50-529 OL
50-530 OL

STAFF
Ex 10 6/12/85

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

May 16, 1985

Robert M. Lazo, Esq., Chairman
Administrative Judge
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dr. Richard F. Cole
Administrative Judge
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dr. Dixon Callihan
Administrative Judge
Union Carbide Corporation
P.O. Box Y
Oak Ridge, TN 37830

In the Matter of
ARIZONA PUBLIC SERVICE COMPANY, ET AL.
(Palo Verde Nuclear Generating Station, Units 2 and 3)
Docket Nos. STN 50-529 and STN 50-530

Dear Administrative Judges:

Attached are copies of the testimony of Dr. Edwin D. Pentecost for the hearing which is schedule to commence June 11, 1985, in Phoenix, Arizona.

Yours truly,

Lee Scott Dewey

Lee Scott Dewey
Counsel for NRC Staff

cc: Arthur C. Gehr, Esq.
Theodore W. Barudin
Atomic Safety and Licensing Board Panel
Lynne Bernabei, Esq.
Docketing and Service Section
Charles Bischoff, Esq.
Ms. Lee Hourihan
Atomic Safety and Licensing Appeal Board
Kenneth Berlin
Ron Rayner

NUCLEAR REGULATORY COMMISSION

Docket No. STN 50-529 OL Official Exh. No. 10

In the matter of Ariz Pub Service Co

Staff ✓ IDENTIFIED ✓

Applicant RECEIVED

Intervenor REJECTED

Cont'g Off'r DATE 6-12-85

Contractor Witness

Other

Reporter K Howard

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
ARIZONA PUBLIC SERVICE COMPANY, *ET AL*.	)	Docket Nos. STN 50-529 STN 50-530
	)	
(Palo Verde Nuclear Generating Station, Units 2 and 3)	)	

NRC STAFF TESTIMONY OF EDWIN D. PENTECOST
REGARDING SALT DEPOSITION FROM PVNGS
ON AGRICULTURAL CROPS

Q1. Please state your name, affiliation and position.

A1. My name is Edwin D. Pentecost. I am employed by the U.S. Nuclear Regulatory Commission, Bethesda, Maryland. I currently hold the position of Environmental Scientist in the Division of Engineering, Office of Nuclear Reactor Regulation.

Q2. Have you prepared a statement of your professional qualifications?

A2. Yes. A statement, which is identified as Attachment 1, is included with this testimony.

Q3. What is the purpose of your testimony in this proceeding?

A3. To testify whether, in my opinion, the agricultural crops grown in the vicinity of the Palo Verde Nuclear Generating Station (PVNGS) will have reduced yields or reduced marketability as a result of salt deposition emanating from the mechanical draft cooling towers at that facility.

Q4. Would you describe the farmland in the vicinity of PVNGS.

A4. Farmland within the immediate vicinity of PVNGS is comprised mainly of three soil associations.

1) Gilman - Estrella - Avondale Association - soils that are nearly level loams and clay loams on valley plains and low terraces

2) Laveen-Coolidge Association - soils that are nearly level sandy loams, loams and clay loams on old alluvial fans and valley plains

3) Casa Grande - Harqua Association - soils that are nearly level to sloping consisting of saline-alkali loams, sandy loams and gravelly clay loams or valley plains.

The high summer temperatures, low annual rainfall (x=7.35 in. based on 68 years of data for Buckeye, Arizona) and low relative humidity (13% to 69%) necessitate the use of irrigation for agricultural crop

production to be economical (U.S. Nuclear Regulatory Commission, 1975). Furrow and border irrigation are the most commonly used methods in the PVNGS vicinity. Periodic flooding of irrigated lands is needed to enhance leaching of salts from the soil root zone since salts accumulate to levels unsuitable for plant growth when the same fields are irrigated continuously. The applicant has estimated in its Environmental Report (CP) that total salt content for soils in the PVNGS area ranges from 2900 - 4300 lb/acre in the top six inches.

Q5. What types of crops have been grown in the past in the area of PVNGS?

A5. The most common agricultural crops grown near PVNGS are short-staple cotton, alfalfa, and barley. Crops of lesser importance based on acreage produced include long-staple cotton, sorghum grain, wheat, sugar beets and watermelon. To illustrate the types and amounts of crops grown near PVNGS I have prepared Attachment 2, which is included with my testimony, that lists the agricultural crop acreage within a five-mile radius of PVNGS for the period 1981-1984. The data for this attachment was compiled from records of the Maricopa County, Arizona, Office of Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture (USDA).

As can be seen in Attachment 2, total acreage for agricultural crops grown within a five mile radius of PVNGS ranged from a low of 1832 acres in 1983 to 2185 acres in 1984. Short staple cotton represented 75-80%

of this acreage for three of the four years. Alfalfa acreage comprised 13-18% of the total during the four-year period.

Attachment 3, which I have prepared and is attached to this testimony, lists agricultural crops grown within a five mile radius of PVNGS for the period 1975-1979. These data were obtained from the Arizona Department of Water Resources (DWR). The DWR data in Attachment 3 compliments the USDA data in Attachment 2 since both show that most of the same types of crops were grown in the area during the period from 1975-1984.

Q6. Why have you chosen a radius of 5 miles from PVNGS for purposes of determining potential adverse effects to agricultural crops from salt deposition caused by PVNGS?

A6. I have selected a five-mile radius for analysis of impacts since the salt deposition model which the parties have agreed to for this proceeding (i.e.: Figure 5.1-4 of the ER-OL) predicts that the greatest salt deposition will occur within approximately five miles of the center bank of the PVNGS mechanical draft towers. A five-mile radius for determining crop injury is also sufficient since the results of a 1983 University of Arizona study, which I shall refer to later in my testimony, indicates that there would be negligible impact to agricultural crops from salt drift beyond a five-miles radius.

Q7. Where is most of the agricultural land located which is within a five-mile radius of PVNGS?

A7. Over 75% of the agricultural land currently in production is located from 3 to 5 miles from PVNGS. A survey conducted by the University of Arizona in 1983 showed that most of that acreage is located southwest, south, and southeast of PVNGS within the five-mile radius. The closest farm to PVNGS is located about 1.5 miles away.

Q8. Does the agricultural land acreage presented in Attachments 2 and 3 constitute all the acreage within five miles of PNVGS that can be used for agricultural crop production in the future?

A8. No. In addition to the 2,185 acres that were actually farmed in 1984, there were another 4,274 acres that could have been farmed. There is thus a total acreage of 6,460 acres within 5 miles of PVNGS that could be irrigated and used for agricultural production in the future. This total represents approximately 12.9% of the land within a five-mile radius of PVNGS.

Q9. Where did you obtain this acreage data for land which was not farmed but which can potentially be farmed?

