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

(Rev. 3)

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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 The original issue was in February 1983; a Revision 1 was prepared but never issued, being superseded by Revision 2, dated April 1983.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 a design for 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	Duration and Periodicity of Study: Operation Period
Drift from cooling tower salt	Foliar deposition of salt	Airborne salt	Salt sensitive plant species	Baseline seasonal data one year prior to operation	Seasonal data until level of impact determined

[a]Environmental Report - Construction Permit Stage, Section 6.2.5.

The monitoring program will determine (1) levels of airborne salt deposition, (2) chemical properties of surficial soils, (3) estimation of species richness and cover and salt deposition/loading of the indigenous natural plant communities, and (4) estimation of salt deposition/loading and yield of cotton and other significant agricultural crops. A comparison of these parameters will be made at several sampling locations between the period prior to normal operation and the period during normal operation. There will also be several control sites, which will be used as background locations not affected by operation of the cooling towers, that will also give an indication of any long term natural changes.

[illegible]

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 will be 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 10 pounds per acre per year, except possibly to the northeast of the plant. Four control sites will also be part of the monitoring program. The purpose of the control sites will be to measure natural background levels of salt deposition at distances unlikely to be significantly affected by PVNGS 2
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 will be located approximately 20 miles to the northwest of the cooling towers, and the two other control sites will be located approximately 15 miles to the southeast of the cooling towers. One control site will be in an agricultural area and the other will be in native desert environment for each of these quadrants. A total of 43 sampling locations were initially selected to provide an adequate number of locations 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

- Demonstrate that the monitoring program can detect site-originated salt deposition and determine the geographical limit of detection

- Provide long-term control plots (at 15 to 20-mile distances and in directions that are least frequently downwind of the cooling towers) for determining natural variations in salt levels in the vicinity of PVNGS. 2

Shown in Figure 2-1 are the approximate locations of the 43 sites for the monitoring of salt deposition and soil sampling, including the 4 control locations that will be used to determine natural changes in salt levels. Table 2-1 presents a summary of the type 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 will also be used to determine airborne salt concentration. At 11 other locations near the site (see Figure 2-2), sampling of the agricultural crops actually under cultivation (e.g., cotton and barley) will be conducted.

At six onsite locations (1 through 6), representative indigenous plant communities of the site, which have been identified and monitored since 1976, will be sampled seasonally (spring and fall). The locations of these six communities are shown in Figure 2-2. These sampling locations will provide continuity with an ongoing baseline study of native vegetation (this part of the monitoring program is discussed in Section 2.2.2.1). Soil and dustfall monitoring will also be conducted at these locations. Sampling locations within 2 miles of the towers were selected to demonstrate that the soil and dustfall monitoring methodologies are capable of detecting salt deposition from the towers and to confirm the predicted location of most concentrated deposition areas.

The monitoring program will have 33 sampling locations within approximately 5 miles of the cooling towers. These locations were selected so that, if there are any measurable changes in deposition due to operation of the cooling towers, the changes would be detected by the monitoring program. Additionally, those sampling locations oriented toward the northeast of the towers correspond to

