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AUTH.NAME AUTHOR AFFILIATION
VAN BRUNT,E.E. Arizona Public Service Co.
RECIP.NAME RECIPIENT AFFILIATION
Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards responses to NRC 810213 request for info re environ rept for facilities.Items addressed include sys demand & reliability,need for power,consequences of delay & geography & demography. 566 ROb

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ARIZONA PUBLIC SERVICE COMPANY
P. O. BOX 21666 · PHOENIX, ARIZONA 85036

March 3, 1981
ANPP-17384-JMA/WFQ

RECEIVED
MAR 05 1981
U.S. NUCLEAR REGULATORY COMMISSION

Director of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Palo Verde Nuclear Generating Station
Units 1, 2 & 3
Docket Nos. STN-50-528/529/530

References: (1) Letter dated February 13, 1981 from Robert L. Tedesco, Assistant Director for Licensing, Division of Licensing, USNRC to E. E. Van Brunt, Jr., Vice President, Nuclear Projects, Arizona Public Service Company

(2) Letter dated March 3, 1981, ANPP-17383 from E. E. Van Brunt, Jr., Vice President, Nuclear Projects, Arizona Public Service Company, to Director of Nuclear Reactor Regulation, USNRC

Dear Sir:

Enclosed are the responses to questions transmitted by Reference (1).

Please note that we have committed to furnish the required information for Questions 310.9, 320.2 and 320.4 on the specific dates indicated. Supplementary loan material referred to in the responses is being provided under separate cover letter noted in Reference (2). The magnetic tape of Hourly Meteorlogical Data requested in Question 450.1 is to be sent by March 9, 1981.

The next amendment of the ER-OL will incorporate the revised and new pages contained in the attachment.

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Please do not hesitate to call if further clarification of these items is necessary or if we can provide any assistance in the expeditious processing of our application.

Sincerely,

E. E. Van Brunt

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

EEVB/WFQ/wp

cc: J. Kerrigan (w/attach.)
R. L. Tedesco (w/attach)

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

Edwin E. Van Brunt, Jr.

Sworn to before me this 27 day of February, 1981.

Norma D. Wayt

Notary Public

My Commission Expires:

May 5, 1984

8103060302

PRELIMINARY

FOREWORD

The engineering symbols used on piping and instrumentation diagrams (P&ID's) are shown on figure F-1. Standards used for editorial abbreviations and symbols are the latest editions of the following American National Standards Institute publications: ANSI-Y1.1, Abbreviations; ANSI-Y10.5, Letter Symbols for Quantities used in Electrical Science and Electrical Engineering; and ANSI-Y10.9, Letter Symbols for Units used in Science and Technology.

The ER-OL includes answers to NRC requests for additional information in the NRC letters from Mr. D. G. Eisenhut to Mr. E. E. Van Brunt, Jr., dated June 18, 1980, and from Mr. R. L. Tedesco to Mr. E. E. Van Brunt, Jr., dated February 13, 1981. The questions and responses or locations of responses are provided in Appendix A of the appropriate chapter of the ER-OL. The cross-reference list from NRC question number to ER-OL question number is as noted below:

NRC QUESTION NUMBER	ER-OL QUESTION NUMBER
Section 1.1.2	1A.1
Section 2.1.2.3	2A.1
Section 2.3	2A.2
Section 2.3	2A.3
Section 3.1.3.1	3A.1
Section 6.1.5.5.3	6A.1
Section 6.2	6A.2
240.1	3A.2
240.2	3A.3
240.3	3A.4
240.4	3A.5
290.1	6A.3
290.2	3A.6

2

	NRC QUESTION NUMBER	ER-OL QUESTION NUMBER
	290.3	6A.4
	290.4	5A.1
	290.5	5A.2
	290.6	5A.3
	290.7	5A.4
	290.8	3A.7
	290.9	5A.5
	290.10	5A.6
	291.1	3A.8
	291.2	3A.9
	291.3	3A.10
	291.4	3A.11
	291.5	3A.12
	291.6	3A.13
2	291.9	3A.14
	291.10	3A.15
	291.11	3A.16
	291.12-3.7.3.3	3A.17
	291.12-5.6.2	5A.7
	291.13	5A.8
	291.15	2A.4
	291.16	2A.5
	291.17	3A.18
	291.18	3A.19
	291.19	3A.20
	291.20	3A.21
	291.21	3A.22
	291.22	3A.23
	291.23	3A.24
	291.24	3A.25
	291.25	3A.26
	310.1	5A.9

NRC QUESTION NUMBER	ER-OL QUESTION NUMBER
310.2	5A.10
310.3	2A.6
310.4	2A.7
310.5	2A.8
310.6	2A.9
310.7	5A.11
310.8	8A.1
310.9	8A.2
311.1	2A.10
311.2	2A.11
311.3	2A.12
311.4	2A.13
311.5	2A.14
320.1	1A.2
320.2	1A.3
320.3	1A.4
320.4	1A.5
320.5	1A.6
320.6	1A.7
450.1	2A.15

2

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units such as PVNGS. The participants will continue seeking means to promote effectively prudent electric energy management practices.

1.1.1.3 Power Exchanges

Past and expected future net power sales and purchases outside the participants' combined system, which are applicable at the time of annual peak demand, are presented in table 1.1-1. Both firm sales and purchases and nonfirm sales and purchases are tabulated; they contribute respectively to load and generation totals. Firm purchases are not included in the resources requiring reserves as the reserves are provided by the seller. Reserve for firm sales is provided on the participants' combined system.

On a load and resource tabulation, firm sales appear as load additions. Firm purchases appear as reductions in load.

A nonfirm sale is a sale of power if that power is available. The delivery of power is contingent on the operation of the stipulated source. The buyer must provide the reserves to back up a nonfirm purchase. 2

On a load and resource tabulation nonfirm sales and purchases are treated as resources. A nonfirm sale of power reduces the capacity of the machine the sale is made from and the resources total is reduced by the amount of the sale. A nonfirm purchase is added to the resources total.

Table 1.1-1, Loads and Resources Summary, tabulates firm sales, firm purchases, nonfirm sales and nonfirm purchases. Table 1.1-2, Load and Energy Requirements by Month, tabulates loads but not resources. It includes firm sales and firm purchases. Table 1.1-3 is a loads and resources summary. It includes firm sales, firm purchases, nonfirm sales and nonfirm purchases. Table 1.1-4 is a monthly loads summary and includes firm sales

and firm purchases. Table 1.1-8, Capability of Resources,
2 tabulates resources but not loads. It includes nonfirm sales
and nonfirm purchases.

1.1.2 SYSTEM CAPACITY

System capabilities for each of the participants at the time of the annual peak demand for 1968 through 1988 are presented in table 1.1-8 along with a combined resources summary for all participants. Representative capacity factors are provided
1 in table 1.1-8A. These resource schedules are the result of generation planning that makes use of the load forecasting discussed in section 1.1.1.2.

Each participant is responsible for determining its own criteria for bulk generation planning, including the methodology for load forecasting. The Reliability Council of the WSCC recently issued guidelines for the measurement of the adequacy of power supply, including as an alternative a reliability test that uses a loss-of-load probability (LOLP) criterion of one day of outage in 10 years.

Table 1.1-9 contains information showing the existing generation capability as of January 1, 1978, for the Arizona-New Mexico Power Area and the Southern California-Nevada Power Area, respectively, as defined in WSCC. Table 1.1-10 is a summary of generation additions for these two power areas.

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1.1.3 RESERVE MARGINS

The participants do not participate jointly in any single regional power pool. Each participant is responsible for establishing and maintaining its own reserve. Reserve criteria vary with the participant. Each participant's reserve requirements are listed below in outline form.

A. Arizona Public Service Company: The APS generation reserve requirements are based on an LOLP criterion applied to the proposed Cactus Pool. The proposed pool includes Arizona Electric Power Cooperative, APS, EPE, Plains Electric Generation and Transmission Cooperative, Public Service Company of New Mexico, and Salt River Project. Although formal operating agreements have not been established for this pool, the pool concept has been used in planning studies to establish APS installed reserve requirements. The LOLP criterion is expressed in terms of the expected number of times in a specified period that the pool generating capacity fails to meet load.

   The criterion used by APS (in conjunction with the APS load forecast on May 31, 1978) is that the pool reserves shall be 16% of pool load from 1979 through 1981 and sufficient to yield an expected failure to meet pool load of no more than one occurrence in 3 years beyond 1981. This is sometimes referred to as a 1/3 LOLP index. A computer simulation that represents both forced and maintenance outages is used to compute the probability of failure to meet load on a daily basis, with the daily probabilities added to yield an annual index. Allocation of the pool reserves among individual utilities is in proportion to the sum of their peak load, plus twice their largest hazard.

1.3 CONSEQUENCES OF DELAY

The load forecasts presented in table 1.1-1 indicate that the combined annual peak demands of the PVNGS participants will increase an additional 6567 megawatts between 1980 and 1986. During this period the combined annual peak will be growing at an average rate of 1094 megawatts per year. To reliably meet this demand, the participants will need to obtain an additional 7385 megawatts of new installed resources between 1980 and 1986. The PVNGS units are an important part of these needed new resources.

The participants are responsible for meeting the growing electric needs of their customers, and by virtue of their franchises, are required by law to do so. Failure to provide power as needed would have serious social, environmental and economic effects on the entire area served by the participants.

If PVNGS-1,2,&3 are not constructed and do not begin commercial operation as scheduled in May 1983, May 1984, and May 1986, respectively, the participants will experience consequences of delay with respect to the adequacy, reliability and cost of their power supplies. The degree of the consequences will depend largely on whether the delays are short- or long-term, and on how much time the participants have to prepare for the delays. Lead times for constructing alternate types of generation are three years for combustion turbine units, four and one-half years for combined cycle units and seven and one-half years for coal-fired steam units. This does not include regulatory review times for environmental or project approval.

The effects of delays of one, two and three years in the commercial operation of the project on the reserve margins of the participants in terms of megawatts and percent of peak are shown in tables 1.3-1 and 1.3-2, respectively. 2

As reserve margins are reduced below the desired
level, the Loss of Load Probability (LOLP) increases to a point
2 of risk that is unacceptable to system integrity. Participant
estimates of system reliability are presented in table 1.3-3.

A delay in the units will increase the probability that one or
more of the participants will be unable to meet its load
requirements during this period. Also, the energy requirements
expected to be met by the nuclear unit will have to be met by
other sources. This would mean burning more oil, gas, and/or
2 coal resources, possibly resulting in adverse environmental
effects and higher costs. Moreover, since fuel oil is scarce,
and since it is expected to remain in short supply, prudent
planning dictates that it be conserved as much as possible.
Delay of the nuclear units will work against the conservation
of this resource. The impact of delay on oil, gas, coal, and
2 uranium fuel consumption is shown in tables 1.3-4, 1.3-5,
1.3-6, and 1.3-7, respectively.

Operating combustion turbine or combined cycle units as baseload units to replace nuclear energy is likely to present additional reliability problems, since this type of unit is not designed for baseload operation. If the delays are known several years in advance, other planned resources may be installed early. It may thus be possible to avoid the reliability problem stated previously. However, the problems related to environmental effect, costs, and fuel conservation will still apply.

While it may be possible for the participants to make some short- or long-term purchases to partially cover the delay of nuclear units, it is not likely that all participants will be able to make sufficient purchases to make up all of the delayed nuclear capacity. Neighboring utilities may be experiencing their own delay problems in installation of generation facilities, and therefore may not have excess power to sell to the participants. Another factor in this regard is the nature of the power supply in the areas served by the participants.

The participants generally rely on a high percentage of resources that are remote from their load areas, with power carried to the load areas over EHV transmission systems. There is a limited number of interconnections between the participants' service areas and surrounding systems. Even assuming that the large amounts of power that may be needed are available for purchase, the limited number of interconnections and high use of the EHV tranmission system will make it difficult for those large amounts of power to be transmitted to the participants' service areas.

Delays in the construction of PVNGS generating facilities will have the following adverse effects on systems planning and operation.

A. Longer Lead Times - Consistent delays in construction lengthen the lead time required for generation planning. This reduces the flexibility and adaptability of incorporating new technology or changes in load forecasts into the planning process.

B. Decreased System Reliability - Delays will result in lower reserve margins that decrease system reliability and thereby cause more frequent service interruptions.

C. Additional Costs - The delay of a generating facility may require the temporary substitution of a more costly alternative with the possibility of a greater environmental impact. Delays also result in additional costs for interest during construction of the planned facility. The impact of delay on production costs is shown in table 1.3-8. 2

PRELIMINARY

Table 1.3-1
1981
RESERVE MARGIN DUE TO DELAY OF PVNGS
(MW) (Sheet 1 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	697	697	697	697	697
LADWP	326	326	326	326	326
El Paso Electric	153	153	153	153	153
Public Service of New Mexico	238	238	238	238	238
Salt River Project	1037	1037	1037	1037	1037
Southern California Edison	2197	2197	2197	2197	2197
Participants Total	4648	4648	4648	4648	4648

2

Table 1.3-1
1982
RESERVE MARGIN DUE TO DELAY OF PVNGS
(MW) (Sheet 2 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	451	451	451	451	451
LADWP	205	205	205	205	205
El Paso Electric	144	144	144	144	144
Public Service of New Mexico	212	212	212	212	212
Salt River Project	861	861	861	861	861
Southern California Edison	2537	2537	2537	2537	2537
Participants Total	4410	4410	4410	4410	4410

2

PRELIMINARY

PRELIMINARY

Table 1.3-1
1983
RESERVE MARGIN DUE TO DELAY OF PVNGS
(MW) (Sheet 3 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	611	495	495	495	495
LADWP	531	542	542	542	542
El Paso Electric	286	86	86	86	86
Public Service of New Mexico	256	126	126	126	126
Salt River Project	1114	758	758	758	758
Southern California Edison	3551	3364	3364	3364	3364
Participants Total	6349	5371	5371	5371	5371

2

PRELIMINARY

Table 1.3-1
1984
RESERVE MARGIN DUE TO DELAY OF PVNGS
(MW) (Sheet 4 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	740	384	268	268	268
LADWP	470	476	488	488	488
El Paso Electric	442	242	42	42	42
Public Service of New Mexico	222	92	0	0	0
Salt River Project	1327	971	615	615	615
Southern California Edison	3532	3345	3158	3158	3158
Participants Total	6733	5510	4571	4571	4571

2

PRELIMINARY

Table 1.3-1
1985
RESERVE MARGIN DUE TO DELAY OF PVNGS
(MW) (Sheet 5 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	634	634	278	162	162
LADWP	467	455	461	473	473
El Paso Electric	391	391	191	(9)	(9)
Public Service of New Mexico	278	278	148	18	18
Salt River Project	1166	1166	810	454	454
Southern California Edison	2800	2800	2613	2426	2426
Participants Total	5736	5724	4501	3524	3524

2

CONSEQUENCES OF DELAY

Table 1.3-1
1986
RESERVE MARGIN DUE TO DELAY OF PVNGS
(MW) (Sheet 6 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	604	248	248	(108)	(224)
LADWP	371	382	369	375	388
El Paso Electric	541	341	341	141	(59)
Public Service of New Mexico	303	173	173	43	0
Salt River Project	1357	1001	1001	645	289
Southern California Edison	2704	2517	2517	2330	2142
Participants Total	5880	4662	4649	3426	2536

2

PRELIMINARY

Table 1.3-1
1987
RESERVE MARGIN DUE TO DELAY OF PVNGS
(MW) (Sheet 7 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	689	689	333	333	(379)
LADWP	397	390	400	388	407
El Paso Electric	519	519	319	319	(81)
Public Service of New Mexico	321	321	191	191	0
Salt River Project	1274	1274	918	918	206
Southern California Edison	2856	2856	2669	2669	2294
Participants Total	6056	6049	4830	4818	2447

2

PRELIMINARY

Table 1.3-1
1988
RESERVE MARGIN DUE TO DELAY OF PVNGS
(MW) (Sheet 8 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	692	692	692	336	(376)
LADWP	452	447	440	450	456
El Paso Electric	472	472	472	272	(128) 2
Public Service of New Mexico	344	344	344	214	0
Salt River Project	1164	1164	1164	808	96
Southern California Edison	2816	2816	2816	2629	2254
Participants Total	5940	5935	5456	4709	2302

Table 1.3-1
1989
RESERVE MARGIN DUE TO DELAY OF PVNGS
(MW) (Sheet 9 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	763	763	763	763	(305)
LADWP	433	433	428	421	437
El Paso Electric	399	399	399	399	(201)
Public Service of New Mexico	337	337	337	337	0
Salt River Project	1058	1058	1058	1058	(10)
Southern California Edison	2983	2983	2983	2983	2421
Participants Total	5973	5973	5968	5961	2342

2

Table 1.3-1
1990
RESERVE MARGIN DUE TO DELAY OF PVNGS
(MW) (Sheet 10 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	839	839	839	839	(229)
LADWP	516	516	516	511	520
El Paso Electric	327	327	327	327	(273)
Public Service of New Mexico	469	469	469	469	79
Salt River Project	954	954	954	954	(114)
Southern California Edison	3103	3103	3103	3103	2541
Participants Total	6208	6208	6208	6203	2524

2

PRELIMINARY

Table 1.3-2

1981

RESERVE MARGIN DUE TO DELAY OF PVNGS

(% OF PEAK) (Sheet 1 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	25.7	25.7	25.7	25.7	25.7
LADWP	28.7	28.7	28.7	28.7	28.7
El Paso Electric	20.6	20.6	20.6	20.6	20.6
Public Service of New Mexico	23.9	23.9	23.9	23.9	23.9
Salt River Project	45.8	45.8	45.8	45.8	45.8
Southern California Edison	16.6	16.6	16.6	16.6	16.6
Participants Average	26.9	26.9	26.9	26.9	26.9

2

Table 1.3-2
1982
RESERVE MARGIN DUE TO DELAY OF PVNGS
(% OF PEAK) (Sheet 2 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	15.8	15.8	15.8	15.8	15.8
LADWP	18.2	18.2	18.2	18.2	18.2
El Paso Electric	18.6	18.6	18.6	18.6	18.6
Public Service of New Mexico	20.0	20.0	20.0	20.0	20.0
Salt River Project	36.5	36.5	36.5	36.5	36.5
Southern California Edison	18.6	18.6	18.6	18.6	18.6
Participants Average	21.3	21.3	21.3	21.3	21.3

2

CONSEQUENCES OF DELAY

PRELIMINARY

PRELIMINARY

Table 1.3-2

1983

RESERVE MARGIN DUE TO DELAY OF PVNGS

(% OF PEAK) (Sheet 3 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	20.7	16.7	16.7	16.7	16.7
LADWP	43.6	44.9	44.9	44.9	44.9
El Paso Electric	35.4	10.6	10.6	10.6	10.6
Public Service of New Mexico	23.6	11.6	11.6	11.6	11.6
Salt River Project	45.2	30.8	30.8	30.8	30.8
Southern California Edison	25.6	24.2	24.2	24.2	24.2
Participants Average	32.4	23.1	23.1	23.1	23.1

2

Table 1.3-2
1984
RESERVE MARGIN DUE TO DELAY OF PVNGS
(% OF PEAK) (Sheet 4 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	24.2	12.5	8.8	8.8	8.8
LADWP	38.8	39.5	40.9	40.9	40.9
El Paso Electric	52.2	28.6	5.0	5.0	5.0
Public Service of New Mexico	20.0	8.3	0	0	0
Salt River Project	50.9	37.3	23.6	23.6	23.6
Southern California Edison	24.7	23.4	22.1	22.1	22.1
Participants Average	35.1	24.9	16.7	16.7	16.7

2

PRELIMINARY

Table 1.3-2
1985
RESERVE MARGIN DUE TO DELAY OF PVNGS
(% OF PEAK) (Sheet 5 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	20.0	20.0	8.8	5.1	5.1
LADWP	38.9	37.5	38.2	39.5	39.5
El Paso Electric	43.8	43.8	21.4	(1.0)	(1.0)
Public Service of New Mexico	23.4	23.4	12.5	1.5	1.5
Salt River Project	43.1	43.1	30.0	16.8	16.8
Southern California Edison	19.0	19.0	17.7	16.5	16.5
Participants Average	31.4	31.1	21.4	13.1	13.1

2

Table 1.3-2
1986
RESERVE MARGIN DUE TO DELAY OF PVNGS
(% OF PEAK) (Sheet 6 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	18.3	7.5	7.5	(3.3)	(6.8)
LADWP	31.0	32.3	30.8	31.5	32.9
El Paso Electric	57.8	36.4	36.4	15.1	(6.3)
Public Service of New Mexico	24.1	13.8	18.8	3.4	0
Salt River Project	48.1	35.5	35.5	22.9	10.2
Southern California Edison	17.8	16.6	16.6	15.3	14.1
Participants Average	32.9	23.7	24.3	14.2	7.4

2

PRELIMINARY

Table 1.3-2
1987
RESERVE MARGIN DUE TO DELAY OF PVNGS
(% OF PEAK) (Sheet 7 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	19.9	19.9	9.6	9.6	(11.0)
LADWP	30.6	29.9	30.9	29.7	31.6
El Paso Electric	52.8	52.8	32.5	32.5	(8.2)
Public Service of New Mexico	23.9	23.9	14.2	14.9	0
Salt River Project	43.9	43.9	31.6	31.6	7.1
Southern California Edison	18.3	18.3	17.1	17.1	14.7
Participants Average	31.6	31.5	22.7	22.6	5.7

2

Table 1.3-2
1988
RESERVE MARGIN DUE TO DELAY OF PVNGS
(% OF PEAK) (Sheet 8 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	19.0	19.0	19.0	9.2	(10.3)
LADWP	32.4	31.9	31.2	32.2	32.7
El Paso Electric	45.8	45.8	45.8	26.4	(12.4)
Public Service of New Mexico	23.9	23.9	23.9	14.9	0
Salt River Project	38.6	38.6	38.6	26.8	3.2
Southern California Edison	17.5	17.5	17.5	16.3	14.0
Participants Average	29.5	29.5	29.3	21.0	4.5

2

PRELIMINARY

Table 1.3-2
1989
RESERVE MARGIN DUE TO DELAY OF PVNGS
(% OF PEAK) (Sheet 9 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	20.0	20.0	20.0	20.0	(8.0)
LADWP	29.6	29.6	29.2	28.6	30.0
El Paso Electric	36.8	36.8	36.8	36.8	(18.5)
Public Service of New Mexico	22.2	22.2	22.2	22.2	0
Salt River Project	33.9	33.9	33.9	33.9	(0.3)
Southern California Edison	18.0	18.0	18.0	18.0	14.6
Participants Average	26.7	26.7	26.7	26.6	3.0

Table 1.3-2
1990
RESERVE MARGIN DUE TO DELAY OF PVNGS
(% OF PEAK) (Sheet 10 of 10)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	21.1	21.1	21.1	21.1	(5.8)
LADWP	32.0	32.0	32.0	31.6	32.4
El Paso Electric	28.7	28.7	28.7	28.7	(23.9)
Public Service of New Mexico	29.3	29.3	29.3	29.3	4.9
Salt River Project	29.6	29.6	29.6	29.6	(3.5)
Southern California Edison	18.1	18.1	18.1	18.1	14.8
Participants Average	26.5	26.5	26.5	26.4	3.2

2

PRELIMINARY

Table 1.3-3
EFFECT OF DELAY ON PARTICIPANT'S SYSTEM RELIABILITY
(Sheet 1 of 5)
ARIZONA PUBLIC SERVICE
RELIABILITY INDEX (ONE DAY IN _ YEARS)

Year	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
1981	29.52	29.52	29.52	29.52	29.52
1982	5.62	5.62	5.62	5.62	5.62
1983	40.99	3.09	3.09	3.09	3.09
1984	47.66	3.67	0.18	0.18	0.18
1985	15.43	10.07	0.45	0.08	0.08
1986	6.86	0.66	0.47	0.06	0.01
1987	4.61	3.43	0.48	0.23	0.01
1988	5.64	4.23	3.16	0.42	0.01
1989	6.92	6.28	4.75	3.59	0.01
1990	6.90	6.90	6.31	4.82	0.01

2

Table 1.3-3

EFFECT OF DELAY ON PARTICIPANT'S SYSTEM RELIABILITY

(Sheet 2 of 5)

LADWP

2

LADWP will maintain a 1 day in 10 years loss of load probability for no delay, 1 year delay, 2 years delay, 3 years delay, and indefinite delay.

Table 1.3-3

EFFECT OF DELAY ON PARTICIPANT'S SYSTEM RELIABILITY

(Sheet 3 of 5)

EL PASO ELECTRIC

LOSS OF LOAD ENERGY

Year	No Delay MWH	1 Year Delay MWH	2 Year Delay MWH	3 Year Delay MWH	Indefinite Delay MWH
1981	1800	1800	1800	1800	1800
1982	3600	3600	3600	3600	3600
1983	1300	3300	3300	3300	3300
1984	800	2700	7300	7300	7300
1985	600	1500	5500	12900	12900
1986	300	1400	2600	9000	24200
1987	600	2000	3600	11300	65900
1988	700	1000	2600	7000	97500
1989	1400	1500	1900	3500	183700
1990	4300	5400	6200	8400	409600

2

Table 1.3-3

EFFECT OF DELAY ON PARTICIPANT'S SYSTEM RELIABILITY

(Sheet 4 of 5)

PUBLIC SERVICE OF NEW MEXICO

LOSS OF LOAD HOURS

Year	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
1981	1.1	1.1	1.1	1.1	1.1
1982	5.9	5.9	5.9	5.9	5.9
1983	9.7	28.3	28.3	28.3	28.3
1984	10.3	19.8	71.9	71.9	71.9
1985	16.1	13.9	28.5	129.7	129.7
1986	14.7	69.1	45.6	115.7	266.7
1987	23.1	20.1	78.0	80.7	372.1
1988	7.8	11.9	12.0	93.1	405.5
1989	7.7	8.1	13.4	11.8	482.0
1990	15.8	16.0	6.1	7.9	316.6

2

Table 1.3-3

EFFECT OF DELAY ON PARTICIPANT'S SYSTEM RELIABILITY

(Sheet 5 of 5)

SALT RIVER PROJECT

SYSTEM RELIABILITY INDEX: LOSS-OF-LOAD HOURS

Year	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
1981	0.8	0.7	0.7	0.7	0.7
1982	5.6	4.7	4.6	4.6	4.6
1983	7.5	14.2	12.4	12.2	12.2
1984	3.4	16.4	34.5	30.3	29.8
1985	6.6	6.9	29.6	65.3	57.7
1986	8.9	20.6	22.1	78.6	165.4
1987	8.8	6.4	28.6	29.7	209.7
1988	8.7	10.5	12.1	46.9	303.3
1989	27.6	30.1	34.4	25.0	388.3
1990	29.0	30.9	33.8	39.2	425.3

2

Table 1.3-4 (**)

Table 1.3-5 (**)

Table 1.3-6 (**)

Table 1.3-7 (**)

** Effect of Delay on Participant's Oil, Gas, Coal, and Uranium Fuel Use will be supplied by March 15, 1981.

Table 1.3-8
1981
PRODUCTION COSTS DUE TO DELAY OF PVNGS
(MILLIONS OF DOLLARS) (Sheet 1 of 11)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	281.8	281.8	281.8	281.8	281.8
LADWP	635.5	635.5	635.5	635.5	635.5
El Paso Electric	143.7	143.7	143.7	143.7	143.7
Public Service of New Mexico	160.6	160.6	160.6	160.6	160.6
Salt River Project	143.4	143.1	143.1	143.1	143.2
Southern California Edison	2582	2582	2582	2582	2582
Participants Total	3947.0	3946.7	3946.7	3946.7	3946.8

2

PRELIMINARY

Table 1.3-8
1982
PRODUCTION COSTS DUE TO DELAY OF PVNGS
(MILLIONS OF DOLLARS) (Sheet 2 of 11)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	361.6	361.6	361.6	361.6	361.6
LADWP	733.7	733.7	733.7	733.7	733.7
El Paso Electric	207.2	207.2	207.2	207.2	207.2
Public Service of New Mexico	173.6	173.6	173.6	173.6	173.6
Salt River Project	211.7	207.7	207.2	207.2	207.2
Southern California Edison	2943	2943	2943	2943	2943
Participants Total	4630.8	4626.8	4626.3	4626.3	4626.3

2

Table 1.3-8
1983
PRODUCTION COSTS DUE TO DELAY OF PVNGS
(MILLIONS OF DOLLARS) (Sheet 3 of 11)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	371.9	404.6	404.6	404.6	404.6
LADWP	872.7	860.4	860.4	860.4	860.4
El Paso Electric	203.4	264.8	264.8	264.8	264.8
Public Service of New Mexico	169.3	201.3	201.8	201.8	201.8
Salt River Project	222.4	250.8	247.9	246.9	247.8
Southern California Edison	3220	3280	3280	3280	3280
Participants Total	5059.7	5261.9	5259.5	5258.5	5259.5

2

PRELIMINARY

Table 1.3-8
1984
PRODUCTION COSTS DUE TO DELAY OF PVNGS
(MILLIONS OF DOLLARS) (Sheet 4 of 11)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	381.7	451.6	491.6	491.6	491.6
LADWP	1019.0	1031.4	1016.0	1016.0	1016.0
El Paso Electric	188.3	265.7	340.3	340.3	340.3
Public Service of New Mexico	193.8	224.3	268.3	268.3	268.3
Salt River Project	240.4	278.8	335.2	328.5	327.6
Southern California Edison	3639	3739	3809	3809	3809
Participants Total	5592.2	5990.8	6260.4	6253.7	6252.7

2

Table 1.3-8
1985
PRODUCTION COSTS DUE TO DELAY OF PVNGS
(MILLIONS OF DOLLARS) (Sheet 5 of 11)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	502.4	521.5	628.5	691.3	691.3
LADWP	1145.2	1159.9	1169.6	1157.1	1157.1
El Paso Electric	203.8	251.2	346.3	429.7	429.7
Public Service of New Mexico	228.0	236.5	270.6	325.1	325.1
Salt River Project	274.7	278.4	333.7	414.0	405.2
Southern California Edison	4161	4221	4331	4401	4401
Participants Total	6515.1	6668.5	7079.7	7418.2	7409.4

2

CONSEQUENCES OF DELAY

PRELIMINARY

Table 1.3-8
1986
PRODUCTION COSTS DUE TO DELAY OF PVNGS
(MILLIONS OF DOLLARS) (Sheet 6 of 11)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	486.6	595.1	629.3	765.5	846.3
LADWP	1314.9	1332.9	1348.4	1357.3	1347.4
El Paso Electric	196.5	263.4	318.7	436.8	527.6
Public Service of New Mexico	236.6	280.3	289.8	334.3	388.6
Salt River Project	293.3	330.3	342.3	430.5	534.6
Southern California Edison	4600	4700	4770	4881	4970
Participants Total	7126.9	7502.0	7698.5	8205.4	8614.5

2

Table 1.3-8
1987
PRODUCTION COSTS DUE TO DELAY OF PVNGS
(MILLIONS OF DOLLARS) (Sheet 7 of 11)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	515.9	530.7	645.2	686.8	1016.2
LADWP	1447.7	1459.6	1472.9	1488.0	1487.2
El Paso Electric	220.1	256.1	335.7	399.7	634.7
Public Service of New Mexico	277.7	282.0	335.3	347.3	451.4
Salt River Project	291.7	298.3	355.9	371.4	613.5
Southern California Edison	4957	5007	5127	5187	5407
Participants Total	7710.1	7833.7	8272.0	8480.2	9610.0

2

PRELIMINARY

Table 1.3-8
1988
PRODUCTION COSTS DUE TO DELAY OF PVNGS
(MILLIONS OF DOLLARS) (Sheet 8 of 11)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	573.7	593.1	605.8	726.3	1167.3
LADWP	1609.6	1612.8	1627.2	1641.5	1664.4
El Paso Electric	258.1	273.4	311.7	410.9	746.2
Public Service of New Mexico	309.7	318.0	325.8	380.7	504.6
Salt River Project	348.0	353.3	365.5	451.1	749.4
Southern California Edison	5081	5101	5161	5281	5591
Participants Total	8180.1	8251.6	8397.0	8891.5	10422.9

2

Table 1.3-8

1989

PRODUCTION COSTS DUE TO DELAY OF PVNGS

(MILLIONS OF DOLLARS) (Sheet 9 of 11)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	661.5	660.4	682.7	697.2	1299.1
LADWP	1767.8	1768.1	1771.8	1786.9	1826.6
El Paso Electric	333.0	324.1	345.3	395.9	867.8
Public Service of New Mexico	364.8	365.3	368.0	375.	570.9
Salt River Project	426.0	430.2	434.6	430.7	932.3
Southern California Edison	5487	5487	5517	5577	6027
Participants Total	9040.1	9035.1	9119.4	9263.4	11523.7

2

PRELIMINARY

Table 1.3-8
1990
PRODUCTION COSTS DUE TO DELAY OF PVNGS
(MILLIONS OF DOLLARS) (Sheet 10 of 11)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	718.6	716.8	713.3	738.8	1338.8
LADWP	1871.9	1871.9	1872.0	1875.5	1929.0
El Paso Electric	366.4	385.2	391.4	414.6	1007.5
Public Service of New Mexico	405.8	411.0	394.7	409.3	628.9
Salt River Project	459.1	461.3	465.2	475.3	1106.8
Southern California Edison	6001	6001	6001	6021	6571
Participants Total	9822.8	9847.2	9837.6	9934.5	12582.0

2

PRELIMINARY

Table 1.3-8
TOTAL 1981 - 1990
PRODUCTION COSTS DUE TO DELAY OF PVNGS
(MILLIONS OF DOLLARS) (Sheet 11 of 11)

	No Delay	1 Year Delay	2 Year Delay	3 Year Delay	Indefinite Delay
Arizona Public Service	4855.7	5117.2	5444.4	5845.5	7898.6
LADWP	12418.0	12466.2	12507.5	12551.9	12657.3
El Paso Electric	2300.4	2634.8	3005.3	3443.6	5169.6
Public Service of New Mexico	2518.9	2652.9	2788.5	2976.7	3673.8
Salt River Project	2910.8	3032.1	3230.7	3498.7	5267.5
Southern California Edison	42671	43061	43521	43962	45581
Participants Total	67674.8	68964.2	70497.4	72278.4	80247.8

2

TABLE OF CONTENTS

QUESTION 1A.1 (NRC comment on Section 1.1.2) (6/18/80) 1.1.2

No estimates of capacity factors. 1

RESPONSE: The response is given in revised section 1.1.2 and table 1.1-8A.