A9. Acreage data for land with irrigation entitlements were obtained from records at the Arizona Department of Water Resources, the state agency responsible for approving irrigation allotments. Under the 1980 Ground Water Code, Arizona Revised Statutes, Volume 15, Titles 45 and 46, landowners could file an application for approval to irrigate lands on which they had a significant capital investment. The applications were submitted to the Arizona Department of Water Resources for evaluation and approval. The data in Attachment 3 was compiled from these records.

As is the case with land currently under irrigation within five miles of PVNGS, most additional acreage which has irrigation entitlements will be located 3-5 miles southwest, south and southeast of the site.

Q10. Have there been any studies or evaluations of the effects of salt deposition on the crops grown in the vicinity of PVNGS?

A10. Yes. In 1983 the University of Arizona conducted greenhouse and field studies in an attempt to determine the impacts of salt drift on cotton, alfalfa, barley and cantaloupe. A saline drift similar in composition to that expected to be emitted from the cooling towers at PVNGS was applied to cotton, alfalfa and barley under greenhouse conditions, and to cotton, alfalfa and cantaloupe at a field site near Tucson, Arizona. Simulated saline drift was applied to crops at the following rates (based on total dissolved solids in anhydrous form):

1) No spray control (field only)

2) 0 (control sprayed with distilled water)

3) 7.4 lbs/ac/yr

4) 74 lbs/ac/yr

5) 370 lbs/ac/yr

6) 740 lbs/ac/yr (not applied in the field to cotton or cantaloupe)

Various parameters were examined throughout the studies including visual sign of leaf damage, leaf tissue chemical analyses and of greatest importance for addressing impacts, effects of salt drift on crop yields. In general, no statistically significant decreases in yield, with increasing salt drift treatment, were demonstrated in either the greenhouse or field studies for any of the crops studied. For example, there was no significant reduction on yields for salt treatment as high as 370 lbs. a year on alfalfa, barley and cantaloupe and on field grown, machine-harvested cotton. The only instance where reduced yields were apparent for lower levels of salt treatment was for hand-harvested field grown cotton where the study (at page 4) noted that 7.4 lbs./yr. could be near the level where "statistically significant reductions" to yield could be detected.

As I will explain further in my testimony, the results of this study are indicative that agricultural crops in the area of PVNGS will not have reduced yields as a result of salt deposition from PVNGS.

Q11. Were the crops used in the University of Arizona study representative of crops grown in the vicinity of PVNGS?

A11. Yes. The University of Arizona conducted field studies of cotton, alfalfa, and cantaloupe and greenhouse studies of cotton, alfalfa and barley. The study was appropriate for the crops grown in the area since, as noted in Attachments 2 and 3, cotton has been by far the number one crop in the area (82% in 1984), alfalfa has been next (17% in 1984), and a significant amount of barley has been grown in some years (11% in 1977). Wheat has also been a relatively common crop (13% in 1976) grown in the vicinity of PVNGS. Although it was not part of the University of Arizona study, results from barley experiments may be applicable to wheat given the similarity of the two species.

Q12. Have there been studies in addition to the University of Arizona study dealing with potential injury to agricultural crops caused by salt deposition from power plants?

A12. Yes. However, these other studies to date were conducted in more mesic environments and the results are not applicable to the Palo Verde site vicinity. Two studies of note (Mulchi and Armbruster, 1974 and Mulchi, et al. 1982) conducted at the Chalk Point Generating Plant, Chalk Point, Maryland, examined the effects of cooling tower salt drift on soybeans and corn. Neither study demonstrated a reduction in yield at salt drift deposition levels expected to occur within a 5-mile radius of the PVNGS. In the 1974 study, corn and soybeans grown in field plots

in Maryland were sprayed with NaCl solutions at varying concentrations for an eight-week period during a single growing season. Plants were sprayed once per week, receiving total application levels (lbs/ac) of 0, 12.96, 25.92, 51.48, and 103.76. Significant reductions in yield occurred in the 51.48 lb/ac and 103.76 lb/ac treatments for both crops when compared to controls. In the 1982 study, the impacts of salt drift from a 120m high natural-draft cooling tower on corn and soybeans grown near the Chalk Point Generating Plant were examined using brackish water (x=7,800 ppm dissolved solids) for heat disposal. Based on four years of operational data, no significant changes in Na^+ and Cl^- deposition rates occurred at or beyond the 1.6 km plots, the agricultural plots nearest the cooling tower. No significant reductions in soybean yield occurred when post-operational and preoperational data were compared. Corn had a significant reduction in yield during the post-operational period but the reduction was believed due to below normal rainfall during the 1976 and 1977 growing seasons. Rainfall for the months of June-August in 1976 and July-August in 1977 was 48 and 36%, respectively, below long-term averages for the region.

Although the Mulchi and Armbruster studies provide some data in understanding the salt deposition question for Palo Verde, they are of limited assistance. No studies other than the University of Arizona study have been conducted on the impacts of foliar salt deposition on cotton, alfalfa and barley grown in an arid environment.

Q13. Has a determination been made as to how much salt will be deposited on agricultural crops gown in the vicinity of the PVNGS?

A13. The Licensing Board's July 23, 1984 Order requires that the calculations set forth in Joint Applicants' Environmental Report are the predictions which must be utilized for determining the amounts of salt deposition from PVNGS in this proceeding. These predictions, which are found in Figure 5.1-4 in Applicants' ER-OL, are based upon a computer modeling program which is commonly referred to as the FOG model. Staff had previously reviewed these predictions for PVNGS and found them to be reasonable. Their reliability is also established by a July 15, 1983 Study prepared by W. E. Dunn which concluded that the FOG Model falls into a category of salt deposition models which could be classified as "better performing".

For purposes of applying the results in Joint Applicants' Environmental Report to this proceeding, I have prepared Attachment 4 which shows total solids deposition anticipated within a 5-mile radius of PVNGS. This Attachment, which is a modification of Figure 5.1-4 of Applicants' ER-OL, depicts the location of agricultural lands during 1983. As shown in this Attachment, agricultural areas presently being farmed will be exposed to total solids deposition levels ranging from less than 1 to less than 5 lbs/ac/yr. There is some potential agricultural land northeast and southwest of the site that can be subjected to up to 10 lbs/ac/yr.

Q14. Based upon the results of the University of Arizona study and the amounts of salts projected to be deposited on the crops in the vicinity of the PVNGS, what are your conclusions regarding possible crop injury caused by the PVNGS facility once all three units are operating?

A14. I conclude that impacts resulting in a reduction in yield or marketability of crops grown in the area are not likely to occur. The 1983 University of Arizona Study supports this conclusion since, with the exception of hand-harvested field cotton, it showed no statistically significant reduction on crop yields which were subjected to very high levels of salt solution. In fact, the salt application levels in the Study are at least 10 times greater than the offsite salt drift deposition rates expected once all three units are operational at PVNGS.

