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

(Rev. 5)

Prepared For
Arizona Nuclear Power Project

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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 The original issue was in February 1983; a Revision 1 was prepared but never issued, being superseded by Revision 2, dated April 1983.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 operation	Seasonal data until level of impact determined

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

The monitoring program (1) determines levels of airborne salt deposition, 4
(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 3
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 approxi-
mately 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 4
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 2
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 southest 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 4
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 2
any changes in vegetation and/or soil chemistry at all nearby
agricultural fields.
- o Establish background data on salt conditions. 3
- o Provide salt deposition data that could possibly be correlated
with ongoing radiological and natural vegetation studies.
- 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 3
directions that are least frequently downwind of the cooling 2
towers) for determining background variations in salt levels in
the vicinity of PVNGS.

Figure 2-1 shows the approximate locations of the 44 sites for the monitor- 4
ing of salt deposition and soil sampling, including the 5 control locations
used to determine background changes, if any, in salt levels. Table 2-1 3
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-

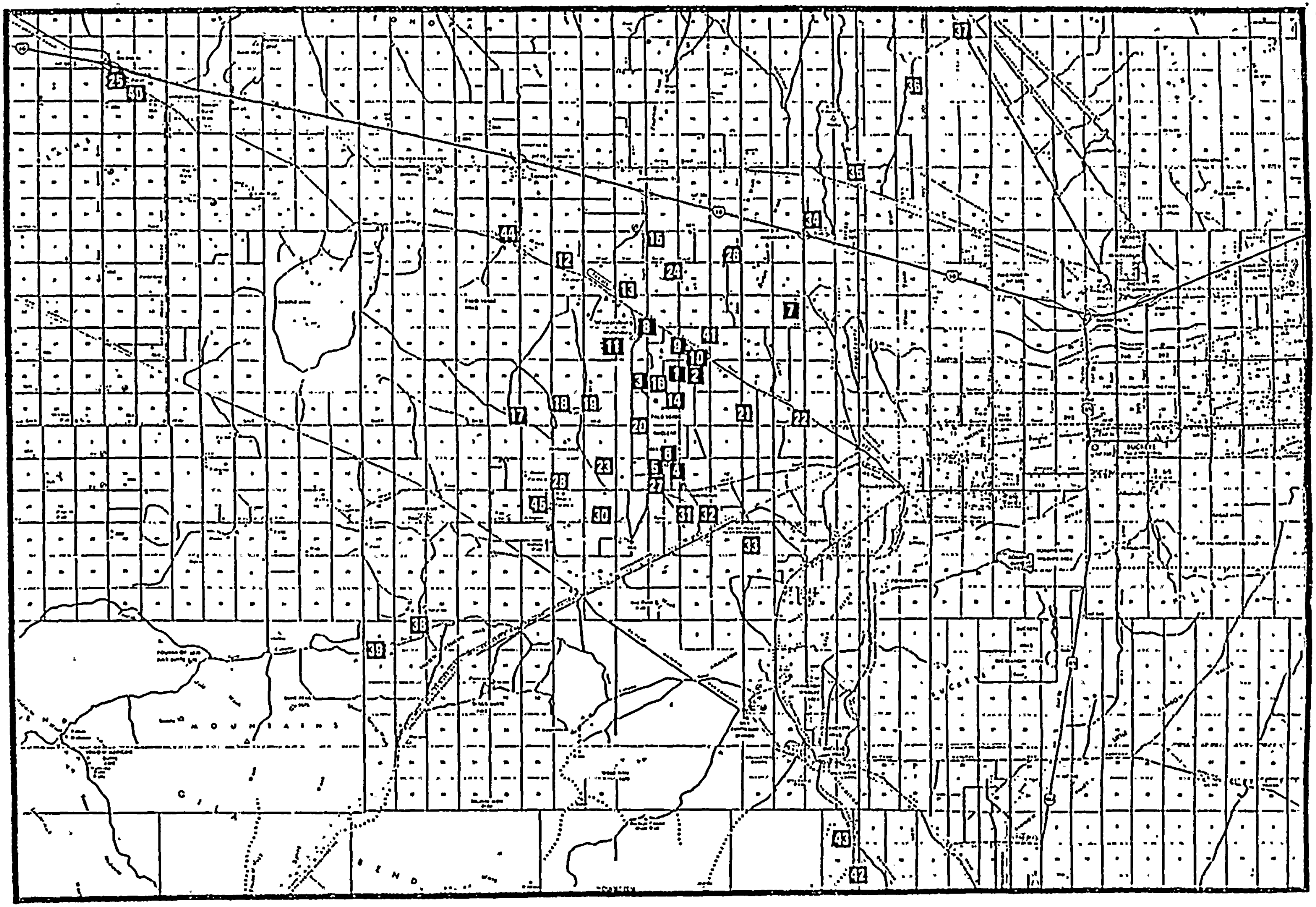

Figure 2-1
Distribution of Dustfall and Soil Sampling Locations

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
2	X	X	X			
3	X	X	X			
4	X	X	X			
5[a]	X	X				4
6	X	X	X			2
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				

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				2
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			4
45[d]	X	X		X		
Total	44	44	8	13	6	

[a]Native vegetation communities destroyed by fire in June 1983.

[b]Decommissioned during June 1984. Monitoring equipment was destroyed by agricultural activity.

[c]Established 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.

[d]Began operation in July 1984 to replace site Number 29.

