of the potential influences from any of the surrounding topography and their proximity to significant sources of fugitive dust or particulate emissions such as industry. Two control sites are located approximately 20 miles to the northwest of the cooling towers and two other control sites approximately 15 miles to the southeast of the cooling towers. One control site will be an agricultural area and the other will be in native desert environment for each of these quadrants. A fifth native vegetation control site is located approximately 7 miles to the northwest of the cooling towers.

A total of 44 sampling locations were selected to meet the following objectives:

- o Measure site-originated deposition via dustfall collection, and any changes in vegetation and/or soil chemistry at all nearby agricultural fields
- o Establish background data on salt conditions

- o Provide salt deposition data that could possibly be correlated with ongoing radiological and natural vegetation studies. 3
- o Demonstrate that the monitoring program can detect site-originated salt deposition and determine the geographical limit of detection.
- o Provide long-term control plots (at 15 to 20-mile distances and in directions that are least frequently downwind of the cooling towers). 3
for determining background variations in salt levels in the vicinity of PVNGS. 2

Figure 2-1 shows the approximate locations of the 44 sites for the monitoring of salt deposition and soil sampling, including the 5 control locations used to determine background changes, if any, in salt levels. Table 2-1 presents a summary of the types of sampling to be performed at each sampling location. At the 6 locations footnoted on Figure 2-1, the existing low-volume samplers used for the station radiological monitoring program are used to determine airborne salt concentrations. At 11 other locations near the site (see Figure 2-2), sampling of the agricultural crops actually under cultivation are conducted. 4

At five onsite locations (1, 2, 3, 4 and 6), representative indigenous plant communities of the site, which have been identified and monitored since 1976, are sampled semiannually (spring and fall). During June 1983, the native vegetation communities at site number 5 were destroyed by fire. Site number 5 was then and is currently maintained as a sampling site for dustfall and soils only. The locations of these five communities, shown in Figure 2-2, provide continuity with an ongoing baseline study of native vegetation (see Section 2.2.2.1). Soil and dustfall monitoring are also conducted at these locations. 4

The monitoring program has 33 sampling locations within approximately 5 miles of the cooling towers. These locations were selected so that any measurable changes in deposition due to operation of the cooling towers would be detected by the monitoring program. Additionally, those sampling locations oriented toward the northeast of the towers correspond to the predicted direction for maximum deposition of salt. 3