In addition to the University of Arizona Study, Applicants' September 29, 1983 Salt Deposition and Impact Monitoring Plan for PVNGS (included with my testimony as Attachment 5) provides a basis for determining whether agricultural crops will be damaged by salts emitted from the facility. Staff will review the annual monitoring report and make a determination of level of impacts and evaluate the need for revisions to the monitoring program. If crop damage is detected by the Monitoring Plan, then Joint Applicants are required to report such damage and take appropriate action pursuant to the provisions of § 5.4.1 of the Palo Verde Nuclear Generating Station, Unit 1, Environmental Protection Plan, which provides that "...If

harmful effects or evidence of trends towards irreversible damage to the environment are observed, the licensees shall provide a detailed analysis of the data and a proposed course of action to alleviate the problem."

The Salt Deposition and Impact Monitoring Plan for PVNGS is, of course, important since there presently is a lack of operational data for nuclear power plants operating in an arid environment. This plan is now in place since it has been made a part of the Environmental Protection Plan for Palo Verde Unit 1.

Q15. Have there been any proposed changes to the Salt Deposition and Impact Monitoring Plan for PVNGS?

A15. Yes. In accordance with section 4.2.2 of Appendix B of the PVNGS Unit 1 Operating License, the applicant has notified the NRC of changes to the existing monitoring plan (submitted by letter dated September 29, 1983 from E. E. Van Brunt, Jr., Arizona Public Service Company to G. W. Knighton, U. S. Nuclear Regulatory Commission) in letters dated March 29, 1985 and May 3, 1985, E. E. Van Brunt, Jr. to G. W. Knighton. This March 29, 1985 letter is included with my testimony as Attachment 6 and this May 3, 1985 letter is Attachment 7. The changes to the existing program set out with these letters can be summarized as follows:

(1) monitoring location changes because of a rangeland fire at one native vegetation sampling station, destruction of a sampling station by agricultural activity and conversion of a station site from native vegetative to agricultural use,

(2) several minor procedural changes in soil sampling analysis,

(3) deletion of the foliar salt deposition study, and

(4) limiting agricultural yield sampling only to cotton.

I have evaluated the changes and conclude that proposed changes 1 through 3 are justified. Changes in the location of the two native vegetative sampling stations and one agricultural station (Change 1) will be needed to provide an adequate number of stations for data comparison between years. The soil sampling procedural changes (Change 2) allow for a better determination of salt migration through the plant root zone and to provide a mechanism for monitoring salt deposition in cotton fields due to the use of salt as a defoliant prior to harvest. The elimination of the foliar salt deposition study (Change 3) is warranted given the high variability between stations caused by dust generated by nearby vehicles or from cultivation and local wind effects on foliar deposition prior to sampling. I await additional information before drawing any conclusions on limiting yield measurements of agricultural crops to cotton in the vicinity of PVNGS (Change 4).

PROFESSIONAL QUALIFICATIONS

Dr. Edwin D. Pentecost
U.S. Nuclear Regulatory Commission
Washington, D. C.

I am presently employed as an Environmental Scientist in the Environmental & Hydrologic Engineering Branch, Division of Engineering, U.S. Nuclear Regulatory Commission (NRC). In this position I provide land use and terrestrial ecology input to the environmental reviews relative to nuclear power plant licensing. As part of this work I also conduct reviews of terrestrial ecology monitoring programs at operating nuclear power plants. During my employment with the NRC which commenced in January 1982, I have also held the positions of Land Use Analyst and Program Assistant. In the latter position I provided administrative support to the Director, Division of Engineering in the areas of budget preparation, work schedule tracking, technical contract administration and personnel for 120 staff members.

Prior to joining the NRC, I was a supervisory biological scientist from 1979-1982 with the Office of Surface Mining, U.S. Department of Interior at the Kansas City Regional Office of the Division of Technical Services and Research. This position involved the supervision of six biological scientists engaged in projects associated with coal mine regulatory programs. My responsibilities were centered on the review and approval of coal mine plans on federal lands, reviews of state abandoned mine and active mining regulatory programs, and providing technical assistance to coal companies. From 1974-1979 I was a terrestrial ecologist in the Division of Environmental Impact Studies at Argonne National Laboratory. In this position I wrote various terrestrial biology and land use sections of impact statements prepared for the NRC on nuclear power plant construction and uranium milling operations. I was also a principal investigator for wildlife studies at two coal research sites as a member of Argonne's Land Reclamation Program. My background also incluses academic experiences when I taught general biology, zoology and ecology in the South Bend Indiana Community School System (1963-1966), the University of Illinois (1970), and the University of Wisconsin - Stevens Point (1972-1974).

I received a Ph.D. degree in zoology from the University of Illinois - Urbana in 1972, and an M.S. and B.A. degree in biology from Ball State University in 1967 and 1963, respectively.

I am a member of the Society of Sigma Xi, the Ecological Society of America, the Wildlife Society and the National Wildlife Federation. My professional interests are currently in applied ecology as related to terrestrial ecosystems, particularly land reclamation and wildlife biology.

Publications

Pentecost, E., 1974, Behavior of Eumeces laticeps exposed to a thermal gradient, J. Herpetology 8(2):169-173.

Pentecost, E. and R. C. Vogt, 1976, Amphibians and reptiles of the Lake Michigan Drainage Basin, Status of the Lake Michigan Drainage Basin, ANL/ES-40. Vol. 16, Argonne National Laboratory, 69 p.

Pentecost, E. D. and I. P. Murarka. 1976. An Evaluation of Environmental Data Relating to Selected Nuclear Power Plant Sites: The Three Mile Island Nuclear Station Site. ANL/ES-4. Argonne National Laboratory, 8 p.

Murarka, I. P., Ferrante, J. G., Daniels, E. W. and E. D. Pentecost, 1976. An Evaluation of Environmental Data Relating to Selected Nuclear Power Plant Sites: Prairie Island Nuclear Generating Plant Site. ANL/EIS-6. Argonne National Laboratory, 54 p.

Dvorak, A. J. and E. D. Pentecost (Project Leaders). 1977. Assessment of the Health and Environmental Effects of Power Generation in the Midwest. Vol. II. Ecological Effects. ANL/ES-00. Argonne National Laboratory. 169 p.

Pentecost, E. C. 1978. A comparison of small mammal populations of a native Atriplex - Artemisia grassland community and a surface-mined reclamation area in the Red Desert of Wyoming. Bull. New Mexico Acad. Sci. 18(1):32.

Pentecost, E. C. and R. C. Stupka. 1979. Wildlife investigations at a coal refuse reclamation site in Southern Illinois. Addendum to Proceedings Symposium Fish/Wildlife Needs on Coal Surface-Mined Areas. Fish and Wildlife Service Office of Biological Services. FWS/OBS-78/81 A, pp. 107-118.