QUESTION 1A.2 (NRC No. 320.1) 1.3

Provide production costs with operation of PVNGS as scheduled, with each of the three PVNGS units delayed one year, delayed two years, delayed three years, and delayed indefinitely.

RESPONSE: The response is provided in the revised section 1.3.

QUESTION 1A.3 (NRC No. 320.2) 1.3

Provide annual fuel use with operation of PVNGS as scheduled, with each of the three PVNGS units delayed one year, delayed two years, delayed three years, and delayed indefinitely. 2

RESPONSE: Tables 1.3-4, 1.3-5, 1.3-6, and 1.3-7 noted in the revised section 1.3 as showing the effect of delay on fuel use will be provided by March 15, 1981.

QUESTION 1A.4 (NRC No. 320.3) 1.3

Provide reserve margins (and LOLP indices if available) with operation of PVNGS as scheduled, with each of the three PVNGS units delayed one year, delayed two years, delayed three years, and delayed indefinitely.

RESPONSE: The response is provided in the revised section 1.3.

QUESTION 1A.5 (NRC No. 320.4) 1.3

The above information should cover the period through 1990 for each participant's system and, where applicable, for the combined system. Also present the basis and assumptions (e.g., average heat rate, fuel costs, O&M costs, and discount rate) that are used in obtaining the above data.

RESPONSE: The response will be provided by March 15, 1981.

QUESTION 1A.6 (NRC No. 320.5) 1.1.1

Explain how the reserve requirements were calculated. Were both firm purchases and sales included in the calculations? Note inconsistency in Table 1.101 and the statements on page 1.1-9.

RESPONSE: The response is provided in the revised section 1.1.1.3.

2

QUESTION 1A.7 (NRC No. 320.6) 1.1.2

Explain the inconsistency in Table 1.1-8 (page 1.1-189/190) in the total installed resources and the summation of power supply from individual plants (e.g., installed resources for 1988 should be 19322 MW, not 18728).

RESPONSE: The Hoover-SCE hydro unit listed on page 1.1-187/188 should have been retired in 1987. Its MW level for 1987 and 1988 should be 0.

The Navajo layoff steam unit listed on page 1.1-189/190 should have been retired in 1985. Its MW level for 1985, 1986, 1987 and 1988 should be 0.

With these two corrections made as shown in the revised table 1.1-8, the table summations are correct.

Figures 2.1-4 through 2.1-12 illustrate the estimated residential population located within a 10-mile radius of the plant site for the years 1980, 1982, 1984, 1986, 1990, 2000, 2010, 2020, and 2030. Data are displayed at 1, 2, 3, 4, 5 and 10-mile distances from the centerline of the Unit 2 containment building, for the 16 compass sectors. Maricopa County population estimates provided by the Arizona State Department of Economic Security[3] for the years 1980, 1982, 1984, 1986, 1990, and 2000 were used for all six radii calculations. Maricopa County population projections for the years 2010, 2020, and 2030 were derived from the assumption that decennial growth rates from 2000 to 2030 would be held constant to the same rate of growth as experienced between 1990 and 2000. Population projections were calculated in the same manner as the 1978 estimated 5-10 mile radius population.

Listed below is a generalized Maricopa County age distribution for the year 2000.

Age Group	Percentage of Total Population
0-11 years	15
12-17 years	9
18-65+ years	76

These figures were derived from data prepared by the Arizona State Department of Economic Security.[3]

2.1.2.2 Population Between 10 and 50 Miles

Figure 2.1-2A illustrates population settlements located within a 50-mile radius of PVNGS. Included are all towns, cities, and unincorporated communities. The most recent available population counts (1980 preliminary census counts) for incorporated cities with populations greater than 500 persons within a 50-mile radius of PVNGS are presented in table 2.1-2A. Preliminary census counts for unincorporated communities will 2

not be available until April 1981. Therefore, the population centers listed in table 2.1-2B are those with less than 500 persons as of July 1, 1978 within a 50-mile radius of PVNGS. Figure 2.1-3 illustrates the 1978 estimated residential population located between 10 and 50 miles of the plant site. Figures 2.1-4 through 2.1-12 show the estimated residential population located between 10 and 50 miles of the plant site for the years 1980, 1982, 1984, 1986, 1990, 2000, 2010, 2020, and 2030. Data are displayed at 10, 20, 30, 40, and 50 mile distances from Unit 2 for 16 compass sectors. Population input data for Maricopa, Pinal, Yavapai, and Yuma Counties were prepared by the Arizona State Department of Economic Security[3] and calculated according to the methodology described in section 2.1.2.1. 10-50 mile radius population projections were calculated in the same manner as the 5-10 mile radius projections as noted in section 2.1.2.1

Maricopa County age distribution projections for the year 2000, are given in section 2.1.2.1. It is assumed that the same age distribution projections will apply to Pinal, Yavapai, and Yuma Counties.

2.1.2.3 Transient Population

Transient population within a 10-mile radius of Unit 2 for 1978 is estimated to have been approximately 155 persons.[4-8,34] This is a conservative estimate based upon the consideration that 100 people included in the total represent migrant farm workers[4]. The remaining 55 persons are either employed at the Hassayampa Cotton Gin, the Ruth Fisher and Arlington School Districts, and Gila Compressor Station, or attend Arlington School. All students who attended Ruth Fisher School during the 1978-1979 academic year resided within 10 miles of PVNGS. Table 2.1-3 lists employment centers and schools within a 10-mile radius of PVNGS according to distance and direction from the plant site, number of employees and students, season

of employment and school year, and combined residential and transient population totals per sector. 1

Construction phase manpower is discussed in section 8.1.

2.1.3 USES OF ADJACENT LANDS AND WATERS

2.1.3.1 Land Use Within a 5-Mile Radius of the PVNGS Plant Site

2.1.3.1.1 Residential Land Use

As indicated in section 2.1.2.1, residential land use within a 5-mile radius of the PVNGS site is low density, since most

Table 2.1-2A

POPULATION ESTIMATE FOR CITIES WITH 500 OR MORE PERSONS WITHIN A 50-MILE RADIUS OF PVNGS

2

City	1980 Preliminary Census Counts	Distance and Direction[a] From PVNGS (Miles)
Buckeye	3,438	16 E
Gila Bend	1,611	31 SSE
Avondale	8,136	30 E
Litchfield Park	3,660	30 ENE
Goodyear	2,730	30 E
Cashion	2,993	33 E
Luke Air Force Base	3,536	31 ENE
Phoenix	781,443	34 E
Surprise	3,716	35 ENE
El Mirage	4,315	35 ENE
Youngtown	2,224	35 ENE
Tolleson	4,381	35 E
Sun City	40,566	36 ENE
Peoria	12,223	39 ENE
Glendale	92,797	40 ENE
Wickenburg	3,536	41 N

a. Measurements taken from centerline of Unit 2 containment building.

Table 2.1-2B

POPULATION CENTERS WITH LESS THAN 500 PERSONS AS OF JULY 1, 1978, WITHIN A 50-MILE RADIUS OF PVNGS
(Sheet 1 of 2)

Center	Distance and Directions[a] From PVNGS (Miles)
Wintersburg	2.5 N
Dixie	6.5 ESE
Crag	6.5 SSW
Arlington	7.5 SE
Hassayampa	8.5 ESE
Tonopah	9.0 NNW
Gillespie	11.0 SW
Palo Verde	11.5 ESE
Harqua	13.0 SW
Harquahala	17.5 NW
Saddle	20.0 SW
Liberty	22.0 E
Perryville	24.0 E
Cotton Center	24.0 SSE
Norton	25.5 E
Sundad	26.0 WSW
Fennemore	28.0 ENE
Sil Murk	29.0 SSE
Montezuma	29.5 SW
Waddell	30.0 ENE
Smurr	32.0 S
Bumstead	32.5 ENE
Theba	32.5 S
Wittman	33.5 NE

a. Measurements taken from centerline of Unit 2 containment building.

2

Table 2.1-2B

POPULATION CENTERS WITH LESS THAN 500 PERSONS AS OF JULY 1, 1978, WITHIN A 50-MILE RADIUS OF PVNGS
(Sheet 2 of 2)

Center	Distance and Directions[a] From PVNGS (Miles)
Camel	34.0 SW
Beardsley	34.0 ENE
Circle City	34.0 NNE
Piedra	34.0 SSW
Bosque	34.0 SSW
Morristown	35.5 NNE
West End	36.5 E
Estrella	37.5 SE
Hyder	38.0 SW
Agua Caliente	38.5 SW
Fowler	39.0 E
Laveen	41.0 E
Komatke	41.0 E
Gila Crossing	41.5 ESE
Centinel	41.5 S
Santa Cruz	42.0 ESE
Mobile	42.0 SE
Aguila	43.0 NNW
Gladden	44.0 NNW
Enid	44.5 ESE
Big Horn	46.0 SE
Love	48.0 NW
Heaton	48.0 ESE
Horn	48.5 SW
Wenden	50.0 NW
Freeman	50.0 SE

2

The types of establishments that exist include a combination grocery store-gas station and two cafes and bars.

2.1.3.1.3 Special Land Use

Within a 5-mile radius of PVNGS, there are two parcels zoned by the Maricopa County Planning Department for special use as a mobile home park and a travel trailer park, respectively.[9] Both are located near the intersection of Wintersburg and Buckeye-Salome Roads.

One parcel, located east of the Wintersburg and Buckeye-Salome Roads intersection has been given a special use permit for a mobile home park valid for 25 years, beginning in 1975.[12] The owner of the property has indicated that he intends to initiate development.[13]

The other parcel, located on the northwestern corner of the same intersection has been given a special use permit for travel trailer park valid for 3 years beginning March 27, 1978.[12] The representative of the property owner has indicated that he intends to develop the parcel.[14]

2.1.3.1.4 Institutional Land Use

There are no public facilities or institutional land uses within a 5-mile radius of the plant site.

2.1.3.1.5 Agricultural Land Use

Agricultural land uses are discussed in section 2.1.3.4.

2.1.3.1.6 Transportation Land Use

2.1.3.1.6.1 Roads. Figure 3.1-3 illustrates the road system within a 5-mile radius of the plant site. It is essentially a rectangular grid oriented on north-south and east-west axes, following township and sectional lines. The plant site is

bounded on two sides by Wintersburg Road and Ward (Elliot) Road. At its closest point, Buckeye-Salome Road is located 2 miles north-northeast of Unit 2. Table 2.1-4 lists Average Daily Traffic (ADT) counted within a 5-mile radius of the PVNGS plant site during a June, 1978 traffic survey.[15] These counts are well below design levels.[16]

Based on a traffic volume survey[35] made by the Maricopa County Highway Department, the average 1980, 24-hour weekday traffic in the vicinity of the plant site is:

344th Avenue

- Between Broadway Road and Salome Highway: 79
- Between I-10 and Van Buren: 75

Elliot (Ward) Road

- West of Wintersburg Rd (383 Ave.): 90
- East of Wintersburg Rd (383 Ave.): 402

2 339th Avenue

- Between Broadway Road and Salome Highway: 100
- Between I-10 and Van Buren: 150

Van Buren Street

- East of 379 Avenue: 100

Wintersburg Road heading south from the site.

- No counts have been made on Wintersburg Road heading south from the site. However the sum of the counts, east and west of Wintersburg on Elliot Road can provide an approximate estimate. This sum is 492.

The following are 24-hour weekday traffic counts for 1980 made on the approaches to I-10 as developed by the Arizona Department of Transportation[36].

Tonopah Interchange (411 Ave.)

- West bound off-ramp: 700
- West bound on-ramp: 950
- East bound off-ramp: 700
- East bound on-ramp: 950

339 Avenue Interchange

- West bound off-ramp: 200
- West bound on-ramp: 50
- East bound off-ramp: 50
- East bound on-ramp: 500

An interchange was constructed at 379 Avenue late in 1980. No traffic counts are available at the present time.

The principal traffic congestion which occurs in the vicinity of the plant site is caused by plant construction workers going to and from work. The major congestion occurs on Wintersburg Road in the afternoon when construction workers leave the plant site. 2

2.1.3.1.6.2 <u>Railroads</u>. Figures 3.1-2 and 3.1-3 illustrate the Southern Pacific Transportation Company railroad located within a 5-mile radius of PVNGS. An average of 5 trains per day are operated on the railroad.[17] At its closest point, the railroad is located approximately 4.5 miles south-southeast of Unit 2. A railroad spur extends from this line to the site as shown in figure 3.1-4.

2.1.3.1.6.3 <u>Airports</u>. Figure 2.1-13 illustrates the Empire Machinery Company-owned airstrip located approximately 5.5 miles north-northwest of Unit 2.

The airstrip is used primarily as a base for crop dusting activities, although there are some company-related flights into the facility. Most airplanes that use the facility are single-engine.(18)

It is estimated that during heavy crop dusting periods of July through September, a maximum of 3 crop dusters, each making between 20 and 30 sorties daily, use the facility. During the rest of the year, it is estimated that one crop duster making one sortie daily uses the facility. Company-related travel to the airstrip averages about one or two flights monthly. Based on this information, the annual maximum number of operations are set at approximately 8600 flights.(18)

There are no plans for expansion and increased use of the facility is expected to be limited to company operations.(18)

Table 2.1-4

AVERAGE DAILY TRAFFIC (ADT) WITHIN A 5-MILE RADIUS OF THE PVNGS PLANT SITE, JUNE 1978

Traffic Count Location	ADT (Actual)
Buckeye-Salome Road between Wintersburg Road and 339th Avenue	4,859
Wintersburg Road between Buckeye-Salome Road and plant site entrance	3,814
Wintersburg Road between Buckeye-Salome Road and Buckeye Road	296

2.1.3.1.6.4 Pipelines. Figure 2.1-14 illustrates the Southern Pacific Pipe Lines, Inc. (SPPL) pipeline located within a 5-mile radius of PVNGS. At its closest point, the SPPL pipeline is located approximately 4.5 miles south-southeast of Unit 2.

SPPL owns and operates a 12-inch, high pressure, refined petroleum products pipeline. The pipeline was constructed in 1955 and buried at a depth of approximately 5 feet. An unmanned booster station is located approximately 11 miles east-southeast of Unit 2, at the intersection of the pipeline right-of-way and Palo Verde Road. 2

2.1.3.1.7 Groundwater Use

The major use of groundwater in the Lower Hassayampa-Centennial area which encompasses the regional aquifer is water for irrigation. An average of 78,000 acre-feet per year was pumped during the period 1966 through 1972. Annual pumpage rates for

other forms of water use, such as municipal, livestock and industrial purposes represent less than 1% of the total.

Well depth and groundwater elevation in the vicinity of the site is provided in section 2.4.2.

2.1.3.2 Selected Land Use Within a 5 to 10-mile Radius of the PVNGS Plant Site

2.1.3.2.1 Industrial Land Use

Figure 2.1-13 illustrates the location of the only industrial facility within a 5 to 10-mile radius of PVNGS, the Hassayampa Cotton Gin. It is located approximately 6.0 miles southeast of Unit 2. Employment information is cited in table 2.1-3.

2

2.1.3.2.2 Institutional Land Use

Figure 2.1-13 illustrates the location of the Ruth Fisher and Arlington Elementary Schools, approximately 7.5 miles north and 8 miles southeast of Unit 2, respectively. Employment information is cited in table 2.1-3.

There are no other public facilities or institutional land uses located within a 5 to 10-mile radius of PVNGS.

2.1.3.2.3 Agricultural Land Use

Agricultural land uses are discussed in section 2.1.3.4.

29. Collier, R., State of Arizona Dairy Commission, Phoenix, Arizona, Letter to Higman, S. L., NUS Corporation, June 15, 1979.

30. Lough, O. G., Agricultural Extension Agent, Maricopa County Cooperative Extension Service, Phoenix, Arizona, Letter to Higman, S. L., NUS Corporation, December 18, 1978.

31. Loughead, H. V., Agricultural Extension Agent, Maricopa County Cooperative Extension Service, Phoenix, Arizona, Personal Interview with Higman, S. L., NUS Corporation, October 13, 1978.

32. Duewer, L. A., U.S. Department of Agriculture, Economics, Statistics and Cooperative Services, Commodity Economic Division, Washington, D.C., Telephone Conversation with Wedgle, S. A., NUS Corporation, April 23, 1979.

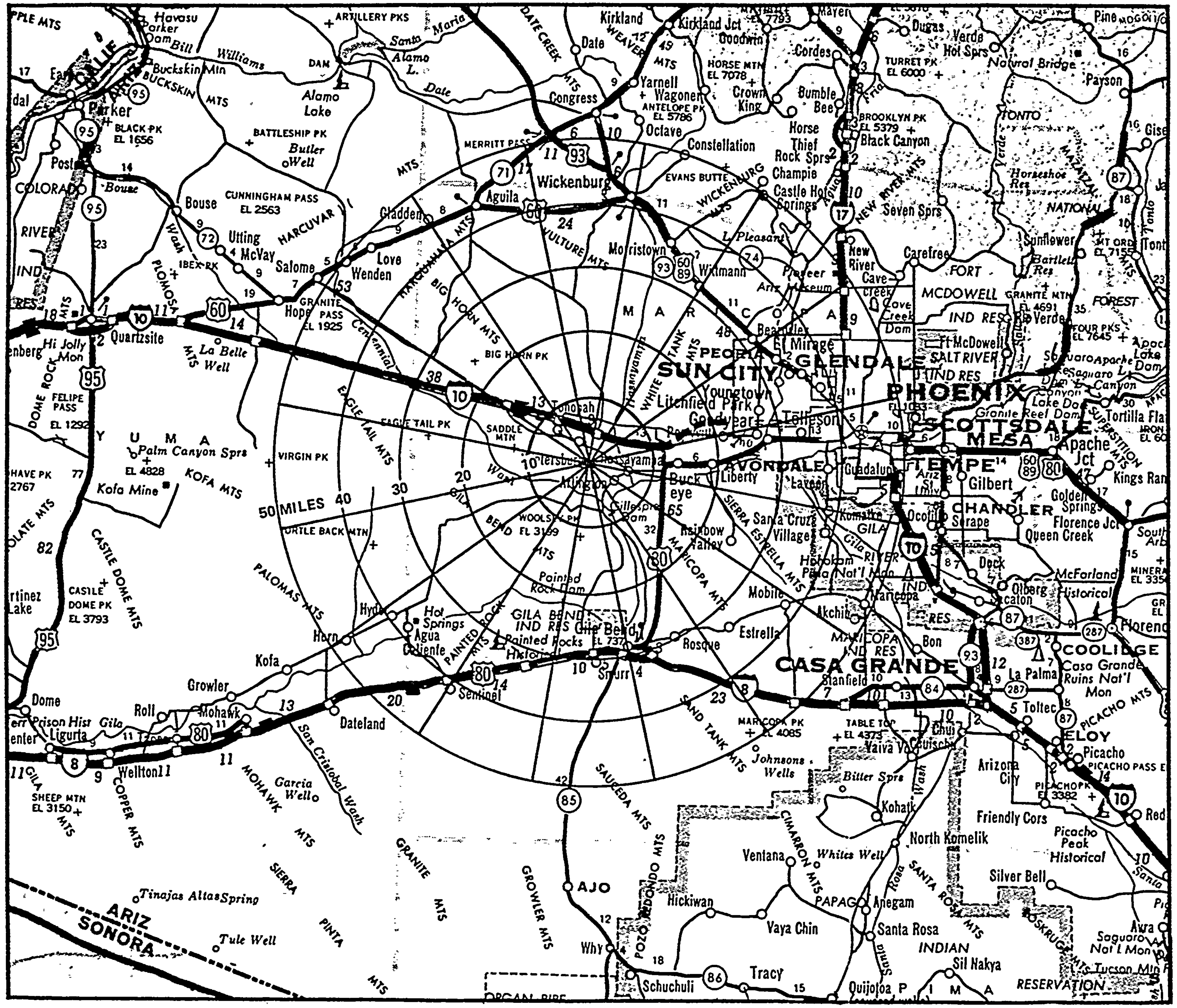
33. Mikles, Dr., Assistant State Veterinarian, Disease Control Section, Arizona State Livestock Sanitary Board, Letter to Higman, S. L., NUS Corporation, October 30, 1978.

34. Hickman, J. L., Superintendent, Arlington School, District No. 47, Arlington, Arizona, Letter to Higman, S. L., NUS Corporation, July 8, 1980.

35. Maricopa County Highway Department 1981 Maricopa County Road Map with Traffic Count, Phoenix.

36. Angell, H., Arizona Department of Transportation, telephone conversation with Moreland, W. B., NUS Corporation, January 21, 1981. 2

PRELIMINARY



EXPLANATION OF MAP SYMBOLS

Complete / Under Construction / Proposed
- TOLL–Limited Access Divided Highways
- FREE–Limited Access Divided Highways
- Other Divided Highways

(Proposed highway alignments are generalized. Many locations are undetermined.)

- Accumulated mileage between red pointers, dots or Interchanges
- Intermediate mileage between towns and junctions
- Scenic Roads
- National Interstate Highways
- Trans-Canada Highway
- U.S. Highways (Alternate, Bypass)
- Mexican and Central American Highways
- State and Provincial Highways
- Interchange Numbers and Names
- Secondary State, County, and Provincial Highways
- Selected State Waysides and Roadside Parks
- County Trunk Highways
- Interchanges and Rest Areas
- Toll Stations and Service Areas
- Principal Through Highways (paved / unpaved)
- Other Through Highways (paved / unpaved)
- Local Through Highways
- Other Roads (local conditions vary – inquiry suggested)
- Cities or Towns, County Seats, State Capitals
- City or Urban Areas
- U.S. National Cemeteries, Historic Sites
- U.S. National Monuments
- Airports (Commercial, Military, Municipal)
- State and Provincial Parks (with camping facilities)
- State and Provincial Parks (no camping facilities)
- State Memorials, Monuments, Historic Sites
- Springs and Wells
- Ranger Stations, etc.
- Points of Interest

Palo Verde Nuclear Generating Station
ER-OL

GENERAL ENVIRONS OF PALO VERDE SITE

Figure 2.1-2A

Table 2.3-24

SEASONAL AND ANNUAL FREQUENCY OF STABILITY CATEGORIES FOR PHOENIX (%)

(August 13, 1973 to August 13, 1978 and January 1, 1960 to January 1, 1964)

Season	Pasquill Stability Category						
	A	B	C	D	E	F	G
Spring:							
1973 to 1978	2.39	12.98	17.45	29.47	16.64	16.70	4.38
1960 to 1964	4.37	15.79	16.66	22.13	11.13	19.43	10.49
Summer:							
1973 to 1978	4.32	15.32	19.69	27.88	14.80	14.49	3.50
1960 to 1964	7.42	18.05	17.58	20.93	11.14	16.27	8.61
Fall:							
1973 to 1978	0.29	12.24	17.52	25.53	15.62	20.11	8.67
1960 to 1964	0.86	14.50	17.09	19.34	12.24	22.03	13.94
Winter:							
1973 to 1978	0.17	6.93	15.42	32.74	15.74	20.28	8.73
1960 to 1964	0.19	8.78	16.30	24.67	12.95	23.88	13.24
Annual:							
1973 to 1978	1.90	11.93	17.55	29.03	15.71	17.73	6.14
1960 to 1964	3.23	14.30	16.91	21.76	11.86	20.38	11.56

Appendix 2B includes grazing and growing season joint frequency distributions used to calculate some D/Q and χ/Q values. Monthly joint frequency distributions are not provided since hourly data on magnetic tape are also being provided.

2.3.2.1.7 Air Quality

The Palo Verde Nuclear Generating Station is located in the western portion of Maricopa County, Arizona. The western portion of Maricopa County is designated as an attainment area for the criteria pollutants of total suspended particulates, sulfur oxide, nitrogen oxide, carbon monoxide and ozone. This means the ambient air quality does not exceed the national ambient air quality standards or state ambient air quality standards as shown in table 2.3-24A. The closest non-attainment
2 area to the site is the Phoenix metropolitan area 30 miles to the east. This nonattainment area exceeds the State and National standards for particulates, carbon monoxide, and ozone. The closest air quality monitoring station to the site is located at Buckeye, 18 miles to the east. This station is privately owned and operated by Phelps Dodge Corporation and collects data for particulates, sulfur dioxide and ozone. Through conversations with State and County personnel, this station is not representative of the air quality for the Palo Verde site because of the influence of agricultural activities. The summary of data for the year 1979 is presented in table 2.3-24B.

2.3.2.2 <u>Topographic Effects on Local Meteorological Conditions</u>

The terrain in the region of the site is generally flat with an approximate elevation of 950 feet above mean sea level (msl). The Palo Verde Hills (elevation 2172 feet msl) are located approximately 5 miles to the west and north of the site.

Table 2.3-24A

SUMMARY OF AMBIENT AIR QUALITY STANDARDS (μg/m^3)

Pollutant	Averaging Time	Arizona[a] Standard	National[b]	
			Primary	Secondary
Carbon Monoxide	1 hr	40	40	-
	8 hr	10	10	-
Nitrogen Dioxide	Annual	100	100	-
Oxidants (Ozone)	1 hr	160	235	-
Particulates	24 hr	150	260	150
	Annual (geom mean)	75	75	60
Sulfur Dioxide	2 hr	1300	-	1300
	24 hr	365	365	-
	Annual	80	80	-

2

a. Not to be exceeded more than once per year.

b. Not to be exceeded more than once per year except in the case of ozone, not to be exceeded more than once per year based on a 3-year running average.

