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

OCT 24 1978

Docket Nos. STN 50-592
and STN 50-593

APPLICANT: Arizona Public Service Company

FACILITY: Palo Verde Nuclear Generating Station, Units 4 and 5

SUBJECT: SUMMARY OF MEETING HELD ON OCTOBER 17, 1978 REGARDING THE SAFETY REVIEW OF PALO VERDE, UNITS 4 AND 5

A meeting was held between NRR staff members and representatives of the Arizona Public Service Company and their consultants in Phoenix, Arizona on October 17, 1978 to discuss the safety review of Palo Verde 4 & 5. The public was invited to attend the meeting, but less than five members of the public were present. The meeting agenda and list of attendees are attached as Enclosures 1 and 2.

Summary of Meeting

Enclosure 3 to this summary is a compilation of the questions and applicant responses discussed during the meeting. In addition to the responses documented in the Enclosure, the following points were made:

1. Concerning Geology question number 1, the applicant agreed to update a few of the figures in PSAR Section 2.5.

2. Concerning Geology question number 3, the applicant agreed to provide an additional discussion of the confidence of seismic activity mapping in the area of concern.

3. Concerning Meteorology question number 5, the applicant agreed to provide the 16 exclusion area boundary distances described in Section C.2 of Regulatory Guide 1.XXX.

4. Concerning Meterorology question number 6, the applicant stated that some of the requested information was in the Environmental Report under the Appendix I discussion.

Questions from the public concerned the uncertainty in geological investigations and the adequacy of the Palo Verde cooling water supply.

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Conclusions

The staff will evaluate the information provided by the applicant and will determine if more information is required in order to draw the conclusions necessary for a safety evaluation report. For those question responses that provided substantive information, the applicant will incorporate the information into a future PSAR amendment.

Robert L. Stright, Project Manager
Light Water Reactors Branch No. 3
Division of Project Management

Enclosures:
1. Meeting agenda
2. List of attendees
3. Questions and responses

cc w/enclosures:
See next page

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ENCLOSURE 1

NUCLEAR REGULATORY COMMISSION - ARIZONA PUBLIC SERVICE COMPANY

MEETING - OCTOBER 17, 1978 - PHOENIX, ARIZONA

I.	Introductory Remarks	-	Roger Boyd
II.	NRC Staff - APS Technical Meeting	-	Robert Stright
	A. Introduction of Participants		
	B. Presentation by APS		
	C. Technical Subjects		
	1. Geology/Seismology	-	Don Caldwell
	(a) Geological Data		
	(b) USGS Report 77-343		
	2. Meteorology	-	Leta Andrews, Earl Markee
	(a) Effects on Local Meteorology		
	(b) Dispersion Parameters		
	(c) Meteorological Model		
	(d) Routine Release Estimates		
	(e) Status of Dust Storm Study		
	3. Hydrology	-	Ray Gonzales, Bill Bivins
	(a) Flooding from Storage Reservoir		
	(b) Groundwater Levels		
	4. Accident Analysis	-	Al Brauner, Len Soffer
	(a) Population Center Distance		
	(b) Nearby Industrial Facilities		
III.	Questions From Public		
IV.	Closing Remarks	-	Roger Boyd

ENCLOSURE 2

LIST OF ATTENDEES

NRC

R. Boyd
R. Stright
D. Caldwell
L. Andrews
E. Markee
R. Gonzales
W. Bivins
A. Brauner
L. Soffer

Arizona Public Service Company

E. E. Van Brunt Jr.
D. Karner
J. Allen
J. Scott - FUGRO Inc.
K. Euge - FUGRO Inc.
A. Gehr - Snell & Wilmer
D. Keith - Bechtel

ENCLOSURE 3

PALO VERDE NUCLEAR GENERATING STATION

UNITS 4 AND 5

DOCKET NOS. STN 50-592 AND STN 50-593

REQUEST FOR ADDITIONAL INFORMATION

Geology

Question 1

Incorporation of new data into existing data set.

For the sake of completeness, new data acquired in the investigation of Units 4 and 5 should be incorporated into appropriate geologic maps and sections which were submitted in the original report. The type of figures which should be revised are 2.5-18, 22, 23, 24, 28 and 34.

Response:

The new data acquired in the investigation of Units 4 and 5 shall be incorporated into the FSAR for the Palo Verde Nuclear Generating Station (PVNGS).

PALO VERDE NUCLEAR GENERATING STATION

UNITS 4 AND 5

DOCKET NOS. STN 50-592 AND STN 50-593

REQUEST FOR ADDITIONAL INFORMATION

Geology

Question 2

Reconciliation of structural interpretations presented in PSAR (Units 1, 2 & 3) and USGS Open-File Report 77-343.

Since we have reviewed the structural interpretations presented in support of the original application, a USGS Report (77-343) has been open-filed which indicates a different structural interpretation in the site area. Although the preliminary work upon which the USGS Report is based has been addressed in Amendments 14 and 16, the discussion in Amendment 18 of the finalized report does not adequately cover the contrast in structural interpretations for the site area.

Response:

The USGS Open-File Report 77-343, "Map of Arizona Showing Selected Alluvia, Structural, and Geomorphic Features, 'by

Maurice Cooley, presents no new field work or structural interpretations since it was reviewed in detail in 1975 and reported in Amendments 14 and 16 of the PVNGS 1, 2 and 3 PSAR. The open-file status has served to provide formal status to the same map and report which was in progress prior to preparation of Amendments 14 and 16.