Dvorak, A. J. (Project Leader). 1977. The Environmental Effects of Using Coal for Generating Electricity. Prepared by Argonne National Laboratory for U.S. Nuclear Regulatory Commission. NUREG-0252.

Dvorak, A. J. and B. G. Lewis (Project Leaders). 1978. Impacts of coal-fired power plants on Fish, Wildlife and their Habitats. U.S. Department of Interior. Fish and Wildlife Service. Biological Services Program. FWS/OBS-78/29. 261 p.

Professional Paper Presentations:

April 1978	Paper presented at Rocky Mt. Division of AAAS Annual Meeting in Albuquerque, entitled, "A comparison of small mammal populations of a native Atriplex - Artemisia grassland community and a surface-mined reclamation area in the Red Desert of Wyoming.
December 1978	Paper presented at Symposium on Surface Mining Fish/Wildlife Needs in the Eastern United States in Morgantown, West Virginia, entitled, "Wildlife investigations at a coal refuse reclamation site in Southern Illinois."
April 1980	Paper presented at the 13th Argonne Universities Association/ Argonne National Laboratory Biology Symposium entitled, "Habitat restoration and wildlife utilization of coal-surface mined lands."
June 1980	Lecture presented at Argonne National Laboratory for Summer College Faculty Institute. Title - Environmental Aspects of Uranium Mining and Milling.
November 1980	Paper presented at meeting of Kansas Energy Advisory Council entitled, "Mined land reclamation requirements."

Table 1a. Agricultural Crop Acreage Within
Five Miles of Palo Verde Nuclear Generating Station

	1981						1982					
	Distance (mi) from PVNGS*						Distance (mi) from PVNGS					
Crop	1-2	2-3	3-4	4-5	Total	% Total	1-2	2-3	3-4	4-5	Total	% Total
Short-Staple Cotton	104.9	62.1	478.8	915.8	1561.6	74.5	85.6	57.9	438.4	939.5	1521.4	77.2
Long-Staple Cotton	-	-	26.0	72.9	98.9	4.7	-	-	25.2	73.0	98.2	5.0
Wheat	-	-	-	63.2	63.2	3.0	-	-	-	-	-	-
Alfalfa	-	222.3	34.8	80.5	337.6	16.1	-	222.3	34.8	94.4	351.5	17.8
Sugar Beets	-	-	-	36.0	36.0	1.7	-	-	-	-	-	-
Total:	104.9	284.4	539.6	1168.4	2097.3		85.6	280.2	498.4	1106.9	1971.1	

* distance interval from center bank of cooling towers at PNVGS

Table 1b. Agricultural Crop Acreage Within
Five Miles of Palo Verde Nuclear Generating Station

	1983						1984					
	Distance (mi) from PVNGS*						Distance (mi) from PVNGS					
Crop	1-2	2-3	3-4	4-5	Total	% Total	1-2	2-3	3-4	4-5	Total	% Total
Short-Staple Cotton	15.7	95.4	299.1	615.3	1070.7	58.4	21.2	212	570.4	972.3	1775.9	81.3
Long-Staple Cotton	-	-	60.2	72.8	133.0	7.3	-	-	30.0	-	30.0	1.4
Wheat	-	-	-	-	-	-	-	-	-	-	-	-
Alfalfa	-	174.2	-	60.5	234.7	12.8	-	174.2	73.5	65.5	313.2	14.3
Sugar Beets	-	-	-	-	-	-	-	-	-	-	-	-
Sorghum-Grain	15.0	-	37.0	-	52.0	2.8	30.8	-	-	-	30.8	1.4
Barley	-	-	284.9	-	284.9	15.6	-	-	35.9	-	35.9	1.6
Watermelon	-	-	56.8	-	56.8	3.1	-	-	-	-	-	-
Total:	30.7	269.6	738.0	784.6	1832.1		52.0	386.2	709.8	1037.8	2185.8	

* distance intervals from center bank of cooling towers at PVNGS

Table 2a. Acreage in Agricultural Crop Production
Within Five Miles of the Palo Verde Nuclear Generating Station

	1975						1976					
	Distance (mi) from PVNGS*						Distance (mi) from PVNGS					
Crop	1-2	2-3	3-4	4-5	Total	% Total	1-2	2-3	3-4	4-5	Total	% Total
Short-Staple Cotton	250	13	384	893.6	1540.6	52.2	250	168.5	575	1055.6	2049.1	55.6
ELS Cotton	-	-	-	-	-	-	-	-	-	-	-	-
Alfalfa	-	-	70	424	494	16.8	-	-	70	315	385	10.4
Barley	-	-	147	155	302	10.2	-	-	76	114	190	5.2
Wheat	-	-	18	96	114	3.9	-	-	51	445	496	13.5
Sugar Beets	-	-	84	31	115	3.9	-	-	65	56	121	3.3
Safflower	-	-	-	-	-	-	-	-	-	-	-	-
Pasture	13.1	57.1	14.5	22	106.7	3.6	13.1	70.1	14.5	24	121.7	3.3
Bermuda Grass	-	-	-	9	9	0.3	-	-	-	14.0	14.0	0.4
Sudan Grass	-	-	-	-	-	-	-	-	-	15.0	15.0	0.4
Sorghum	-	-	-	-	-	-	-	-	-	-	-	-
Grain Sorghum	-	-	-	-	-	-	-	-	-	-	-	-
Milo	-	-	-	-	-	-	-	-	-	15	15	0.4
Corn	-	270	-	-	270	9.1	-	270	-	-	270	7.3
Millet	-	-	-	-	-	-	-	-	-	-	-	-
Pecan Trees	-	-	-	-	-	-	-	-	-	-	-	-
Fruit Trees	-	-	-	2	2	_0.1	-	-	-	2	2	_0.1
Jojoba	-	-	-	-	-	-	-	-	-	-	-	-
Other**	-	-	-	-	-	-	-	8	-	-	8	0.2
Total:	263.1	340.1	717.5	1632.6	2953.3		263.1	516.6	851.5	2055.6	3686.8	

* Based on data from the Arizona Department of Water Resources; no acreage in production within 1-mile radius of PVNGS.
** Consisted of small mixed-crop acreage comprised of shrubs, miscellaneous fruit trees, grapes, etc.