Table 2.3-24B

1979 BUCKEYE STATION AIR QUALITY DATA SUMMARY ($\mu g/m^{-3}$)

Pollutant	Annual	24 Hr	3 Hr	1 Hr
Particulate[a]	150	1654 max 597 second high		
Sulfur dioxide	3	103 max	173 max	
Ozone				147 max 147 second high

a. Influenced by dust storms and agricultural activities

PRELIMINARY

Table 2.3-25
METEOROLOGICAL DATA RECOVERY AT PVNGS (%)
(August 13, 1973 - August 13, 1978)

Month	200-Foot Wind Data	35-Foot Wind Data	ΔT_{200-35} Data	Joint Recovery 35-Foot Wind and ΔT_{200-35} Data	35-Foot Dew Point	35-Foot Temperature
August	79	93	93	92	93	93
September	92	94	93	92	91	93
October	98	98	90	90	95	95
November	96	96	94	92	93	94
December	98	97	90	89	93	90
January	93	98	97	96	97	97
February	97	99	98	98	98	98
March	97	99	99	98	96	97
April	97	97	97	97	94	96
May	94	99	98	98	95	96
June	93	95	96	94	92	92
July	95	96	84	83	95	92
Annual	94	97	94	93	94	94

Other scattered hills are in the area (approximately 2 miles from the site) with peak elevations of 1100 feet above msl. One effect on site meteorology results from the mountains to the north and the north-to-south downward sloping terrain. At night, when stable atmospheric conditions are prevalent at the site, drainage wind flows from the north can occur. Figures 3.1-3 and 2.3-1 are topographic maps of the site area within 5-mile and 50-mile radii, respectively. Figures 2.3-15 through 2.3-22 are the topographic cross-sections of the site area, to distances of 10 miles. A more detailed site area map with proposed buildings, site boundary, meteorological tower location, etc., is provided in figure 3.1-4.

2.3.3 METEOROLOGICAL DATA RECOVERY

The meteorological data recovery rates for the PVNGS meteorological program (August 13, 1973 to August 13, 1978) are listed in table 2.3-25.

The data recovery for wind data at the 35-foot level and 200-foot level was 97% and 94%, respectively, for the report period. Data recovery of the dew point temperature was 94%. The data recovery for $\Delta T_{200'-35'}$ was 94%.

2.3.4 ATMOSPHERIC DISPERSION ESTIMATES

Onsite meteorological data for the 5-year period August 13, 1973 through August 13, 1978 were analyzed to determine the atmospheric diffusion characteristics representative of the PVNGS site region. Dilution factors, χ/Q values, were calculated for input into dose computations for analysis of the environmental effects of accidents. Estimates of χ/Q values and relative deposition, D/Q values, were provided for dose calculations for determining the environmental effects of plant operation. These calculations are based on the meteorological models discussed in section 6.1.3. Table 2.3-26 provides

short-term (50th percentile) χ/Q values as well as annual average χ/Q and D/Q values at the site boundary. Zero to 50 mile short-term χ/Qs are listed in table 2.3-27. Zero to 50-mile dispersion and deposition parameters are listed in tables 2.3-28 through 2.3-33.

2.3.5 ABSOLUTE HUMIDITY

Absolute humidity as a function of the various grazing seasons as well as the absolute humidity used for the dose analysis are presented in table 2.3-34.

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PRELIMINARY

2.7 NOISE

Ambient noise levels in the vicinity of the site were measured prior to construction and presented in ER-CP Section 2.9. L_{50} sound levels at 10 sampling points varied from 17 to 66 dBa with an overall average of 34 dBa. Daytime, evening, and nighttime sound levels are shown in figures 2.7-1 through 2.7-3. Preconstruction noise survey methodology is described in section 6.1.

The noise sensitive land uses in the vicinity of the plant site are residences. Distances from major noise sources to nearby residences are indicated in table 2.7-1. There are no institutions or wildlife preserves in the vicinity of the plant site.

There are few terrain features and little significant ground cover in the vicinity of the site which would have significant effect on propagation of sound from the plant. Most of the vegetation in the area lies along drainage gullies and would provide little attenuation of sound. The terrain in the vicinity of the site is generally flat, sloping gently to the south, and interrupted occasionally by rock formations that vary in height from 20 to 100 feet. The only features of potential significance for sound attenuation are those immediately to the north of the site and to the east of the site. Due to the distance of these barriers from the plant noise sources and the limited width of these features, little attenuation of sound at the residences in these directions is anticipated. 2

Table 2.7-1

DISTANCES TO NEAREST RESIDENCES WITHIN FIVE MILES OF MAJOR NOISE SOURCES

2

Direction	Distance from Source Location (Miles)			
	Nearest Cooling Tower	Nearest Unit	Transformer (Switchboard)	Reclamation Water Pumps
N	1.2	1.4	1.8	0.9
NNE	1.7	1.8	2.1	1.2
NE	1.8	1.9	2.1	1.3
ENE	2.7	2.7	2.7	2.4
E	3.3	3.2	3.0	3.1
ESE	3.7	3.5	3.2	3.6
SE	-	-	-	-
SSE	4.0	3.9	3.6	4.5
S	3.7	3.7	3.7	4.7
SSW	2.9	2.9	3.2	4.1
SW	3.6	3.7	4.0	4.8
WSW	-	-	-	-
W	-	-	-	-
WNW	-	-	-	-
NW	2.0	2.3	2.6	2.1
NNW	2.2	2.4	2.8	2.0

PRELIMINARY

TABLE OF CONTENTS

QUESTION 2A.3 (NRC comment on section 2.3) (6/18/80) 2.3

No monthly mixing height data.

RESPONSE: The seasonal mixing height data provided in ER-OL section 2.3.1.2.7 are adequate to represent the mixing heights of the region. These data are the same as that provided in the Environmental Report - Construction Permit Stage (ER-CP) for Units 1-3 and the ER-CP for Units 4-5. In all dispersion calculations σ_z was constrained to values less than 1000 meters. This is consistent with average afternoon mixing heights for all seasons. Therefore, dispersion calculations implicity account for mixing heights appropriate to the PVNGS climatic regime, regardless of whether monthly or seasonal data is used. 1

QUESTION 2A.4 (NRC No. 291.15) 2.7

Provide a discussion of noise sensitive land uses in the vicinity of the plant site. The discussion should describe the type of land use (e.g., hospital, cemetery, school, residence, wildlife management area), and its location and distance from plant noise sources such as cooling towers, circulating water pumps, plant transformers, switchyard, steam vent locations and outdoor paging systems. 2

RESPONSE: The response is provided in the revised section 2.7.

QUESTION 2A.5 (NRC No. 291.16) 2.7

Provide a discussion of all significant barriers (natural or otherwise) to noise propagation and ground cover (such as groves of trees and other vegetation) that could possibly affect sound propagation to offsite areas. Indicate their location, extent, elevation, proximity to noise sources and noise sensitive land uses, and estimate their effect on noise propagation offsite.

RESPONSE: The response is provided in the revised section 2.7.

QUESTION 2A.6 (NRC No. 310.3) 2.1.2

Based upon available 1980 preliminary census counts, locate on a map all population centers within a 50-mile radius of PVNGS, including all towns, cities, and unincorporated communities. Update of tables 2.2-1 and 2.2-2 in the CP-ER would be
2 appropriate.

RESPONSE: The response is provided in the revised section 2.1.2.

QUESTION 2A.7 (NRC No. 310.4) 2.1.2

Provide updated zoning and current and future land use plans for the 0-50 mile radius from the site, including Maricopa County and the Phoenix area.

RESPONSE: Four counties are included in a 50-mile radius of the PVNGS: Maricopa, Pinal, Yuma, and Yauapai. Zoning maps are available for Maricopa County, including the City of Phoenix, and Pinal and Yuma Counties, but not for Yauapai County. Current and future land use plans are available for Maricopa County, including the City of Phoenix, and Yauopai County, but not for Pinal and Yuma Counties. The

following items will be sent under separate cover in fulfillment of this request:

Zoning Information

1. Maricopa County, Unincorporated Area, Zoning District Maps, various dates.
2. City of Phoenix Zoning Maps, various dates.
3. Pinal County Zoning Map, including Hidden Valley area inset, May 13, 1968.
4. Yuma County Zoning Maps (Area No. 4).

Current and Future Land Use Plans

1. Maricopa Association of Governments, Transportation and Planning Office: Guide for Regional Development and Transportation, July 23, 1980.
2. Maricopa County Planning and Zoning Department, Westcentral Maricopa County, Arizona Plan, October 1971. 2
3. City of Phoenix, Arizona, Phoenix Concept Plan 2000: A Program for Planning.
4. City of Phoenix, Arizona, Interim 1985 Plan.
5. Northern Arizona Council of Governments, "Regional Comprehensive Plan" and "Existing Population/Land Use" (Youapai County).

QUESTION 2A.8 (NRC No. 310.5) 2.1.2

Explain the method by which the 5-50 mile radius population figures in Section 2.1.2.1 were calculated.

RESPONSE: The 5-50 mile radius population figures were calculated in the same manner as the 5-10 mile radius population figures, as noted in sections 2.1.2.1 and 2.1.2.2.

QUESTION 2A.9 (NRC No. 310.6) 2.1.3

In addition to traffic counts provided in the OL-ER Table 2.1-4, please provide traffic counts on the following roads:

355th Avenue
Elliot (Ward) Road
339th Avenue
Van Buren Street
Wintersburg road heading south from the site, and
U.S. Highway approaches (I-10).

Identify any places where traffic congestion or problems of interference with patterns of local and pedestrian traffic might be anticipated.

2 RESPONSE: The response is provided in the revised section 2.1.3.1.6.

QUESTION 2A.10 (NRC No. 311.1) 2.1

A number of discrepancies between information supplied in the PSAR vs. the FSAR have been noted regarding information concerning the site vicinity. Examples of such discrepancies are as follows:

(a) The CP lists the PVNGS site as being 15 miles west of Buckeye and 36 miles west of Phoenix, whereas the FSAR lists these distances as 16 and 34 miles, respectively.

(b) The PSAR lists the elevation of the northern site boundary as 975 feet MSL, whereas the FSAR indicates 1030 feet MSL.

(c) There are some differences between the PSAR and FSAR in the distances and even some directions of the towns and communities listed.

(d) There is considerable difference in the population distribution shown on the charts in the CP and OL submittals. The distribution in certain sectors is confusing. Following is an example of some of the obvious population shifts noted in 6 of the sectors.

	40 - 50		30 - 40		20 - 30		0 - 5	
	N	NNE	ESE	SE	SE	SSE	NW	NNW
CP-1970	0	2698					125	0
OL-1978	3397	358					0	174
CP-1980	0	4261	955	0	534	0	197	0
OL-1980	3623	381	0	916	0	502	0	186
CP-1990	0	6291	1439	0	788	0	291	0
OL-1990	4621	187	0	1168	0	640	0	237
CP-2000	0	8682	1986	0	1088	0	402	0
OL-2000	5935	625	0	1500	0	822	0	304
CP-2010	0	11983	2741	0	1501	0	555	0
OL-2010	7622	803	0	1927	0	1055	0	390

2

The above data is representative but does not include all of the questionable population numbers noted throughout the document.

Please resolve these discrepancies and amend the FSAR, as appropriate.

RESPONSE: A review of the data presented in the PVNGS FSAR indicates that the statistics stand as correct and should be used as the basis for evaluation of environmental impacts. The difference in the data reflects refinement of the population modeling methodology since the PSAR.

QUESTION 2A.11 (NRC No. 311.2) 2.1.3

The population for the year 2030, for the cities of Avondale and Goodyear has a higher residential population than the sector (E) in which these cities are located. Please resolve this discrepancy. Also, explain how the population projections for the entire 30 mile radius around the site can be lower than either of the above (Section 2.1.3.6).

RESPONSE: The reason for these apparent discrepancies can be explained as a function of the methodology employed in preparing the population distribution projections. As noted in sections 2.1.2.1 and 2.1.2.2, 1978 population distributions are based on the location of U.S. Bureau of the Census - defined population centroids relative to PVNGS.

QUESTION 2A.12 (NRC No. 311.3) 2.1.3

2 Sun City has been designated as the nearest population center as defined by 10 CFR Part 100. However, since the projected population for the cities of Avondale and Goodyear, which are closer to the site than Sun City, is expected to reach 25,000 prior to the end of plant life, please amend your application accordingly by designating Avondale/Goodyear as the nearest population center.

RESPONSE: FSAR section 2.1.3.5 identifies two sets of nearest population centers for differing time periods. Sun City for the period 1978 to 1995; and Avondale and Goodyear for the period 1995 to 2030. Since the latter designation is based on projections only, it appears preferable to leave these designations as such in order to clarify the reasons for designating Sun City as the nearest population center.

QUESTION 2A.13 (NRC No. 311.4) 2.2.2

Southern Pacific Pipelines is "currently studying the feasibility of installing a pipeline parallel to the existing pipeline" which is 4.5 miles from Unit 2. There is no indication as to whether the new pipeline will be closer to the site, or exactly where it will be located. Please discuss the proposed location more fully and provide all pertinent additional information regarding this pipeline.

RESPONSE: Southern Pacific Pipelines does not now plan to construct a second pipeline parallel to the existing line for transport of refined petroleum products[a]. Section 2.1.3.1.6.4 has been revised accordingly.

a. McDaniel, R. R., Manager, Engineering, Southern Pacific Pipelines, Inc., telephone conversation with Higman, S. L., NUS Corporation, February 20, 1981.

QUESTION 2A.14 (NRC No. 311.5) 2.2.2 2

Provide more information on the current status of the proposed energy research park and petroleum refinery mentioned in the FSAR.

RESPONSE: FSAR Section 2.2.2.4, Projections of Industrial Growth, includes a brief discussion of a tentatively proposed energy research park and petroleum refinery to be located within a 20-mile radius of PVNGS. A preliminary report and plan was submitted by the project developers to the Maricopa County Planning Department in June, 1977 for information only. No further action had been taken by either parties, i.e., the developer or the planning department, during the time the FSAR was prepared and submitted.

The Maricopa County Planning Department indicates that the project has been abandoned[a]. In conclusion, it appears that the project can be stricken from the record. Section 2.1.3.2-1 has been revised accordingly.

a. Rengenburg, L., Principal Planner, Maricopa County Planning Department, telephone conversation with Higman, S. L., NUS Corporation, February 20, 1981.

2 QUESTION 2A.15 (NRC No. 450.1) 2.3

Provide a magnetic tape of hourly meteorological data for the five-year period described in the ER-OL. The data should be in the format described in Appendix A of the Draft of Revision 1 to Regulatory Guide 1.23. The tape should be compatible with IBM computer equipment.

RESPONSE: The tape is being provided under separate cover.

PRELIMINARY

3.2 REACTOR AND STEAM-ELECTRIC SYSTEM

Design parameters of the reactor and steam-electric system have not changed significantly since the ER-CP. This section summarizes design details.

Each PVNGS unit contains a nuclear steam supply system (NSSS) powered by a light-water moderated and cooled, pressurized water reactor (PWR). Each reactor is fueled with 102,780 kg of slightly enriched uranium in the form of sintered uranium dioxide (UO_2) pellets clad in 56,876 zircalloy-4 fuel rods.

Four-fingered and 12-fingered control element assemblies (CEAs) are used in the core. The CEAs provide short-term reactivity control under normal and anticipated transient conditions.

Each NSSS has a rated core thermal power of 3800 MWt. The reactor coolant pumps add 17 MWt of heat for an NSSS power level of 3817 MWt. The turbine-generator gross generator output corresponding to 3817 MW is 1304 MWe at design condenser back pressure of 3.5 in. Hg absolute. The nominal net output of each PVNGS unit is 1270 MWe. Each turbine-generator consists of a tandem compound type, six flow exhaust, 1800 r/min, steam turbine with 43-inch last stage buckets (blades). The turbine-generator is hydrogen cooled with a 0.9 power factor and operates at 24 kV, 3-phase and 60 Hz.

The relationship between the station gross heat rate and unit load is summarized in table 3.2-1.

The condenser is a three shell, single pass, multipressure, reheat condenser. The circulating water is divided into two parallel paths for a total design flow of 560,000 gal/min. The titanium tubes (25,426 per shell) provide a total effective surface area of 1,123,000 ft^2. The heat rejection rate is 8.9 x 10^9 Btu/h with a temperature rise of 32.1F. 2

Thus, at annual average inlet (basin) temperature of 89F, the outlet temperature would be 121.1F. The transit time between 2

Table 3.2-1

STATION GROSS HEAT RATE VS. POWER LEVEL

Power	Station Gross Heat Rate[a] (Btu/kWh)
60%	11,014
80%	10,320
100% (3817 MWt)	9,987
Stretch (Valves Wide Open)	9,998

a. At design condenser backpressure of 3.5 in. Hg absolute.

2 condenser inlet and the cooling tower basin is approximately 2.6 minutes at design flow. The transit time from the cooling tower basin to the condenser inlet is approximately 6.9 minutes at design flow. There are no appreciable pH fluctuations during the cycle.

The design lifetime of each PVNGS unit is 40 years.

PRELIMINARY

3.3 PLANT WATER USE

Parameters of plant water use have not changed substantially from those presented in ER-CP Section 3.3 and the FES. This section provides additional information and summarizes PVNGS water use.

Figure 3.3-1 presents a schematic flow diagram of the basic plant water use and lists the expected maximum, average, minimum, and shutdown flow rates of those water systems that require makeup and/or generate waste.

3.3.1 INFLUENT WATER SOURCES

There are two influent water sources to PVNGS. The primary plant water source is waste water effluent from the City of Phoenix 91st Avenue Sewage Treatment Plant. The processed effluent is delivered to the onsite water reclamation plant via pipeline from the 91st Avenue Sewage Treatment Plant. It is further treated and then stored in the 2300 acre-foot onsite reservoir. To retard seepage, the reservoir will be spray-lined at the bottom with rubberized asphalt at least 200 mils thick. The sides of the reservoir will be lined with 45-mil thick reinforced hypalon. No surface diversion occurs. The secondary plant water source is from on-site wells that supply water to the domestic water system. The two onsite wells are shown in figure 3.1-4. The wells are located wholly within the site boundary. No well water will be used offsite. The effect of well water withdrawal on the local groundwater hydrology is discussed in section 5.6. The domestic water system supplies potable water to each generating unit for domestic, utility, and air conditioning services. 2

The total annual makeup water requirement for PVNGS from the city of Phoenix is estimated at 21,350 acre-feet per year per unit. The average well water requirement is approximately 1300 acre-feet per year for all PVNGS units.

The water reclamation plant and the domestic water system are described in section 3.6.

3.3.2 PLANT WATER USES

3.3.2.1 Circulating Water System

Each unit's circulating water system removes waste heat resulting from normal operation of the unit and rejects it to the atmosphere via the three cooling towers in each system. Heat rejection is accomplished by the evaporation of a portion of the circulating water flow. To maintain the chemical concentration of circulating water at or below 15 times that of makeup water (15 cycles of concentration), a quantity of water, called blowdown, must be discharged from the system. In addition to evaporation and blowdown losses, a small amount of water in the form of entrained droplets (drift) is carried away in the cooling tower air stream. Makeup water to replace these losses in each unit is drawn from the reservoir.

During the period when the reactor is shut down for refueling and maintenance, the circulating water system is not used and makeup water is not required.

3.3.2.2 Essential Spray Pond System

Each generating unit has two spray ponds that provide the ultimate heat sink for cooling the auxiliary systems required for reactor shutdown. The domestic water system provides makeup water to the essential spray ponds. The spray ponds are normally in use only during a reactor shutdown. Hence, makeup from the domestic water system during normal operation is only required to replace water lost by natural surface evaporation and periodic blowdown to the circulating water system. During a reactor shutdown, makeup requirements to

the spray ponds are increased because of the increased evaporation to dissipate the imposed heat load and the drift associated with the operation of the ultimate heat sink sprays.

3.3.2.3 Domestic and Demineralized Water Systems

The onsite wells provide makeup to the domestic water system where it is processed in a reverse osmosis system to produce potable water. The product of the reverse osmosis system is used as makeup to the demineralized water system. Demineralized water is supplied to each unit.

3.3.3 PLANT WASTE WATER

The major source of waste water is blowdown from the circulating water system of each unit. Additional waste water is produced from sources such as: Nonradioactive demineralizer regenerants, demineralized water wastes, domestic water wastes and miscellaneous (e.g., floor drains) nonradioactive wastes. This wastewater is directed to the onsite evaporation ponds without requiring any offsite discharges.

Sanitary waste from each unit is kept separate from other plant wastes and is directed to the shared, onsite sanitary waste treatment facility. Liquid effluent from the sanitary waste treatment facility is returned to the water reclamation plant for reuse.

Treatment processes for the circulating water, domestic water, demineralized water, and condensate polishing systems, including chemical consumption, are discussed in section 3.6.

3.6 CHEMICAL AND BIOCIDE WASTES

Information presented in ER-CP Section 3.6 and the FES has been updated. As part of this update, detailed parameters such as flowrates, chemical consumption and operational frequencies are presented.

3.6.1 PREOPERATIONAL AND PERIODIC CLEANING WASTES

Prior to the initial startup of each unit, the feedwater system from the condensers to the containment isolation valves (approximately 450,000 gal) will be flushed and chemically cleaned to remove dirt, grease, oil, rust, and mill scale. This will be accomplished by the following operations:

A. Dirt and construction debris, estimated at 7470 lb, will be removed by flushing the piping with a high velocity water flush of approximately two system volumes of demineralized water.

B. Chemical cleaning is not expected to be required. Should it become necessary, however, the following steps would be performed:

   1. Grease, oil, and dirt, estimated at 3735 lb, will be removed by flushing each system with approximately 450,000 gallons of an alkaline phosphate solution of approximately 1% concentration. This will be followed with a rinse of approximately two system volumes of demineralized water.

   2. Rust and mill scale will be removed from each system by circulating a 3% organic acid (2% hydroxyacetic, 1% formic) solution containing a 0.2% acid inhibitor, such as Dow Chemical Co. A-145, for several hours. This will be followed with a rinse of approximately two system volumes of demineralized water containing an estimated 5600 lb of citric acid. An estimated 33,615 lb of iron will be removed.

c. The system may be passivated by filling with demineralized water containing 200-400 ppm hydrazine and 0-60 ppm ammonia, to a pH of 9.0-10.0.

Estimated total water volume used in a complete cleaning would be approximately 4,050,000 gallons.

Wastes from this cleaning process will be directed to the onsite evaporation ponds. Periodic, non-radioactive operational equipment cleaning wastes will be discharged to the evaporation ponds.

3.6.2 NONRADIOACTIVE OPERATIONAL WASTES

The plant is designed to have no requirement for offsite disposal of any chemical or liquid wastes. Operational nonradioactive liquid wastes are collected and discharged to the onsite evaporation ponds.

During normal operation of the plant, nonradioactive wastes come from the following sources:

- Water reclamation plant
- Circulating water system
- Demineralized water system
- Domestic water system
- Condensate polishing demineralizer system
- Laboratories and laundry
- Floor drains

Figure 3.3-1 diagrams all plant water and wastewater flows and includes a tabulation of the respective flow rates at various operating conditions. Table 3.6-1 includes a summary of the expected maximum and average concentrations of dissolved solids in the plant influent water from the City of Phoenix 91st Avenue Sewage Treatment Plant and the onsite wells. The

table includes the quality of the circulating water which is discharged as cooling tower blowdown and drift. Annual discharges are summarized in table 3.6-2. 2

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Table 3.6-1
ESTIMATED MAXIMUM AND AVERAGE CONCENTRATION OF CHEMICALS IN THE INFLUENT AND PROCESS WATER SYSTEMS (mg/l) (Sheet 1 of 3) 2

Chemical	Influent Streams				Process Streams		
	Influent from Phoenix 91st Avenue Sewage Treatment Plant		Influent from Onsite Wells		Water Reclamation Plant Effluent	Circulating Water System (Cooling Tower Blowdown and Drift)	
	Maximum	Average	Maximum	Average	Average	Maximum (20 cycles)	Average (15 cycles)
Calcium	67.2	52.9	16.0	14.0	28.0	560.0	420.0
Magnesium	29.6	22.9	8.0	4.6	10.0	200.0	150.0
Sodium	192	186	269.0	225.0	225.0	4,500.0	3,375.0
Chloride	270	253	290.0	232.0	160.0	3,200.0	2,400.0
Sulfate	95.0	91.0	131.0	103.0	150.0	3,000.0	2,250.0
Nitrate	4.20	1.85	12.0	6.5	110.0	2,200.0	1,650.0
Silica	32.0	28.8	55.0	45.0	10.0	200.0	150.0
Phosphate	68.9	22.1	0.1	0.1	<0.1	2.0	1.5
Fluoride	4.8	3.5	10.0	6.2	--	70.0	52.5
Potassium	14.7	13.8	2.0	1.1	--	276.0	207.0
Copper	0.26	0.017	0.1	0.02	0.013	0.4	0.3
Zinc	0.080	0.067	--	--	0.05	1.3	1.0

2

2

PRELIMINARY

Table 3.6-1

ESTIMATED MAXIMUM AND AVERAGE CONCENTRATION OF CHEMICALS IN THE INFLUENT AND PROCESS WATER SYSTEMS (mg/l) (Sheet 2 of 3)

	Influent Streams				Process Streams		
	Influent from Phoenix 91st Avenue Sewage Treatment Plant		Influent from Onsite Wells		Water Reclamation Plant Effluent	Circulating Water System (Cooling Tower Blowdown and Drift)	
Chemical	Maximum	Average	Maximum	Average	Average	Maximum (20 cycles)	Average (15 cycles)
Iron	0.15	0.035	0.1	0.8	0.005	0.1	0.075
Arsenic	0.02	0.007	0.02	0.01	0.008	0.16	0.12
Boron	0.09	0.037	7.0	3.2	--	0.74	0.56
Ammonia-N	45.4	30.9	0.3	0.08	5.0	100.0	75.0
Phenol	0.018	0.009	0.01	0.009	--	0.18	0.14
Dissolved Oxygen	8.2	6.7	--	--	--	134.0	100.5
Suspended Solids	68	35.7	--	--	10.0	200.0	150.0
COD	187.7	87	14.0	6.0	--	1740.0	1305.0
Alkalinity	285	272	230.0	143.0	100.0	2000.0	1500.0
TDS	1,083	1,039	886.0	740.0	800.0	16,000.0	12,000.0
Silver	0.02	<0.006	--	--	0.003	0.06	0.05

Table 3.6-1

ESTIMATED MAXIMUM AND AVERAGE CONCENTRATION OF CHEMICALS IN THE INFLUENT AND PROCESS WATER SYSTEMS (mg/l) (Sheet 3 of 3) 2

	Influent Streams				Process Streams		
	Influent from Phoenix 91st Avenue Sewage Treatment Plant		Influent from Onsite Wells		Water Reclamation Plant Effluent	Circulating Water System (Cooling Tower Blowdown and Drift)	
Chemical	Maximum	Average	Maximum	Average	Average	Maximum (20 cycles)	Average (15 cycles)
Barium	0.1	<0.033	--	--	0.01	0.2	0.15
Cadmium	0.002	<0.002	--	--	0.001	0.02	0.015
Chromium	0.035	<0.014	--	--	0.004	0.08	0.06
Lead	0.03	<0.02	--	--	0.02	0.4	0.3
Mercury	0.0005	0.0001	--	--	0.0001	0.002	0.0015
Berylium	0.02	0.02	--	--	0.02	0.4	0.3
Selenium	0.015	<0.003	--	--	0.001	0.02	0.015
Manganese	0.1	0.05	--	--	--	1.0	0.75

Table 3.6-2

ESTIMATED CONCENTRATION AND ANNUAL DISCHARGE OF HEAVY METALS, AND TOXIC AND DELETERIOUS SUBSTANCES IN COOLING TOWER DRIFT AND BLOWDOWN[a]

Heavy Metals, Toxic and Deleterious Substances	15-cycle Concentration mg/l	Total lb/yr	
		Drift[b]	Blowdown
Arsenic	0.12	4.5	144.1
Barium	0.15	5.6	180.1
Berylium	0.3	11.3	360.2
Boron	0.56	21.0	672.3
Cadmium	0.015	0.6	18.0
Chromium	0.06	2.2	72.0
Copper	0.3	11.3	360.2
Fluoride	52.5	1971.4	63,026.3
Iron	0.075	2.8	90.0
Lead	0.3	11.2	360.2
Manganese	0.75	28.1	900.4
Mercury	0.0015	0.1	1.8
Selenium	0.015	0.6	18.0
Silver	0.05	1.9	60.0
Zinc	1.0	37.6	1,200.5
TOTAL	24.39	2110	67,464

a. Essentially no biocides. Refer to section 3.6.2.1.

b. Drift rate of 0.0044%.

2

3.6.2.1 Water Reclamation Plant

The water reclamation plant receives the wastewater effluent from the City of Phoenix 91st Avenue Sewage Treatment Plant, processes it further in four stages of treatment, and stores it in the onsite reservoir. This onsite treatment of the station makeup water is required to reduce the concentration levels of calcium, phosphate, silica, magnesium, and ammonia. Design effluent chemical concentrations are shown in table 3.6-1. |2 Some incidental removal of organics occurs. The removal of these compounds allows the treated effluent to be concentrated to approximately 15 cycles in each generating unit circulating water system without excessive scaling or fouling of system components and heat exchangers.

The water reclamation plant process is shown schematically in figure 3.6-1. The four stages of treatment are:

- Biological nitrification
- Lime treatment
- Filtration
- Chlorination

The influent to the water reclamation plant (WRP) consists of effluent from the Phoenix treatment plant which provides primary sedimentation and secondary activated sludge treatment.

No further removal of organics is required in order to use the WRP influent water for cooling purposes in the power plant; therefore, treatment processes in the WRP have not been designed to remove organics. However, some incidental removals will occur in certain processes as estimated by the following:

Treatment Process	Removal
Biological nitrification (see section 3.6.2.1.1)	10 to 20% removal of dissolved (or colloidal) organics,

Treatment Process	Removal
	measured as BOD_5 (5-day bio-chemical oxygen demand) or COD (chemical oxygen demand).
Lime soda softening and clarification (see section 3.6.2.1.2)	Better than 95% removal of suspended organics, measured as volatile suspended solids, and 5 to 10% removal of colloidal BOD_5 and COD.
Entire WRP, considered as a whole	Better than 95% removal of suspended organics, and 10 to 25% removal of dissolved or colloidal organics.

The WRP influent will contain an average of about 30 mg/ℓ BOD_5, 40 mg/ℓ suspended solids, and 100 mg/ℓ COD. Lime clarification should provide high removal rates for viruses and bacteria, so pathogen levels in the WRP effluent are expected to be low. However, this water is expected to contain the broad spectrum of organics which typically occur in secondary sewage effluent due to their relative resistance to biodegradation.