The main points of structural contrasts raised by Cooley's report were bedrock faulting along the basis edges and subsidence axis in Quaternary alluvial formations (a synclinal axis projecting toward the site). In terms of the faults near the site area, Cooley proposes bounding faults along (a) the northwest edge of the Palo Verde Hills, (b) the north flank of the Buckeye Hills, (c) the east edge of the Gila Bend Mountains (coincident with the bend in the Gila River) and, (d) a small northwest trending fault through the Palo Verde Hills. These fault locations are very similar to those shown on Figure 2.5-7 (PVNGS 1, 2 and 3 PSAR) which were derived from the tectonic map of the western United States (USGS). Detailed geologic investigation for the PSAR considered all these structural interpretations in addition to other possible undiscovered faults within a 5-mile radius. The faults Cooley has depicted in his Open-File Report 77-343, in the vicinity of the PVNGS site, are identified on the basis of significantly less definitive data obtained from methods such as aerial photographs, and field reconnaissance performed between 1963 and 1974. The detailed surface and subsurface geologic data gathered during the PVNGS siting study

clearly demonstrates the absence of any faulting that disrupts the basin fill strata, such as the continuity of the Palo Verde Clay. The Palo Verde Clay is continuous and flat-lying in the immediate site area, and has been traced more than five miles north of the site and to the southeast where it underlies the Arlington basalt flow (radiometrically dated at about 2 million years old). No major northwest-trending faults are exposed in the Palo Verde Hills based on detailed geologic mapping and trenching.

Detailed geophysical surveys performed to supplement geologic field activities tend to support the absence of faults in the basin fill sediments. No buried faults were identified as a result of the surveys performed in the valley bounded by the Palo Verde Hills. A deep-seated bedrock fault was identified north of the Palo Verde Hills but its character (short length and irregularity) does not corroborate Cooley's interpretation. These surface and subsurface investigations itemized in Sections 2.5.1.2.1, 2.5.1.2.2, and 2.5.1.2.3 of the PVNGS 1, 2 and 3 PSAR showed that no capable faults exist within the site area.

In terms of Cooley's synclinal axis extending westward from Phoenix toward the site area, others who have studied this problem viz. Schumann, Lanoy, Davidson and Pewe have agreed that the unusually thick accumulations of fluvial gravel in

the basins and the downstream convergence of terraces along Gila and Salt Rivers were valid evidence of basins lowering relative to the mountains north and east of Phoenix. However, these authorities feel that Cooley's evidence for an axis of subsidence west of Buckeye was tenuous.

The Palo Verde Clay and other fine-grained basin fill deposits in the site area are overlain by the Arlington basalt (radiometrically dated at about 2 million years). These deposits lie across Cooley's proposed axis of late Cenozoic subsidence, yet show no evidence of warping. Moderately to well preserved gravelly river terrace deposits border the Gila River, standing about 40 feet above it, between the Arlington and Gillespie basalt flows. The flows overlie river gravel at the same elevation as the surface of the river terrace and are dated at about 2 and 3 million years, respectively. Therefore, an axix of late Quaternary subsidence does not exist in the site area.

Therefore, Cooley presents no new data on geologic or structural interpretations at PVNGS and the conclusions of our original investigation have remained unchanged:

(a) Cooley presents no evidence for capable faults.

(b) Cooley and others present permissible evidence for late Cenozoic subsidence in the Phoenix Basin east of the Buckeye.

(c) The USGS Open-File Report 77-343, "Map of Arizona Showing Selected Alluvial, Structural and Geomorphic Features" (1977), by Maurice Cooley has formalized Mr. Cooley's preliminary investigation. The open-file report has been reviewed and it has been found to have no additional significance with respect to previous geologic conclusions.

PALO VERDE NUCLEAR GENERATING STATION

UNITS 4 AND 5

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REQUEST FOR ADDITIONAL INFORMATION

Geology

Question 3

Is any information available regarding the structural relationships of two mico-earthquakes which occurred about 20 miles north of Phoenix in December, 1974?

Response:

There was no ground rupture on faults reported from the New River earthquakes nor were there any faults in the vicinity of the epicenter indicated from available publications. Discussions in January, 1975 with Dr. William Sauck of Arizona State University, who originally studied the New River Earthquakes indicated the following:

(1) The first earthquake occurred about 8:01 p.m. on December 19. It was felt by many people within a 5-6 mile radius of the town of New River, Arizona. Hairline cracks occurred in plaster in a 2 year old home near New River. The estimated magnitude was about 2.5.

(2) The second earthquake occurred about 11:00 p.m. on December 23, 1974, and was felt by many people in a 10-15 mile radius, from New River, Black Canyon City, Carefree, and as far south as Bell Road and 22nd Street in Phoenix. The

hairline cracks in plaster were enlarged and cracks were reported in a chimney and fireplace. Some dishes were knocked down. The estimated magnitude was about 3.0. This event was also recorded by seismograpns at Tucson and Albuquerque, New Mexico.

(3) Both earthquake epicenters appeared to be roughly 45 - 55 km away from the seismographs at A.S.U. and near New River, Arizona. Both were accompanied by rumbling and a loud noise like a sonic boom.