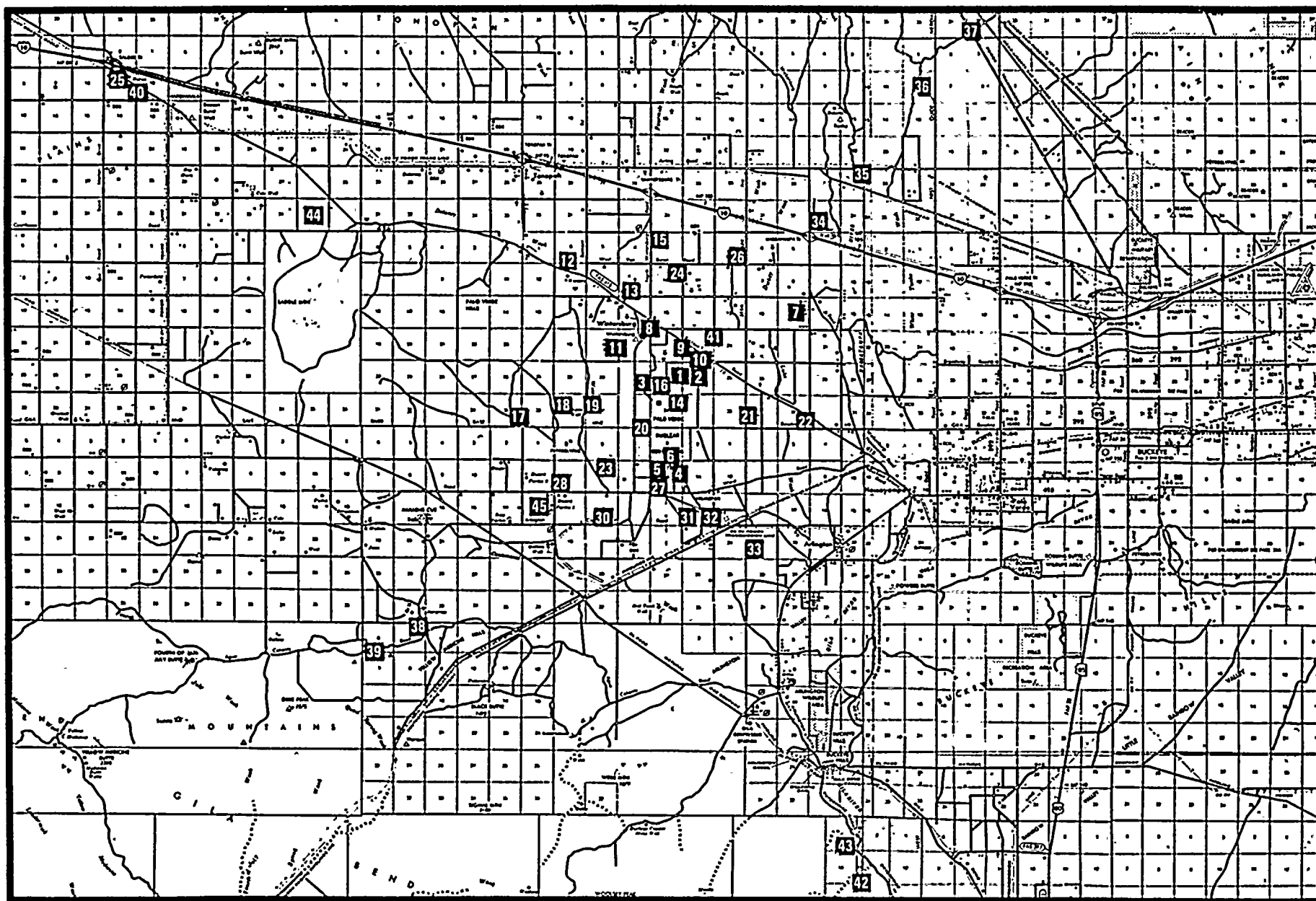


Figure 2-1

Distribution of Dustfall and Soil Sampling Locations

Footnote:

Low-volume air samplers are located at 8,9,10,20,21,27.

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Table 2-1

Summary of the Types of Sampling to be Performed
at Each Sampling Location

Sampling Location No.	Airborne Salts Via Dustfall Collection	Soils	Native Vegetation	Agricultural	Airborne Salts Via Low Volume Samplers
1	X	X	X		
2	X	X	X		
3	X	X	X		
4	X	X	X		
5 ^a	X	X			
6	X	X	X		
7	X	X		X	
8	X	X			X
9	X	X			X
10	X	X			X
11	X	X		X	
12	X	X		X	
13	X	X		X	
14	X	X			
15	X	X			
16	X	X			
17	X	X			
18	X	X			
19	X	X			
20	X	X			X
21	X	X			X
22	X	X			
23	X	X		X	
24	X	X		X	
25	X	X		X	
26	X	X			
27	X	X			X
28	X	X		X	
29 ^b					
30	X	X		X	
31	X	X		X	
32	X	X		X	
33	X	X			
34	X	X			
35	X	X			
36	X	X			

2

4

2

Table 2-1 (Continued)

Summary of the Types of Sampling to be Performed
at Each Sampling Location

Sampling Location No.	Airborne Salts Via Dustfall Collection	Soils	Native Vegetation	Agricultural	Airborne Salts Via Low Volume Samplers
37	X	X			
38	X	X			
39	X	X			
40	X	X	X		
41	X	X			
42	X	X	X		
43	X	X		X	
44 ^c	X	X	X		
45 ^d	X	X		X	
Total	44	44	8	13	6

^aNative vegetation communities destroyed by fire in June 1983.

^bDecommissioned during June 1984. Monitoring equipment was destroyed by agricultural activity.

^cEstablished as a native vegetation control site for salt bush. In May 1984, the saltbush plant community at site Number 42 was tilled and the land was converted to agricultural use sometime prior to May 1984.

^dBegan operation in July 1984 to replace site Number 29.