Chlorinated hydrocarbons, chlorophenoxys and polychlorinated biphenyls (PCBs) biocides have been routinely monitored at the 91st Avenue Plant since August, 1975. With the exception of two months, these biocides have been at levels less than the minimum detectable. Detection limits are provided in
2 table 3.6-3. During June, 1976, PCB was detected at 0.0221 mg/ℓ. It is believed the cause of the PCB was a transformer failure. During August, 1976, Aldrin, Dieldrin, p,p′-DDT and 2,4,5-TP (Silvex) were detected at concentrations of 0.002, 0.002, 0.005, and 0.08 mg/ℓ, respectively, during a period of significantly lower than normal effluent flow rates. Consequently,

Table 3.6-3

BIOCIDE DETECTION LIMITS (Sheet 1 of 2)

Biocide	Concentration (mg/ℓ)
Phosdrin	0.01
Thimet	0.05
Diazinon	0.002
Heptachlor	0.0001
γ- BMC	0.001
Aldrin	0.00015
Methyl Parathion	0.001
Heptachlor Epoxide	0.0001
Malathion	0.001
Ethyl Parathion	0.001
p,p´-DDE	0.001
Dieldrin	0.0015
Endrin	0.0002
o,p´-DDT	0.001
p,p´-DDD	0.001
p,p´-DDT	0.002
Methoxychlor	0.1
Dimethoate	0.0001
Guthion	0.05
α- BMC	0.001
p - BMC	0.001
Lindane	0.004
Ethion	0.1
Trithion	0.01
Tedion	0.01
Chlordane	0.003
Toxaphene	0.005
2,4-D	0.1
2,4,5-TP (Silvex)	0.01

2

Table 3.6-3

BIOCIDE DETECTION LIMITS (Sheet 2 of 2)

Biocide	Concentration (mg/ℓ)
2,4,5-T	0.01
PCP	0.1
p,p´-DDT	0.0015
Perthane	0.1
o,p´-DDD	0.001
o,p´-DDT	0.001
PCB	0.0025

2

these values are considered atypical and essentially no biocides are expected to be contained in blowdown or cooling tower drift.

3.6.2.1.1 Biological Nitrification

Biological nitrification refers to the bacterial conversion of ammonia nitrogen to the nitrate nitrogen form. The following equations summarize the two-step reaction:

$$NH_4^+ + 3/2\ O_2 \xrightarrow{\text{bacteria}} NO_2^- + 2H^+ + H_2O$$

$$NO_2^- + 1/2\ O_2 \xrightarrow{\text{bacteria}} NO_3^-$$

For nitrification, the trickling filter process has been selected. In this process, nitrifying bacteria are attached to a solid medium along with other microorganisms. By distribution

3.6.2.2 Circulating Water System

Each generating unit is provided with an independent circulating water system. This system, shown schematically in figure 3.6-2, removes waste heat developed during normal operation and rejects it to the atmosphere via the three mechanical draft cooling towers. The circulating water system is discussed in section 3.4.

Waste from the circulating water system consists of blowdown and drift from the cooling towers. Blowdown is continuously discharged to the evaporation ponds as required to maintain water quality. Drift is maintained at approximately 0.0044% of the 587,000 gal/min combined flow of the circulating water and plant cooling water system by the use of integral drift eliminators in the cooling towers. Drift from the cooling towers is discussed in sections 5.1 and 5.3.

Chlorine is added to the circulating system, as a sodium hypochlorite solution, to control biological growth. The amount of chlorine added is dependent upon the rate of biological growth in the circulating water. During the summer, because of increased biological growth on warm days, chlorine is injected in approximately three 40-minute injection periods per day for shock treatment. During the winter, when chlorine demand is low, only two 40-minute injection periods per day are required. It is expected that approximately 3500 pounds per day per unit of chlorine during the summer, and approximately 2300 pounds per day per unit of chlorine during the winter will be required for biogrowth control. The process consists of injecting the chlorine into the circulating water and the plant cooling water pump suctions in sufficient quantity to maintain a chlorine residual at the discharge of the condenser and heat exchangers of approximately 1 to 2 parts per million. Since the chlorine is injected in the hypochlorite form, no elemental chlorine is released to the atmosphere.

Sulfuric acid is added to maintain the pH at approximately 7 to prevent deposition of calcium carbonate scale. Acid, 66° Baume, is diluted and distributed in the circulating water stream upstream of the circulating water pumps to ensure complete mixing and pH adjustment prior to entering the pumps. A dispersant is added to the circulating water to inhibit the formation of scale on condenser and heat exchanger tube surfaces.

The main condenser and heat exchanger tubes are titanium with negligible corrosion rate. No other sources of corrosion products are expected since the circulating water lines are constructed of concrete and the plant cooling water lines and cooling tower risers are suitably lined, as are all valves and ferrous fittings. Since the rate of corrosion is minimal, it is anticipated that no corrosion inhibitors will need to be added to the system.

3.6.2.3 Domestic Water System

The domestic water system consists of four reverse osmosis modules in parallel. The reverse osmosis product is shared between the domestic and demineralized water systems. Internal valves in the reverse osmosis system allow the output to be distributed on a 1:3, 1:1, or 3:1 basis to the receiving systems. A schematic flow diagram of the domestic water system is shown as figure 3.6-3.

The reverse osmosis modules rated at approximately 200 gallons per minute each, remove approximately 90% of the total dissolved solids (TDS) in the water, to bring the water quality within U.S. Public Health Service limits. The units reject approximately 20% of the incoming water as a concentrate containing the removed dissolved solids. This concentrate is
2 discharged into the evaporation pond. During reverse osmosis module operation approximately 0.02 GPM of sodium hypochlorite

is added at 0.75 ppm Cl_2 equivalent. Sulfuric acid at 66° Baume' is also added intermittently at 19 GPM. NALCO 8102 (cationic polymer) and NALCO 8182 (anionic polymer) are added as required at 0.5 and 0.2 ppm. Sodium hypochlorite is added downstream of the reverse osmosis units at 1-2 ppm prior to storage in the domestic water chlorine contact tank. 2

As part of the cleaning process, approximately 500 gallons of 20,000 ppm citric acid is added and recirculated through each module (2000 gallons total) once every three months. During reverse osmosis module layup, the module will be filled with a 0.2% solution of formaldehyde. Chemicals used for cleaning are not discharged to the storage tanks; they are diverted to the evaporation ponds. 2

2 This page intentionally left blank.

Provisions are made to direct floor drains to the liquid radwaste system or to the neutralizer tanks, if necessary.

3.6.3 NONRADIOACTIVE LIQUID WASTE DISPOSAL

Chemical and liquid waste is disposed of in the onsite evaporation ponds and retention basin.

3.6.3.1 Evaporation Ponds

The onsite evaporation ponds receive liquid waste from the generating units and remove moisture by natural evaporation. Initially, 250 acres of evaporation ponds will be constructed. The evaporation ponds may be expanded to contain additional liquid wastes. It is expected that such expansion would be of no more than 420 acres for a total of 670 acres.

The bottom of the initial 250 acre evaporation ponds will be lined with rubberized asphalt. The rubberized asphalt compound will be a blend of asphalt cement, aromatic rubber extender oil and 22 percent of powdered rubber by weight combined so as to produce an impermeable material with minimum softening point of 135 F and maximum brittle point of 10 F. The material is hot spray applied at temperatures below 425 F. The minimum thickness of the lining shall be 200 mils.

The interior side slopes of the initial 250 acre pond will be lined with hypalon. The hypalon lining will be reinforced with a polyester scrim. The minimum thickness of the hypalon lining will be 45 mils. 2

The permeability of the initial 250 acre lined ponds shall be 10^{-10} cm/sec. or lower. Liner material resists chemical degradation to the limits specified in table 3.6-4.

The liner integrity will be confirmed by periodic monitoring of the leak detection system liquid collection points and groundwater monitoring wells.

Table 3.6-4

CHEMICAL TOLERANCE SPECIFICATION FOR LINER[(a)(b)]

Species	Concentration (mg/l)
Total Dissolved Solids	300,000
Sodium (as Na)	105,000
Chloride (as Cl)	98,900
Sulphate (as SO_4)	48,000
Nitrate (as NO_3)	47,500
Calcium (as Ca)	4,000
Silicon (as SiO_2)	2,000
Alkalinity (as $CACO_3$)	700
Magnesium (as Mg)	500
Ammonia (as NH_3)	50
Fluoride (as F)	200
Hydrazine (N_2H_4)	10

a. pH is essentially neutral and corresponds to the species in solution.

b. Liner resists oxidative degradation

2

3.7 SANITARY AND OTHER WASTE SYSTEMS

The information presented in ER-CP Section 3.7 and the FES has been updated to reflect peak construction work force and gaseous effluent quantities based on plant specific equipment data. The information is updated and summarized in this section.

3.7.1 LIQUID WASTES

3.7.1.1 Sanitary Wastes

Facilities are provided to treat sanitary wastes produced during construction and operation except for that produced by field construction workers. Chemical toilets are used by field construction workers; wastes from the chemical toilets are hauled approximately 10 miles to the Maricopa county land fill site for disposal.

The peak construction workforce (office plus field) was about 6200. The estimated quantity from chemical toilets is 34,000 gal/d based on 3400 field workers at 10 gal/d. It is estimated that a peak sanitary waste flowrate of 30,000 gal/d will be processed by the onsite sewage treatment package plants. This sanitary waste will contain approximately 300 ppm of 5-day BOD and 300 ppm suspended solids.

During construction, two package sewage treatment plants will be used, each with a rated capacity of 17,500 gal/d for a total capacity of 35,000 gal/d. During normal plant operation, the expected sewage load will be less than 15,000 gal/d. The treated effluent is recycled to the onsite water reclamation plant. Solid wastes are transported to the onsite solid waste disposal area discussed in section 3.7.2.2.

PRELIMINARY

3.7.1.2 Other Liquid Wastes

Chemical laboratory wastes, dry cleaning waste, and decontamination solutions are described in section 3.6.2.

3.7.2 SOLID WASTES

3.7.2.1 Sources of Solid Waste

3.7.2.1.1 Water Reclamation Plant

Sludge produced by the two-stage lime treatment process from the water reclamation plant is further concentrated in the centrifuges. A portion of the concentrated sludge is recal-
2 cined to recover lime for reuse in the lime softening process. Approximately 15,500 tons of sludge per PVNGS unit requiring disposal is produced annually at the water reclamation plant.

3.7.2.1.2 Sanitary Waste Treatment Plant

Sanitary sludge is produced in the package sewage treatment plants. Pathogen levels will be low as the plants incorporate aerobic digestion and chlorination. The plants achieve a 90-95% BOD and a 90% suspended solids removal efficiency. Approximately
2 8 tons of dried sludge are produced annually during normal plant operation. It is transported offsite to an existing sanitary fill area. Reclaimed wastewater is routed to the water reclamation plant for reuse.

3.7.2.1.3 Service Buildings

Wastes from the service buildings consist of paper, rags, grit, and other nonrecyclable materials. This waste essentially is in solid form. Approximately 150 tons per year are expected from this source.

3.7.2.1.4 Miscellaneous

Various other solid wastes, such as those obtained in inter-
2 mittent cleaning of windblown dust, sand, and/or debris or

minor amounts of $CaCO_3$ due to post-precipitation from the plant cooling tower basins and water storage reservoir, are anticipated and require disposal. The quantities produced will be small compared to other sources. Removed soils and $CaCO_3$ will 2
be disposed of with the sludge described in section 3.7.2.1.1. Debris will be collected and disposed of as trash.

3.7.2.2 Solid Waste Disposal Area

The solid waste disposal area is approximately 200 acres. Sludge waste will be spread in the area to dry out. Water reclamation plant waste is centrifuge dried prior to disposal in the solid waste disposal area.

3.7.3 GASEOUS EFFLUENTS

The gaseous effluents estimated for the diesel generators and 2
auxiliary boilers are based upon the emission parameters noted in table 5.4-1.

3.7.3.1 Diesel Generators

Each diesel generator (two per unit) nominally operates for test purposes once a month for approximately 1 hour, and discharges approximately 2300 pounds NO_x, 675 pounds SO_x, and 2
35 pounds of hydrocarbons annually. Each diesel generator discharges through its own stack approximately 93 feet above plant grade.

3.7.3.2 Auxiliary Boilers

During operation, the auxiliary boilers are available for backup and are not normally used after initial startup. The three units share one set of two auxiliary boilers. When the boilers operate (approximately 8 days per unit per initial startup)

2 they will produce about 2300 pounds NO_x, 7583 pounds SO_x, and 682 pounds of hydrocarbons daily. The auxiliary boilers discharge through their own stacks 50 feet above plant grade.

3.7.3.3 Water Reclamation Plant

Gaseous wastes from the wastewater reclamation system will be generated from the lime recalcination operations. The furnace exhaust gas discharged will contain a maximum of 84 pounds particulate matter, 180 pounds SO_x, 23 pounds CO, 17 pounds
2 hydrocarbons, heavy metals as noted in Table 3.7-1, and 456 pounds NO_x, daily, after treatment in a wet scrubber. Under normal plant operating conditions, the major portion of
2 the exhaust will be injected into the water in the second stage solids contact clarifiers as a source of CO_2 for recarbination. This will tend to reduce the discharges of all of the above pollutants from the maximum levels specified.

The calculations establishing the furnace stack heavy metal emissions noted in table 3.7-1 were based on analyses of samples from various waste and process streams taken during the demonstration plant testing in Phoenix and recalcine furnace testing in Brisbane, California and the following assumptions:

- Seventy-five percent solids recovered in the
2 classifying centrifuge:
- Sixty-five percent recalcine furnace reduction efficiency:
- 99.5 percent furnace scrubber efficiency (virtually all solid heavy metals retained).
- Maximum furnace temperature of 1800° F
- Metal quantities in waste lime sludge as shown in table 3.7-1.

Table 3.7-1

LIME RECALCINATION FURNACE HEAVY METAL GAS EMISSIONS AND LIME SLUDGE CONCENTRATIONS

Element	Gas Emission (lb/day)	Waste Lime Sludge (lb/day)
As	0.0001	0.3
Ag	0.003	0.3
Ba	0.0001	1.3
Cd	0.001	1.3
Cu	0.002	2.0
Cr	0.007	8.0
Fe	0.07	55.3
Pb	0.007	2.3
Hg	-	-
Be	-	-
Zn	0.008	1.3
Se	0.00001	0.3

2

3.9.1.4.3 PVNGS To Devers Structure

Information concerning the PVNGS to Devers line is contained in the U.S. Department of Interior Bureau of Land Management and U.S. Nuclear Regulatory Commission Final Environmental Statement, Palo Verde-Devers 500 kV Transmission Line, February, 1979. Descriptions are presented for preferred and alternate routes. Final route approval has not been received from the Bureau of Land Management. 2

3.9.2 PVNGS WASTEWATER CONVEYANCE SYSTEM

Information presented in ER-CP Section 3.9.2 and the FES has been updated to reflect final pipeline routing. Description of the wastewater conveyance system is updated and summarized in this section. Refer to section 5.6.1 for an updated description of wastewater availability. 2

As shown in figure 3.9-5, the wastewater conveyance system route extends from the City of Phoenix 91st Avenue Sewage Treatment Plant approximately 36.5 miles to the PVNGS site.

A 114-inch diameter pipeline leaves the 91st Avenue Sewage Treatment Plant, conveying treated wastewater effluent by gravity flow for about 6 miles, where it is reduced to a 96-inch diameter. The 96-inch diameter pipeline continues gravity flow for about 3.3 miles to a turnout (refer to figure 3.9-5) for delivery of effluent to the Buckeye Irrigation Company (BIC) canal. From the turnout, the 96-inch pipeline proceeds by gravity flow generally parallel to the BIC canal for about 19.2 miles to a pumping station near the Hassayampa River. The remaining 8 miles to the PVNGS site are traversed by a 66-inch diameter pipeline. The entire 36.5 miles of pipeline will be underground with above ground structures limited to manholes approximately each 1/2 mile and vents, at high points, about 1-2 feet above grade; these are anticipated to have minimal visual impact. A 50 foot wide permanent access right-of-way will be required for the entire length of the pipeline. 2

The majority of the wastewater conveyance pipeline passes through agricultural land. The remaining areas are scattered residential, mostly associated with the agricultural activities, and some scattered light industry. There are no existing recreational areas along the route. After construction the right-of-way will be regraded, and topsoil will be replaced in agricultural areas for future cultivation. Table 3.9-1 lists the land types and the distances associated with the wastewater conveyance pipeline route.

Table 3.9-1

LAND TYPE ADJACENT TO WASTEWATER CONVEYANCE PIPELINE

Land Use Types	Route
Open land	12.5 miles
Agricultural land	19.0 miles
Residential areas	3.5 miles
Industrial areas	0.5 mile
Other	1.0 mile

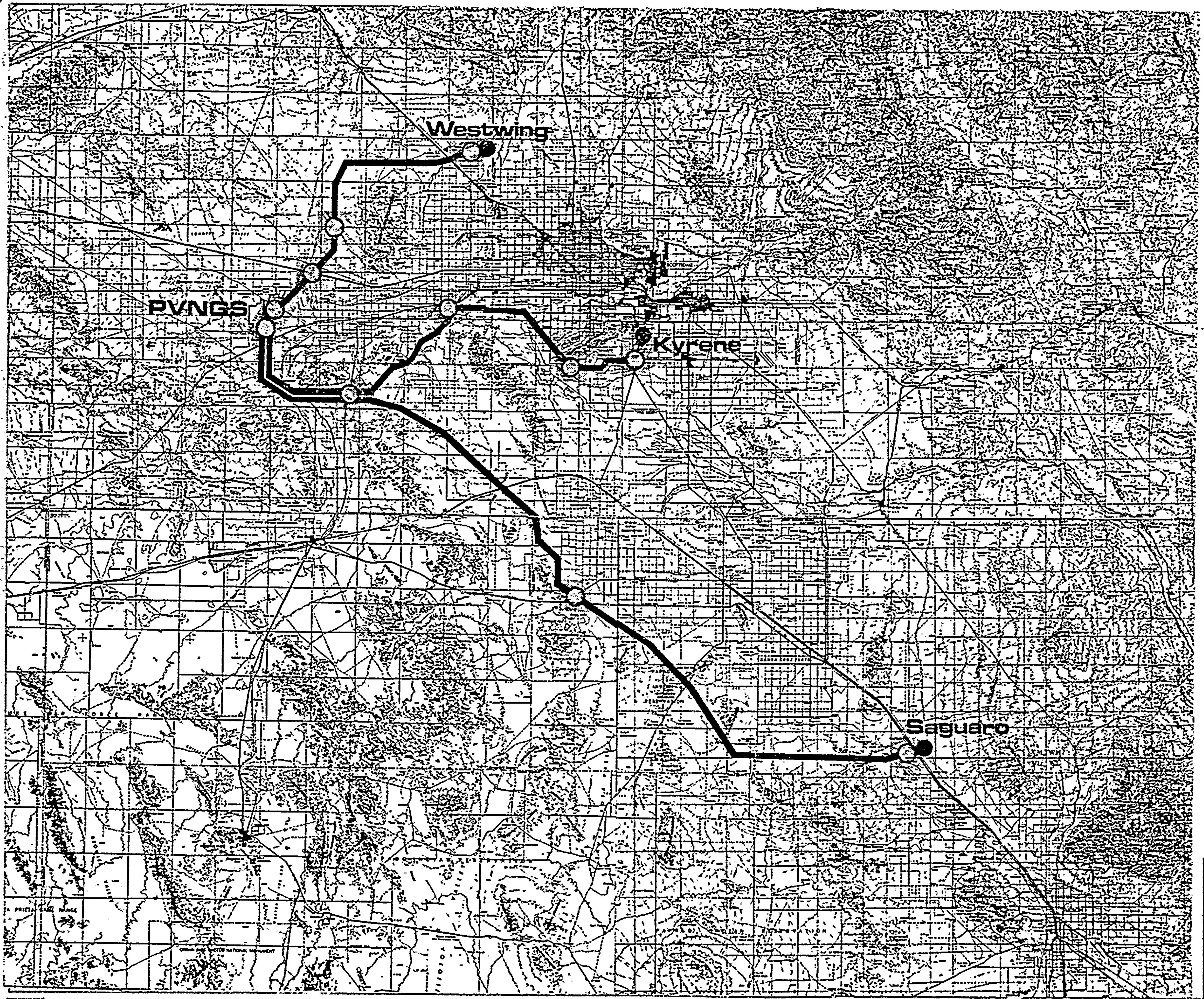
3.9.3 REFERENCES

1. Letter dated December 7, 1978 from E. E. Van Brunt, Jr., Arizona Public Service Company, Vice President, Nuclear Projects to Dr. Robert A. Gilbert, Project Manager, Environmental Projects Branch 3, U.S. Nuclear Regulatory Commission.

2. Letter dated January 4, 1979 from W. H. Regan, Jr., Chief, Environmental Projects Branch 2, U.S. Nuclear Regulatory Commission to E. E. Van Brunt, Jr.

3. Letter dated December 3, 1979 from E. E. Van Brunt, Jr., Arizona Public Service Company, Vice President, Nuclear Projects to Dr. Robert A. Gilbert, Project Manager, Environmental Projects Branch 3, U.S. Nuclear Regulatory Commission.

PRELIMINARY



LEGEND

⊙ POTENTIAL ACCESS POINTS

Palo Verde Nuclear Generating Station
ER-OL

TRANSMISSION LINE ROUTES
PROJECT 1

Figure 3.9-1

CHANGE

March 1981

Supplement 2

02-27-81

PRELIMINARY

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QUESTION 3A.1 (NRC comment on section 3.1.3.1) (6/18/80) 3.1.3-1

Location of release points not illustrated on figure 3.1-9. 1

RESPONSE: The response is given in revised section 3.1.3.1.

QUESTION 3A.2 (NRC No. 240.1) 3.9.2

Sewage effluent from the city of Phoenix is to be utilized as the source of condenser cooling water and the amount of effluent produced at the 91st Avenue Sewage Treatment Facility will determine the amount of cooling water available for plant use. At the present time, the sewage treatment facility is being expanded from a capacity of 95 MGD (million gallons per day) to 120 MGD. It is likely that this facility will not be expanded any further before Palo Verde Unit 3 goes into operation. Assuming that there is no further expansion, will there be sufficient cooling water available for all three units? If yes, provide the basis on which you made your determination. Include as a minimum the following information.

(1) How much effluent will be produced at the 91st Avenue Facility once the 120 MGD expansion is completed, i.e., will the plant operate at full capacity? 2

(2) Of the total effluent produced, how much will be available for use at Palo Verde? Provide and explain the basis used to determine this quantity and show how your right to this effluent relates to other effluent users, i.e., will the amount of effluent available satisfy all user demands? If not, how will the available effluent be apportioned between users and what is the basis for the apportionment.

(3) Of the effluent determined in (2) above to be available for Palo Verde use at the 91st Avenue Facility, provide an estimate of the net amount that will be available at Palo Verde once all losses have been accounted for. Provide the basis for this determination and include

all losses such as pipe leakage, evaporation, seepage, etc. Define the criteria used in determining these losses.

If the 120 MGD expansion will not provide an adequate quantity of effluent for all three Palo Verde units, provide information on how the Palo Verde plant will be operated to compensate for this reduced supply of water.

RESPONSE: Expansion of the 91st Avenue Sewage Treatment Plant to 120 MGD will provide adequate cooling water for all three units. This evaluation considers the most recent MAG 208 Plan and City of Phoenix projections as well as recent flow measurements. Revised projections of effluent availability and PVNGS usage (including losses) are presented in the revised section 5.6.1.

2 The revised section 5.6.1 also presents descriptions of the current rights to obtain effluents.

<u>QUESTION 3A.3</u> (NRC No. 240.2) 3.9.2

If the 120 MGD capacity will not provide an adequate amount of cooling water for Palo Verde and you anticipate further expansion of the 91st Avenue Facility, provide information on when this expansion will occur and relate this to your schedule for operation of the Palo Verde station. Also provide data on the status of future expansion plans, i.e., are plans in the planning stage or is a contract ready to be let or is the status somewhere in between?

RESPONSE: Capacity of 120 MGD will provide adequate cooling water for Palo Verde for the reasons noted in the response to Question 3A.2.

QUESTION 3A.4 (NRC question 240.3) 3.6.3.1

At the site visit and meeting of January 27-28, 1981, we were informed that the liner for the evaporation and storage ponds will consist of an asphalt bottom with hypalon on the side slopes. Provide plans of this proposal and a description of how the liner is to be installed.

RESPONSE: The response is provided in the revised section 3.6.3.1.

QUESTION 3A.5 (NRC No. 240.4) 3.3

In the key to Figure 3-3 of the FES, the influent from the City of Phoenix 91st Avenue Sewage Treatment Plant is 48,890 gpm for three units at maximum output and annual average ambient conditions. In Figure 3.3-1 of the ER-OL, the influent from the sewage treatment plant is 39,700 gpm for three units at 95% output and annual average ambient conditions and a one month shutdown for each unit. Please explain how the second value is obtained from the first. 2

RESPONSE: The FES-CP was based upon the use of rectangular, induced draft cooling towers. As noted at the Atomic Safety and Licensing Board (ASLB) construction permit hearings, February 23 through 27, 1976, final PVNGS design incorporates round induced draft cooling towers. Round towers have lower drift and require less evaporation, and thus less water (587,000 gal/m compared to 620,000 gal/m) is circulated. Therefore, the water use numbers in the FES-CP and the ER-OL are independent. The ER-OL value of 39,700 gal/m for three units at 95% load and average conditions with a one-month shutdown is based upon final equipment design.

QUESTION 3A.6 (NRC No. 290.2) 3.6.2

Provide the value of the total dissolved and suspended solids (TDS and TSS) in the circulating cooling water systems used in the drift calculations. Also, provide information on the relative amounts of the various chemicals in the circulating water.

RESPONSE: The response is provided in the revised sections 3.6.2.

QUESTION 3A.7 (NRC No. 290.8) 3.9

Provide an updated description of the transmission lines. The description should include the number of lines, routes, and access corridors. Plans for maintenance and monitoring of the transmission line rights-of-way, as well as for access corridors should also be described. If these plans differ from the
2 BLM procedures for the Devers line, provide an outline of the differences. Describe the normal use for access roads and discuss any problems anticipated from dust.

RESPONSE: Transmission line routings described in section 3.9 have not changed. The response for maintenance and access is provided in the revised sections 3.9 and 5.5.

QUESTION 3A.8 (NRC No. 291.1) 3.6.2

Based on the updated information provided in Table 3.6-1, provide an estimate of the amounts of the chemical constituents expected in the Water Reclamation Plant effluent.

RESPONSE: The estimate is provided in the revised section 3.6.2.

QUESTION 3A.9 (NRC No. 291.2) 3.6.2

Estimate the capacity of the onsite reservoir and describe methods to control and monitor seepage.

RESPONSE: The onsite reservoir will have capacity for approximately 2300 acre feet of water. To retard seepage, the reservoir will be spray-lined at the bottom with rubberized asphalt at least 200 mils thick. The sides of the reservoir will be lined with 45-mil thick reinforced hypalon. As the reservoir will contain essentially clean water, there are no plans to monitor seepage.

QUESTION 3A.10 (NRC No. 291.3) 3.6.2

Provide an updated estimate of the types and amounts of pathogens, heavy metals, and biocides expected in: the influent from the Phoenix 91st Avenue Sewage Treatment Plant; the effluent from the Water Reclamation Plant; and in blowdown and cooling tower drift.

RESPONSE: The response is provided in the revised section 3.6.2.1 and in the response to Question 3A.20. 2

QUESTION 3A.11 (NRC No. 291.4) 3.6.2

Identify the dispersant to be added to the circulating water and provide the EPA Registration No. If proprietary, provide toxicity data.

RESPONSE: Dispersant is Nalco 345. It does not have an EPA registration number as it is not a biocide. The LD_{50} for guppies is >1000 ppm. Normal concentration is 20-30 ppm.

QUESTION 3A.12 (NRC No. 291.5) 3.6.2

Provide an updated estimate of the concentrations and annual discharges of heavy metals, toxic and deleterious substances, and biocides in the cooling tower drift using a drift rate of 0.0044%.

RESPONSE: The response is provided in the revised section 3.6.2.

QUESTION 3A.13 (NRC No. 291.6) 3.6.2

Identify types and amounts (providing concentration and flow rates) of chemicals to be used in the Reverse Osmosis Units during RO operation or layup.

RESPONSE: The response is provided in the revised section 3.6.2.3.

QUESTION 3A.14 (NRC No. 291.9) 3.7.1.1

The CP-FES describes the two packaged sanitary waste treatment units as activated sludge units using aeration, final clarification, continuous sludge recirculation and chlorination. If
2 there have been any changes in the sanitary waste system besides the decrease in the rated capacity of each unit, please provide an update.

RESPONSE: There have been no changes to the sanitary waste system.

QUESTION 3A.15 (NRC No. 291.10) 3.7.2.1.4

Identify the types and amounts of constituents expected in the solid wastes obtained from cleaning of the cooling tower basins and the water storage reservoir. Identify the location of the disposal site.

RESPONSE: The response is provided in the revised section 3.7.2.

QUESTION 3A.16 (NRC No. 291.11) 3.7.2.2

Identify the measures taken to assure no adverse effects from onsite disposal of sanitary waste sludge. Identify the type of lining to be used and estimate the types and amounts of pathogens expected in the sludge. Provide the location of the disposal site.

RESPONSE: The response is provided in the revised section 3.7.2.1.2.

QUESTION 3A.17 (NRC No. 291.12-3.7.3.3) 3.7.3.3

Estimate the amount of metals, in gaseous and solid form, discharged to the atmosphere by sublimation or evaporation during lime recalcination. Provide the basis for the estimate, including the quantity of each metal associated with the lime and the maximum temperature required during the calcining process. 2

RESPONSE: The response is provided in the revised section 3.7.3.3.

QUESTION 3A.18 (NRC No. 291.17) 3.6

Provide an updated estimate of the types of biocides, and their concentrations, present in the effluent from the 91st Avenue Sewage Treatment Plant. If the effluent has been monitored for physical, chemical, or microbiological characteristics, please provide an update of Table 3.1 of the CP-FES. If monitoring data is not available, provide an estimate and basis therefore of the effluent temperature and pH ranges.