(4) Dr. Sauck has installed several electric tape seismometers in the New River area to monitor further seismicity. To our knowledge, there have been no results reported from these seismometer arrays.

The seismic activity within central Arizona is relatively low, sufficient felt and instrumented earthquakes have been recog- nized to characterize the region (seismic zone D) for design purposes as being capable of randomly generating up to a mag- nitude 4 earthquake. This is one order of magnitude (10 times the energy release) of the largest of the New River tremors. Therefore, earthquakes similar to the New River events are considered normal for the seismic zone D area and PVNGS has been designed to accomodate the largest earthquakes from any of the seismic zones within a 200 mile radius of the plant. Additionally, the two strong motion accelerometers installed at PVNGS, indicate no activity.

PALO VERDE NUCLEAR GENERATING STATION

UNITS 4 AND 5

DOCKET NOS. STN 50-592 AND STN 50-593

REQUEST FOR ADDITIONAL INFORMATION

Meteorology

Question 1

Discuss the incremental impact of the evaporative cooling system on local meteorology due to the addition of Palo Verde Units 4 and 5. Provide a reference for and discuss the technologies and bases for humidity, plume length, and plume width estimates.

Response:

The NUS FOG code[1] used for calculating these effects, is a one-dimensional analytical model which was used to determine the environmental effects due to the operation of evaporative cooling systems for Palo Verde Units 4 and 5. These environmental effects include reduced ground level visibility, airborne concentration and ground deposition of dissolved solids contained in drift droplets released from the towers, horizontal and vertical icing, visible plume lengths and increased ground level relative humidity and temperature.

The FOG code makes calculations over a polar grid centered on the cooling system using sequential meteorological data. The grid consists of 16 directions corresponding to the routinely

observed wind directions, and up to 15 downwind distances. The ground elevation at each grid point relative to the cooling system is employed in the calculation of the effective plume height. As the plume extends downwind from the cooling system, it is assumed to propagate rectilinearly, with any meandering effects due to wind shifts being neglected. In addition, formulations for the critical wind speed resulting in the aerodynamic downwash of the exhaust plume are also included in the FOG code.

The environmental impact of the evaporative cooling system is discussed in detail in the PVNGS 4 & 5 Environmental Report and is considered in the NEPA review of these units.

The ground level relative humidity below the plume centerline is calculated based on the plume rise[2,3,4] and Gaussian dispersion. This value is compared against the ambient relative humidity to determine the increase. These increases are summarized by direction and distance from the cooling system. A climatology of the ambient ground level relative humidity is also produced; it is stratified by season and by occurrence of natural fog conditions. The same methodology is used in determining the increase of ground level temperature.

The results of the FOG code calculations for increased ground level relative humidity and temperature from Palo Verde Units 4 and 5 show insignificant increases for both parameters.

The maximum annual increase of ground level relative humidity was .08 percent at a location of 1.0 mile to the northeast of the towers. The range of maximum of seasonal values showed a high of .17 percent during the spring (March, April and May) at a location of 1.0 mile to the northeast of the towers and a low of .04 percent during the fall (September, October and November) at a distance 2.5 miles to the northeast of the towers.

The maximum annual increase of ground level temperature was less than .01°F at a location of 1.0 mile to the northeast of the towers. The maximum seasonal value showed a high of .01°F during the spring at a distance of 1.0 mile to the northeast of the towers.

The plume rise is calculated by the FOG code using Brigg's[2,3] equation under all stability conditions. In addition, two other equations from Brigg's[4] are used by the FOG code to account for multiple source plume rise. The model treats the cooling system plume as a bent over plume with an entrainment rate of 0.5 to the point of maximum rise.

After the plume reaches its maximum rise, the dispersion is controlled by atmospheric turbulence. At the point where the plume levels off at a constant height, virtual point source distances are then calculated from the respective Gaussian dispersion coefficients at that point. These virtual distances are used as starting values in the subsequent dispersion analysis at greater downwind distances. The subsequent dispersion coefficients σ_y and σ_z are determined from the Pasquill Stability Class which in turn has been related to values of $\Delta T/\Delta Z$ obtained from the onsite meteorological data.

The length of the visible plume is calculated for each hourly (or 3-hourly) case. Calculations are made at successive downwind distances of the total flux of air normal to the plume axis; this calculation is made whether the plume is in the rising stage or has reached its maximum height. The amount of entrained ambient air can be computed as the difference between this total flux and the flux of air emerging from the cooling system. These two air masses (expresses as a flux, m^2/sec), each having distinct temperature and moisture characteristics, are assumed to be thoroughly mixed isobarically. A routine in the FOG code calculates the new thermodynamic states of the mixture. It is possible to produce condensation

of moisture by the mixing of two parcels, each of which was initially subsaturated. A visible plume occurrence is predicted if a supersaturated condition is predicted at a certain downwind distance.