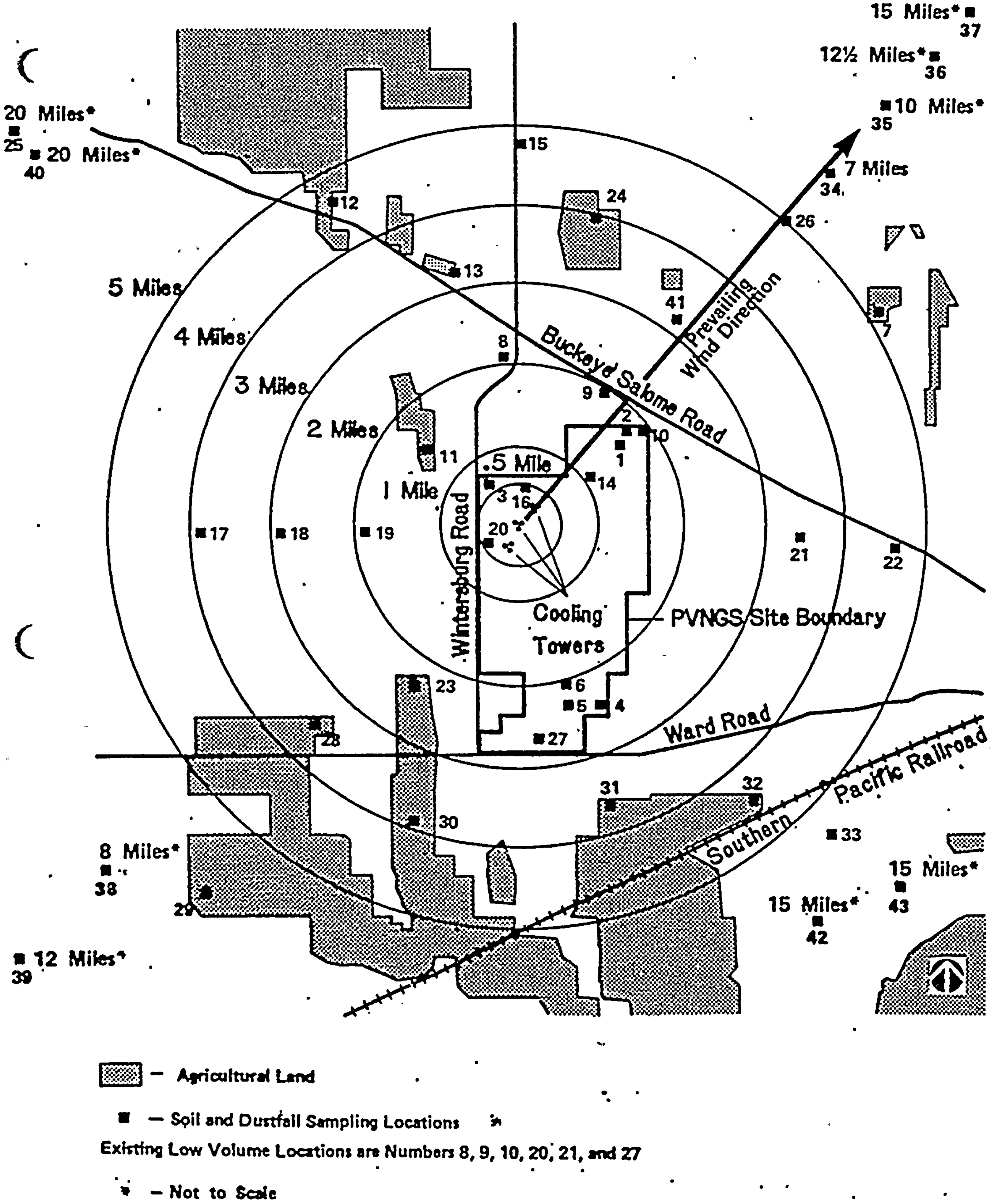

Figure 2-1. Distribution of Soil and Dustfall Sampling Locations

Table 2-1

Summary of the Type 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	X	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	X	X		X	
30	X	X		X	
31	X	X		X	
32	X	X		X	
33	X	X			
34	X	X			
35	X	X			
36	X	X			

Table 2-1 (Continued)

Summary of the Type 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			
41	X	X			
42	X	X			
43	X	X		X	
Total	43	43	6	13	6