RESPONSE: The response is provided in the revised section 3.6.2.

QUESTION 3A.19 (NRC No. 291.18)

Indicate the maximum and average time necessary for water to travel the distance from the 91st Avenue Sewage Treatment Plant to PVNGS. Indicate whether the influent from the 91st Avenue STP will ever be stored onsite prior to treatment by the water reclamation plant or will always be treated immediately.

RESPONSE: Under average operating conditions, the transit time will be approximately 23 hours. Depending on the flow conditions, the transit time can be either longer or shorter. With the minimum design flow of 5,000 gpm, the transit time will be 9.5 days, although this time can be lengthened by alternately starting and stopping the pipeline pumps. With maximum flow conditions, the transit time is approximately 14.3 hours. The pipeline is fed directly into the WRP without any time delay (holdup).

2

QUESTION 3A.20 (NRC No. 291.19) 3.6

Predict the effect of the 36-mile pipeline passage on physical, chemical, and microbiological parameters of the effluent from the 91st Avenue Sewage Treatment Plant. Provide references used in reaching your predictions regarding microbiological organisms.

RESPONSE:

Physical

The only physical change in effluent will be decreased maximum temperatures and increased minimum temperatures. (Depending on depth, ground max/min temperatures lag up to 3 months behind ambient air max/min). At average flow, the effect will be negligible. At low flows, the change in temperature may be 1 or 2 degrees.

Chemical

The maximum changes in chemical quality of effluent as it passes through the pipeline are estimated as:

COD	-30 mg/l
DO	to less than 1 mg/l
Nitrate	to zero
Alkalinity	+ 5 mg/l (equiv. to change in nitrate)

(Residence time in pipeline is expected to have negligible effect on other dissolved solids including trace metals and any biocides.) This estimate is based on the following analysis:

> The chemical changes anticipated in the passage of the effluent through the pipeline will result from the reduction of BOD (COD). In this process, the dissolved oxygen will be used up within 3 hours for maximum summer temperatures of 30 C. The fact that anaerobic conditions will predominate during the passage will mean that nitrification of ammonia to nitrate will be insignificant. Hence, the nitrate available for bacterial utilization (as electron donor for COD reduction) will be limited essentially to that in the effluent at 91st Avenue. The maximum increase in alkalinity due to conversion of 2.7 mg/l of NO_3 to N, is 4.1 mg/l as $CaCO_3$. 2

Under anaerobic conditions, sulphate will be the next electron donor. Sulfides will be produced; but, after air injection at Hassayampa Pumping Station, the sulfides will be bacteriologically oxidized back to thiosulfates. Hence, there is no net change in SO_4

concentration. The oxygen from the injected air will be used up almost as quickly as it is dissolved and any increase in DO will be slight. For this reason, and because residence time is short in the 66-inch pipeline, further nitrification will be insignificant.

Microbiological

Bacterial changes will include further decreases in any enteric organisms (fecal coliforms, fecal strep, enteric pathogens) due to the inhospitable environment. The total bacterial population will decline as substrate is utilized. The reduction for coliforms, fecal coliforms and fecal strep may be conservatively estimated as 30% in one day, 90% in 6 days, and 96% in 10 days.

2 This estimate is consistent with the final report (Water Pollution Control Research Series Publication No. WP-20-7) of the Santee Recreational Project, Santee, California where activated sludge plant effluent, when held for 15 days in an oxidation pond experienced coliform, fecal coliform and fecal strep reductions as follows (average of 8 months data):

	Secondary Effluent	Pond Effluent (Before Cl_2)	Reduction
Coli	14.7×10^6	410×10^3	97%
F. Coli % of Coli	14.7×10^6	29.6%	98%
F. Strep	0.5×10^6	5.12×10^3	99%

QUESTION 3A.21 (NRC No. 291.20) 3.6

Provide an updated estimate of the type and amount of biocides expected in the effluent from the PVNGS Water Reclamation Plant.

RESPONSE: Biocides in the PVNGS Water Reclamation Plant effluent are expected to be no greater than the concentrations found in the 91st Avenue Sewage Treatment Plant as described in section 3.6.2.1.

QUESTION 3A.22 (NRC No. 291.21) 3.6

Describe the average and maximum time periods that the effluent from the PVNGS Water Reclamation Plant will remain in the onsite storage reservoir prior to entering the cooling system.

RESPONSE: Residence time in the reservoir during operation will vary from 11 to 35 days depending on the season and number of units in operation.

QUESTION 3A.23 (NRC No. 291.22) 3.6

Describe the effects that a breakdown at the Pheonix 91st Avenue Plant would have on the efficiency of the PVNGS Water Reclamation Plant, on the storage reservoir capacity, and on plant operation. 2

RESPONSE:

Case 1 - Total Breakdown

If the WRP were to continue to operate, reservoir quality would slowly degrade. After several days, the cycles of concentration in the cooling tower loop would have to be reduced from 15 cycles. Alternately, PVNGS Operations could decide to shut the WRP down if they find that the 91st Avenue plant will be inoperable for several days. Under the most adverse conditions, the reservoir would provide at least 7 days storage assuming maximum (full power) usage rates.

The likelihood of the total breakdown is very remote because:

- 91st Avenue has a double ended power supply
- The plant is divided into 3-30 MGD modules (which in turn are subdivided) which can operate completely independently.
- Phoenix does not have a major wet industry that would cause complete upset of its biological plant.
- In the last few years, Phoenix's wastewater quality has exceeded discharge permit levels 10 to 20 times. Generally, even during these periods, quality is acceptable for treatment at PVNGS.

Case 2 - Partial

2 Breakdown of a portion of the Phoenix plant is a possibility. When this occurs, generally a 7.5 MGD unit-train is off line and flow is redistributed. Wastewater quality would still be acceptable under these terms since less than 10% of the plant would be affected at this time.

In either case, there is enough flexibility in the WRF, reservoir and blowdown system to keep the power plant on line should the 91st Avenue Plant suffer a partial or complete breakdown.

QUESTION 3A.24 (NRC No. 291.23) 3.2

Describe the temperature and pH fluctuations that will occur in the cooling water as it travels through the cooling system. Estimate the time duration for the water to be at each temperature and pH level.

RESPONSE: The response is given in the revised section 3.2.

QUESTION 3A.25 (NRC No. 291.24) 3.6.3.2

Identify the type of liner and specifications (e.g., permeability, thickness, composition, temperature and pH tolerance, susceptability to chemical degradation) of the liner to be used in the evaporation ponds. Describe the inspection and maintenance procedures to be used to assure the integrity of the liner. Provide the Resource Conservation and Recovery Act determination as to whether all contaminants contained in the plant waste streams discharging to the evaporation ponds may be as discharged.

RESPONSE: Liner specifications and maintenance procedures are provided in the revised section 3.6.3.1. Wastewater flow to the evaporation pond will come from three sources: (1) cooling tower blowdown; (2) spent demineralizer regenerants and (3) power plant washdown. Flow is made via a retention basin. The approximate composition and concentration of these sources as they exist in the retention basin was estimated and submitted to the Arizona Department of Health Services. It was their conclusion that the material would be nonhazardous according to current criteria established in their regulations[a]. A sample solution was also analyzed by an independent laboratory and was determined to be nonhazardous per EPA criteria. As there is no appreciable holdup time at the retention basin prior to transfer to the evaporation pond, the chemical concentrations at the inlet to the evaporation pond should be essentially the same as the retention basin. However, a final determination of RCRA compliance for the evaporation ponds will not be made until the chemical composition can be exactly determined. 2

a Letter from Mapes, S.L., Hazardous Waste Specialist, Division of Environmental Health Services, Arizona Department of Health Services, to Lay, T., Arizona Public Service, August 26, 1980

2 QUESTION 3A.26 (NRC No. 291.25)

Estimate the final total area to be occupied by the evaporation ponds over the life of the plant, assuming that no additional water recovery/reclamation plans are implemented at the site.

RESPONSE: The response is given in the revised section 3.6.3.1.

are the characteristics and quantity of effluent air, the height of the effluent plume rise, and the downwind dispersion of the effluent plume.

Potential horizontal and vertical icing conditions were not considered in the analysis. A day or more of subfreezing temperatures is necessary for any ice to accumulate to significant thickness. Therefore, because the maximum daily temperature in the site vicinity has never been reported below 32F,[2-5] no quantitative estimates were made of potential icing conditions.

The fogging results were calculated based on the visibility criterion that a liquid water content of 1.2×10^{-5} pound liquid water per pound of dry air (0.015 g H_2O/m^3 of dry air) would result in a visibility of 1000 meters or less.[6]

5.1.4.2.1 Effects on Ground Transportation

Generally, driving conditions can be affected by visibility reductions caused by fogging over roadways resulting from moisture emissions from the operation of cooling systems. The surrounding roadways within 10 miles of PVNGS include Wintersburg Road, Buckeye-Salome Road, 339th Avenue, Ward Road, and Interstate 10. The location and orientation of each of these roadways relative to the site are listed in table 5.1-2. The predicted annual mean frequencies of occurrence of reduced ground-level visibility to less than 1000 meters (5/8 mile) were less than 1 h/yr for all roads except Ward Road which is predicted not to have any reduced ground-level visibility.

These predictions of insignificant fogging occurrences produced by the operation of the cooling towers for PVNGS are consistent with the experience of the Arizona Public Service Company (APS) with operating cooling towers in the Phoenix area.

Due to the very low relative humidity in the Phoenix area, cooling tower plumes are relatively bouyant during cold temperatures, when fogging would normally be a problem. In checking 2

Table 5.1-2
MAJOR ROADWAYS WITHIN 10 MILES OF PVNGS

Major Roadways and Orientation	Classification	Distance and Direction from PVNGS (miles)[a]
Wintersburg Road (N-S)	Asphalt	0.8 W
Ward Road (E-W)	Dirt	1.4 S
Buckeye-Salome Road (NW-SE)	Asphalt	2.0 NE
339th Avenue (N-S)	Asphalt/ Dirt	4.5 SE
I-10 (NW-SE)	Interstate highway	5.8 NE

a. 8-point compass used.

the past history of the Saguaro, Ocotillo, Aqua Fria, and Kyrene Power Plants, no record or memory was found of any fog-
2 ging that restricted traffic in any way. This history is significant in that some of the cooling towers listed are within a few hundred feet of a road.

5.1.4.2.2 Effects on Air Transportation

The closest air carrier airport to the plant site is the Phoenix Sky Harbor International Airport, approximately 50 miles east of the site. At this distance, the cooling systems would not affect airport operations.

5.1.4.2.3 Effects on Water Transportation

There are no major waterways in the vicinity of the site; therefore, the cooling tower system would not affect water transportation.

5.1.4.3 Elevated Visible Plumes

The predicted occurrences of elevated visible plumes from the cooling towers, and their environmental impact on surrounding area airports and population centers, are discussed in this section.

5.1.4.3.1 Maximum Occurrence of Elevated Visible Plumes

Isopleths of the predicted annual frequency of occurrence of elevated visible plumes are presented in figure 5.1-1. The isopleth is based upon a 100% capacity factor for Units 1, 2 and 3, and corresponds to data presented in table 3.4-1 and figure 3.4-3. The maximum predicted occurrences are approximately 530 h/yr in the immediate vicinity of the cooling towers. 2

5.1.4.3.2 Occurrence of Elevated Visible Plumes at Airports

Sky Harbor International Airport is located at too great a distance to be affected by elevated visible plumes generated by the operation of the cooling towers.

5.1.4.3.3 Occurrence of Elevated Visible Plumes at Surrounding Population Centers

The surrounding population centers within 10 miles include Wintersburg, Arlington, Dixie, Hassayampa, and Tonopah, Arizona. The location of these population centers relative to the site are listed in table 5.1-3. The predicted annual mean frequencies of occurrences of elevated visible plumes are approximately 1 h/yr for Wintersburg, less than 1 h/yr for Arlington and 0 h/yr for Dixie, Hassayampa, and Tonopah, Arizona.

5.1.4.3.4 Occurrence of Elevated Visible Plumes by Month

Table 5.1-4 presents the maximum frequencies of occurrence of elevated visible plumes greater than 0.50 mile in length for

Table 5.1-3
POPULATION CENTERS WITHIN 10 MILES OF PVNGS

Population Center	Distance and Direction from PVNGS (miles)
Wintersburg	3.5 N
Arlington	7.5 SE
Dixie	6.5 ESE
Hassayampa	8.8 ESE
Tonopah	9.0 NNW

each month of the year and for each of the 16 compass directions. The tabulated values are of plumes from the nine round mechanical draft cooling towers. The results show a maximum frequency of approximately 15 h/mo during March in a northeast direction from the round mechanical draft cooling towers. Table 5.1-5 presents the predicted maximum monthly visible plume lengths for the cooling towers.

5.1.4.4 Solids Discharge from the Cooling System

5.1.4.4.1 Dissolved Solids Deposition

To evaluate the environmental impacts associated with dissolved solids in the cooling tower drift, the predicted deposition was separated into deposition as dry drift particles, as droplets, and as total. Deposition is based upon a 100% capacity factor for Units 1, 2, and 3 and corresponds to data presented in table 3.4-1 and figure 3.4-3. Figure 5.1-2 displays isopleths of the predicted annual solids deposition for dry particles that remain after the water completely evaporates from the drift droplets. Predictions of the annual solids deposited in droplet form are presented in figure 5.1-3. The predicted total annual solids deposition patterns--solid materials deposited as dry particles and in droplet form--are shown in figure 5.1-4.

2

5.1.4.4.2 Airborne Concentration of Dry Drift Particles

Figure 5.1-5 presents isopleths of the predicted annual mean airborne concentrations of dry drift particles. The maximum calculated values at the site boundary were 51 $\mu g/m^3$ and approximately 1 $\mu g/m^3$ for 24-hour and annual time periods, respectively.

The maximum 24-hour airborne dry drift concentration of 51 $\mu g/m^3$ was calculated at the site boundary northeast of the towers. This concentration decreased with downwind distance. For example, at 1 mile beyond the site boundary, the estimated concentrations are reduced to approximately 47 percent of the maximum value, at 2 miles they are approximately 22 percent, and at 3 miles they are approximately 20 percent.

5.1.4.5 <u>Increased Ground-Level Temperature</u>

The round mechanical draft cooling towers for PVNGS are predicted to have a negligible effect on ground-level temperature. The maximum predicted increased ground-level temperature was less than 0.1F.

5.1.4.6 <u>Increased Ground-Level Relative Humidity</u>

The mean annual increases of ground-level relative humidity beneath the plume from the cooling system were calculated on a polar grid centered on the cooling system. These values represent represent the mean predicted increases of ground-level relative humidity above ambient when the cooling system plume is overhead. Figure 5.1-6 presents isopleths of the annual predicted increase of ground-level relative humidity caused by the operation of the round mechanical draft cooling towers. As can be seen, these annual ground-level relative humidity increases are less than 1% and would be difficult to detect.

5.1.4.7 Cooling Tower Plume Behavior

Upper-air soundings taken at the Sky Harbor International Airport were used by the NUS LVPM computer code as basic states of meteorological conditions to investigate the general cooling tower plume behavior. (Refer to section 6.1). The reference or basic state at PVNGS is generally similar to that at Phoenix. Soundings were averaged by month and hour of observation during the period July 1952 through May 1957. This period represents the latest 5 years of data on magnetic tape. Subsequent to this period, the Sky Harbor station no longer took soundings. Behavior of the cooling tower plume predicted by the model represents the mean for a given month.

Average January and July soundings were used as representative winter and summer conditions, respectively. For an average winter morning (0800 Mountain Standard Time), a strong ground-based inversion (12.1F per 1000 feet) with surface temperature at 42F existed to the first 850-foot level. Surface windspeed was 4.0 mi/h from the east, increasing to 11.5 mi/h at a height of about 2300 feet. Relative humidity was 75 percent at the surface, decreasing to 40 percent at the 2300-foot level.

The average summer morning sounding (0800 Mountain Standard Time) reveals a constant temperature lapse rate of approximately 4.2F per 1000 feet for the first 6560 feet. In the evening (2000 Mountain Standard Time), the atmosphere is in neutral condition because of daytime surface heating. Average surface temperature is 88F in the summer morning, and 100.4F in the summer evening. Relative humidity during an average summer morning is about 49 percent near the ground, decreasing to 45 percent at 2170 feet. A nearly constant relative humidity was observed in the average summer evening sounding with a value near 32 percent in the lower 2170 feet.

The initial momentum and buoyancy of the effluent from the cooling towers are expected to raise the vapor plume to a height of approximately 920 feet during the average winter

morning. Neutral buoyancy height is about 630 feet. No major difference in plume rise was predicted between winter mornings and evenings. For all wind directions, a saturated plume extending through the maximum height of penetration was predicted.

During the average summer morning, a plume can penetrate through a height of approximately 1900 feet. Plume buoyancy becomes neutral at a height of 1210 feet. No saturated plume was predicted for the average summertime condition for any hour of the day.

Figures 5.1-7 and 5.1-8 show some of the plume parameters as a function of height for winter and summer mornings, respectively. The height of maximum penetration is determined by taking the height where the vertical velocity of the plume becomes zero. Neutral buoyancy height (equilibrium level of buoyancy) is defined as the level where the plume and ambient temperatures are identical. Cloud water is defined as condensed water droplets that have a negligible terminal velocity and are carried by the updraft in the plume.

Figures 5.1-7 and 5.1-8 display these plume parameter variations to the maximum penetration heights which correspond to downwind distances of 3.59 and 7.64 kilometers, respectively, from the tower locations. These calculated values represent the operation of one cooling tower. No reinforcement of the plumes generated from the towers is associated with the simultaneous operation of all 3 units. 2

The average visible plume length is estimated to be 870 feet during the average winter morning and 780 feet during the average winter evening. Ground-level moisture excess over ambient in the vicinity of the cooling towers is estimated to be insignificant under normal weather conditions in the area, as listed in table 5.1-6. Figures 5.1-9 and 5.1-10 show the excess relative humidity profile at the plume centerline at

Table 5.1-6

RELATIVE HUMIDITY EXCESS, AT GROUND LEVEL, CAUSED BY OPERATION OF COOLING TOWER SYSTEM

Ambient Condition	Ambient Relative Humidity	Excess Relative Humidity at Ground Level (%)			
		1 km Downwind	3 km Downwind	5 km Downwind	10 km Downwind
Mean winter morning (0800 MST)	72	0.01	0.03	0.06	0.11
Mean winter afternoon (2000 MST)	55	0.07	0.17	0.23	0.22
Mean summer morning (0800 MST)	49	0.00	0.00	0.00	0.00
Mean summer afternoon (2000 MST)	34	0.00	0.00	0.00	0.00

various distances downwind from the cooling towers under average winter and summer morning conditions. Significant weather modification from the operation of the cooling tower system is not expected.

5.1.4.8 Parametric Study of Plume Rise

To examine expected plume rise in the site area, a parametric analysis was performed for the average winter and summer morning conditions. The LVPM computer code was used (see section 6.1). Two major parameters influence the plume rise: the ambient temperature lapse rate and the ambient windspeed. Using these parameters, the following analyses were performed:

- Plume rise was examined as a function of vertical temperature gradient, assuming the gradient is constant with height. (See figure 5.1-11.)
- Examination of plume rise as a function of ambient windspeed at the tower top. (See figure 5.1-12.)

In the second analysis, the wind profile was assumed to vary according to the empirical power law:

$$U_2 = U_H\left(\frac{z}{H}\right)^P$$

where

U_z = windspeed at height z

U_H = windspeed at tower height H

P = empirical constant, which is 0.25 for the winter morning and 0.12 for the summer morning from Phoenix upper-air soundings

The average January and July morning soundings were used as representative winter and summer morning reference states,

respectively, when not defined in the above analysis. The plume height from the cooling tower system can be expected to exceed 410 feet for all seasons, as shown in figure 5.1-12. Lowest plume rise is found under strong ground-based inversions in the summer morning.

The effect of windspeed on plume rise is pronounced. Very strong winds (on the order of 30 to 40 mi/h) could limit the plume rise to less than 310 feet from the tower top as illustrated in figure 5.1-12.

5.1.4.9 Noise

The noise sources associated with the round mechanical draft cooling towers are described in section 5.6.

5.1.4.10 Consumptive Water Loss

For the round mechanical draft cooling towers, the major consumptive water loss will be through the evaporative cooling process. The entrainment of droplets as drift in the effluent plume will cause additional water losses. Table 5.1-7 presents a summary of the average consumptive water losses by month. The values in this table are based upon a 95-percent load factor for each month and were calculated from monthly averages of meteorological data obtained from 5 years of hourly onsite data. Each of the generating units will be shut down for refueling during 1 month in each year. Correcting the annual average consumptive water loss for refueling shutdowns leads to an annual average consumptive water loss for the three units of approximately 64,000 acre-ft per year. The effects of this water use is discussed in section 5.6.

Blowdown from the cooling towers will be directed to the evaporation ponds.

5.4 EFFECTS OF SANITARY AND OTHER WASTE DISCHARGES

This section has been revised to reflect upd[illegible]d meteorological data and current PVNGS system design.

5.4.1 SANITARY WASTES

During plant operation, treated effluent from the package sewage treatment plant will be delivered to the water reclamation plant. The treated onsite sewage effluent will be available as additional water for cooling system makeup during normal operations. When the water reclamation plants are temporarily not operating, chlorinated effluent from the package sewage treatment plant will be delivered to the onsite evaporation pond. No major adverse environmental impact is anticipated from this operation, because there will be no direct discharges from the evaporation pond. Lining the evaporation pond limits seepage of the impounded effluent into local groundwater aquifers. Therefore, the evaporation pond is not expected to significantly affect recharge to the aquifers.

5.4.2 GASEOUS EFFLUENTS

There are three groups of facilities on the PVNGS site that are stationary sources of pollutants; the diesel generators, auxiliary boilers and recalciners. Source operational modes and emission parameters are described in section 3.7 and listed in table 5.4-1.

The diesel generators and auxiliary boilers are operated only on a limited basis:

A. The diesel generators are each tested for about 1 hour per month. This testing is not concurrent and the generators are not otherwise operated except under abnormal conditions.

PRELIMINARY

Table 5.4-1

EMISSION PARAMETERS FOR FOSSIL FUEL-FIRED FACILITIES

PRELIMINARY

Parameter	Diesel Generator	Auxiliary Boilers		Recalciner	
		Large	Small		
Stack diameter (in)	32	84	44	36	
Stack height (above grade) (ft)	93	50	50	80	
Exhaust temperature (^{o}F)	910	622	579	165	
Exhaust flow rate (ACFM)	48,950	100,000	24,000	-	
Exhaust velocity (ft/min)	-	-	-	1,800	
Fuel type	No. 2 diesel[d]	No. 2 diesel[d]	No. 2 diesel[d]	No. 2 diesel[d]	2
Operational mode	1 h/mo	8 d/yr/unit	8 d/yr/unit	Continuous	
Emissions:					
Nitrogen oxides	2,300[a]	2,300[b]	-	456	
Sulfur Oxides	675[a]	7,583[b]	-	180	
Hydrocarbons	35[a]	682[b]	-	17	2
Particulates	164[a,c]	209[b,c]	-	84	
Carbon monoxide	766[a]	522[b,c]	-	23	

ACFM = Actual cubic feet per minute.

a. Per diesel generator. Two generators per PVNGS unit. Emissions in units of pounds per year.

b. Based on both boilers. Ratio by ACFM to separate between boilers. Emissions in units of pounds per day. 2

c. Emission ratioed from those for NO_x by means of emission factors for diesel-powered industrial equipment and distillate oil-burning industrial boilers in reference 5. 2

d. Normalized to 1% sulfur fuel with no SO_2 removal from flue gases.

B. The auxiliary boilers are operated for approximately 8 days per year for each unit served during the initial startup of the nuclear generating units.

The diesel generators and auxiliary boilers are operated only a small fraction of the year and are not expected to be 2
operated simultaneously. Therefore, the offsite concentrations are predicted only for the operation of each of the facilities separately. No nitrogen oxides (NO_x) concentrations are predicted, as there is only an annual NAAQS for NO_x.

The offsite concentration values for SO_2 and other pollutants presented in table 5.4-2 were determined for the diesel generators using the EPA dispersion model RAM[(1)] and for the auxiliary boilers using the EPA dispersion model ISC[(2)]. Since both sources are close enough to the unit structures to be within the "region of building influence," the RAM model was modified to account for the effects of aerodynamic downwash by a methodology described by Briggs[(3)] to determine conditions of downwash and concentrations during downwash.
The existing ISC model includes the effects of aerodynamic 2
downwash and was therefore not modified.

The comprehensive ISC model was used with four years of onsite meteorological data (1974 through 1977) to predict the short-term concentrations presented in table 5.4-2 for SO_2 and other criteria pollutants due to operation of the auxiliary boilers. A recent summary of the ISC Model obtained from the EPA "Guideline on Air Quality Models" is provided in Appendix 5A. The use of four years of meteorological data as input to this model allows the use of the highest second-highest calculated concentration for any given year to be compared to NAAQS for SO_2 due to the operation of the two auxiliary boilers.

Table 5.4-2

MAXIMUM EXPECTED OFFSITE CONCENTRATIONS AND COMPARISON WITH STANDARDS

PRELIMINARY

Maximum Offsite Concentrations Expected Due to Operation of Auxiliary Boilers and Diesel Generators					
		Maximum Offsite Concentration ($\mu g/m^3$) Expected for Given Averaging Period due to Operation of			
		Auxiliary Boilers	Diesel Generators		
Pollutant	Short-Term National Ambient Air Quality Standard (and Averaging Period) ($\mu g/m^3$)	for Units 1, 2, & 3	for Unit 1	for Unit 2	for Unit 3
Sulfur oxides	365 (primary 24-h)	45	36	30	38
	1300 (secondary 3-h)	185	68	56	70
Particulates	260 (primary 24-h) } 150 (secondary 24-h) }	1.2	9	7	9
Carbon monoxide	10,000 (8-h)	21	83	67	86

2

Maximum Offsite Concentrations Expected Due to Operation of Recalciner		
Pollutant	National Ambient Air Quality Standard (and Averaging Period) ($\mu g/m^3$)	Maximum Offsite Concentration ($\mu g/m^3$) Modeled for Each Averaging Period
Sulfur oxides	80 (annual)	.45
	365 (primary 24-h)	8.3
	1300 (secondary 3-h)	15.4
Particulates	75 (Primary annual) } 60 (Secondary annual) }	.21
	260 (Primary 24-h) } 150 (Secondary 24-h) }	3.8
Nitrogen oxides	100 (annual)	1.1
Carbon monoxide	10,000 (8-h)	2.1

2

PVNGS ER-OL Table 5.A-2

The diesel generators do not have the potential to produce high air pollution concentrations; therefore, the conservative NUS modified RAM model was used with one year of meteorological data (1975) to predict the highest short-term concentrations presented in table 5.4-2. The use of one year of meteorological data requires the use of the highest calculated concentrations for comparison to NAAQS. The normal variations in yearly meteorological data could not radically increase the calculated impact concentrations to approach the NAAQS.

In regard to predicted concentration of pollutants presented in table 5.4-2 due to operation of the diesel generators, it was assumed that only two generators which serve one of the three generating units would be in operation at any given time. Thus, a set of two generators were assumed to be operating 24 hours per day for 365 days a year. This mode of operation is considered conservative since the diesel generators are anticipated to be tested separately for about one (1) hour per month. This testing is not concurrent and the generators are not otherwise operated except under abnormal conditions. 2

In regard to predicted concentration of pollutants presented in table 5.4-2, due to operation of the auxiliary boilers, it was conservatively assumed that both the large and the small boilers were in operation continuously at maximum load (i.e., 24 hours per day for 365 days per year). However, it should be noted that these two boilers which serve all three nuclear operating units are anticipated to be operated for approximately 8 days per year for each nuclear generating unit during the initial start-up of each unit.

The recalciners are operated continuously throughout the year. The highest predicted offsite concentrations for the operation of these facilities are also compared with the annual and short-term NAAQS for SO_2, and other pollutants in table 5.4-2. The concentrations were calculated using the EPA dispersion

model CRSTER[4] modified to accept terrain elevations higher than the lowest stack height. One year of onsite meteorological data (1975) was used to predict the annual and short-term concentrations. The recalciners are not affected by downwash and do not have the potential to produce air quality impact concentrations close to the NAAQS. Therefore, the use of one year of meteorological data is sufficient to determine
2 maximum air quality impacts. An assumed constant mixing height of 500 meters was used for all modeling since no mixing height information is currently available in a format acceptable to CRSTER or RAM for the surface data examined. This mixing depth was selected based on the tabulated mixing height information of Holzworth[5]. The low effective plume heights (less than 100 meters) under all stability conditions means that plume reflection from the top of the mixing layer is insignificant for these emissions.

The maximum expected short-term offsite concentrations caused by the operation of auxiliary boilers and the diesel generators located closest to the PVNGS site boundary are presented in table 5.4-2. These predicted concentrations are less than the short-term NAAQS for the respective pollutants. The primary 24-hour average NAAQS for SO_2 and PM are 365 and 260 $\mu g/m^3$, respectively. The secondary 24-hour average NAAQS for total suspended particulates (TSP) is 150 $\mu g/m^3$. The highest 24-hour average concentrations of SO_2 and PM predicted at the PVNGS site boundary due to the emissions from the auxiliary boilers
2 are 45 and 1.2 $\mu g/m^3$. The highest 24-hour average SO_2 and PM concentrations predicted at the site boundary due to the diesel
2 generators at Unit 1 are 36 and 9 $\mu g/m^3$, while those predicted at the site boundary due to the diesel generators at Unit 3 are
2 38 and 9 $\mu g/m^3$. Because the Units 1 and 2 generators are located further from the site boundary than the Unit 3 generator, offsite concentrations due to their operation are lower. The primary 8-hour average NAAQS for carbon monoxide standard

is 10,000 μg/m^3 and the concentrations predicted at the site boundary due to the auxiliary boiler emissions is 21 μg/m^3. 2
The highest 8-hour average carbon monoxide concentrations predicted at the site boundary due to the diesel generators at Units 1 and 3 are 83 and 86 μg/m^3, respectively.