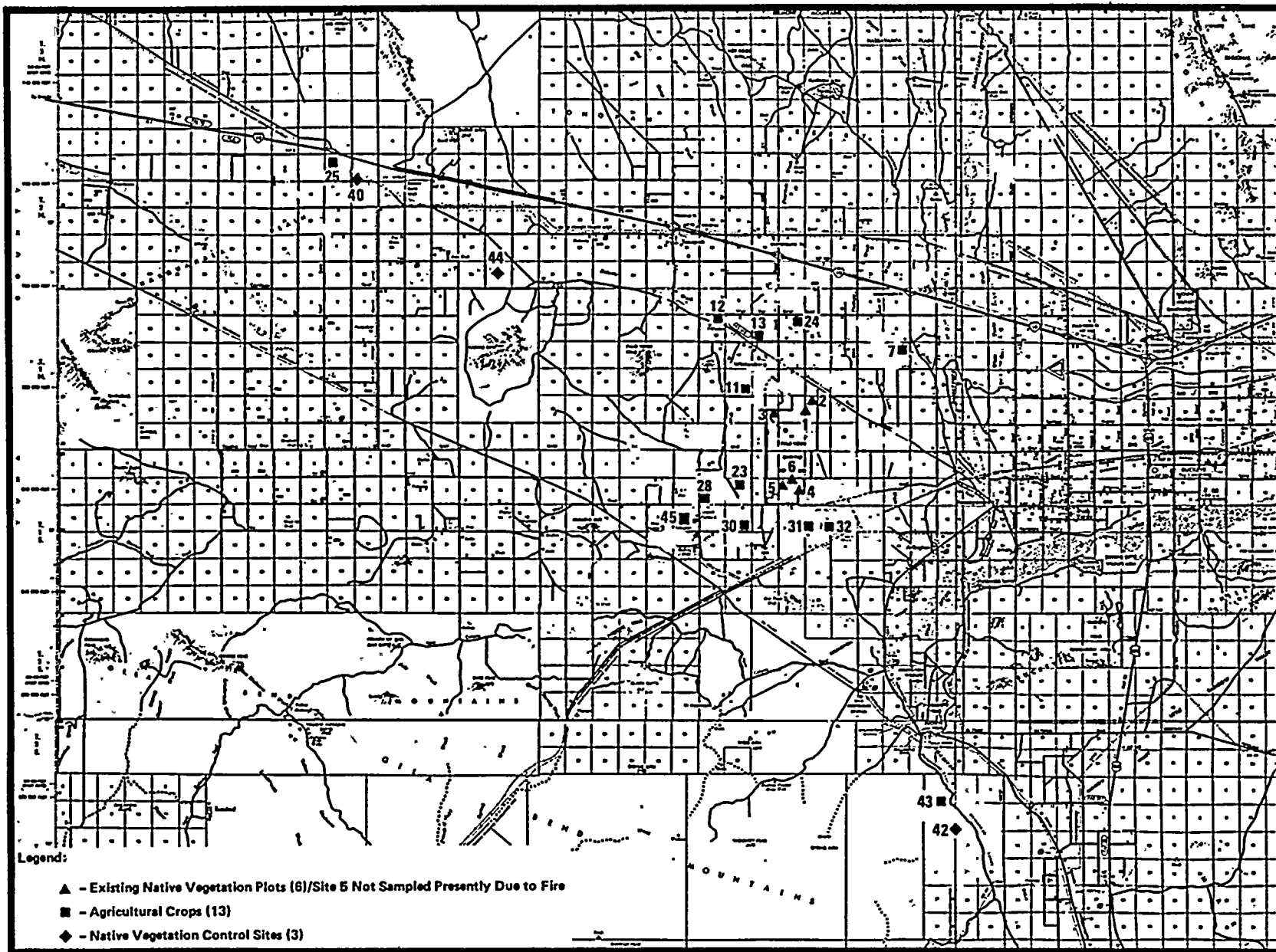


Figure 2-2
Distribution of Vegetation Sampling Locations

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Additional criteria used as a basis for selection of the monitoring sites included the specification of their location at a distance from roads adequate to minimize the collection of traffic-generated dust.

2.2 Sampling Methods

The sampling methodologies presented below and described in further detail in the applicable work instructions are designed to assure valid data acquisition. Five separate sampling methodologies are described; one for soils, two for vegetation (indigenous and agricultural); and two for airborne salt.

2.2.1 Soil Sampling

At each of the 44 monitoring locations, composite soil samples (based on 5 cores from each of 2 transects) are collected at the end of the dry season (July-August), and at the end of the wet season (normally February-March); an additional sampling is conducted at all 13 agricultural sites after cotton defoliation. The sampling procedure (Reference Work Instruction GO 5.2.16.1) follows the DOE Environmental Measurements Laboratory's HASL-300 Method for soil sampling,⁽¹⁾ and uses a soil auger to collect 3-inch diameter core samples in depth increments to 30 cm, which are divided into upper and lower segments. The depth to the break between upper and lower segments is determined in the field for uncultivated soils based on the depth to a textural change. Cores in cultivated areas are divided into equal upper and lower segments. All upper segments and all lower segments for each transect are separately combined to form 4 composites (2 depth increments for each of 2 transects) from each of which 2 samples are taken and labelled. One sample of each composite is shipped to the analytical laboratory for analysis and the other retained in storage.