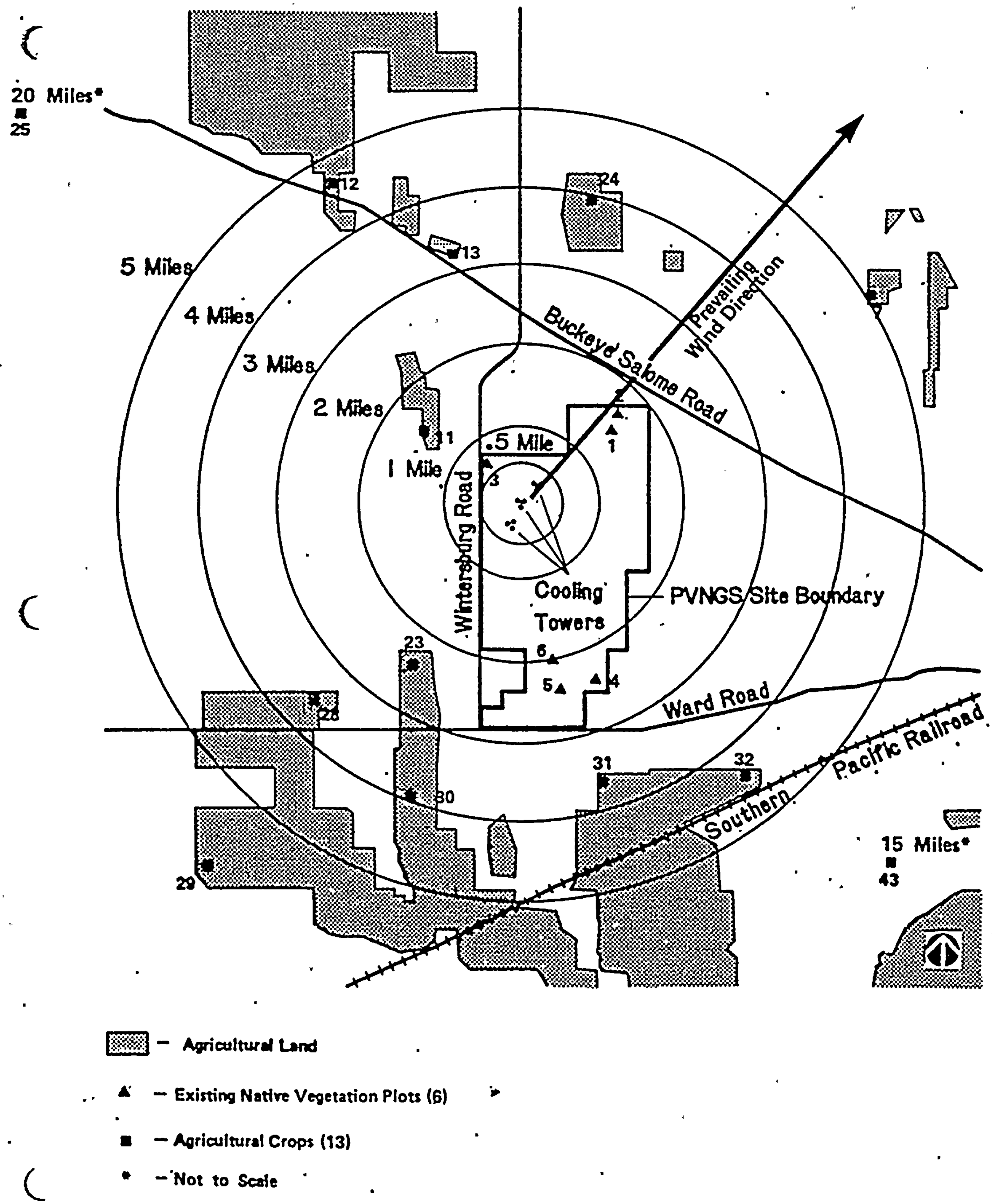

Figure 2-2. Distribution of Vegetation Sampling Locations

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the predicted direction for maximum deposition of salt and will be used to determine the geographical limit of detection of salt deposition.

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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. The need to add or adjust sampling locations will be assessed once the initial results of the monitoring program are known.

2.2 Sampling Methods

The sampling methodologies presented below and described in further detail in the applicable work instruction 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 43 monitoring locations, two composite soil samples (based on 5 cores each) will be collected at the end of the dry season (July-August) and again at the end of the wet season (normally February-March). The sampling procedure (Reference Work Instruction GO 5.2.16.1) will follow the DOE Environmental Measurements Laboratory's HASL-300 Method for soil sampling,[1] and will use a soil auger to collect 3-inch diameter core samples to a depth of 30 cm. Cores will be combined to form two separate composites from each of which two samples will be taken and labeled. One sample of each composite will be shipped to the analytical laboratory for analysis and the other retained in storage.

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

2.2.2 Indigenous Vegetation Sampling

2.2.2.1 Native Vegetation

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

The indigenous vegetation of the PVNGS includes creosote bush plain, saltbush plain, creosote bush-cacti, mesquite-creosote bush wash, and saltbush-creosote bush plain communities. The vegetative monitoring program which will be conducted 2
within the six vegetative communities (Reference Work Instruction SRO 5.2.32.2) will include:

- The measurement of species richness and relative cover

- The measurement of salt loading in tissues of the dominant or co-dominant flora (other than cacti); salt deposition density measurements will be made on species with leaves of sufficient size to permit surface area measurements.

2.2.2.2 Crop Sampling

At each of the 13 agricultural monitoring locations (Figure 2-2), agricultural crops will be 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) in order to estimate the amount of foliar salt deposition and plant tissue salt loading. Additionally, yield will be estimated by collecting the seed and fiber (boll) from selected cotton plots (see Work Instruction for methods), or for other crops by measures appropriate for those crops.

2.2.2.3 Infrared Photography

In addition to the quantitative vegetative analyses, both native vegetation and agricultural crops will be monitored using infrared photography (Reference Work Instruction SRO 5.2.32.3). Healthy vegetation reflects infrared energy differently than stressed or unhealthy vegetation. This results in spectral "signatures" or tonal contrasts that can reveal the extent and magnitude of environmental changes at a specific time. Aerial photography (false color infrared) will be planned to coincide with peak vegetative crop productivity for the principal crops grown in a 5-mile radius of PVNGS (e.g. June/July and August/September for cotton). This approach, when combined with field inspection, will permit the detection of vegetative stress due to natural or artificially induced (e.g., salt drift) conditions. Also it will provide a documented, historical record of existing environmental conditions. 2

2.2.3 Airborne Salt Deposition Sampling

The physical measurement of salt deposition will be accomplished through the collection of dustfall samples which will be 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 will be placed at each sampling location to provide an estimate of sample precision.