The short-term NAAQS for SO_2 is 365 μg/m^3 for 24 hours and 1300 μg/m^3 for three hours which is not to be exceeded more than once per year. The short-term SO_2 concentrations presented in table 5.4-2 due to the operation of the auxiliary boilers is the second highest value predicted for any given year (this is sometimes referred to by the EPA as the highest second-highest concentration). The short-term SO_2 concentrations presented in table 5.4-2 due to the operation of the diesel generators and recalciner represent the highest value predicted for any given year.

In summary, no offsite violations of the NAAQS are predicted for SO_2 or any other criteria pollutants due to the operation of the diesel generators, auxiliary boilers or recalciners at PVNGS. 2

5.4.3 REFERENCES

1. User's Guide for RAM Volume 1 & II, Environmental Sciences Research Laboratory, Research Triangle Park, North Carolina EPA-600/8-78-106, November, 1978

2. Bowers, J. F., J. R. Bjorklund and C. S. Cheney. "Industrial Source Complex (ISC) Dispersion Model User's Guide, Volumes 1 and 2." Publication Nos. EPA-450/4-79-0, 1 (NTIS PB-80-133044, 133051, Magnetic tape PB-80-133036), Office of Air Quality Planning and Standards, U. S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, December 1979

3. Briggs, Gary, "Diffusion Estimation for Small Emissions," Air Resources Atmospheric Turbulence and Diffusion Laboratory, National Oceanic and Atmospheric Administration, ATDL Contribution File No. 769 (Draft), Oak Ridge, Tennessee, May 1973.

2 4. "User's Manual for Single-Source (CRSTER) Model," Office of Air and Waste Management, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Report No. EPA-450/2-77-013, Research Triangle Park, North Carolina, July 1977.

5. Holzworth, George C., "Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States", Environmental Protection Agency, Office Of Air Programs, Research Triangle Park, North Carolina, January 1972.

PRELIMINARY

5.5 EFFECTS OF OPERATION AND MAINTENANCE OF THE TRANSMISSION AND CONVEYANCE SYSTEMS

5.5.1 TRANSMISSION SYSTEM

The transmission systems associated with PVNGS are described in section 3.9.1. Information presented in ER-CP Section 5.6.1 and the FES has been updated to reflect final line routing and the addition of a transmission line from PVNGS to Devers Substation in California. The impacts expected due to operation and maintenance of the Projects 1 and 3 transmission systems are updated and summarized in this section. Information concerning the expected impacts of the PVNGS to Devers line is presented in the U.S. Department of Interior Bureau of Land Management and U.S. Nuclear Regulatory Commission Final Environmental Statement, Palo Verde-Devers 500 kV Transmission Line, February 1979. Descriptions are presented for preferred and alternate routes.

5.5.1.1 Transmission System Impacts

5.5.1.1.1 Maintenance Program

Maintenance programs are not expected to have significant environmental effects; however, those environmental effects that do occur from maintenance will be short term. Transmission-system construction practices will result in stable open-field associations and therefore minimal right-of-way maintenance. Where maintenance clearing is required the biotic association as a whole will not be adversely affected.

Maintenance will be conducted on an as-required basis. Frequent ground access to the transmission lines for maintenance will not be required. Transmission line access points are indicated on figures 3.9-1 and 3.9-2. The same environmental precautions that were taken during construction will be taken for non-emergency maintenance and repairs. Noise and dust created by maintenance-vehicle traffic is not expected to be bothersome due to the low frequencies of ground patrol. 2

It is expected that maintenance/surveillance for Project 1 lines will be as follows:

- Air patrol - three times per year
- Ground Patrol - once per year
- Walk and climb - once every five years
- Repair and maintenance items identified in surveillance on an as-required basis.

2 It is expected that maintenance/surveillance for Project 3 lines will be as follows:

- Ground patrol - three times per year
- Repair and maintenance items identified in surveillance on an as-required basis.

The PVNGS - Devers line will be maintained according to a plan to be developed by Southern California Edison and approved by the Bureau of Land Management, as required by the Final Environmental Statement, Palo Verde - Devers 500 kV Transmission Line.

Access roads built during the construction phase of the transmission systems ordinarily will not be maintained.

Herbicides and pesticides will not be used for maintenance of transmission-system corridors. Soil sterilants may be used within the confines of substations to control weed growth.

5.5.1.1.2 Electrical Effects

5.5.1.1.2.1 Line Clearances. No adverse effects resulting
2 from corona or electrical field effects are expected. Vertical height guidelines of Section 232 of the National Electric Safety Code will be followed to eliminate the interference with communication or railroad systems.

5.5.1.1.2.1 Grounding Systems. Grounding systems will be installed to handle currents that occur under fault conditions. 2

5.5.1.1.2.1.1 Project 1 Grounding Systems. Counterpoise shall be installed in accordance with figure 5.5-1. Foundation resistance tests shall be conducted and counterpoise installed in accordance with the following:

- Footing resistance at each tower/pole shall be tested while it is completely isolated from any ground connection, excluding the foundations.
- The testing shall be during periods of relatively dry soil conditions, if possible.
- Tower/pole foundation resistance tests shall be measured with a Vibroground Model #263A meter manufactured by Associated Research, Inc. of Chicago, Illinois, or equivalent. Foundation resistance shall be measured using the three-probe method. 2
- Where tower/pole foundation resistance measures 20 ohms or less, no corrective measures are required. For tower and poles with foundation resistance in excess of 20 ohms, the foundation resistance shall be corrected to 20 ohms, if possible, with the installation of ground rods as needed, but not to exceed 20 ground rods per tower/pole. The method of installation for ground rods is shown on figure 5.5-1.

5.5.1.1.2.1.2 Project 3 Grounding Systems. Grounding will be by copper butt raps on each wooden pole leg as indicated in figure 5.5-2.

5.5.1.1.2.1.2 PVNGS-Devers Grounding Systems.

The ground resistance of the towers shall be measured after towers are assembled and prior to installation of conductor

and shield wire. Measurements of tower to ground resistance shall be made by utilizing the three-point method and a self-contained instrument reading ohms directly, such as the Vibroground Model No. 263a meter, manufactured by Associated Research, Inc. of Chicago, Illinois; the Megger Earth Tester Model 63220, by James G. Biddle Co. of Plymouth Meeting, Pennsylvania; or approved equal. All measurements shall be made at a distance of not less than 100 feet from base of tower. The three-point method is described in IEEE Std. 80.

Soil conditions, at time of measurement, shall be evaluated.

Where the ground resistance is less than specified for the tower no supplemental ground connections will be required. Where measurements show that the tower to ground resistance is more than specified, supplemental grounding shall be installed to lower the ground resistance as shown on figure 5.5-3. After each separate installation of any counterpoise and/or ground
2 rods, additional ground resistance measurements shall be made. Ground rods shall be as shown on figure 5.5-3. The tops of ground rods shall be set a minimum of one foot below normal ground surface.

Counterpoise installations shall be installed within the right of way. All counterpoise installations shall be made as shown on figure 5.5-3. In the area of the El Paso Natural Gas pipeline, the counterpoise installed on the pipeline side of the tower shall be installed along the direction of the line and not at an angle. Included therein shall be the excavation and backfill of the trench for the counterpoise, anchoring the counterpoise to the surface of the ledge as required, and the connection of the counterpoise to the towers. Connecting cables for ground rods and counterpoise shall be 3/8 inch in diameter, 7-strand galvanized cable Utility Grade guy strand ASTM class "C" galvanizing or equal. No splices below ground in ground cables shall be permitted except in ground rod clamps.

5.5.1.1.3 Ecological Resources

The effects of transmission-line operation and maintenance relate primarily to the access roads that create increased access to areas that were previously difficult to reach. The operation and maintenance activities will have very little, if any, adverse effects on terrestrial and aquatic systems once construction activities have been completed.

In sensitive areas with species such as Gila monster, desert tortoise and bighorn sheep, and in areas vegetated with endangered and threatened plant species, fences and gates will be placed appropriately to inhibit unauthorized off-highway vehicle use of access roads. It is expected that no changes of long-term significance to the area's fauna will result from operation and maintenance activities.

5.5.1.1.4 Cultural and Paleontological Resources

Cultural and paleontological resources are likely to be impacted the greatest during the construction phase of the project. Access and spur roads will be closed as required (and contingent on the consent of the land owner) after construction to minimize relic hunting. 1

5.5.1.1.5 Land Use

Land use can be affected in two ways by a transmission line. The presence of the transmission line can change current practices and/or alter future flexibility in land use. These effects will vary depending on existing land use.

Land used for grazing will not be significantly impaired by the transmission line systems. Normal grazing practices will be maintained because cattle will be able to graze under the lines. Cultivation practices on agricultural lands may be slightly modified due to the presence of the proposed transmission system. The aerial application of seed, herbicides,

and other materials to the crops may be altered by the transmission lines.

5.5.2 WASTEWATER CONVEYANCE PIPELINE

Information presented in ER-CP Section 5.6.2 and the FES remain valid. The impacts expected due to the operation and maintenance of the wastewater conveyance pipeline as well as mitigation measures are summarized in this section.

5.5.2.1 General Maintenance

Pipeline maintenance will be minimal. The pipeline will be underground and the land in the right-of-way will revert to its original state, which is either agricultural or natural desert. The existing service roads and highways will be used for the minimal maintenance access that may be required.

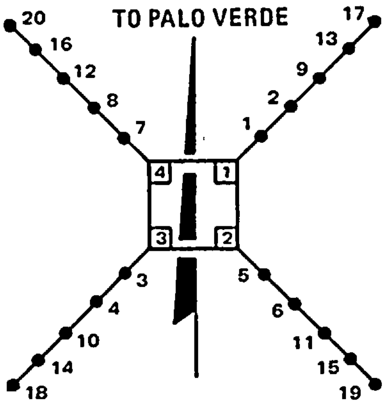
5.5.2.2 Effects of Operation Maintenance

No significant environmental effects are expected as a result of the operation and maintenance programs. Ecological impact of maintenance of the pipeline will be minimal. Since portions of the right-of-way will not be returned to agricultural use, certain noxious weeds will rapidly emerge. APS has proposed to mitigate this ecological detriment by judicious application of a suitable weed control chemical in the affected areas.(1) Adverse archaeological and ecological effects of the maintenance of the wastewater pipeline, once installed, should be minimal because additional maintenance roads are not required.

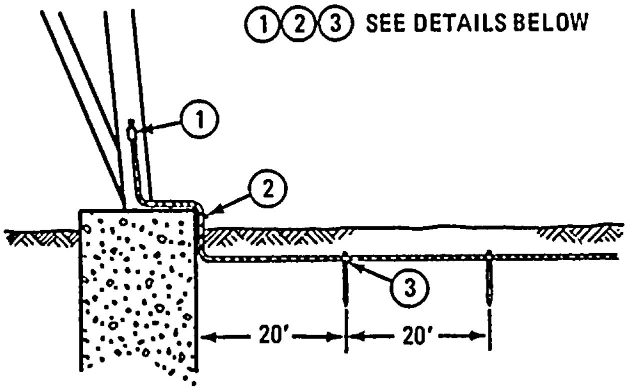
5.5.3 REFERENCES

1. Letter to the Nuclear Regulatory Commission, from E. E. Van Brunt Jr., October 2, 1979.

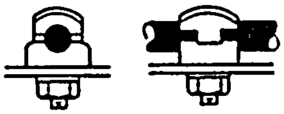
PRELIMINARY



INSTALLATION OF RODS SHALL BE IN ORDER SHOWN.

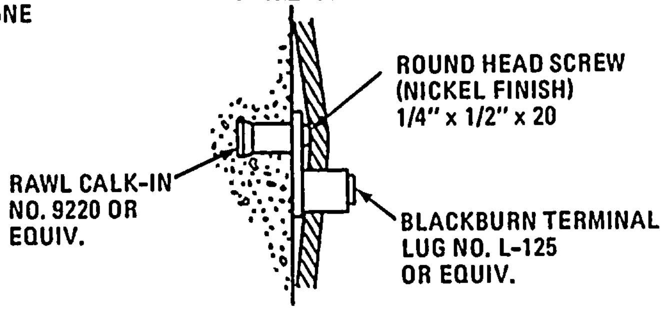


DETAIL 1

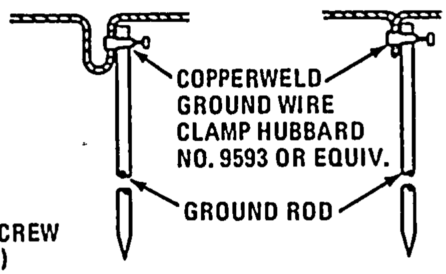


CABLE TO FLAT TERMINATING CLAMP. PENN-UNION LSN025NE OR EQUIV.

DETAIL 2



DETAIL 3



EITHER METHOD ACCEPTABLE

2

NOTES:

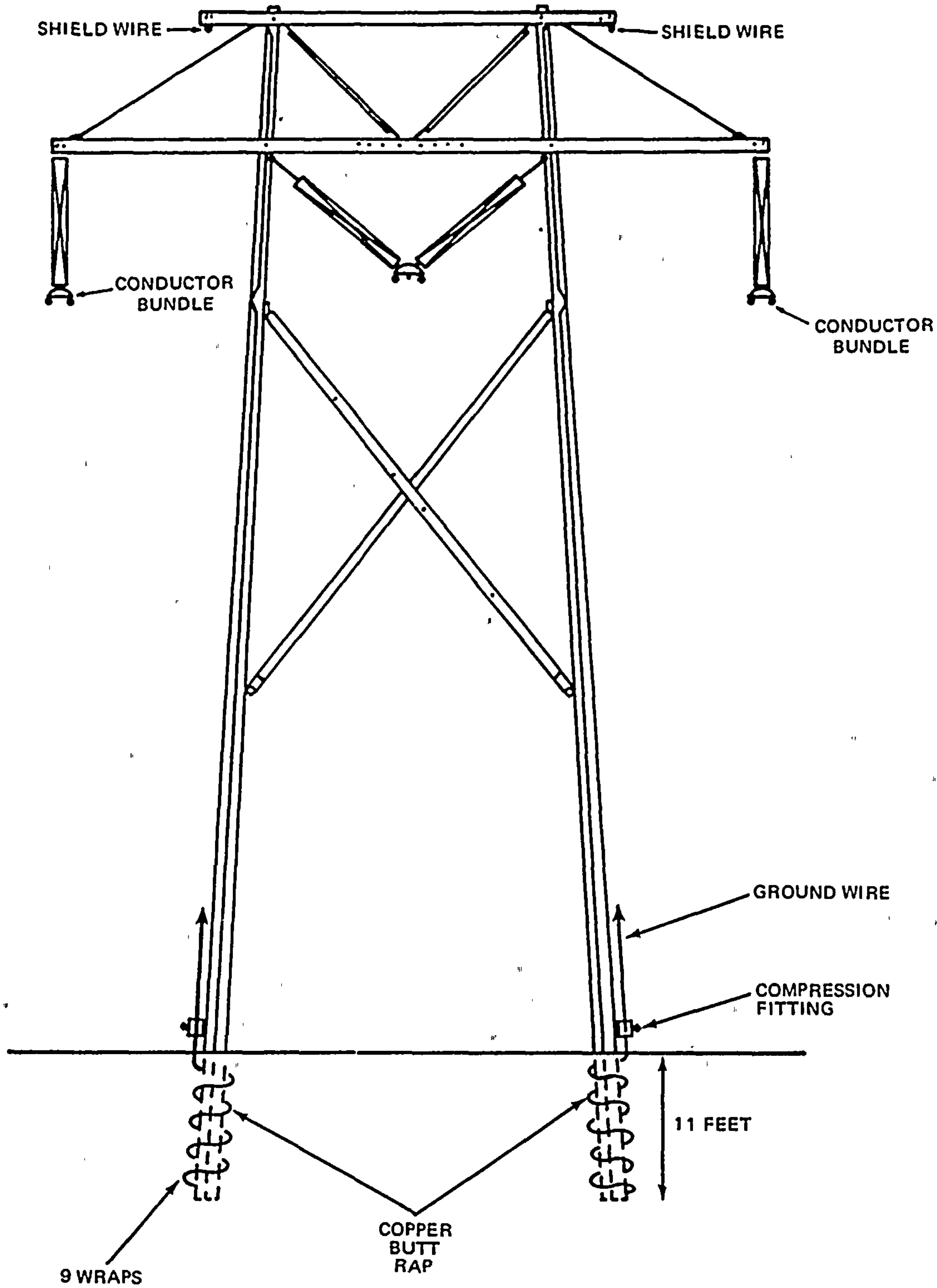
1. GROUND WIRE MAY BE EITHER 5/16" OR 3 NO. 8 COPPERWELD ATTACHED TO CONCRETE FOOTING PER DETAIL 2 IF PROJECTION IS 18-INCHES OR OVER.
2. WIRE TO BE BURIED 12-INCHES DEEP IN UNCULTIVATED AREA WHERE SOIL IS AVAILABLE AND COVERED WITH ROCK WHERE NO SOIL IS AVAILABLE. IN CULTIVATED AREA, WIRE DEPTH IS TO BE 2-FEET OR AS SPECIFIED.
3. ONE 3/4-INCH x 10-FOOT COPPERWELD ROD FOR EACH 20-FOOT LENGTH OF COUNTERPOISE IS TO BE USED WHERE REQUIRED WITH CONCRETE OR GROUTED FOOTING.
4. GROUND RODS ARE TO BE DRIVEN OR A HOLE DRILLED AND THE ROD GROUTED SO THE TOP OF THE ROD MATCHES THE COUNTERPOISE IN DEPTH BELOW THE SURFACE OF THE GROUND.
5. ALL COUNTERPOISE MUST BE CONTAINED WITHIN THE LIMITS OF THE RIGHT-OF-WAY. THE DIRECTION OF THE COUNTERPOISE MAY BE ALTERED UP TO 15° OR DOUBLED BACK TO AVOID OBSTRUCTIONS PROVIDED IT DOES NOT HAVE A TURNING RADIUS OF LESS THAN 10-FEET OR COME WITHIN 20-FEET OF ITSELF OR ANY PART OF THE TOWER.
6. GROUT FOR RODS IN ROCK HOLES TO CONSIST OF ONE PART PORTLAND CEMENT AND THREE PARTS CLEAN SAND WITH SUFFICIENT WATER FOR EASY PLACEMENT.

Palo Verde Nuclear Generating Station
ER-OL

COUNTERPOISE INSTALLATION DETAILS
PROJECT 1

Figure 5.5-1

PRELIMINARY

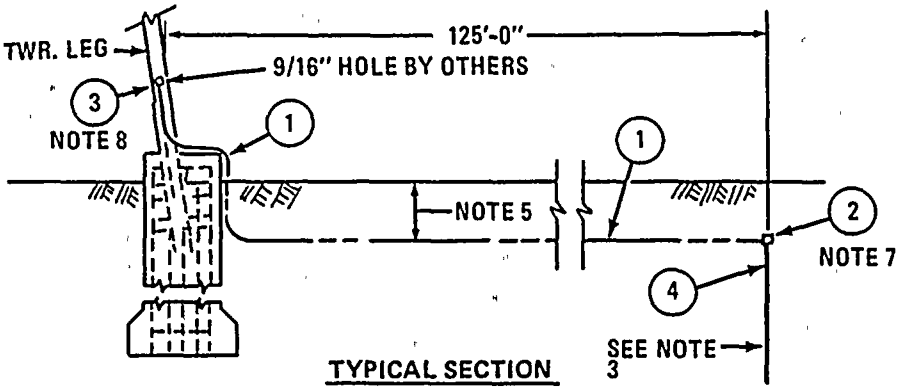


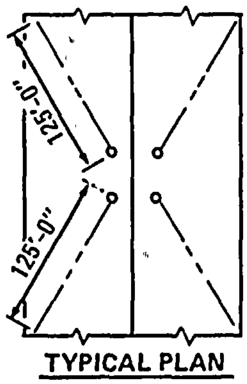
2

Palo Verde Nuclear Generating Station
ER-OL

PROJECT 3
GROUNDING DETAILS

Figure 5.5-2





NOTES:

1. FOLLOWING TOWER ERECTION BUT BEFORE GROUND WIRE INSTALLATION, THE RESISTANCE BETWEEN THE TOWER STEEL AND GROUND SHALL BE MEASURED. IN ADDITION, A MEASUREMENT SHALL BE TAKEN AFTER COUNTERPOISE IS INSTALLED.
2. ALL COUNTERPOISE MUST BE CONTAINED WITHIN THE LIMITS OF THE RIGHT-OF-WAY. THE DIRECTION OF THE COUNTERPOISE MAY BE ALTERED OR DOUBLED BACK TO AVOID OBSTRUCTIONS PROVIDED IT DOWS NOT HAVE A TURNING RADIUS OF LESS THAN 10 FT. OR COME WITHIN 20 FT. OF ITSELF OR ANY PART OF THE TOWER.
3. GROUND RODS ARE TO BE DIRVEN OR A HOLE DRILLED AND THE ROD GROUTED SO THE TOP OF THE ROD MATCHES THE COUNTERPOISE IN DEPTH BELOW THE SURFACE OF THE GROUND. 2
4. IF ONLY TWO ARMS ARE REQUIRED, ANY TWO DIAGONALLY OPPOSITE TWR LEGS MAY BE USED.
5. CABLE TO BE BURIED 12" DEEP IN UNCULTIVATED AREAS WHERE SOIL DEPTH IS AVAILABLE AND COVERED WITH ROCK OR ANCHORED TO LEDGE WHERE NO SOIL IS AVAILABLE. IN CULTIVATED AREAS, CABLE DEPTH IS TO BE 18".
6. GROUND CONNECTION BETWEEN FOOTING AND TOWER LEG SHALL BE MADE IN ALL CASES.
7. TWO CROSBY TYPE CONNECTORS TO BE USED.
8. ATTACH COUNTERPOISE TO TOWER LEG AT THE BACKSIDE OF FOOTING GROUND CONNECTION OR IN A VACANT STEPBOLT HOLE.
9. THE CONTRACTOR SHALL PROVIDE THE EDISON APPROVED COUNTERPOISE MATERIAL.

COUNTERPOISE TABLE

FOOTING RESISTANCE (OHMS)	COUNTERPOISE REQUIRED (PER TOWER)
0 – 30	NONE
31 – 100	TWO
OVER 100	FOUR

Palo Verde Nuclear Generating Station
ER-OL

COUNTERPOISE DETAILS
PVNGS-DEVERS

Figure 5.5-3

PRELIMINARY

5.6 OTHER EFFECTS

5.6.1 ENVIRONMENTAL EFFECTS OF WATER DIVERSION

5.6.1.1 Wastewater Effluent Use

Information presented in ER-CP Section 5.7 and the FES has been updated by the following changes:

A. Condenser cooling water requirements for PVNGS have been revised to 21,350 acre-ft/yr/unit.

B. Estimates of sewage effluent availability have been prepared by the City of Phoenix Water and Sewer Department and by the Maricopa Association of Governments (MAG) Regional Council.

C. A number of reports have been prepared on the water use, reuse, and associated habitats along the Salt and Gila Rivers from 23rd Avenue in Phoenix to Gillespie Dam.

5.6.1.1.1 PVNGS Condenser Cooling Water Requirements

As discussed in section 3.3.1, the per-unit condenser cooling water requirement at the Palo Verde site is estimated to be 21,350 acre-ft/yr. This requirement is based on the following assumptions:

A. City of Phoenix wastewater effluent is utilized as the source of condenser cooling water.

B. Wastewater effluent is obtained from the 91st Avenue Sewage Treatment Plant.

C. The planned unit capacity factor is 95%.

D. Annual average ambient meteorological conditions.

E. There will be no blowdown treatment.

F. Losses will be as defined in figure 3.3-1.

G. One month per year allowed for refueling.

PVNGS water requirements vary by month. The sum of the requirements for each month gives the per-unit requirement of
2 21,350 acre-ft/yr.

5.6.1.1.2 Effluent Availability Projections

Projections of effluent availability from the 91st Avenue Sewage Treatment Plant have been made by the Corps of Engi-
2 neers and U.S. Environmental Protection Agency for the Maricopa Association of Governments (MAG) and by the City of Phoenix Water and Sewer Department.

The Corps of Engineers and the U.S. Environmental Protection Agency have estimated[18] the quantity of effluent discharges from the 91st Avenue Plant as follows:

1980	1983	1985	1990	1995	2000
84.5 MGD	98.0 MGD	102.9 MGD	113.7 MGD	124.3 MGD	137.0 MGD

In comparison to the foregoing estimates, in September, 1979, the City of Phoenix estimated[1] effluent discharges from the 91st Avenue Plant for the same years as follows:

1980	1983	1985	1990	1995	2000
100,200	116,000	126,600	153,060	179,500	205,900
2 a-f[a]	a-f	a-f	a-f	a-f	a-f
(89.5 MGD)	(104 MGD)	(113 MGD)	(137 MGD)	(160 MGD)	(184 MGD)

On the basis of these two independent estimates (extrapolating the increase in flows from 1985 to 1986 from the differential between the estimates for 1983 and 1985), the effluent discharges in 1986 are expected to fall within the range of 105.35 MGD to 117.5 MGD, or 118,000 to 131,600 acre-feet. The validity of estimates is confirmed at least partially by

---

a. acre-feet

comparison of estimates for 1980 with the actual flows from the 91st Avenue Plant, as follows:

COE/EPA 1980 Estimate	84.5 MGD
Phoenix 1980 Estimate	89.5 MGD
Actual 1980 Effluent Discharges(19)	88.46 MGD

Assuming that the total effluent produced at the 91st Avenue Plant in 1986 will be in the range of 118,000 to 131,600 acre-feet, the amount available for use at Palo Verde will be in the range of 79,500 to 93,100 acre-feet. The basis used to determine the amount available for use at Palo Verde assumes that 38,500 acre-feet will be delivered or discharged to users having prior rights to use at Palo Verde pursuant to Agreement No. 13904, as follows:

Buckeye Irrigation District	30,000 acre-feet
Arizona Game & Fish Department	7,300 acre-feet
U.S. Water Conservation Lab	1,200 acre-feet

2

This deduction is conservative insofar as predicting the amounts available to Palo Verde, because the U.S. Water Conservation Laboratory has completed its experiments and is no longer using its reserved effluent and the Arizona Game & Fish Department has abandoned its wildlife project for which 7,300 acre-feet were reserved. There are no other users of effluent with rights prior to Palo Verde.

The only other user of effluent from the 91st Avenue Plant is the Buckeye Irrigation District, which, in the five-year period from 1972 to 1977, diverted on the average 82,000 acre-feet per year from the Gila River at the Buckeye Heading. Of this average amount, the source of 14,500 acre-feet was the Salt River Project feeder ditch. The balance, or 67,500 acre-feet, is assumed to be effluent from the 91st Avenue and the 23rd Avenue Plants (Reference 18, page 3-42). Of such

67,500 acre-feet of effluent, 30,000 acre-feet was discharged into the river pursuant to the agreement between BID and the City of Phoenix. Assuming that in 1987 (the first year in which all three Palo Verde units will be in operation for a full year) the total effluent discharges from the 91st Avenue Plant are the same as in 1986, the amount of effluent available to BID for agricultural irrigation would be 54,000 to 67,600 acre-feet, determined as follows:

	COE/EPA Estimate (acre-feet)	Phoenix Estimate (acre-feet)
Total Effluent Available	118,000	131,600
BID/Phoenix Contract	30,000	30,000
PVNGS Use	64,000	64,000
Total	94,000	94,000
2 Balance discharged to River and available to BID	24,000	37,600
Total Effluent Available to BID	54,000	67,000

If the Phoenix estimates prove to be accurate, there will be sufficient effluent available to meet BID's 1972-77 average uses. If the COE/EPA estimates are assumed, then the difference between the total amount available to BID (54,000 acre-feet) and its average 1972-77 usage (67,500 acre-feet) will have to be made up from one or more of the following sources:

(1) Annual increases in effluent discharges from 91st Avenue Plant - (COE/EPA Est. 1985-1990) ..... 2,400 acre-feet/year

(2) Effluent discharges from 23rd Avenue Plant .... 41,000 acre-feet/year[b]

(3) Pumped Water .... Difference between 13,500 acre-feet and the sum of sources (1) and (2)

On the basis of the foregoing assumptions, there will be no apportionment of effluent (except pursuant to contract) and none will be required.

Assuming each of the three Palo Verde units is shut down for one month each year for refueling and maintenance, and operates at a 95% capacity factor during the balance of the year, and assuming average ambient conditions, the effluent usage is estimated to be (refer to figure 3.3-1). 2

	Each Unit	3 Units
Miscellaneous Pipeline and Reclamation Plant Losses	--	0.10 MGD
Reservoir Evaporation and Seepage	--	0.26 MGD
Miscellaneous Unit Waste	--	0.26 MGD
Cooling Tower Evaporation, Drift and Blowdown	19	57 MGD
Essential Spray Pond Evaporation and Drift	0.01	0.03 MGD
Domestic and Demineralized Water Systems Wastes	--	0.25 MGD
Output from Onsite Wells	--	(1.14) MGD
	Total	57 MGD

b. Roosevelt Irrigation District has a prior right (which has not yet been exercised) to purchase up to 20,000 acre-feet of effluent from the 23rd Avenue Plant.

The criteria used in evaluating losses included specification requirements for pipe leakage, solar evaporation rates appro-
2 priate for the site, design permeability of the reservoir liner, and specification details of the cooling towers and other plant systems.

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2 5.6.1.1.3 Environmental Effects of Water Diversion

A number of reports have been prepared on the water use, reuse, and associated habitats along the Salt and Gila Rivers from 23rd Avenue in Phoenix to Gillespie Dam.[3-8] These reports point out that the total water balance of the beds of the Salt and Gila Rivers from the City of Phoenix 23rd Avenue Sewage Plant, downstream to Gillespie Dam (hereinafter described as the River Study Area), must be considered in order to accurately predict the ecological effects of wastewater use.

Although the surface water and groundwater regimes are interdependent, the major potential ecological impacts from use of the wastewater effluent can be classified as those resulting from alterations of habitats which are primarily dependent on groundwater (e.g., the areas supporting phreatophytes) and habitats primarily dependent on surface water.