The plume width is calculated by the FOG code in a two step method. Initially, when the plume is in the rising stage, the plume width is calculated to be,

$$L(x) = DHX(x) + W_i = 4\sigma_y$$

where,

W_i = crosswind dimension of the cooling tower, m

$L(x)$ = plume width, m

$DHX(x)$ = plume height, m

Similarly, plume depth, $D(x)$, is calculated as

$$D(x) = DHX(x) + L_i = 4\sigma_z$$

where,

L_i = downward dimension of the cooling tower

For downwash conditions,

$4\sigma_z$ = DHX (x) + ah

where,

a = 4 for mechanical draft towers

h = tower height, m

When the plume reaches its maximum height and levels off, virtual point source distances are then calculated from the respective Gaussian dispersion coefficients at that point and later it is assumed that the plume will now expand at a rate of $4\sigma_y$ and $4\sigma_z$ respectively, in the y and z directions.

REFERENCES

1. Fisher, G. E., "FOG Model Description," NUS-TM-S-185, (July 1974).

2. Briggs, G. A., "Plume Rise," Oak Ridge; USAEC, 1969.

3. Briggs, G. A., "Some Recent Analyses of Plume Rise Observations," Oak Ridge; NOAA, 1970.

4. Briggs, G. A., "Plume Rise From Multiple Sources," Cooling Tower Environment - 1974, ERDA Symposium Series; Conf-740302, 1975, pp. 161-179.

PALO VERDE NUCLEAR GENERATING STATION

UNITS 4 AND 5

DOCKET NOS. STN 50-592 AND STN 50-593

REQUEST FOR ADDITIONAL INFORMATION

Meteorology

Question 2

As currently proposed the Palo Verde site will include five units which are more than are currently located at any other site in the United States. Discuss the anticipated impact of the construction of Units 4 and 5 and the operation of Units 1-5 on local atmospheric conditions as related to the public health and safety such as atmospheric dispersion and impacts on severe weather.

Response:

The anticipated impact of construction of Units 4 & 5 and operation of Units 1-5 on local atmospheric conditions is expected to be minor. The reactor buildings and associated structures are expected to have some small influence on the local air flow; specifically mechanical turbulence is expected downwind of the plant, enhancing dispersion. This has been shown as part of the results of the Rancho Seco dispersion experiments. In addition, the addition of heat to the atmosphere from plant operation is expected to create a small "heat island effect" which would further enhance the dispersion in the vicinity of the site. No impact on severe weather is expected.

PALO VERDE NUCLEAR GENERATING STATION

UNITS 4 AND 5

DOCKET NOS. STN 50-592 AND STN 50-593

REQUEST FOR ADDITIONAL INFORMATION

Meteorology

Question 3

Are the horizontal and vertical dispersion parameters used in the short-term release estimates (for Units 4 and 5) based on the Pasquill-Gifford curves, or were the σ_y and σ_z terms used in your estimates modified to reflect desert dispersion conditions? If a modification was made, describe the changes, their bases and applicability to the Palo Verde site. Provide supporting references.

Response:

The horizontal and vertical dispersion parameters used in the short-term release estimates for both PVNGS 1, 2 and 3 and PVNGS 4 and 5 were based on the Pasquill-Gifford curves.

The only modification made to the analysis for PVNGS 4 and 5 was to incorporate the different distances to the site boundary and exclusion zone for PVNGS 4 & 5 as required by the PVNGS Qualification Review Letter, dated December 12, 1977. No other changes were required by either the qualification review letter or the "final listing of the issues originally addressed in Category E of the qualification review letter," dated October 12, 1978.

PALO VERDE NUCLEAR GENERATING STATION

UNITS 4 AND 5

DOCKET NOS. STN 50-592 AND STN 50-593

REQUEST FOR ADDITIONAL INFORMATION

Meteorology

Question 4

Table 2.3-22 of the Palo Verde Units 4 and 5 PSAR lists five percentile short-term X/Q values by direction. What is the basis for selection of the fifth percentile? Does this percentile represent five percent of the time the wind is blowing into the sector?

Response:

The basis for the selection of the fifth percentile was the requirements of Regulatory Guide 1.70. The fifth percentile was determined for both PVNGS 1, 2 and 3 and PVNGS 4 and 5, by calculating the X/Q values for each observation for the August 13, 1973 to August 13, 1974 data period and by ordering these values and selecting that value which is exceed 5% of the time without regard to wind direction. This percentile does not represent five percent of the time the wind is blowing into a sector.

PALO VERDE NUCLEAR GENERATING STATION

UNITS 4 AND 5

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REQUEST FOR ADDITIONAL INFORMATION

Meteorology

Question 5

To calculate short-term diffusion estimates, you have used a directional dependant model. Although you are under no obligation to use either of the models discussed, this is to inform you of two models which may be used to evaluate atmospheric transport conditions for analysis of accidents. Attached are a copy of our Interim Branch Technical Position concerning a model which considers horizontal plume meander and the directional dependence of dispersion conditions, air flow, and exclusion area boundaries, and a copy of our DRAFT Regulatory Guide 1.XXX, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants." 9/23/77. The Model was approved for interim use by the Regulatory Requirements Review Committee on May 2, 1978. If you choose to revise your estimates based on this position, the Palo Verde Units 4 & 5 PSAR should be updated to reflect this change. To facilitate our review we request that you provide the 16 exclusion area boundary distances as described in Section C.2 of Regulatory Guide 1.XXX.

Response:

The applicant does not choose to re-evaluate the short-term diffusion estimates provided in Section 2.3.4 of the Units 4 & 5 PSAR.