(1) Department of Energy, Environmental Measurements Laboratory, EML Procedures Manual, HASL-300, New York, NY, undated.

2.2.2 Indigenous and Agricultural Vegetation Sampling

2.2.2.1 Native Vegetation

Representative native plant communities, which have been identified and monitored since 1976 to determine baseline conditions, are sampled semi-annually (March/April and August/September). Eight vegetative study areas are sampled as depicted in Figure 2-2.

The indigenous plant communities of the PVNGS are dominated by creosote and salt bush. Associated with these are mesquite and several species of cacti. The vegetative monitoring program conducted within the eight vegetative communities (Reference Work Instruction SRO 5.2.32.2) includes:

- o The measurement of species richness and relative cover.
- o The measurement of salt loading in tissues of the dominant or co-dominant flora (other than cacti).

2.2.2.2 Crop Sampling

At each of the 13 agricultural monitoring locations (Figure 2-2), agricultural crops are sampled (Reference Work Instruction SRO 5.2.32.1) twice each growing season (e.g., June and September for cotton) prior to defoliation (or harvest) to determine the amount of plant tissue salt loading. Additionally, cotton yield is obtained by collecting the seed and fiber (boll) from selected cotton plots (Reference Work Instruction SRO 5.2.32.1) as well as from the Agricultural Stabilization Conservation Service.

2.2.2.3 Infrared Photography

In addition to the quantitative vegetative analyses, both native vegetation and agricultural crops are monitored using infrared photography (Reference Work Instruction SRO 5.2.32.3). Aerial photography (false color infrared) is performed to coincide with peak vegetative crop productivity for the principal crops grown in a 5-mile radius of PVNGS (e.g., August/September for cotton).

3
This methodology permits the detection of vegetative stress, confirmed by field inspection, whether due to natural or artificially induced (e.g., salt drift) conditions and provides a documented photographic record of existing environmental conditions.

2.2.3 Salt Deposition Sampling

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The rate of salt deposition is measured by the collection of dustfall samples which are analyzed for salt content. The dustfall sampling (described in ASTM method D1739(2)) is accomplished by placing pairs of open jars at the selected monitoring locations. Two jars are placed at each sampling location to provide an estimate of sample precision.

The jars are elevated approximately three feet above the ground on stands, with a bird ring placed around the edge of the jar to prevent birds from perching and contaminating the sample. This height differs from the recommended minimum height of eight feet presented in the ASTM method to permit the collection of dustfall at the approximate plant crown height. A chemically inert 1 to 2 mm conical screen is hung above the maximum water level in the jars to keep out any potential contaminants such as insects.

The monthly sampling (Reference Work Instruction EMD 5.2.17.27) follows the ASTM method for collection of dustfall. At the end of each month the jars are collected and replaced by a clean set of jars. The collected jars are rinsed to transfer the samples to shipping bottles which are labeled and sent to a laboratory for analysis. At least one inch of water is maintained in the jars to prevent collected dust from being blown out. The distilled water added to the jars contains 15 mg/liter of copper sulfate as an algicide. An 18-inch deep ASTM jar used for dustfall collection is the most suitable collection jar for sampling in a desert environment; it requires less frequent checking and replenishment of the water level than other, shallower jars.

(2) American Society of Testing and Materials (ASTM), Standard Method for Collection and Analysis of Dustfall (Settleable Particulates) D1739-70, Annual Book of ASTM Standards, Part 26, Philadelphia, PA., 1970.

2.2.4 Airborne Salt Sampling

Airborne salt concentrations are measured by collecting particles on a low-volume particulate sampler. Measurements are taken from the six existing low volume samplers (Figure 2-1) being used as part of the radiological monitoring program. The samplers are made by Schmidt, Inc., and draw air through a 50 mm diameter filter. The filters are collected weekly for radiological analysis and are composited for the additional chemical analyses on a monthly basis.

2.2.5 Sampling Schedule

The monitoring program frequency for salt deposition is generally on a monthly basis. Although the low-volume particulate filters are collected weekly, the filters collected during any one month are combined and processed as one collective sample for each site. Other exceptions include: native vegetation, sampled twice each year, in March/April and in September/October; agricultural sampling in June/July and again with aerial photography in August/September; and soils sampled at the end of the rainy (normally February/March), and the dry seasons (July/August) and post-defoliation (November). The dustfall samples and low-volume sampler filters are analyzed on a regular monthly schedule. Cooling tower basin water is sampled at least quarterly to provide the chemical composition data used as a basis for comparison with the analyses of deposited and airborne material samples. Table 2-2 summarizes the sampling schedule for components of the program.