Table 2b. Acreage in Agricultural Crop Production Within Five Miles of the Palo Verde Nuclear Generating Station

	1977						1978					
	Distance (mi) from PVNGS*						Distance (mi) from PVNGS					
Crop	1-2	2-3	3-4	4-5	Total	% Total	1-2	2-3	3-4	4-5	Total	% Total
Short-Staple Cotton	407	217.2	395	1919.5	2938.7	60.4	407	255.9	648	1821.7	3132.6	68.6
ELS Cotton	-	-	-	48	48.0	1.0	-	-	-	78	78	1.7
Alfalfa	-	190	70	297	557	11.5	-	255	101	190.5	546.5	12.0
Barley	-	112.4	77	384	573.4	11.8	-	-	47	77	124	2.7
Wheat	-	-	42	200	242	5.0	-	-	-	113	113	2.5
Sugar Beets	-	-	58	54	112	2.3	-	-	37	24	61	1.3
Safflower	-	-	-	32	32	0.7	-	157.1	70	-	227.1	5.0
Pasture	13.1	57.1	14.5	24	108.7	2.2	13.1	57.1	18.5	33	121.7	2.6
Bermuda Grass	70	-	-	14	84	1.7	70	-	-	13.3	83.3	1.8
Sudan Grass	-	-	-	-	-	-	-	-	-	4	4	<0.1
Sorghum	-	65	-	-	65	1.3	-	-	-	-	-	-
Grain Sorghum	-	-	78	-	78	1.6	-	39.1	-	-	39.1	0.9
Milo	-	-	-	-	-	-	-	-	-	-	-	-
Corn	-	-	-	15	15	0.3	-	-	-	15	15	0.3
Millet	-	-	-	-	-	-	-	-	-	-	-	-
Pecan Trees	-	-	-	-	-	-	5.0	-	-	-	5	0.1
Fruit Trees	-	-	-	2	2	<0.1	-	-	-	2	2	<0.1
Jojoba	-	-	-	-	-	-	0.5	-	-	-	0.5	<0.1
Other**	-	8	-	-	8	0.2	-	13	-	-	13	0.3
Total:	490.1	649.7	734.5	2989.5	4863.8		495.6	777.2	921.5	2371.5	4565.8	

* Based on data from the Arizona Department of Water Resources; no acreage in production within 1-mile radius of PVNGS.

** Consisted of small mixed-crop acreage comprised of shrubs, miscellaneous fruit trees, grapes, etc.

Table 2c. Acreage in Agricultural Crop Production
Within Five Miles of the Palo Verde Nuclear Generating Station

1979

Crop	Distance (mi) from PVNGS* 1-2	2-3	3-4	4-5	Total	% Total
Short-Staple Cotton	407	272.1	587	1958.5	3224.6	65.5
ELS Cotton	-	-	-	-	-	-
Alfalfa	-	255	90	224.3	569.3	11.6
Barley	-	-	-	89	89	1.8
Wheat	-	-	-	60	60	1.2
Sugar Beets	-	73.6	60	20	153.6	3.1
Safflower	-	305.4	116	87	508.4	10.3
Pasture	13.1	57.1	59.5	25	154.7	3.1
Bermuda Grass	70	-	-	-	70	1.4
Sudan Grass	-	-	-	15	15	0.3
Sorghum	-	-	-	-	-	-
Grain Sorghum	-	-	-	-	-	-
Milo	-	-	-	15	15	0.3
Corn	-	-	-	-	-	-
Millet	-	-	28	-	28	0.6
Pecan Trees	5	8	-	-	13	0.3
Fruit Trees	-	-	-	2	2	0.1
Jojoba	-	-	-	-	-	-
Other**	-	20	-	-	20	0.4
Total:	495.1	991.2	940.5	2495.8	4922.6	

* Based on data from the Arizona Department of Water Resources; no acreage in production within 1-mile radius of PVNGS.

** Consisted of small mixed-crop acreage comprised of shrubs, miscellaneous fruit trees, grapes, etc.

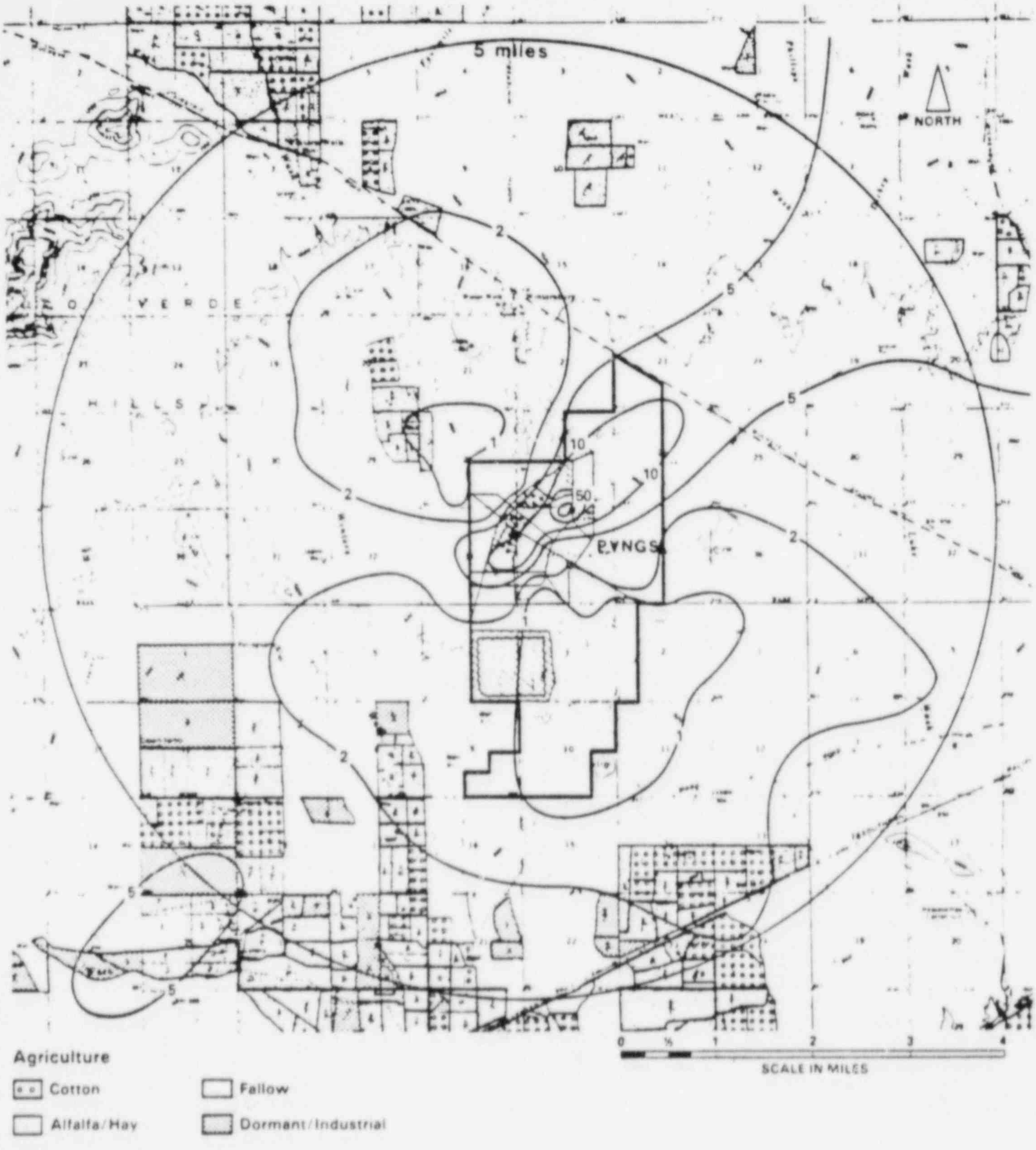


Figure 2. Agricultural Land and Total Solids Deposition (lbs/ac/yr) in the Vicinity of PVNGS