The jars will be 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 that actually occurs at the plant crown height. A chemically inert 1 to 2 mm conical screen will be hung above the maximum water level in the jars to keep out any potential contaminents such as insects.

(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.

The monthly sampling (Reference Work Instruction GO 5.2.12.25) will follow the ASTM method for collection of dustfall. At the end of each month the jars will be collected and a clean set of jars installed. 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 will be maintained in the jars to prevent collected dust from being blown out. The distilled water in the jars will contain copper sulfate at an initial concentration of 15 mg/liter as an algicide. The 18-inch deep ASTM jar will be used for dustfall collection and is the most suitable collection jar for sampling in a desert environment; it will require less frequent checking of the water level than other, shallower jars. 2

2.2.4 Airborne Salt Concentration Sampling

Airborne salt concentration will be measured by collecting particles on a low-volume particulate sampler. Measurements will be taken from the six existing low volume samplers (Figure 2-1) currently 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. The processing of the filters will be changed to allow for the additional chemical analyses.

The primary purpose of analyzing the filters for salt concentration is to determine if there is a correlation between salt deposition (determined from the dustfall analysis) and the airborne concentration at a location. If a strong correlation exists based on the pre-operational monitoring results, the salt concentrations from earlier filters may be useable for estimating baseline salt deposition rates for the period prior to implementing the monitoring plan. Additionally, should the validity of the salt deposition data become suspect, then additional low-volume samplers may be installed at the suspect locations to provide an additional basis for an estimate of salt deposition.

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 presently collected weekly, this schedule would not change for the salt monitoring program; the filters collected during any one month will be combined and processed as one collective sample for each site. Other exceptions will include: native vegetation, which will be sampled twice each year, in March/April and in August/September; agricultural sampling and aerial photography in June/July and August/September; and soils sampled at the end of the rainy (normally February/March) and the dry seasons (July/August). The dustfall samples and low-volume sampler filters will be analyzed in the laboratory on a regular monthly schedule. Cooling tower basin water will be sampled at least quarterly to provide chemical composition data which will be used as a basis for comparison with the laboratory analyses of deposited and airborne material samples. Table 2-2 summarizes the sampling schedule for components of the program. 2

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				
Native Vegetation			X /	X				X /	X			
Crops						X /	X	X /	X			
Aerial Infrared Photography						X /	X	X /	X			
Cooling Tower Basin Water			X			X			X			X

2.3 Sample Analysis

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

Soil samples will be analyzed for the following: pH; exchangeable Na, Ca, K, Mg, and electrical conductivity, as well as for anions (in particular, $SO_4^{=}$, NO_3^-, Cl^-, F^-, $CO_3^{=}$, HCO_3^-, NH_4^+ and $PO_4^{=}$). Native vegetation and crop samples 2
will be oven-dried at 70°C for 24 hours, dry weighed, ground in a blender, and stored in Kraft paper bags prior to analyses. The dried samples will be analyzed for Na, Ca, K, Mg and for S (as $SO_4^{=}$), N (as NO_3^-), Cl^-, F^- and P (as $PO_4^{\equiv}$). For those species with measurable leaf areas, field rinses will be analyzed for the same cations and anions, and the leaf areas measured.

The chemical laboratory will analyze the collected dustfall samples 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 is to also include copper.

Finally, cooling tower basin water will be sampled and analyzed 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 as an indication of the composition of the drift (and blowdown). As a minimum, these will include: Ca, Mg, Na, K, Cl^-, NO_3^-, $SO_4^{=}$, and Si. Additionally, minor constituents shall be quantitatively assessed to the extent possible.

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

2.4 Data Review

The reported data will be examined by NUS for consistency. Suspicious data may prompt a request for a repeat analysis of the sample(s). Meteorological data will be 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 will be prepared. Data will be compared for 2
discernible differences between the control samples.

Seasonal and annual summaries will be prepared and the data examined for correlations with meteorological conditions over the period. Methods for demonstrating differences in the annual data may include changes in the chloride to sodium ratios, and isopleths of annual concentrations. The evaluation of the control and plant vicinity differences may include 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 may be 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:

- Colocated samples at each sampling location to determine sample precision;

- An observation and data record for each sample;

- The checking of the algicide concentration as an indication of sample integrity for dustfall samples;

- 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;

- Detailed written procedures for all aspects of the program

Written quality assurance procedures have been developed in accordance with the quality assurance requirements of ANPP. Those procedures currently address the collection and shipping of the samples to the selected laboratories. 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.