2.3 Sample Analysis

Samples collected during this program are sent to selected laboratories for the indicated analyses. The laboratory procedures adopted for analysis of soils, vegetation, water, and dustfall are documented. The procedures include the documentation of quality control checks on the instrumentation and the analyses.

Table 2-2. Program Sampling Schedule

COMPONENT	MONTH											
	J	F	M	A	M	J	J	A	S	O	N	D
Particulate Dustfall	X	X	X	X	X	X	X	X	X	X	X	X
Airborne Salt Concentration (Mo. Avg.)	X	X	X	X	X	X	X	X	X	X	X	X
Soils		X / X					X / X				X	
Native Vegetation			X / X						X / X			
Crops						X / X		X / X				
Aerial Infrared Photography								X / X				
Cooling Tower Basin Water			X			X			X			X

Soil samples are analyzed for the following: pH; soluble Na, Ca, K, Mg; B; exchangeable Na, Ca, K, Mg; electrical conductivity; $\text{SO}_4^{=}$, NO_3^- , Cl^- , F^- , $\text{CO}_3^{=}$, HCO_3^- , NH_4^+ and $\text{PO}_4^{=}$. Textural analysis is performed once as part of a baseline characterization for each monitoring site. Native vegetation and crop samples are analyzed for Na, Ca, K, Mg and for as $\text{SO}_4^{=}$, NO_3^- , Cl^- , F^- and $\text{PO}_4^{=}$.

The collected dustfall samples are analyzed for total suspended solids and the most significant components of the cooling tower blowdown (and drift) as identified in Table 3.6-1 of the PVNGS ER-OL, Units 1-3. Since copper sulfate is used as an algicide, the analysis also includes copper.

Finally, cooling tower basin water is sampled and analyzed at least quarterly for the same major constituents as the dustfall samples and identified in Table 3.6-1 at the PVNGS ER-OL, Units 1-3, to confirm the composition of the drift (and blowdown). As a minimum, these include: Ca, Mg, Na, K, Cl^- , NO_3^- , $\text{SO}_4^{=}$, and Si. Additionally, minor constituents are quantitatively assessed to the extent possible.

Interpretation of the aerial photography is conducted by qualified personnel. Areas of apparent vegetative stress are delineated, and a field inspection conducted to identify causal effects for all areas of apparent stress. If there are any environmental changes, a map is prepared which indicates those areas.

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2.4 Data Review

The reported data is examined by NUS for consistency. Suspicious data may prompt a request for a repeat analysis of the sample(s). Meteorological data are used to ascertain that the pattern of salt deposition is consistent with the prevailing winds, stability classes, and precipitation over the period of sampling. Patterns of inconsistent data, or locations with large differences in the paired samples may indicate that the locations are subject to interferences or tampering. Additional sampling or an alternate sampling location may be required for these locations. Once the individual data have been examined, timely summaries are prepared. Data are compared for discernible differences between the control samples.

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Seasonal and annual summaries are prepared and the data examined for correlations with meteorological conditions over the period. Methods for demonstrating differences in the annual data include changes in the chloride to sodium ratios, and isopleths of annual concentrations. The evaluation of the control and plant vicinity differences includes analyses for correlation between salt deposition, airborne concentration, and changes in soil and/or plant chemistry. Detailed evaluation of changes in any of the three media (air, soil, plants) at one or more sampling locations are evaluated by appropriate statistical analyses.

2.5 Quality Assurance Program

A comprehensive quality assurance program is essential for the successful conduct of a good monitoring program. The quality control measures designed into the program include:

- o Colocated samples at each sampling location to determine sample precision;
- o An observation and data record for each sample;
- o The checking of the algicide concentration as an indication of sample integrity for dustfall samples;
- o Sampling at a range of distances from the cooling towers to show the procedures are capable of detecting salt deposition and also for determining the limit of detection;
- o Detailed written procedures for all aspects of the program

Written quality assurance procedures have been developed in accordance with the quality assurance requirements of APS. The laboratory quality assurance programs provide the required quality assurance checks on the sample analyses at the laboratory. An independent audit and inspection will be conducted to review the sampling methods and the techniques and records of the analytical laboratory.

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