Attachment 5

Arizona Public Service Company
P.O. BOX 21666 • PHOENIX, ARIZONA 85036

September 29, 1983
ANPP-27921 - WFQ/MAJ

Director of Nuclear Reactor Regulation
Attention: Mr. George Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Palo Verde Nuclear Generating Station
(PVNGS) Units 1, 2 and 3
Docket Nos. STN-50-528/529/530
File: 83-056-026; G.1.01.10

Dear Mr. Knighton:

Arizona Public Service Company, as Project Manager and Operating Agent for Palo Verde Nuclear Generating Station Units 1, 2 and 3, (PVNGS), is submitting herewith the Salt Deposition and Impact Monitoring Plan for PVNGS, Revision 3, dated July, 1983, for your information.

If you have any questions, please call me.

Very truly yours,

E. E. Van Brunt

E. E. Van Brunt, Jr.
APS Vice President,
Nuclear Projects
ANPP Project Director

EEVBJr/MAJ/sp
Attachment

cc: E. A. Licitra (w/a)
E. Pentecost "
L. Dewey "
A. C. Gehr "

B001
1/1

September 29, 1983
ANPP-27921 - WFO/MAJ

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, Edwin E. Van Brunt, Jr., represent that I am Vice President Nuclear Projects of Arizona Public Service Company, that the foregoing document has been signed by me on behalf of Arizona Public Service Company with full authority so to do, that I have read such document and know its contents, and that to the best of my knowledge and belief, the statements made therein are true.

Edwin E. Van Brunt, Jr.

Edwin E. Van Brunt, Jr.

Sworn to before me this 30th day of September, 1983.

Nora E. Meador

Notary Public

My Commission expires:

My Commission Expires April 6, 1987

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

(Rev. 3)

Prepared For
Arizona Public Service

Prepared By
NUS Corporation
910 Clopper Road
Gaithersburg, Maryland

July 1983

Table of Contents

2

i

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.

List of Tables

List of Figures

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.

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 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: 2

- Measure site originated deposition via dustfall collection, and any changes in vegetation and/or soil chemistry at all nearby agricultural fields
- Establish background data on salt conditions
- Provide salt deposition data that could possibly be correlated with ongoing radiological and natural vegetation studies

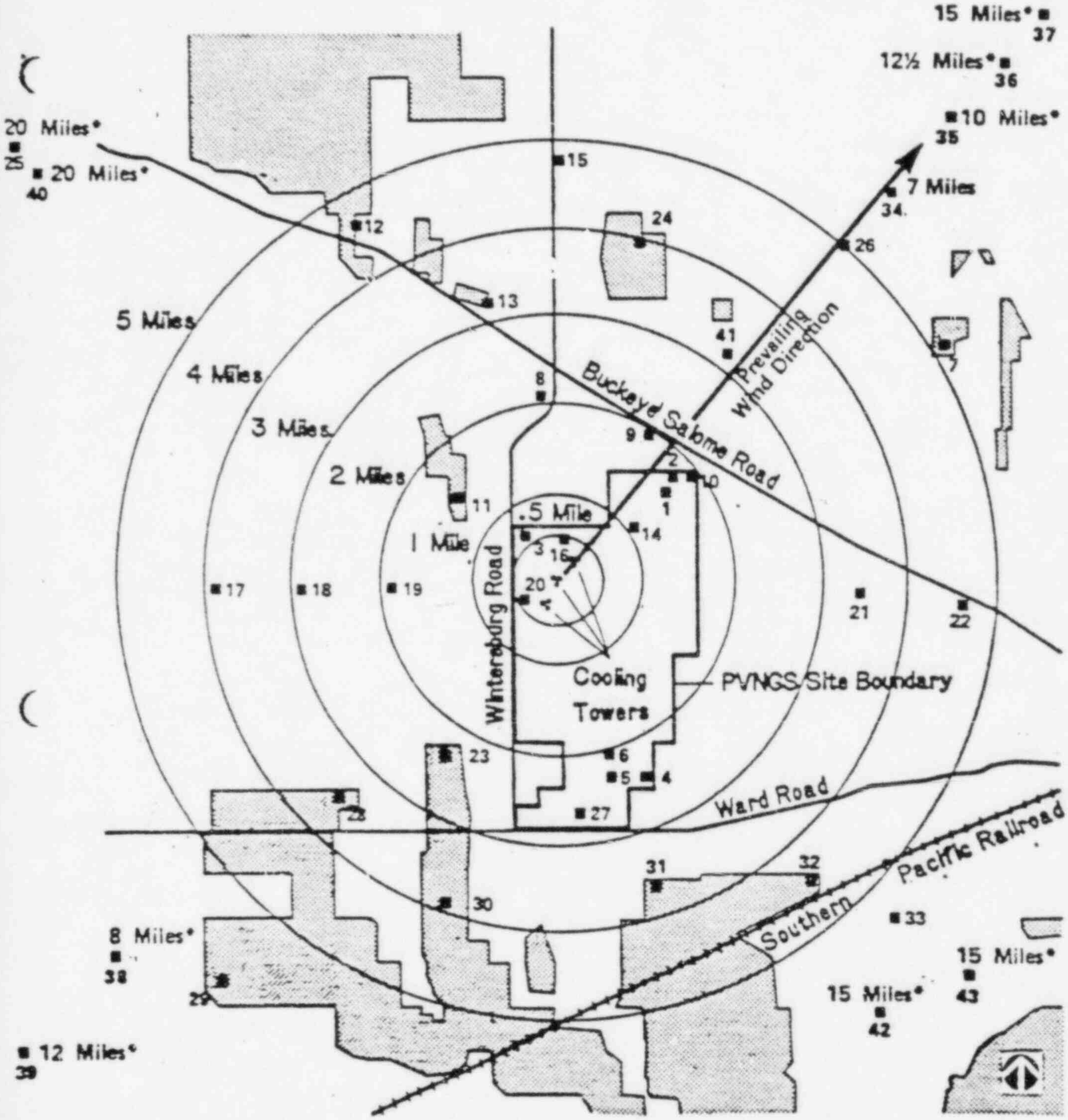
- Demonstrate that the monitoring program can detect site-originated salt deposition and determine the geographical limit of detection