5.6.1.1.3.1 Groundwater Dependent Habitat. Based on historical rates of groundwater recharge, it does not appear that piping the wastewater effluent required to meet the cooling requirements will substantially alter the groundwater-dependent habitats of the River Study Area. The important phreatophyte habitats in the River Study Area are largely recharged from other sources. For example, the winter flood of 1965-1966 contributed to substantial replenishment of the underground water supply in the greenbelt region between 91st Avenue and Buckeye Heading, and this stretch of the river currently receives underflows from the Gila River (estimated to be 3500 acre-feet per year).[3,4]

Considering the next reach of river between Buckeye Heading and the South Extension Canal, it is anticipated that Buckeye Irrigation District (BID) will continue to exercise its appropriative rights and divert almost all the water in the Gila River at Buckeye Heading during much of the year. Therefore, this region is expected to change little in phreatophyte habitat quality. The BID has under contract 30,000 acre-ft/yr of wastewater effluent from the 91st Avenue Sewage Treatment Plant. When the PVNGS pipeline becomes operational, this wastewater effluent will be delivered via the pipeline and may result in BID having to pump less groundwater to supplement its irrigation needs. Therefore, the nearby adjacent section of the River Study Area could have a faster groundwater recharge rate.

The last region of the River Study Area, extending from the South Extension Canal to Gillespie Dam, presently supports an extensive phreatophyte habitat which is heavily used by white-winged doves. This stretch of the River Study Area has historically had a shallow water table, resulting in water-logged conditions in lands adjacent to the river. Sewage effluent has never had a very important role in the continual maintenance of this portion of the River Study Area,[3] and it is not anticipated to have a significant role in the future.

5.6.1.1.3.2 Surface Water Dependent Habitats. Use of wastewater effluent for PVNGS would result in a gradual reduction of the surface water-dependent habitats during the 1983-1986 period. The resulting impact on the surface water habitat is expected to be minimal. It is known that decreasing the amount of surface water will result in altering wildlife habitat, making it less favorable to some species and more favorable to others.[8] Although it is speculative to determine what the everchanging river channel will be like in the future, it has been documented that one endangered species, the Yuma Clapper Rail, inhabited the 107th Avenue Flushing Meadows Marsh as early as 1970.[9]

The seasonal and daily fluctuations in water levels in the river channel can affect various biological phenomena ranging from plant germination to mosquito breeding. The upper reaches of the River Study Area (whose surface water habitats are comprised primarily of wastewater effluent) presently have a wide fluctuation of water level over a 24-hour period, since maximum effluent discharges can be up to four times the minimum discharges into the river. The River Study Area also undergoes irregular seasonal fluctuations as a result of runoff from rains, rain interception, and periodic flooding. Use of wastewater effluent at PVNGS will result in wider seasonal (although not daily) fluctuations of the surface water levels in the upper reaches of the River Study Area compared to those existing presently.
2 Effluent used by the Buckeye Irrigation Company is diverted as shown in figure 3.9-5.

Although reducing the wastewater flow will cause a temporary loss of open water aquatic habitat, this loss would not substantially reduce the number of any wildlife species which may be using the area. For example, the Yuma Clapper Rail is most prevalent in the Colorado River Delta in Mexico and along the southern portions of the Colorado River in the United States.(10) The status of Yuma Clapper Rail populations remains uncertain; however, its numbers are apparently greater than originally thought when this species was classified as endangered.(11)

5.6.1.1.4 Conclusions

The ultimate effect of using wastewater effluent at PVNGS is dependent upon the actual quantities of effluent available. Using the MAG estimates, the effects are expected to be more severe than with the City of Phoenix estimates. However, even using the MAG estimates, which are considered to be a lower bound of effluent availability, it is anticipated that transporting water to PVNGS would have no substantial long-term negative impacts on the Sonoran desert riparian or aquatic ecosystems. PVNGS water use would have negligible ecological

power level of the turbines, transformers, and pumps and motors is based on published source-term data that has been appropriately scaled to the size of the PVNGS equipment[13,14,15]

Operational sound levels were predicted using the computer code SOCON. SOCON calculates resultant sound levels, including background sound, on a grid basis from an arbitrary number of noise sources at different locations, assuming uniform hemispherical sound propagation and frequency-dependent atmospheric absorption. Inputs include the sound-power frequency spectrum and grid coordinates of each source. These are provided in table 5.6-1. Outputs include coordinates of A-weighted sound-level isopleths, which are then plotted on a site map. 2

The attenuation factors used to account for atmospheric absorption in the analysis are based on information presented by Beranek.[16] The basic model is conservative in that no credit is given for excess attenuation by vegetation, ground effects, topographical effects, or meteorological effects such as shadow zones induced by wind or thermal gradients.

Point sources were considered in this analysis, including the three cooling towers for each unit, the equipment within each unit, the switchyards, and the reclamation plant. Predicted sound levels from the operation of PVNGS are presented in figure 5.6-2. Because the sound power level of each source is assumed to be constant, the predicted sound levels are approximately equal to the L_{eq} sound levels (refer to section 6.1.1.2). Actual sound levels will vary depending on the operation of auxiliary equipment, the use of equipment producing intermittent noise, and atmospheric conditions.

The maximum predicted sound level at the site boundary will occur along the west boundary near the cooling towers of Unit 3 where the maximum predicted L_{dn} sound level is 64 dBa. Sound levels due to plant operation are conservatively predicted not to exceed the HUD acceptable noise criteria of 65 dBa for L_{dn} in any offsite areas.

Table 5.6-1

SOUND POWER SPECTRA AND LOCATION FOR NOISE SOURCES

PRELIMINARY

Table 5.6-1

SOUND POWER SPECTRA AND LOCATION FOR NOISE SOURCES

Source	Location[(a)(b)] (feet)	Overall Sound Power Level (dB, re: 10^{-12} Watts)	Frequency Spectrum (dB, re: 10^{-12} Watts) 63 Hz	125	250	500	1000	2000	4000	8000
Unit 1	E211400 N870510	105.9	-	-	-	-	-	-	-	-
Unit 2	E210650 N869760	105.9	-	-	-	-	-	-	-	-
Unit 3	E210350 N868710	105.9	-	-	-	-	-	-	-	-
Transformers	E212450 N868860	119.9	-	-	-	-	-	-	-	-
Reclamation Pumps	E212600 N872910	108.7	-	-	-	-	-	-	-	-
Cooling Towers:										
Unit 1 A	E211250 N871710	-	123.5	120.5	116.6	111.7	107.9	110.3	112.2	112.9
B	E210600 N871860	-	123.5	120.5	116.6	111.7	107.9	110.3	112.3	112.9
C	E210950 N871360	-	123.5	120.5	116.6	111.7	107.9	110.3	112.2	112.9
Unit 2 A	E210200 N870660	-	125.5	120.5	116.6	111.7	107.9	110.3	112.2	112.9
B	E209750 N870660	-	123.5	120.5	116.6	111.7	107.9	110.3	112.2	112.9
C	E209900 N870210	-	123.5	120.5	116.6	111.7	107.9	110.3	112.2	112.9
Unit 3 A	E209450 N869310	-	123.5	120.5	116.6	111.7	107.9	110.3	112.2	112.9
B	E209000 N869160	-	123.5	120.5	116.6	111.7	107.9	110.3	112.2	112.9
C	E209300 N868860	-	123.5	120.5	116.6	111.7	107.9	110.3	112.2	112.9

(a) Grid coordinates are for the site grid as shown in Figure 3.1-4 which corresponds to a 20,000 foot grid based on the Arizona coordinate system, central zone.

(b) All sources assumed at ground level. 2

Along the Buckeye-Salome Road the noise levels, due primarily to traffic, exceed the HUD acceptable noise criterion of $L_{dn} \leq 65$ dBA for residential areas and fall within the HUD normally unacceptable range of 65 dBa < L_{dn} < 75 dBa. Information on the background sound levels is presented in section 2.7. Traffic noise levels will tend to mask the noise of plant operation along and to the north of the Buckeye-Salome Road. Plant operation noise will not significantly increase the noise levels at the residences along Buckeye-Salome Road. However, because of the low ambient noise levels in areas other than along the Buckeye-Salome Road, the plant operation noise may be audible approximately 4 miles from the plant cooling towers.

5.6.2.1 Documentation of SOCON

SOCON was written by B. Bartram and R. Werth based on references 16 and 17 in FORTRAN-IV on the NUS Prime 500 system. SOCON produces A-weighted sound pressure level contours on a 27x27 grid using sound power level spectrums from a number of sources (up to 50) and background sound levels. The contributions from each source to the sound pressure level at a grid point is calculated on the basis of the following equations: 2

$$SPL_s = 10 \log \sum_f 10^{(SPL_f/10)}$$

$$SPL_f = PWL_f + AA_f - 1.7\times10^{-6}\, fr - 20 \log r + 2.5$$

where:

SPL_s = sound pressure level contribution for the source (re: 2×10^{-5} N/m^2)

SPL_f = sound pressure level contributions for each center band frequency, i. (re: $2x10^5$ N/m^2)

PWL_f = sound power level for the source for frequency f (re: 10^{-12} Watts)

f = frequency, H_2 (SOCON considers eight octave bands - 63, 125, 250, 500, 1000, 2000, 4000, and 8000 H_2)

AA_f = A-weighting factor for the frequency band. SOCON uses the following A-weighting factors for the eight octave bands above: -26.1, -16.2, -8.6, -3.3, 0.0, 1.2, 1.0 and -1.1 (dB).

r = distance from the source to the grid point (feet)

SOCON produces tables of 1) the sound pressure level of each grid point, 2) the background sound pressure level, 3) the
2 increase over the background, and 4) the contribution of the sources to the sound levels. Further, for each dBA value selected, SOCON produces a map with the coordinates of that sound pressure level contour.

SOCON calculates atmospheric attenuation with the factor $1.7x10^{-6}$ f r (dB) which is based on curves of excess attenuation due to molecular absorption (Reference 17). SOCON assumes hemispherical sound propagation in the terms -20 log r + 2.5. The SOCON predictions are conservative in that no credit is given for excess attenuation by vegetation, ground effects, topographical effects, or meteorological effects such as shadow zones induced by wind or thermal gradients.

5.6.3 OPERATIONAL WORKFORCE IMPACTS

The projected number of operational workers at PVNGS is provided in table 8.1-3A. The table provides a quarterly accounting of the workforce increase as Units 1, 2, and 3 are completed. It

Table 5.6-2

ESTIMATE OF STARTUP PERIOD OPERATIONAL TRAFFIC VOLUME IN AND OUT OF PLANT

Year	Projected Average # of Cars & Buses In and Out Per Day		Projected Average Number of Common Carrier Trucks In and Out Per Day	Projected Total Average of Vehicles In and Out Per Day
	Buses	Cars		
1981	12	28	3	43
1982	17	33	3	53
1983	19	51	3	73
1984	20	50	3	73
1985	22	58	3	83
1986	23	67	3	93

is expected that 75% of the operational workforce will be hired from outside the area. It is also expected that they will reside in west Phoenix. 2

Estimated annual averages of traffic volume in and out of PVNGS during operation is provided in table 5.6-2.

5.6.4 REFERENCES

1. Letter from Robert B. Steytler, Assistant Director, City of Phoenix Wastewater Operations, to Mr. Terry Hudgins, Arizona Public Service Company, September 20, 1979.

2. Maricopa Association of Governments, 208 Water Quality Management Program, Final Plan, July, 1979.

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3. Halpenny, L. C. and Greene, D. K., Water Balance Investigation of River Bed, Salt and Gila Rivers, 23rd Avenue to Gillespie Dam, Arizona Water Development Corp., Tucson, Arizona, 1975.

4. Halpenny, L. C. and Clark, S. D., 1977 Supplement to Water Balance Investigation of River Bed, Salt and Gila Rivers, 23rd Avenue to Gillespie Dam, Arizona Water Development Corp., Tucson, Arizona, 1977.

5. Water Resources Associates, Inc., Report on Water Balance, Salt and Gila Rivers, 23rd Avenue to Gillespie Dam, Scottsdale, Arizona, 1975.

6. Water Resources Associates, Inc., Explanatory Notes on Mapping of Vegetation Types, Salt and Gila Rivers, 23rd Avenue, Phoenix, to Gillespie Dam, Scottsdale, Arizona, 1976.

7. Potential Reuse Options for Wastewater Effluent and Residual Solids, U.S. Army Corps of Engineers, Los Angeles District, Phoenix urban study, 1977.

8. Haase, E. F., 1973. Draft Environmental Study. Gila River from the Confluence of the Salt River Downstream to Gillespie Dam. Submitted to the U.S. Army Engineer District, Los Angeles, California.

9. Personal communications. B. Pinkowski, NUS Corp. with Richard Todd, Arizona Game and Fish Dept., November 4, 1977.

10. Tomlinson, R. E. and Todd, R. L., "Distribution of Two Western Clapper Rail Races as Determined by Responses to Taped Calls", The Condor, Vol. 75, No. 2, 1973, pp. 177-183.

11. American Ornithologists Union, Report of the American Ornithologists Union Committee on Conservation, 1976-1977, supplement to AUK, Vol. 94, No. 4, 1977.

12. Personal communication, R. Andes, NUS Corp., with J. S. Gosmano, Marley Cooling Tower Company, September 23, 1977.

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15. Berger, B., et al., "Transformer Noise," Philosophical Transactions of the Royal Society, Series A, Vol. 263, pp 381-411, 1968.

16. Beranek, L. L., Noise and Vibration Control, McGraw-Hill Book Co., Inc., New York, 1971.

17. Beranek, L. L., Noise Reduction, McGraw-Hill Book Co., Inc., New York, 1960.

18. Final Environmental Impact Statement on the Maricopa Association of Governments Point Source Metro Phoenix 208 Waste Water Management Plan, U.S. Environmental Protection Agency, July 1979. 2

19. Memo from K. E. Spiker to R. B. Stextler, Phoenix Water & Sewer Department, January 23, 1981

Figure 5.6-1 DELETED 2

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2

QUESTION 5A.1 (NRC No. 290.4) 5.1

State the distance from the towers for which Figures 5.1-7 and 5.1-8 are valid. Are these values for 3-unit operation?

RESPONSE: The response is provided in the revised section 5.1.4.7.

QUESTION 5A.2 (NRC No. 290.5) 5.4

Describe in more detail how the value of 365 $\mu g/m^3$ of SO_2 was calculated in Table 5.4-2. Was it assumed that 1 or 3 units were in operation for the full 24 hours? Also, the NAAQS standard is that 365 $\mu g/m^3$ is not to be exceeded more than once per year (indicated as the second highest calculated value). 2

RESPONSE: The response is provided in the revised section 5.4.

QUESTION 5A.3 (NRC No. 290.6) 5.4

Please provide information on existing air quality at the site so that the staff can determine if applicable air quality standards will be violated by emissions from the plant. Are the air pollution standards given in Section 5.4 still valid? If not, present the new values.

RESPONSE: The response is given in the revised section 2.3.2.1 and below.

The federal air standards presented in section 5.4 are still valid. Supplementary standards of the State of Arizona are provided in table 2.3-24A.

QUESTION 5A.4 (NRC No. 290.7) 5.6.1

Describe how the Buckeye Irrigation Company will receive its water from the 91st Avenue Sewage Plant during PVNGS operation. Identify the location where water for the Buckeye Irrigation Company is diverted from water sent to PVNGS. Describe the mitigation measures planned to preserve the riparian habitates and green belts (CP-FES Section 2.7) once the water is diverted from the 91st Avenue Sewage Treatment Plant to PVNGS.

RESPONSE: The Buckeye Irrigation Company diversion location is provided in the revised section 3.9.

The mitigation measures that can be taken to preserve the riparian habitats and green belts referred to in the question are dependent primarily upon the steps that are taken to process the treat wastewater produced in the Phoenix metropolitan area. Such steps hinge, in turn, upon the development and implementation of areawide water
2 quality management plans pursuant to Section 208 of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500) and the Clean Water Act of 1977 (P.L. 95-217), which amends P.L. 92-500. Pursuant to such statutory provisions, the Maricopa Association of Governments (MAG) has been designated as Section 208 planning agency for Maricopa County. After extensive studies conducted for MAG by the Corps of Engineers with substantial public input, MAG adopted in 1979 its Point Source Metro Phoenix 208 Wastewater Management Plan (hereinafter, the "Plan"). The Plan has been approved, as required by law, by the Governor and by the U.S. Environmental Protection Agency (EPA). In July, 1979, the EPA issued its Final Environmental Impact Statement on the Maricopa Association of Governments Point Source Metro Phoenix 208 Wastewater Management Plan (EPA-FEIS).

Under the Plan, approximately 85% of the wastewater from the Phoenix area would be treated at the 91st Avenue and

23rd Avenue treatment plants in Phoenix, with the remainder treated at nine satellite plants. A more complete description of the Plan may be found in Section 2.2 of the EPA-FEIS. The sources of wastewater inflows to the 91st Avenue and 23rd Avenue Plants are essentially the same as contemplated in the Palo Verde CP-FES (NUREG 75-078) and as committed under Section 7.3 of Agreement No. 13904 between the multi-cities owning and operating the 91st Avenue Plant, Arizona Public Service Company (APS) and Salt River Project (SRP). The only exceptions are the provision of small additional inflows to the 91st Avenue Plant from Luke Air Force Base and from the communities of Surprise and El Mirage. All of the planned satellite plants are outside the drainage area which the 91st Avenue Plant was originally designed to serve.

The Plan requires the upgrading of the 23rd Avenue and 91st Avenue treatment plants and the expansion of the 91st Avenue Plant in two stages: In 1981, from its present design capacity of 90 MGD to 120 MGD and, in 1990, or sooner, from 120 MGD to 137 MGD. In implementation of the Plan, the Phoenix City Council awarded in early 1981 a contract for the first stage expansion of the 91st Avenue Plant. 2

In considering, adopting and approving the Plan, MAG, the Governor and EPA rejected one alternative that would have provided an even greater expansion of the 91st Avenue Plant to serve areas outside its normal drainage area. Such alternative, if adopted, would have resulted in greater effluent discharges from the 91st Avenue Plant and the potential, absent increased diversions for reuse, for more support to some riparian habitats in some segments of the Salt and Gila Rivers.

The other alternatives to the Plan that were considered and rejected (i.e., no action and Alternatives 3 and 4) would

have resulted in reduced inflows into the 91st Avenue Plant and, consequently, reductions in effluent discharges and the potential for reuse to support riparian habitats in the Salt and Gila Rivers, as well as for reuses for agriculatural irrigation and power production. Accordingly, it may be concluded that the Plan preserves the originally planned mitigation of impacts upon wildlife habitats on the Salt and Gila Rivers.

With respect to the Plan, EPA concluded that "it satisfies the requirements of the Clean Water Act and there are no adverse impacts of sufficient magnitude to outweigh the benefits to be derived." [EPA-FEIS, pages iv and 2-81.]. In its consideration of the benefits of the Plan, the EPA recognized that the Phoenix area is semi-arid and water short, that there is a need to conserve water resources and that the reuse of wastewater would help conserve water resources and would make other better-quality water available for higher uses. [EPA-FEIS, page 2-11.] The reuses identified by EPA for effluent from the 91st Avenue and 23rd Avenue plants included agricultural irrigation, power production and support of riparian habitats. [EPA-FEIS, pages 2-44 to 2-46.]

With respect to impacts of effluent reuse on riparian habitats, EPA concluded:

> "Despite some habitat losses, net biological changes throughout the area are expected to be beneficial as a result of implementation of the plan (Table 4-3). This is expected because increased water supply will enhance riparian habitat and associated aquatic conditions that in turn will contribute to wildlife diversity, particularly aquatic, semiaquatic, riparian-dwelling, and certain upland wildlife. [EPA-FEIS, page 4-16; further, see pages 5-48.]

Respecting the specific riparian habitats downstream of the 91st Avenue Plant, EPA concluded that it was unlikely that the diversions through the effluent pipeline to Palo Verde and Buckeye would have any significant impact on vegetation

downstream of 115th Avenue because other flows into the river below that point (EPA-FEIS, page 4-24). EPA also concluded with respect to the 2-1/2 mile river segment from 91st Avenue to 115th Avenue that reduced effluent flows could lead to degradation of riparian habitat. This conclusion, however, was based upon the assumptions (i) that Palo Verde Units 4 and 5 would be built and in operation in 1988 and 1990, respectively, and that, consequently, (ii) diversions of effluent from both the 23rd Avenue Plant and the 91st Avenue Plant to provide 107,000 acre-feet to Palo Verde would reduce annual flows of effluent in the river to a minimal discharge of 7,300 acre-feet (EPA-FEIS, page 4-20). Since the plans for Palo Verde Units 4 and 5 have been cancelled, these assumptions are no longer valid.

With three Palo Verde units in operation, diversions for PVNGS are not expected to exceed 64,000 acre-feet per year. Diversion of this amount and other committed diversions for irrigation would still permit the annual discharge of effluent into the Salt River in 1987 (the first year when three Palo Verde units will be in operation for a full year) of more than 50,000 acre-feet and in 1990, more than 59,000 acre-feet to support riparian habitats in the 91st Avenue to 115th Avenue segment of the river -- more than eight times the minimal discharge assumed by EPA. */ Consequently, the 2

*/ Assumes EPA projections in effluent flows in 1985, as shown in Table 4.4 of the EPA-FEIS (page 4-1), effluent from the Tolleson plant in the amount of 2,800 acre-feet (EPA-FEIS, page 2-54), and annual increases from 1985 to 1987 in effluent discharges equal to EPA's projected average annual increases for the 1985-1990 time period, less diversions of effluent for PVNGS in the amount of 64,000 acre-feet, Buckeye Irrigation District in the amount of 30,000 acre-feet and Roosevelt Irrigation District in the amount of 20,000 acre-feet (EPA-FEIS, page 2-44). The later diversion was not included in EPA's Table 4.4. On the basis of EPA's 1990 projections of effluent flows and the same diversions, the total effluent available to support riparian habitat in the 91st Avenue to 115th Avenue river segment would be 59,000 acre-feet per year.

conclusion that riparian habitat in that segment of the Salt River may be degraded is no longer valid.

It may be noted that EPA also stated that it has asked NRC to ensure that PVNGS uses only the minimum amount of effluent necessary. (EPA-FEIS, pages 4-24 and 5-78.) In this connection, four points should be made. First, there are no facilities at Palo Verde nor have there been discharge permits obtained or requested that would permit the diversion of more effluent than is required for operation of the Palo Verde units. In fact, that is the reason that the contract for effluent permits APS and SRP to take only that amount of effluent required for Palo Verde operations.

Second, the costs of treating effluent for use in the Palo Verde circulating water systems provides adequate incentive to minimize the effluent usage.

Third, APS has made a concerted effort to minimize losses
2 from pipeline leakage and reservoir seepage and evaporation. This has been achieved through applicability of quality assurance programs to the design and installation of the pipeline, the decision to line the reservoir, and the design of the reservoir which minimizes the surface area of the reservoir.

Fourth, the design of the water reclamation facility, the cooling towers and the balance of the circulating water systems are state-of-the-art. The result is a total system designed to permit recycling of treated effluent through the cooling towers to 15 times original concentrations of TDS, to minimize losses due to evaporation and drift and to significantly reduce losses from blowdown.

<u>QUESTION 5A.5</u> (NRC No. 290.9) 5.5

Provide a description of the grounding systems and line clearances which will be used to reduce induced voltages

and currents in conducting objects, such as fences and large tractor-trailers, in the vicinity of the right-of-way.

RESPONSE: The response is provided in the revised section 5.5.1.1.2.

QUESTION 5A.6 (NRC No. 290.10) 5.3.1

Describe how the growth of vegetation, along the perimeter of the evaporation pond will be controlled, if any exists.

RESPONSE: Upon completion of evaporation pond berms, vegetation will be encouraged. This should assist in preventing berm erosion. Since revegetation is desired, it is not expected that a vegetation control program will be required.

QUESTION 5A.7 (NRC No. 291.12-5.6.2) 5.6.2 2

Provide the sound-power frequency spectrum and grid coordinates of each sound source used as input to the computer code SOCON. Include the elevation of each assumed source.

RESPONSE: The response is provided in the revised section 5.6.2.

QUESTION 5A.8 (NRC No. 291.13) 5.6.2

Provide documentation on the computer program SOCON.

RESPONSE: The response is provided in the revised section 5.6.2.

QUESTION 5A.9 (NRC No. 310.1) 5.6.3

Provide the updated number and distribution over time of operation workers including reclamation and contracted workers

as the three units come on line and during the first five years of operation of all three units.

RESPONSE: The response is provided in the revised section 5.6.3.

QEUSTION 5A.10 (NRC No. 310.2) 5.6.3

How many operation and reclamation workers would be hired from outside the area, and where would they be likely to live?

2 RESPONSE: The response is provided in the revised section 5.6.3.

QUESTION 5A.11 (NRC No. 310.7) 5.6.3

Provide an updated of 'operation vehicles' as provided in CP-ER Table 4.1-2.

RESPONSE: The response is provided in the revised section 5.6.3.

PRELIMINARY

APPENDIX 5C

SUMMARY OF THE INDUSTRIAL SOURCE COMPLEX MODEL (ISC) 2

A. INDUSTRIAL SOURCE COMPLEX MODEL (ISC)

Reference: Bowers, J. F., J. R. Bjorklund and C. S. Cheney. "Industrial Source Complex (ISC) Dispersion Model User's Guide, Volumes 1 and 2." Publication Nos. EPA-450/4-79-0, 1 (NTIS PB-80-133044, 133051, Magnetic tape PB-80-133036), Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, December 1979.

Abstract: The ISC model is a steady-state Gaussian plume model which can be used to assess pollutant concentrations from a wide variety of sources associated with an industrial source complex. This model can account for settling and dry deposition of particulates, downwash, area, line and volume sources, plume rise as a function of downwind distance, separation of point sources, and limited terrain adjustment. It operates in both long- and short-term modes. 2

Equations: The ISC short-term concentration model for point sources uses the steady-state Gaussian plume equation for a continuous elevated source. For each stack and each hour, the hourly ground-level concentration at downwind distance x and crosswind distance y is given by:

$$\chi\{x,y\} = \frac{KQ}{\pi \ \bar{u}\{h\} \ \sigma_y \ \sigma_z} \exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)\right]^2$$

{Vertical Term} {Decay Term}

The ISC area source model is based on the equation for a finite crosswind line source. The ground-level concentration at downwind distance x (measured from the downwind edge of the area source) and crosswind distance y is given by

$$\chi\{x,y\} = \frac{KQ_A \; x_o}{\sqrt{2\pi}\; \bar{u}\{h\}\; \sigma_z} \{\text{Vertical Term}\} \left\{ \text{erf}\left(\frac{x'_o/2 + y}{\sqrt{2}\;\sigma_y}\right) + \text{erf}\left(\frac{x'_o/2 - y}{\sqrt{2}\;\sigma_y}\right) \right\} \{\text{Decay Term}\}$$

Deposition for particulates in the n^{th} settling-velocity category or a gaseous pollutant with zero settling velocity V_{sn} and a reflection coefficient γ_n is given by

2

$$DEP_n\{x,y\} = \frac{KQ_\tau \;(1 - \gamma_n)\; \phi_n}{2\pi\; \sigma_y\; \sigma_z\; x} \exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right] \exp\left[-\psi\; x/\bar{u}\{h\}\right]$$

$$\left\{ \left[\bar{b}H + (1-\bar{b})\; V_{sn}\; x/\bar{u}\{h\}\right] \exp\left[-\frac{1}{2}\left(\frac{H-V_{sn}\; x/\bar{u}\{h\}}{\sigma_z}\right)^2\right] \right.$$

$$+ \sum_{i=1}^{\infty} \left[\gamma^{i-1} \left[\bar{b}\;(2iH_m - H) - (1 - b)\; V_{sn}\; x/\bar{u}\{h\}\right] \right.$$

$$\exp\left[-\frac{1}{2}\left(\frac{2iH_m - H + V_{sn}\; x/\bar{u}\{h\}}{\sigma_z}\right)^2\right]$$

$$+ \gamma^i \left[\bar{b}\;(2iH_m + H) + (1 - \bar{b})\; V_{sn}\; x/\bar{u}\{h\}\right]$$

$$\left.\left. \exp\left[-\frac{1}{2}\left(\frac{2iH_m + H - V_{sn}\; x/\bar{u}\{h\}}{\sigma_z}\right)^2\right] \right] \right\}$$

The parameter Q_τ is the total amount of material emitted during the time period τ for which the deposition calculation is made.