The only modifications made to the analysis for PVNGS 4 and 5 was to incorporate the different distances to the site boundary and exclusion zone for PVNGS 4 and 5 as required by the PVNGS Qualification Review Letter, dated December 12, 1977. No other changes were required by either the qualification review letter or the "final listing of the issues originally addressed in Category E of the qualification review letter," dated October 12, 1978.

PALO VERDE NUCLEAR GENERATING STATION

UNITS 4 AND 5

DOCKET NOS. STN 50-592 AND STN 50-593

REQUEST FOR ADDITIONAL INFORMATION

Meteorology

Question 6

Provide the bases for routine release estimates of relative deposition out to a distance of 50 miles from the Palo Verde Nuclear Generating Station for all release heights. As a result of the addition of Units 4 & 5, for specific receptor locations such as site boundaries, gardens, and dairy or beef farms, provide relative concentration and deposition estimates. In addition, a plot of maximum elevation versus distance centered on the release point in each of the sixteen 22½--degree compass point sectors (i.e., centered on true north) radiating from the station should be presented.

Response:

Routine releases for PVNGS 4 and 5 were calculated by the same methods utilized for PVNGS 1, 2 and 3. The only modification made to the analysis for PVNGS 4 & 5 was to incorporate the different distances to the site boundary and exclusion zone for PVNGS 4 & 5 as required by the PVNGS Qualification Review Letter, dated December 12, 1977. No other changes were required by either the qualification review letter or the "final listing of the issues originally addressed in Category E of the qualifications review letter," dated October 12, 1978.

As the calculation methods for routine releases were reviewed and approved for PVNGS 1, 2 and 3, and not required by the qualification review, no additional information should be required.

PALO VERDE NUCLEAR GENERATING STATION

UNITS 4 AND 5

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REQUEST FOR ADDITIONAL INFORMATION

Dust Study

Question 1

What is the status of the PVNGS dust storm study?

Response:

Actual dust storm study has been complete. A report of this study will be formally submitted to the NRC prior to December 1, 1978.

PALO VERDE NUCLEAR GENERATING STATION

UNITS 4 AND 5

DOCKET NOS. STN 50-592 AND STN 50-593

REQUEST FOR ADDITIONAL INFORMATION

Hydrology

Question 1

Provide the cross sections used in determining the extent of flooding during a postulated failure of the 80 acre reservoir. Provide documentation of the methods used to determine the starting water level used in the backwater analysis and the peak discharge of the dam-break wave. Provide the basis for your analysis and for all assumptions used in determining the water surface profile at the plant, including as a minimum, Mannings "n" valves, slopes, transition losses and routing coefficients.

Response:

The proposed Units 4 & 5 plant site is located about 6000 feet southwest of the 80-acre storage reservoir (see attached drawing). The terrain between the plant and the reservoir has a slope of about 0.0037 descending in a general north-to-south direction. In the event of a postulate failure of the 80-acre storage reservoir, the main flood path would be in the low valley stretch located between the East Wash embankment and the Unit areas. The 80-acre storage reservoir has a maximum design water level of 951.5 feet which is 9.5 feet above the ground grade of 942 feet. This above-ground portion of water, approximately 738 ac-ft.,

is considered as the water body to be released during an accidental break-down of the reservoir.

In performing the flood analysis, the following were considered:

1) The flood water released from the reservoir will spread out and fill the low valley stretch while moving southward.

2) The Units 4 & 5 site area is not directly located in the flood pathway and, therefore, will not be subject to damage resulting from the high velocity momentum of the flood water.

In order to determine if the Units 4 & 5 site area is susceptible to the backwater flooding caused by the reservoir failure, the HEC-2 model was employed along with the following data:

1) A total of eight (8) cross-sections (see attached drawing) were used to represent the land terrain characteristics.

2) Field reconnaissance has shown that the Manning "n" coefficient of the land surface ranges from 0.035 to 0.050. For conservative purpose, a Manning's n of 0.05 was used.

3) The starting water level was estimated by the model using the slope-area method. The initial energy slope was approximated by using the average land slope (0.0037).

4) The transition loss from cross-section to cross-section was neglected.