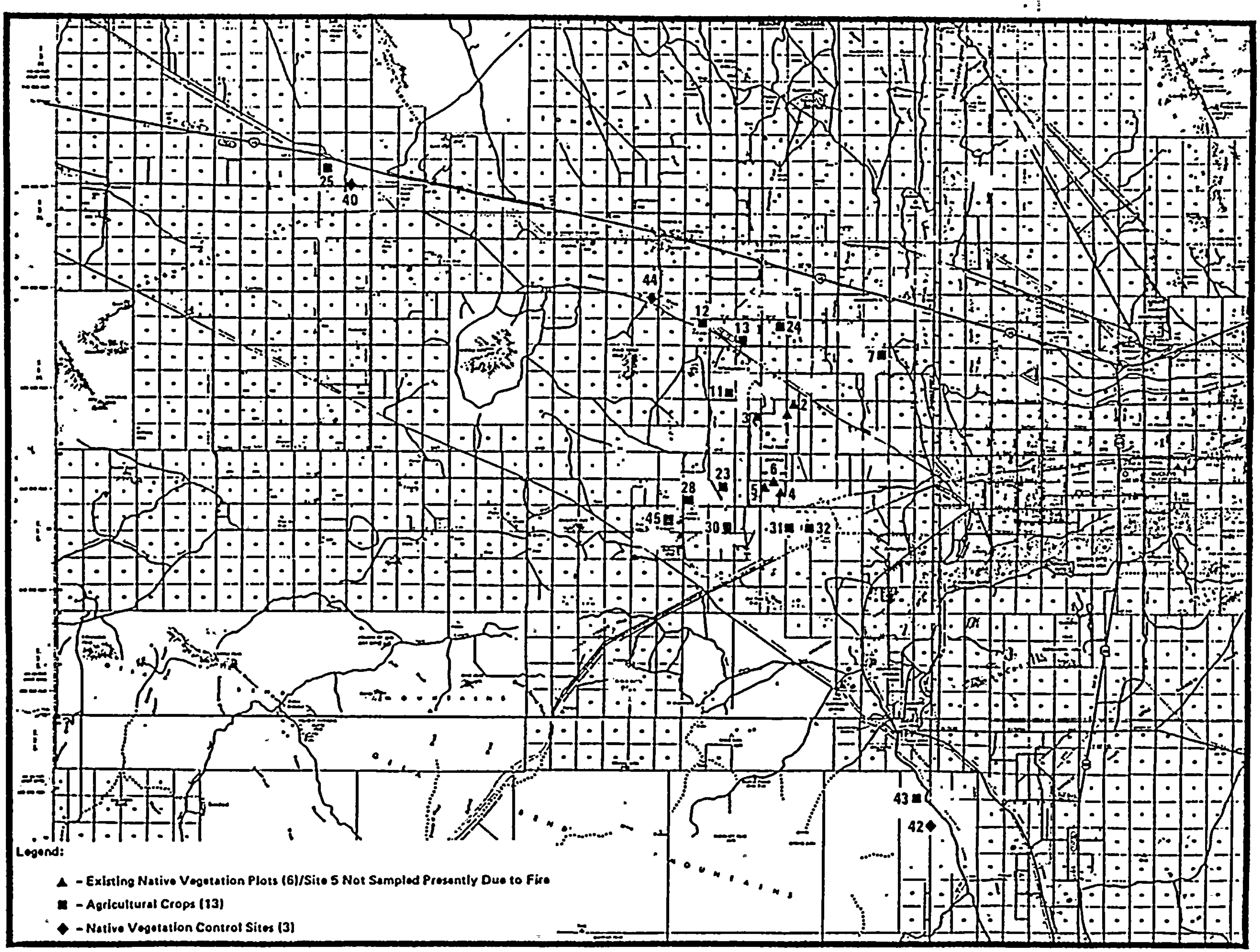

Figure 2-2
Distribution of Vegetation Sampling Locations

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volume samplers used for the station radiological monitoring program are 3
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.

At five onsite locations (1, 2, 3, 4 and 6), representative indigenous plant 4
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 dust-
fall and soils only. The locations of these five communities, shown in Fig- 3
ure 2-2, provide continuity with an ongoing baseline study of native vegeta-
tion (see Section 2.2.2.1). Soil and dustfall monitoring are also conducted
at these locations.

The monitoring program has 33 sampling locations within approximately 5 3
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.

Additional criteria used as a basis for selection of the monitoring sites 2
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 2
in the applicable work instructions are designed to assure valid data acqui-
sition. 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 4
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 cot-
ton 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

(1) Department of Energy, Environmental Measurements Laboratory, EML 2
Procedures Manual, HASL-300, New York, NY, undated.

increments for each of 2 transects) from each of which 2 samples are taken 4
and labelled. One sample of each composite is shipped to the analytical
laboratory for analysis and the other retained in storage.

2.2.2 Indigenous and Agricultural Vegetation Sampling

2.2.2.1 Native Vegetation

Representative native plant communities, which have been identified and mon-
itored since 1976 to determine baseline conditions, are sampled semi-
annually (March/April and August/September). Eight vegetative study areas 4
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 vegeta-
tive communities (Reference Work Instruction SRO 5.2.32.2) includes:

- The measurement of species richness and relative cover. 3
- The measurement of salt loading in tissues of the dominant or co- 4
  dominant flora (other than cacti).

2.2.2.2 Crop Sampling

At each of the 13 agricultural monitoring locations (Figure 2-2), agricul- 2
tural 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. Addi- 4
tionally, 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 2
and agricultural crops are monitored using infrared photography (Reference