- 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



Agricultural Land

■ — Soil and Dustfall Sampling Locations

Existing Low Volume Locations are Numbers 8, 9, 10, 20, 21, and 27

* — Not to Scale

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

Revision 3

June 1, 1983

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

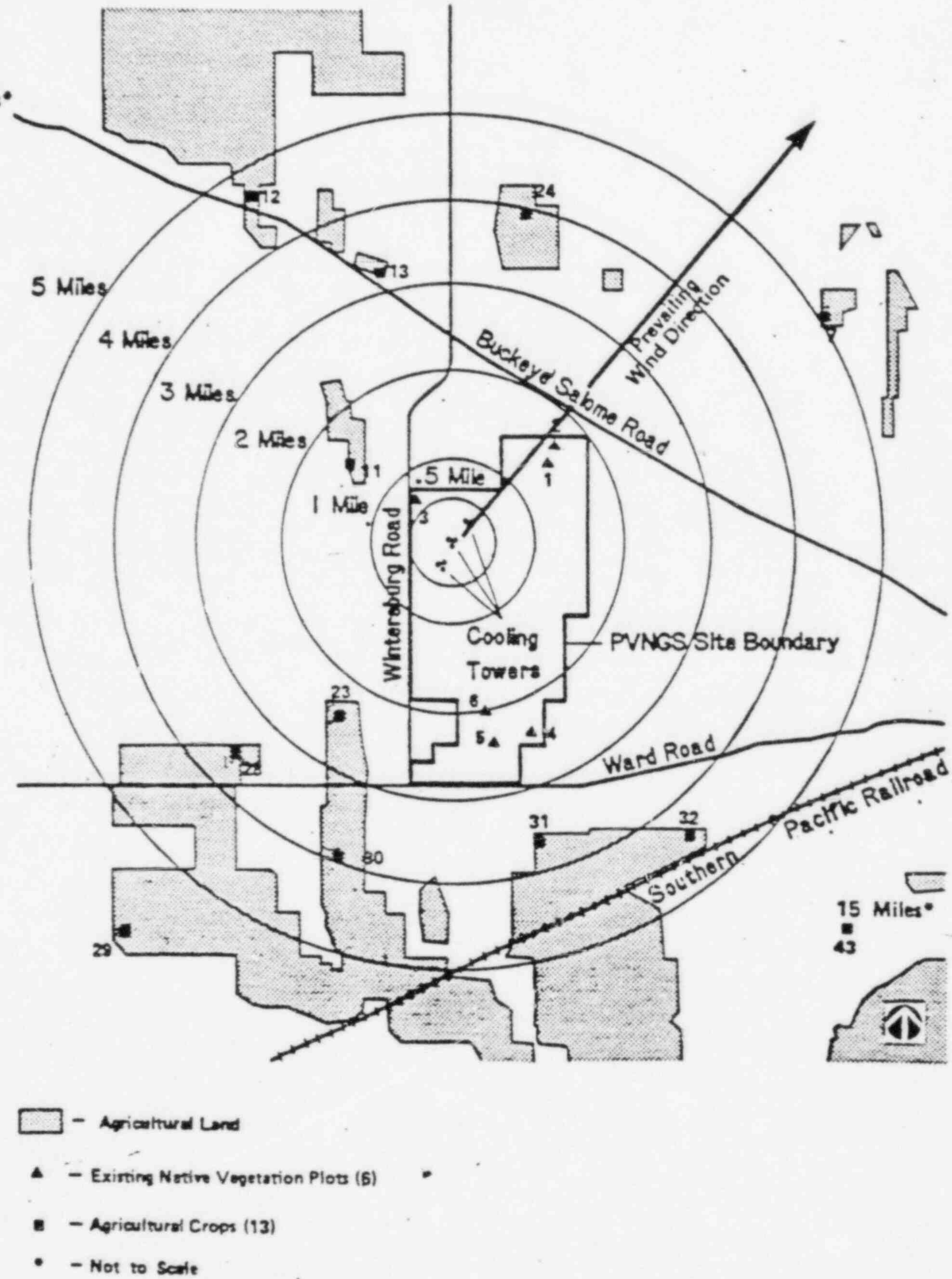


Figure 2-2. Distribution of Vegetation Sampling Locations

Revision 3

June 1, 1983

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

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

2.2 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.

(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 2
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.

2.2.3 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.

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 consis-
tent 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.

Attachment 6

Arizona Nuclear Power Project

P O BOX 52034 • PHOENIX, ARIZONA 85072-2034

ANPP-32275-EEVB/WFQ
March 29, 1985

Director of Nuclear Reactor Regulation
Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Docket Nos. STN 50-528(License No. NPF-34)/529/530
Salt Drift Monitoring
File: 85-004-419.06

Dear Mr. Knighton:

In accordance with the requirements of section 4.2.2 of Appendix B of the Palo Verde Nuclear Generating Station (PVNGS) Unit 1 Operating License, changes have been made to the Salt Deposition and Impact Monitoring Plan submitted by letter dated September 26, 1983 from E. E. Van Brunt, Jr., Arizona Public Service Company, to G. W. Knighton, U.S. Nuclear Regulatory Commission. These changes do not affect the program objectives described in the introduction of the Monitoring Plan. The enclosure describes the changes made, the reasons for making the changes and the effect on the continuity of the study.

If you have any questions or require further information, please contact Mr. W. F. Quinn of my staff at (602) 943-7200 extension 4087.

Very truly yours,

E. E. Van Brunt

E. E. Van Brunt, Jr.
Executive Vice President
Project Director

EEVB/MLC/mb
Enclosure

cc: R. P. Zimmerman
E. A. Licitra
A. C. Gehr

8504050189 850329
PDR ADOCK 05000528
P PDR

CHANGES MADE TO THE SALT DEPOSITION AND IMPACT MONITORING PLAN FOR THE PALO VERDE NUCLEAR GENERATING STATION UNITS 1, 2, and 3, REVISION 3 SINCE JULY 1983

1. Monitoring Location Changes

   a. During June 1983, the native vegetation communities at Monitoring Site No. 5 were destroyed by fire. Site No. 5 was then and is currently maintained as a sampling site for dustfall and soils only.

   b. During May 1984, Site No. 44 was established as a native vegetation (saltbush) control site. Site No. 44 is located approximately 7 miles to the northwest of the PVNGS cooling towers.

      The saltbush (Atriplex Polycarpa) plant community in the vicinity of existing native vegetation control Site No. 42 was tilled and the site converted to agricultural use sometime prior to May 1984. A survey of the land area which met the criteria of a control site was conducted and the result was the establishment of Site No. 44 as the new control site for the saltbush.

   c. During June 1984, monitoring equipment at Site No. 29 was destroyed by agricultural activity. It was necessary to decommission this site and establish another representative agricultural site in the nearby vicinity. Site No. 45 was then established approximately 5000 feet to the north of Site No. 29. Site No. 45 began operation in July 1984.