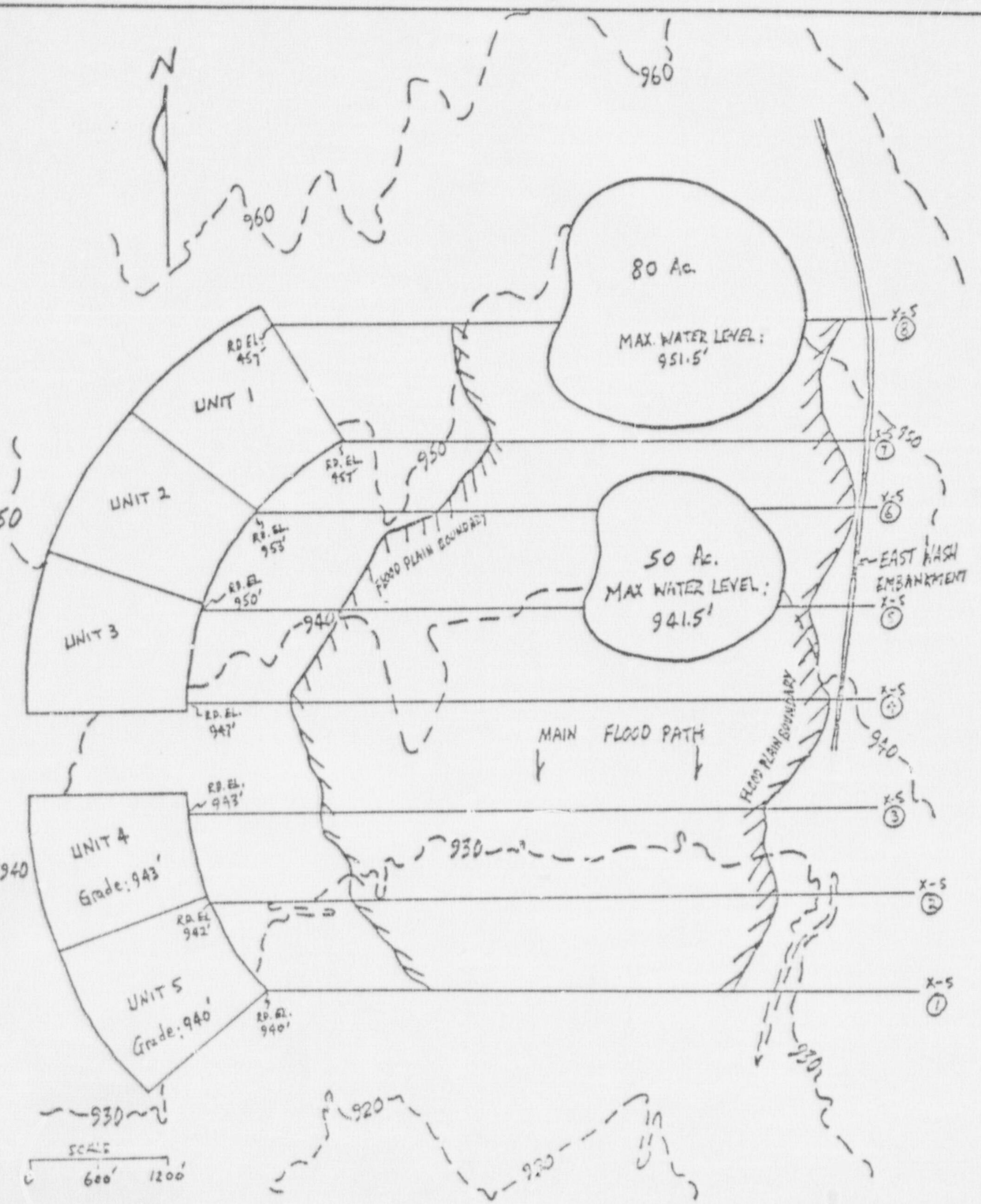
An iterative process was applied to input various peak discharges into the model until the total water volume under the calculated backwater flood profile is equivalent to the total above-ground water, 738 ac-ft., stored by the reservoir. When this condition is satisfied, the reservoir is considered to be drained out and the resulting backwater curve represents the maximum flood level downstream from the reservoir. In the calculation for the 80-acre reservoir break-down, a peak discharge of 150,000 cfs was observed to back up a total volume of 898 ac-ft of water. For conservative purpose, further attempts to reduce the total water volume to 738 ac-ft were not made.

The flood plain resulting from this 150,000 cfs peak discharge was delineated on the attached drawing. As shown, the maximum flood elevations approaching Units 4 & 5 are about 936 feet and 927 feet, respectively. Compared with the design plant grade of 943 feet at Unit 4 and 940 feet at Unit 5, it may be concluded that Units 4 & 5 are not subject to flooding due to failure of the 80-acre storage reservoir.

DATE 10-13-78

CLIENT ANPP - APS TASK NO. ________ By J. Annett

SUBJECT 80-Acre Storage Reservoir Failure Flood Study Checked By M. Warner



PALO VERDE NUCLEAR GENERATING STATION

UNITS 4 AND 5

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REQUEST FOR ADDITIONAL INFORMATION

Hydrology

Question 2

On page 2.1-12, you have stated that groundwater wells installed in 1974 show water levels decreasing at about 3 feet per year. This being the case, perched groundwater levels should have dropped about 6 feet between September, 1975 when irrigation was discontinued and November, 1977 when groundwater levels were measured for Units 4 and 5. This drop is not evident in comparing the groundwater contour map for Units 1, 2 and 3 PVNGS 1, 2 & 3 figure 2.4-29c) with that for Units 4 and 5 (figure 2,5-203). Provide additional information to substantiate your statement that water levels are decreasing at about 3 feet per year. Alternately, revise the estimated rate of decrease and adopt the implied elevations in pertinent seepage analyses for the site.

Response:

In order to substantiate the statement that perched water levels are declining at a rate of about 3 feet per year, Tables A and B are provided which summarize the water levels and net change for general site area and PVNGS 4 & 5 site specific area, respectively. Refer to hydrographs in PVNGS 1, 2 & 3 PSAR figure 2.4-30 and in PVNGS 4 & 5 PSAR figures 2.4-203 and 202 for an illustration of the perched water levels throughout the period of record, 1977 and 1978, respectively.