Work Instruction SRO 5.2.32.3). Aerial photography (false color infrared) 4
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).

This methodology permits the detection of vegetative stress, confirmed by 3
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

The rate of salt deposition is measured by the collection of dustfall 3
samples which are analyzed for salt content. The dustfall sampling

(described in ASTM method D1739[2]) is accomplished by placing pairs of 3
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 5
the ASTM method for collection of dustfall, except for Section 9.1.2 (Preservation). This section, calling for the use of an algicide ($CuSO_4$) was determined to be inapplicable and unnecessary at PVNGS in April 1987.
At the end of each month the jars are collected and replaced by a clean set 3
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. 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.

2.2.4 Airborne Salt Sampling

Airborne salt concentrations are measured by collecting particles on a low- 3
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 radi- 4
ological 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 4
sampled at least quarterly to provide the chemical composition data used as a basis for comparison with the analyses of deposited and airborne material

(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.

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		4
Native Vegetation			X /	X					X /	X			
Crops						X /	X	X /	X				
Aerial Infrared Photography								X /	X				4
Cooling Tower Basin Water			X			X			X			X	

Soil samples are analyzed for the following: pH; soluble Na, Ca, K, Mg; 4
B; exchangeable Na, Ca, K, Mg; electrical conductivity; $SO_4^=$, NO_3^-, Cl^-,
F^- $CO_3^=$, HCO_3^-, NH_4^+ and $PO_4^=$. Textural analysis is performed once as part 2
of a baseline characterization for each monitoring site. Native vegetation and crop samples are analyzed for Na, Ca, K, Mg and for as $SO_4^=$, NO_3^-, Cl^-, F^- and PO_4^-.

The collected dustfall samples are analyzed for total suspended solids and 3
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.

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^-, $SO_4^=$, 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.

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. 3

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:

- 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. 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. 3