   None of the changes described in item 1a-c will affect the continuity of the study.

2. Soil Sampling Analysis Changes

   a. In November 1983, textural analysis of soil samples was initiated and was completed in March 1984. Textural analysis are performed once for each of the monitoring sites in order to physically characterize the soils at each sampling location.

   b. In November 1983, split vertical column sampling of soils commenced. 12 inch deep core samples are taken and divided into upper and lower segments. The depth to 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.

      The purpose of performing the split vertical soil column sampling is to define better any salt migration through the column.

   c. Post-defoliation soil sampling was initiated in November 1983. This sampling is conducted at agricultural monitoring sites after the crops (usually cotton) grown at these locations have been defoliated. This sampling is desirable to assess the potential effect on soil salt concentration of the application of crop defoliants which may contain significant concentrations of soluble salts.

   None of the changes described in items 2a-c will affect the continuity of the study.

3. Vegetation Sampling/Analysis Changes

   a. Beginning with the 1984 agricultural sampling season, only cotton yield was determined by field sampling since that crop was the most significant crop grown within a 10-mile radius of PVNGS.

      This change does not affect the continuity of the study.

Attachment 7

Arizona Nuclear Power Project
P.O. BOX 52034 • PHOENIX, ARIZONA 85072-2034

Director of Nuclear Reactor Regulation
Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ANPP-32547-EEVB/WFQ
May 3, 1985

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Docket Nos. STN 50-528(License No. NPF-34)/529/530
Salt Drift Monitoring
File: 85-004-419.06; 85-056-026

Dear Mr. Knighton:

In accordance with the requirements of section 4.2.2 of Appendix B of the Palo Verde Nuclear Generating Station (PVNGS) Unit 1 Operating License, an additional change to discontinue foliar deposition analysis has been made to Revision 3 of the Salt Deposition and Impact Monitoring Plan. This change does not affect the program objectives described in the introduction of the Monitoring Plan. Enclosure 1 provides the changed pages of the Monitoring Plan. Enclosure 2 provides the justification for the discontinuance of foliar deposition analysis.

If you have any questions or require further information, please contact Mr. W. F. Quinn of my staff at (602) 943-7200 extension 4087.

Very truly yours,

E. E. Van Brunt

E. E. Van Brunt, Jr.
Executive Vice President
Project Director

EEVB/WFQ/mb
Enclosures

cc: R. P. Zimmerman (w/e)
E. A. Licitra (w/e)
A. C. Gehr (w/e)

Arizona Nuclear Power Project
P.O. BOX 52034 • PHOENIX, ARIZONA 85072-2034

Director of Nuclear Reactor Regulation
Mr. George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

ANPP-32547-EEVB/WFQ
May 3, 1985

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Docket Nos. STN 50-528(License No. NPF-34)/529/530
Salt Drift Monitoring
File: 85-004-419.06; 85-056-026

Dear Mr. Knighton:

In accordance with the requirements of section 4.2.2 of Appendix B of the Palo Verde Nuclear Generating Station (PVNGS) Unit 1 Operating License, an additional change to discontinue foliar deposition analysis has been made to Revision 3 of the Salt Deposition and Impact Monitoring Plan. This change does not affect the program objectives described in the introduction of the Monitoring Plan. Enclosure 1 provides the changed pages of the Monitoring Plan. Enclosure 2 provides the justification for the discontinuance of foliar deposition analysis.

If you have any questions or require further information, please contact Mr. W. F. Quinn of my staff at (602) 943-7200 extension 4087.

Very truly yours,

E. E. Van Brunt

E. E. Van Brunt, Jr.
Executive Vice President
Project Director

EEVB/WFQ/mb
Enclosures

cc: R. P. Zimmerman (w/e)
E. A. Licitra (w/e)
A. C. Gehr (w/e)

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, Edwin E. Van Brunt, Jr., represent that I am Executive Vice President, Arizona Nuclear Power Project, that the foregoing document has been signed by me on behalf of Arizona Public Service Company with full authority to do so, that I have read such document and know its contents, and that to the best of my knowledge and belief, the statements made therein are true.

Edwin E. Van Brunt

Edwin E. Van Brunt, Jr.

Sworn to before me this 3 day of May, 1985.

Nora E. Mesder
Notary Public

My Commission Expires:

My Commission Expires April 6, 1987

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 within the six vegetative communities (Reference Work Instruction SRO 5.2.32.2) will include: 2

- 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.

2.3 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 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. 2

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.

DISCONTINUANCE OF FOLIAR DEPOSITION ANALYSIS

The determination of foliar deposition on native and cultivated vegetation is being discontinued. This determination involves the measurement of salts on selected leaf surfaces by rinsing the leaves in distilled water and analyzing the rinsate, and the measurement of leaf areas to obtain estimates of deposition per unit area. It was initially proposed as a direct measure of the contribution of the plant drift to the salt burden in plant tissue by the airborne deposition route. Based on the results available to date, it is recognized as uncorrelated with ambient dustfall results, and unreliable as an indicator of foliar burden because of the infrequent sampling.

Dustfall samples represent a continuous record of deposition over a period of a month, and over the course of a year probably record over 95% of the sampled material, the losses occurring during sample collection and jar changing intervals. Crop tissues which are sampled for analysis twice during the growing season also "integrate" their exposure to foliar deposition as well as to ions taken up through their roots. However, the deposition measured on leaf surfaces can only be described as representative of an unknown history.

Foliar deposition sampling takes place on only two days out of a more than 200 day growing season; thus the statistical power of the samples as representative of the entire growing season is very small. The quantity of foliar deposition measured is a very strong function of local occurrences over the relatively brief period immediately preceeding the sampling. For example, the passage of farm machinery will add a significant amount of deposited material to the leaf, while a shower or strong winds on the preceeding day will remove it.

In the University of Arizona salt drift research program, the measurements of leaf surface salt per unit area (Appendix I) showed no correlation with applied salt at dosages up to 500 lb per acre-year for cantaloupe and alfalfa in the field, or for cotton or barley in the greenhouse. At dosages of 500 lb per acre-year, cantaloupe surface salt per unit area was elevated, as was the case for one harvest of field alfalfa at 500 and 1000 lb per acre-year dosages. Cotton leaf surface salt showed no correlation with applied salt up to 1000 lb per acre-year in the greenhouse studies. Again, alfalfa in the greenhouse showed elevated leaf surface salt per unit area at 500 lb per acre-year. These values are several orders of magnitude greater than those predicted to result from PVNGS operations.

Considering both the impracticality of increasing sampling frequency to a rate which would provide a more representative sampling of foliar deposition, and the results of the University of Arizona which indicate no correlation between deposition and leaf surface concentration per unit area except at very high dosages, it is felt that the discontinuance of this analysis would not materially reduce the useful information obtained from the sampling program for salt deposition at PVNGS.

5/1/85
WFQ