TABLE A

General Site Area Perched Zone Water Level and Net Water Level Change Between September 1975 and October 1977, PVNGS

Observation Well	Water Level Elevation (ft MSL)			Net Change	
	9/75	8/31/76	10/19/77	9/75-8/31/76	8/31/76-10/19/77
PV-14H	876.3	876.4	875.1	+0.1	-1.3
PV-21H	904.3	897.1	893.7	-7.2	-3.4
PV-22H	901.2	902.4	901.6	+1.2	-0.8
PV-24H	896.8	897.5	907.2	+0.7	+9.7
PV-25H	924.8	916.1	914.9	-8.7	-1.2
PV-28H	917.7	914.8	911.3	-2.9	-3.5
PV-29H	921.5	917.8	912.3	-3.7	-5.5
PV-30H	912.4	910.7	907.1	-1.7	-3.6
PV-31H	912.6	911.6	903.9	-1.0	-7.7
PV-33H	899.5	894.9	889.7	-4.6	-5.2
PV-34H	(a)	892.6	887.0	-	-5.6
R2	857.5	860.0	862.1	+2.5	-2.1
U3-PTW-1	917.5(b)	915.0	912.0	-2.5	-3.0
Q1	(c)	876.7	874.1	-	-2.6
Q5	(c)	917.0	913.4	-	-3.6
Q8	(c)	Dry	Dry	-	-
TR-1	(c)	899.6	897.0	-	-2.6
		Average for Period (d)		-2.59 ft.	-3.17 ft.
		Average/Year (d) (c)		-2.59 ft.	-2.82 ft.

(a) Blocked

(b) Reading October, 1975, well pumping in September

(c) Not drilled

(d) Average not including PV-24H; water level increase at 24H due to transient response resulting from the abandonment of an adjacent irrigation well.

(e) Value extrapolated.

TABLE B

PVNGS-4 & 5 Site Specific Area Perched Zone
Water Level and Net Water Level Change
Between November 1977 and June 1978

Observation Well	Water Level Elevation (ft MSL) 11/16/77	6/30/78	Net Change
U4-H1	912.3	910.7	-1.6
U4-H2	913.5	911.9	-1.6
U4-H3	914.3	912.8	-1.5
U4-H4	912.4	910.8	-1.6
U4-H5	913.7	912.1	-1.6
U4-H6	914.4	913.2	-1.2
U4-H7	913.6	911.7	-1.9
U5-H1	910.6	909.4	-1.2
U5-H2	911.6	910.0	-1.6
U5-H3	911.4	910.1	-1.3
U5-H4	911.4	910.0	-1.4
U5-H5	912.3	910.7	-1.6
U5-H6	912.8	911.1	-1.7
U5-H7	912.3	910.6	-1.7
U5-H8	(a)	910.0	-
U5-H9	912.4	910.7	-1.7
U5-H10	(b)	911.4	-
U5-H11	(b)	911.9	-

Average for Period -1.55 ft.

Average/Year (c) -2.48 ft.

(a) No reading taken

(b) Not drilled

(c) Value extrapolated

PALO VERDE NUCLEAR GENERATING STATION
UNITS 4 AND 5
DOCKET NOS. STN 50-592 AND STN 50-593
REQUEST FOR ADDITIONAL INFORMATION

Hydrology

Question 3

In our review of the PSAR for Units 1, 2 & 3, we concluded that the design basis groundwater levels should be 930 feet above mean sea level for all three units. As an alternative, you proposed groundwater design levels of 907,920 and 920 for Units 1, 2 & 3, respectively. Furthermore, you stated that the groundwater would not be allowed to rise more than one foot above these design levels. You committed to investigate three alternatives to minimize seepage from the storage reservoir and/or evaporation ponds and to provide your analyses for our review and approval prior to initiating construction of storage reservoir of the evaporation ponds. We note that construction may already be underway. Therefore, it is our position that prior to a decision on issuance of a CP for Units 4 & 5, you should adopt a design basis groundwater elevation one foot below plant grade for all safety-related structures, systems and components. Alternately identify and commit to adopt an alternative which effectively reduces the design basis groundwater elevation. (We note that acceptable alternatives were identified, but not selected or substantiated during the review of Units 1, 2 & 3.) In addition, submit full documentation of the effectiveness of the selected alternative for staff review and concurrence during the CP review for Units 4 & 5.

Response:

Refer to the PVNGS 4 and 5 PSAR Section 2.4.13.1.2 which states in part; "The effects of pond seepage upon the perched water zone is presently an open issue on PVNGS 1, 2 and 3 PSAR. The seepage analysis for PVNGS Units 4 and 5 will be based upon the seepage analysis for PVNGS Units 1, 2 and 3, once it is accepted by the NRC staff.

Present seepage analysis investigations are nearing completion. Results and conclusions addressing NRC concerns will be submitted in a future amendment. This seepage analysis will be used to establish a design groundwater level. We will not commit to adopt a design basis groundwater elevation on foot below plant grade for all safety structures and system.

PALO VERDE NUCLEAR GENERATING STATION

UNITS 4 AND 5

DOCKET NOS. STN 50-592 AND STN 50-593

REQUEST FOR ADDITIONAL INFORMATION

Accident Analysis

Question 1

Ref. Qualification Review Item A.1

Sun City, with a population of 40,000, is referred to in the PVNGS 4 & 5 PSAR as the nearest population center. Information obtained from the Arizona Department of Economic Security indicates that the population in several communities east of the site may exceed 25,000 during the life of the plant. Please address the potential for population centers nearer than the designated one during the lifetime of the plant.