For area source emissions, the first line of the above equation is changed to the form

$$\chi_\ell\{r,\theta\} = \frac{2K}{\sqrt{2\pi}\ r\ \Delta\theta'} \sum_{i,j,k} \left[\frac{Q_{i,k,\ell}\ f_{i,j,k,\ell}}{u_{i,k}\ \{h\}\ \sigma_{z;k}} S\{\theta\}\ V_{i,k,\ell} \right.$$

$$\left. \exp\left[-\psi\ r/\bar{u}_{i,k}\ \{h\}\right] \right]$$

where

$Q_{i,k,\ell}$ = pollutant emission rate (mass per unit time), for the i^{th} wind-speed category, k^{th} stability category and ℓ^{th} season

$f_{i,j,k,\ell}$ = frequency of occurrence of the i^{th} wind-speed category, j^{th} wind-direction category and k^{th} stability category for the ℓ^{th} season 2

$\Delta\theta'$ = the sector width in radians

$S\{\theta\}$ = a smoothing function similar to that of the AQDM

$u_{i,k}\{h\}$ = mean wind speed (m/sec) at stack height h for the i^{th} wind-speed category and k^{th} stability category

$\sigma_{z;k}$ = standard deviation of the vertical concentration distribution (m) for the k^{th} stability category

$V_{i,k,\ell}$ = the Vertical Term for the i^{th} wind-speed category, k^{th} stability category and ℓ^{th} season

ψ = the decay coefficient (sec^{-1})

The seasonal deposition at the point (r,θ) with respect to the base of a stack or the center of a volume source for particulates in the n^{th} settling-velocity category or a gaseous pollutant with zero settling velocity V_{sn} and a reflection coefficient γ_n is given by

$$DEP_{\ell,n}\{r,\theta\} = \frac{K(1-\gamma_n)\,\phi_n}{\sqrt{2\pi}\,r^2\,\Delta\theta'} \sum_{i,j,k} \left[\frac{Q_{\tau;i,k,\ell}\, f_{i,j,k,\ell}}{\sigma_{z;k}} \right.$$

$$\exp\left[-\psi\, r/\bar{u}_{i,k}\{h\}\right] S\{\theta\}$$

$$\left\{ \left[\bar{b}_k H_{i,k,\ell} + (1-\bar{b}_k) V_{sn}\, r/\bar{u}_{i,k}\{h\}\right] \right.$$

$$\exp\left[-\frac{1}{2}\left(\frac{H_{i,k,\ell} - V_{sn}\, r/\bar{u}_{i,k}\{h\}}{\sigma_{z;k}}\right)^2\right]$$

2

$$+ \sum_{a-1}^{\infty} \left[\gamma^{a-1}\left[\bar{b}_k\,(2aH_{m;i,k,\ell} - H_{i,k,\ell})\right.\right.$$

$$\left. - (1-\bar{b}_k) V_{sn}\, r/\bar{u}_{i,k}\{h\}\right]$$

$$\exp\left[-\frac{1}{2}\left(\frac{2aH_{m;i,k,\ell} - H_{i,k,\ell} + V_{sn}\, r/\bar{u}_{i,k}\{h\}}{\sigma_{z;k}}\right)^2\right]$$

$$+ \gamma^a\left[\bar{b}_k\,(2aH_{m;i,k,\ell} + H_{i,k,\ell}) + (1-\bar{b}_k) V_{sn}\, r/\bar{u}_{i,k}\{h\}\right]$$

$$\left.\left.\left.\exp\left[-\frac{1}{2}\left(\frac{2aH_{m;i,k,\ell} + H_{i,k,\ell} - V_{sn}\, r/\bar{u}_{i,k}\{h\}}{\sigma_{z;k}}\right)^2\right]\right]\right]\right\}\right]$$

where $Q_{\tau;i,k,\ell}$ is the product of the total time during the ℓ^{th} season and the seasonal emission rate $Q_{i,k,\ell}$ for the i^{th} wind-speed category and k^{th} stability category.

$$DEP_{\ell,n}\{r,\theta\} = \frac{K(1 - \gamma_n)\, \phi_n\, x_o^2}{\sqrt{2\pi}\, R^2\, \Delta\theta'} \sum_{i,j,k} \left[\frac{Q_{A\tau;i,k,\ell}\, f_{i,j,k,\ell}}{\sigma_{z;k}} \exp\left[-\psi\, r/\bar{u}_{i,k}\{h\}\right] S\{\theta\} \ldots \right]$$

where

$Q_{A\tau;i,k,\ell}$ = the product of the total time during the ℓ^{th} season and the emission rate per unit area for the i^{th} wind-speed category and k^{th} stability category

a. <u>Input Requirements</u> 2

Emissions data: Location, emission rate, pollutant decay coefficient, elevation of source (MSL), stack height, stack exit velocity, stack inside diameter, stack exit temperature, particle size distribution with corresponding settling velocities, surface reflection coefficient, dimensions of adjacent buildings

Meteorological data: Short-term -- hourly surface weather data including cloud ceiling, wind direction, wind speed, temperature, opaque cloud cover. Daily mixing height is also required.*

Long-term -- stability wind rose (STAR deck), average afternoon mixing height, average morning mixing height, and average air temperature.

*These data are input into a preprocessor program which prepares the data for input to the model. The same preprocessor program is used for CRSTER, RAM, MPTER, and ISC.

b. Output

Concentration or deposition for any averaging time. High, second-high values and highest 50 table.

c. Model Options

Site-specific wind profile exponents, site-specific vertical temperature gradients, dry deposition, terrain effects (limited), variable emission rates, stack and building downwash

d. Model Limitations

Flat or gently rolling terrain

e. Pollutant Types

Non-reactive

Particulates with or without significant settling velocities

2 Reactive pollutants if they can be accounted for by the exponential decay term.

f. Source-Receptor Relationships

Arbitrary location for point, line, area, and volume sources

Arbitrary receptor locations or receptor rings

Receptors at ground level at elevation not exceeding stack height

g. Plume Behavior

Briggs plume rise formulas

Building downwash and stack tip downwash

If plume height exceeds mixing height, ground level concentrations set to zero

Does not treat fumigations

h. Horizontal Wind Field

Uses user-supplied hourly wind speeds

Uses user-supplied hourly wind direction (nearest 10 degrees), internally modified by addition of a random integer value between -4 degrees and +5 degrees

Wind speeds corrected for release height based on power law variation, different exponents for different stability classes, reference height = 10 meters

Constant, uniform (steady-state) wind assumed within each hour

i. Vertical Wind Field

Assumed equal to zero

j. Horizontal Dispersion

Semi-empirical/Gaussian plume

Hourly stability class determined internally by Turner procedure, 6 classes used 2

Dispersion coefficients from McElroy and Pooler (urban) or Turner (rural). No further adjustments made for variations in surface roughness or transport time

k. Vertical Dispersion

Semi-empirical/Gaussian plume

Hourly stability class determined internally

Dispersion coefficients from McElroy and Pooler (urban) or Turner (rural). No further adjustments made for variations in surface roughness

l. Chemistry/Reaction Mechanism

Exponential decay, user input time constant

Surface deposition when deposition calculations are requested

m. Physical Removal

Settling and dry deposition of particulates is accounted for

n. Boundary Conditions

Lower boundary: reflection efficiency supplied by user

2 Upper boundary: perfect reflection

Multiple reflections handled by summation of series until $\sigma_z = 1.6 \times$ mixing height

Uniform vertical distribution thereafter

o. Background

Not treated

p. Evaluation Studies

The drift deposition routines in FOG consist of the following three calculational procedures: (1) the sequential release of the entrained drift droplets from the effluent plume, (2) the subsequent horizontal transport of the drift droplets as they fall to the ground, and (3) the calculation of the airborne concentrations and deposition rates at pre-specified downwind distances for each of the 16 wind directions.

It is assumed in the FOG model that the excess water vapor, the temperature excess, the vertical velocity, and the concentration of drift droplets follow a Gaussian distribution normal to the plume axis. The plume is assumed to extend two standard deviations (i.e., $2\sigma_y$ and $2\sigma_z$) away from the plume axis. The release of the entrained droplets at any point within the plume depends on the relative magnitudes of the terminal fall velocity of the droplets and the vertical velocity of the air in the plume. At each downwind distance under consideration, these two velocities are compared for the various size categories of droplets in the plume, and a fraction of the droplets is released. This process is repeated until all droplets are released from the plume. When the plume reaches its maximum height, the vertical velocity throughout the plume is zero. Any droplets remaining in the plume at the leveloff point are then released. Droplets released from the plume then fall, first through the plume air, and then through the ambient air beneath the plume. This drift is carried downstream by the ambient wind until it is deposited on the ground. The rate of fall of the drift droplets is proportional to their terminal velocity, which in turn is dependent on the droplet size. The droplet size can change by evaporative processes, which depend on the physical and transport properties of the liquid droplets and the surrounding air. For relative humidities below 50%, complete evaporation of the drift droplets to dry particles is possible. A stepwise

procedure is employed in FOG to compute the trajectory of the droplets by considering the above effects.

Drift deposition rates and airborne concentrations of dry drift particles are calculated for each of the sequential meteorological records included in the 5-year meteorological data set. These are then summarized to obtain the deposition (in terms of lb/acre-year) and airborne concentrations of dry particles (in $\mu g/m^3$) over the entire grid. The airborne concentration calculation is made at a height of 2 meters above the ground surface.

For the round mechanical draft cooling towers, the critical wind speed is developed from a discussion by Halitsky (1968) of flow fields near buildings. He indicates a wake boundary originating at the edge of a plate representing a building, which develops into a paraboloid of revolution. The curve of the boundary in a longitudinal section through the axis is given as

$$\frac{r_w}{L} = \left(\frac{X}{L}\right)^{1/4}$$

where

2 r_w = radial distance from the axis at longitudinal distance X,

L = length of side of plate.

For mechanical draft towers, downwash can be assumed to occur when the plume centerline intersects the wake boundary. In this circumstance the variable r_w is equal to the tower height plus the plume rise. Therefore, for each point on the wake boundary a corresponding wind speed can be calculated from the basic Briggs (1969) equation

$$\Delta h = 1.6F^{1/3} U^{-1} X^{2/3}$$

where

Δh is plume rise, m

F is buoyancy flux term, m^4/sec^3

U is wind speed at top of tower, m/sec.

These wind speeds are a function of downwind distance. From the previous two equations, the minimum critical wind speed is

$$U_{CR} = 2.933 \left(\frac{F}{L}\right)^{1/3}$$

where

L is defined as twice the tower height.

The above derivation is contained in reference 5.

For the round mechanical draft cooling towers at PVNGS, the buoyancy flux term (F) is calculated based on air flow from all 16 fans atop one tower. The calculated critical wind speed varies for each input meteorological case depending upon ambient temperature and relative humidity. Presented in table 6.1-3A are calculated critical wind speeds for selected ambient conditions. Note that calculations for the design case (first calculation in table 6.1-3A) yields a slightly negative buoyancy due to the cooling of the air stream through the tower. For the higher ambient temperature cases, downwash conditions would be calculated more frequently. 2

Since these cooling towers are round, no dependence is placed on wind direction. Also, adjacent cooling towers and other structures were not considered in the calculation of downwash conditions. Considering a grouping of three towers, there may be some sheltering effect on the downwind tower. The turbine buildings and containment buildings are approximately 60 meters in height and approximately 200 meters from the cooling towers. The cooling towers are most likely beyond the cavity zone

Table 6.1-3A
COOLING TOWER CRITICAL WINDSPEED

Ambient				Cooling Tower					
T	TW	RH	ρ	Tc	TWc	RHc	ρc	F	Ucr
116	75	13	1.0835	104	101	90	1.0845	-29	-
80	60	29	1.1576	95	95	100	1.1064	1399	9.7
50	40	38	1.2281	86	86	100	1.1305	2513	11.8
24	20	47	1.2953	78	78	100	1.1515	3511	13.1

T, Ambient dry bulb temperature, F

TW, Ambient wet bulb temperature, F

RH, Ambient relative humidity, percent

ρ, Ambient air density, kg/m^3

2 Tc, Effluent dry bulb temperature, F

TWc, Effluent wet bulb temperature, F

RHc, Effluent relative humidity, percent

ρc, Effluent density, kg/m^3

F, Buoyancy flux parameter, m^4/sec^3

Ucr, Critical wind speed for downwash, m/sec

(calculations at 1000 mb)

induced by the buildings (which is estimated[14] to extend to 2 to 3.5 times building height), but within the downwind wake zone. The wake zone would cause some increased dispersion due to the associated mechanically induced turbulence. Insight into the wind flow pattern for such a facility as well as any modification of cooling tower plume rise and dispersion could best be obtained through physical modeling.

6.1.3.3.3.4 Detailed Plume Analysis Model. Cooling tower plume trajectories were calculated by the Lagrangian Vapor Plume Model (LVPM).[11] LVPM is a one-dimensional numerical mmodel capable of predicting the detailed behavior of either wet or dry plumes for a given meteorological condition. The model incorporates the thermodynamics and microphysics of condensation and evaporation, superimposed upon a dynamic model of buoyant convection. In the case of wet plumes, the release of latent heat through the condensation of moisture enhances the vertical growth of the effluent plume. This situation is somewhat similar to the development of an isolated cumulus cloud, where condensation enhances the growth in the core of the plume, while mixing and evaporation take place near its edge. 2

The dynamic framework of LVPM is described by the equations of motion for a quasi-incompressible fluid. A steady-state plume is assumed to simulate the continuous efflux to a horizontally homogeneous atmosphere. This assumption simplifies the numerical computation and leads to practical and economical application. Ambient meteorological conditions are obtained by reducing standard rawinsonde data.

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4. NUS Corporation, "NUSPUF, A Segmented Plume Dispersion Program for the Calculation of Average Concentration Time-Dependent Meteorological Regime," NUS-TM-260, Rockville, Maryland, March 1976.

5. Fisher, G. E., FOG Model Description, NUS-TM-S-185, July 1974.

6. Briggs, G. A., Plume Rise, Atomic Energy Commission Critical Review Series, TID-25075, 1969.

7. Briggs, Gary A., Plume Rise from Multiple Sources, Cooling Tower Environment, Energy Research and Development Administration, Conf-740302, 1974.

8. Nuclear Regulatory Commission, Subroutine POLYN, developed by Bob Kornasiewiez to compute dispersion parameters σ_y and σ_z for desert like meteorological situations.

9. Huschke, R. E., Glossary of Meteorology, American Meteorological Society, Boston, Massachusetts, pp. 227-228, 1959.

10. Petterssen, S., Weather Analysis and Forecasting, Volume II, McGraw-Hill, New York, 1956.

11. Lee, J., "The Lagrangian Vapor Plume Model - Version 3," NUS Corporation, NUS-TM-S-184, Rockville, Maryland, July 1974.

12. U. S. Environmental Protection Agency, "Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with Adequate Marginal Safety," EPA550/9-74-004, March 1974.

13. Department of Housing and Urban Development, "Environmental Criteria and Standards," (44FR 40860-6) July 12, 1979.

2 14. Briggs, G. A., 1973, "Diffusion Estimation for Small Emissions," Draft No. 79, Atmospheric Turbulence and Diffusion Laboratory, NOAA, Oak Ridge, Tenn.

PRELIMINARY

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right-of-way for weed control during construction only [Reference (3)]. For these reasons, environmental technical specifications (non-radiological) have not been proposed.

REFERENCES

1. U.S. NRC "Rules and Regulations", Title 10, Chapter 1, Part 50, Code of Federal Regulations

2. NUREG-75/078 Final Environmental Statement Palo Verde Nuclear Generating Station, Units 1, 2, and 3, Docket STN-528/529/530, September 1975, pages 5-17.

3. Letter to E. E. Van Brunt, Jr. from the Nuclear Regulatory Commission, dated November 30, 1979

QUESTION 6A.3 (NRC No. 290.1) 6.1.3.3.3

Describe the validation studies (done either by APS or others) of the FOG, drift and LVPM models since the References 6.1-5 and 6.1-7 were published.

RESPONSE: NUS submitted the machine language program for LVPM to Dr. Policastro in 1977 for inclusion into ANL's model evaluation program. The results of the validation work, including the review of the LVPM model, were presented in a paper at the winter meeting of the ANS, Nov. 12-16, 1979.[a] The LVPM model, identified in the paper as LEE (NUS), showed calculated plume rises in 29 out of 36 single tower data sets to be within a factor of 2 of the observed values, with no "failures." For the multiple tower data set, 19 out of 26 data sets were within a factor of 2, again with no "failures." The performance of the predictive trend of the LVPM model is stated in the paper to be "Balanced for plume rise; very short for plume length." It should be noted 2

that the ER-OL presents LVPM predictions with emphasis on plume heights and vertical variation of selected plume parameters. The FOG model was used for the detailed analysis of plume lengths and their frequencies of occurrence. A copy of the referenced 1979 ANL model verification results report[a] is being transmitted under separate cover.

During the latter part of 1974 the FOG and LVPM programs were used to calculate vertical profiles of plume temperature and mixing ratio based on preliminary field data collected at Florida Power & Light's Turkey Point Plant. These field data were collected under the direction of EPA NERC - Corvallis, Oregon. The model calculated plume profiles were sent to Mr. Larry Winiarski of EPA on October 4, 1974;[b] they showed reasonable agreement with the observed plume profiles. With permission from Mr. Winiarski, these model predictions were forwarded to Dr. James E. Carson of Argonne
2 National Laboratory on October 15, 1974.[c]

There is no separate computer model for the drift calculations. Subroutines for the drift related calculations are contained within the FOG model.

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a. Policastro, A. J., R. A. Carhart, S. Ziemer, K. Haake, M. Wastag, W. E. Dunn, P. Gavin, and B. Boughton. "Investigation of Mathematical Models for Cooling-Tower Plumes and Drift." Presented at ANS Meeting, Nov. 12-16, 1979.

b. Taylor, John H. of NUS Corporation, Personal Communication to Mr. Larry Winiarski of USEPA, ESD-74-1035(AQ), October 4, 1974.

c. Taylor, John H. of NUS Corporation, Personal Communication to Dr. James E. Carson of Argonne National Labs., ESD-74-1090(AQ), October 15, 1974.

QUESTION 6A.4 (NRC No. 290.3) 6.1.3

Provide the critical wind speed for aerodynamic downwash for the circular mechanical-draft cooling towers. Describe the basis for this value. Describe how the presence of other structures near the towers and/or wind direction affect the critical windspeed. 2

RESPONSE: The response is provided in the revised section 6.1.3.3.3.3.

Table 8.1-3
CONSTRUCTION STAGE MANPOWER AND DIRECT PAYROLL
(Sheet 1 of 2)

Time Period	Average Manpower	$1,000 Average Direct Payroll
1st Quarter 1976	176	1,115
2nd Quarter 1976	692	4,303
3rd Quarter 1976	864	5,418
4th Quarter 1976	1,036	6,533
1st Quarter 1977	1,048	6,533
2nd Quarter 1977	1,588	9,880
3rd Quarter 1977	1,760	10,995
4th Quarter 1977	2,272	14,182
1st Quarter 1978	2,996	18,485
2nd Quarter 1978	3,552	21,831
3rd Quarter 1978	4,416	27,250
4th Quarter 1978	5,328	32,827
1st Quarter 1979	6,028	50,454
2nd Quarter 1979	6,208	51,939
3rd Quarter 1979	5,676	47,489
4th Quarter 1979	5,316	44,518
1st Quarter 1980	5,316	44,518
2nd Quarter 1980	5,316	44,518
3rd Quarter 1980	5,316	44,518
4th Quarter 1980	5,120	43,035
1st Quarter 1981	4,644	38,587
2nd Quarter 1981	4,644	38,587
3rd Quarter 1981	3,716	31,166
4th Quarter 1981	3,540	29,683
1st Quarter 1982	3,540	29,683
2nd Quarter 1982	3,380	28,193
3rd Quarter 1982	3,176	26,711
4th Quarter 1982	3,176	26,711
1st Quarter 1983	3,176	26,711
2nd Quarter 1983	3,176	26,711
3rd Quarter 1983	2,676	22,261
4th Quarter 1983	2,676	22,261

Table 8.1-3
CONSTRUCTION STAGE MANPOWER AND DIRECT PAYROLL
(Sheet 2 of 2)

Time Period	Average Manpower	$1,000 Average Direct Payroll
1st Quarter 1984	2,320	19,290
2nd Quarter 1984	1,960	16,324
3rd Quarter 1984	1,592	13,357
4th Quarter 1984	1,592	13,357
1st Quarter 1985	1,220	10,385
2nd Quarter 1985	1,040	8,903
3rd Quarter 1985	872	7,420
4th Quarter 1985	708	5,938
1st Quarter 1986	352	3,012
April 1986	276	785
Approximate Total Direct Payroll		976,400

Economic and Business Research at Arizona State University[1], the employment multiplier for Maricopa County was determined to be 3.6; that is, for each new base job created, 2.6 secondary jobs would result.

8.1.2.1.2 Operation

2 A staff of approximately 844 will be required to operate and maintain PVNGS. In 1986 the full staff will be employed, at which time the annual payroll for permanent personnel will be approximately $28 million. Table 8.1-3A provides a breakdown
2 of the average number of operational workforce personnel by time period and average direct payroll. The actual secondary impact of these permanent employees will depend on how many of the jobs represent a net increase in utilities employment. When compared to a personal income of $10.1 billion for

Table 8.1-3A

OPERATIONAL MANPOWER AND DIRECT PAYROLL

Time Period	Average Manpower	$1,000 Average Direct Payroll (a) (b)
4th Quarter 1979	102	846
1st Quarter 1980	105	871
2nd Quarter 1980	117	970
3rd Quarter 1980	165	1,368
4th Quarter 1980	230	1,908
1st Quarter 1981	386	3,202
2nd Quarter 1981	435	3,608
3rd Quarter 1981	464	3,848
4th Quarter 1981	495	4,106
1st Quarter 1982	538	4,462
2nd Quarter 1982	591	4,902
3rd Quarter 1982	678	5,623
4th Quarter 1982	706	5,856
1st Quarter 1983	721	5,980
2nd Quarter 1983	740	6,138
3rd Quarter 1983	760	6,304
4th Quarter 1983	774	6,420
1st Quarter 1984	777	6,445
2nd Quarter 1984	799	6,627
3rd Quarter 1984	808	6,702
4th Quarter 1984	818	6,785
1st Quarter 1985	824	6,835
2nd Quarter 1985	835	6,926
3rd Quarter 1985	842	6,984
4th Quarter 1985	844	7,001
Approximate Total Direct Payroll		120,717

2

a. Based on 1980 dollars
b. $2765 average loaded monthly salary

Maricopa County in 1978[2], the net addition of PVNGS payroll is not likely to have significant impact on county-wide employment.

8.1.2.2 Tax Benefits

Major tax benefits in the area of income, excise, and ad valorem taxes will accrue to the Federal Government and the State of Arizona as a result of the construction and operation of PVNGS. State and local political subdivisions affected are as follows:

- State of Arizona
- Maricopa County, Arizona
- Ruth Fisher Elementary District No. 90
- Arlington Elementary District No. 47
- Buckeye Union High School District
- Maricopa County Community College District
- Central Arizona Water Conservation District
- Flood Control District of Maricopa County

8.1.2.2.1 Income Tax

Income tax revenues resulting from employment during the construction phase can be estimated for both the State of Arizona and the United States. The estimates are based on existing tax rates.

Approximately 1.3% of personal income earned in Arizona is paid in taxes to the state.[3] The United States income tax estimates are based on the assumption of a typical worker with a family of four who uses the standard deduction. This results in an average tax rate of 20%, based on tax schedules in effect from 1977 to 1979. Table 8.1-4 presents the annual payroll and estimated state and federal income taxes expected during the

Table 8.1-4
ANNUAL CONSTRUCTION STAGE PAYROLL INCOME AND SALES TAX ESTIMATES (in Millions of Dollars)

Year	Estimated Average Direct Payroll	Estimated Arizona Income Tax	Estimated United States Income Tax	Estimated Sales Tax Revenue
1976	17.4	0.226	3.48	0.574
1977	41.6	0.541	8.32	1.373
1978	100.4	1.305	20.08	3.313
1979	194.4	2.527	38.88	6.415
1980	176.6	2.296	35.32	5.828
1981	138.0	1.794	27.60	4.554
1982	111.3	1.447	22.26	3.673
1983	97.9	1.273	19.58	3.231
1984	62.3	0.810	12.46	2.056
1985	32.7	0.425	6.54	1.079
1986	3.8	0.049	0.76	0.125
Total	976.4	12.69	195.3	32.2

construction phase. Taxes on the 1986 operating payroll are estimated to be $364,000 for Arizona income tax and $5,610,000 for United States income tax. 2

Table 8.1-4A presents the annual payroll and estimated state and federal income taxes expected during the operational phase. 2

8.1.2.2.2 Excise Taxes

In addition to the state income tax revenues, the State of Arizona and its municipalities will benefit from the sales tax revenues which can be anticipated on the basis of payroll generated by PVNGS. Approximately 3.3% of personal income is paid in the form of state sales tax levies[4]. Table 8.1-4

Table 8.1-4A

ANNUAL OPERATIONAL PAYROLL INCOME AND SALES TAX ESTIMATES (in Millions of Dollars)

Year	Estimated Average Direct Payroll	Estimated Arizona Income Tax	Estimated United States Income Tax	Estimated Sales Tax Revenue
1983[a]	12.7	0.165	2.55	0.420
1984	26.6	0.345	5.32	0.876
1985	27.7	0.360	5.55	0.916
1986	27.7	0.364	5.61	0.924
1987	27.7	0.364	5.61	0.924
1988[b]	14.0	0.182	2.80	0.462
Total	136.4	1.78	27.44	4.52

a. 3rd and 4th Quarters

b. 1st and 2nd Quarters

2

provides an estimate of the annual sales tax collected during the construction phase. It has been assumed that all wages generate sales tax. Sales tax revenues for the 1986 operating payroll are estimated to be $617,000.

8.1.3 OTHER BENEFITS

8.1.3.1 Local Expenditures

A substantial amount of the total expenditures during construction for materials, equipment, and services will be spent in Arizona. The experience of the participating utilities and the constructor indicates that approximately $285 million will be spent in Maricopa County. This impacts secondary employment, personal income, and local taxes in a favorable manner. Local purchases will be approximately equivalent to 40% of the annual operations budget during the years 1981 to 1986. The percentage could increase based upon qualifications of local suppliers. 2

8.1.3.2 Purchase of Wastewater Effluent

A current benefit of PVNGS is the revenue received by Phoenix and five other municipalities through an option and purchases agreement with APS and Salt River Project for the sale of wastewater effluent not committed as of the contract date (April 1973) to other parties (hereafter referred to as uncommitted effluent). The City of Phoenix operates two sewage treatment plants near the Salt River. The first, at 23rd Avenue, is owned by Phoenix; the second, at 91st Avenue, is a joint venture of Phoenix and five other municipalities. At the present time, the participants pay $2.00 per year per acre-foot option payment for uncommitted wastewater effluent being discharged by these plants. The contract provides that APS and Salt River Project may purchase uncommitted effluent, when available, up to a maximum amount of 140,000 acre-feet per year for electric generation purposes.

For the period, April 23, 1979, to April 22, 1980, the participants made option payments for 89,192 acre-feet of uncommitted effluent; 30,604 acre-feet from the 23rd Avenue plant and 58,588 acre-feet from the 91st Avenue plant, based

on actual effluent flow records for 1978. Table 8.1-6 shows the option revenue derived by each of the cities participating in the 91st Avenue plant. The option payment for the 23rd Avenue discharge goes solely to the City of Phoenix.

The price to be paid for uncommitted effluent purchased for PVNGS is tied to the price for Central Arizona Project municipal and industrial water subject to a minimum price of $20 per acre-foot and a maximum price of $30 per acre-foot.

Table 8.1-6

PROJECTED MINIMUM ANNUAL REVENUE RECEIVED FOR UNCOMMITTED EFFLUENT FROM THE CITY OF PHOENIX 91st AVENUE SEWAGE TREATMENT PLANT

City	Percent of Revenue[a]	1979 Actual Option Revenue	Range of Anticipated Revenue[b]	
			$20 per Acre-Ft Delivered	$30 per Acre-Ft Delivered
Phoenix	51.76	$ 60,650	$ 663,046	$ 994,568
Glendale	13.79	16,176	176,650	264,975
Tempe	12.75	14,936	163,327	244,991
Mesa	10.93	12,810	140,013	210,020
Scottsdale	10.45	12,242	133,865	200,797
Youngtown	0.32	382	4,099	6,149
Total	100.0	$117,176	$1,281,000	$1,921,500

a. Calculated, based on a letter dated March 19, 1979 from P. W. Slagel, City of Phoenix Wastewater Operations to the 91st Avenue Sewage Treatment Plant Multi-City Participants.

b. Based on station water use of 64,050 acre-ft/yr with no additional uncommitted effluent available.

When Unit 3 becomes operational, it is expected that the price for the purchased uncommitted effluent will be $30 per acre-foot. In addition to purchase payments, the participating utilities will make option payments of $2 per acre-foot per year, for each acre-foot of effluent, reserved for use at PVNGS but not delivered. Each of the communities will share the revenue generated on that portion of the effluent coming from the 91st Avenue plant on the basis of their respective deliveries of sewage for treatment at the 91st Avenue plant.

A range of minimum revenues which could be realized by each of the participating cities is presented in table 8.1-6. This projection is based on:

- Influent ratios of the participating cities being constant with 1978 values.
- Annual station water use of 64,050 acre-ft (21,350 acre-ft/yr/unit).
- Availability of no uncommitted effluent in excess of the annual station requirement of 64,050 acre-ft/year.
- Payments of $20 and $30 per acre-ft of delivered effluent.
- All effluent for PVNGS will come from the 91st Avenue plant.

It is assumed that all residents of the cities participating in the 91st Avenue Plant will derive economic benefits.

8.1.4 IMPACTS IF OPERATION IS DELAYED

As discussed in chapter 1, load requirements for the PVNGS participants will increase substantially during the early 1980s. In order for the participants to reliably meet the needs of their customers in those years (1980 to 1986), additional generation of 7385 megawatts will be required from new

resources. PVNGS makes a major contribution toward meeting these needs.

Any delays in the construction of these units could seriously affect the reliability of the system. The level of impact of the delay varies with the participant. If PVNGS Unit 1 is not put into operation as planned, the reserve margin for PVNGS Units 1,2&3 participants will drop as described in section 1.3.

The service areas of the participants cover sizable portions of four states; consequently, significant differences exist in the geographic, demographic, economic, and social characteristics as well as total load and load characteristics of each participant. These differences make it difficult to quantify the impact of electrical shortages. Some electric utilities have experienced some major bulk power failures during the last several years. The severity of these failures varies. Major power failures are very costly. There are no dollar figures on the cost of load shortages for the participants. However, the blackout of the northeast portion of the U.S. in 1965 affected approximately 30 million people and cost an estimated $100 million. The New York City blackout in 1978 led to widespread looting and rioting.

8.1.5 REFERENCES

1. Arizona State University, College of Business Administration, Bureau of Economic and Business Research, "Maricopa County: An Economic Base Analysis", Tempe Arizona, December 1973.

2. Ellis, T., Marketing Services Staff, First National Bank of Arizona, Phoenix, Arizona, personal communication, June 27, 1979.

3. Merrill, R., Income Tax Division, Arizona Department of Revenue, personal communication, June 27, 1979.

4. Townsend, J., Sales Tax Division, Arizona Department of Revenue, personal communication, June 27, 1979.

PRELIMINARY

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QUESTION 8A.1 (NRC No. 310.8) 8.1.2

Provide annual estimates of the operation work force as the three units come on line and during the first five years of operation of all three units. This data should be presented in the format of Tables 8.1-3 through 8.1-6. Provide yearly dollar estimates of local purchases for goods and services (including contract workers) based on 1981 dollars.

RESPONSE: The response is provided in the revised sections 8.1.2.1.2, 8.1.2.2.1, and 8.1.3.1. 2

QUESTION 8A.2 (NRC No. 310.9) 8.1.2

Estimate the average annual tax revenues from sale of electricity as the three units come on line and during the first five years of operation of all three units.

RESPONSE: The response will be provided by March 15, 1981.