Response:

Sun City was indicated as the nearest population center which met the population center designation of 10 CFR 100.3(c) at the time of filing the Units 4 & 5 PSAR. This was based on population estimates of Arizona as of July 1, 1976 per Reference 2.1.5 #12. Population projections in this reference were made only by counties and no allocation to cities within the counties were made. Since this original report allocations have been made to zones in the county and Municipal Planning Areas and approved by the Maricopa Association of

Governments (MAG) Regional Council. The attached population distribution from <u>Guide for Regional Development Transportation and Housing</u> (January 4, 1978, MAG) shows three cities in Table 2.2-1 PVNGS 4 & 5 PSAR which are projected to be greater than 25,000 by year 2000. As seen in Table 2.2-1 PVNGS 4 & 5 PSAR, the nearest city (Avondale) reduces the distance to the site from 34 miles to 31 miles. This distance is still much greater than the 1 1/3 times the distance of the reactor to the outer boundary of the low population zone as stated in 10 CFR 100 100.11(a)(3).

TABLE B

FUTURE POPULATION DISTRIBUTION
FOR MARICOPA COUNTY - 1980-2000

Planning Area	1975	% of Total County	1980	% of Total County	1985	% of Total County	1990	% of Total County	1995	% of Total County	2000	% of Total County
Avondale	11,405	0.8	11,700	0.8	14,100	0.9	21,300	1.2	28,600	1.4	36,300	1.6
Chandler	22,496	1.8	30,000	2.1	42,500	2.6	58,800	3.2	75,200	3.7	92,700	4.0
El Mirage	3,954	0.3	5,700	0.4	7,500	0.5	9,400	0.5	11,400	0.6	13,500	0.6
Gilbert	7,091	0.6	10,800	0.8	14,700	0.9	24,800	1.4	34,800	1.7	45,500	2.0
Glendale	71,292	5.7	80,000	5.7	97,700	6.1	115,800	6.3	134,400	6.6	154,800	6.7
Goodyear	5,745	0.4	7,000	0.5	9,400	0.6	18,100	1.0	26,800	1.3	35,900	1.6
Guadalupe	4,285	0.3	4,500	0.3	5,000	0.3	6,000	0.3	6,900	0.3	8,000	0.3
Mesa	117,099	9.4	137,200	9.8	160,800	10.0	180,400	9.9	200,500	9.8	223,500	9.7
Paradise Valley	11,532	0.9	13,500	1.0	15,800	1.0	16,200	0.9	16,700	0.8	17,400	0.8
Peoria	13,302	1.3	19,800	1.4	23,400	1.5	37,900	2.1	52,300	2.6	67,700	2.9
Phoenix	699,006	56.0	741,000	52.7	802,200	49.0	875,900	47.9	952,100	46.5	1,042,100	45.4
Scottsdale	78,065	6.3	84,500	6.0	92,700	5.8	96,600	5.3	100,700	4.9	106,400	4.6
Surprise	3,400	.3	3,600	0.3	3,700	0.2	4,700	0.3	5,700	0.3	6,800	0.3
Tempe	94,063	7.5	126,800	9.0	162,700	10.1	168,600	9.2	175,100	8.6	184,000	8.0
Tolleson	3,778	0.3	4,100	0.3	4,700	0.3	9,400	0.5	14,100	0.7	19,000	0.8
Youngtown	2,000	0.2	2,000	0.1	2,000	0.1	2,000	0.1	2,100	0.1	2,200	0.1
Maricopa County Inside Urban Planning Area	80,807	6.5	103,400	7.4	128,745	8.0	152,900	8.4	177,300	8.7	204,200	8.9
Subtotal Urban Planning Area	1,229,320	98.6	1,385,600	98.6	1,587,645	98.5	1,798,800	98.5	2,014,700	98.4	2,260,000	98.4

TABLE B (Continued)

FUTURE POPULATION DISTRIBUTION
FOR MARICOPA COUNTY - 1980-2000
(Continued)

Planning Area	1975	% of Total County	1980	% of Total County	1985	% of Total County	1990	% of Total County	1995	% of Total County	2000	% of Total County
Buckeye	2,675*	0.2	3,000	0.2	3,800	0.2	5,100	0.3	6,500	0.3	8,000	0.3
Gila Bend	2,300*	0.2	2,600	0.2	3,300	0.2	3,800	0.2	4,200	0.2	4,800	0.2
Wickenburg	2,908*	0.2	3,500	0.3	4,500	0.3	5,600	0.3	6,700	0.3	8,000	0.3
Maricopa County Outside Urban Planning Area	9,297	0.8	10,300	0.8	12,755	0.8	13,700	0.8	14,900	0.7	16,200	0.7
Subtotal Remainder of County	17,180	1.4	19,400	1.4	24,355	1.5	28,200	1.5	32,300	1.6	37,000	1.6
TOTAL	1,246,500	100.0**	1,405,000	100.0**	1,612,000	100.0**	1,827,000	100.0**	2,047,000	100.0**	2,297,000	100.0**

* Existing City Limits Only.

** May Not Add Due To Rounding.