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July 26, 1982

Secretary
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Chief, Docketing and Service Section

RE: Palo Verde Nuclear Generating Station
Units 1, 2 and 3
Docket Nos. STN50-528/529/530

Dear Sir:

Enclosed for filing by Joint Applicants in the above-referenced proceeding are three copies of "Proposed Initial Decision Prepared and Submitted by Joint Applicants".

Sincerely,

Charles A. Bischoff
Attorney for Joint Applicants

CAB:er
Enclosures

cc: Atomic Safety and Licensing Appeal Board Panel
Atomic Safety and Licensing Board Panel
Robert M. Lazo, Esq.
Dr. Richard F. Cole
Dr. Dixon Callihan
Lee Scott Dewey, Esq.
Edwin J. Reis, Esq.
Rand L. Greenfield, Esq.
Lynne Bernabei, Esq.
Chairman, Maricopa County Board of Supervisors

PROPOSED INITIAL DECISION PREPARED AND
SUBMITTED BY JOINT APPLICANTS

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges

Robert M. Lazo, Esq., Chairman
Dr. Richard F. Cole
Dr. Dixon Callihan

In the Matter of	)	
	)	
ARIZONA PUBLIC SERVICE COMPANY, et al.	)	Docket Nos. STN 50-528 STN 50-529 STN 50-530
	)	
(Palo Verde Nuclear Generating Station, Units 1, 2 and 3)	)	July 26, 1982

Appearances

Messrs. Arthur C. Gehr, Esq. and
Charles A. Bischoff, Esq.
for the Applicants

Messrs. Lee Scott Dewey, Esq. and
Edwin J. Reis, Esq.
for the Nuclear Regulatory Staff

Lynne Bernabei, Esq.
for the Intervenor

INITIAL DECISION

OPINION

I. BACKGROUND

This is a decision on an application from the Arizona Public Service Company (APS), Salt River Project Agricultural Improvement and Power District (SRP), El Paso Electric Company (EPE), Southern California Edison Company (SCE) and the Public Service Company of New Mexico (PNM) (collectively, Applicants) for a license to operate a nuclear power plant. The application is for the operation of three pressurized water reactors, Units 1, 2 and 3, at Applicants' Palo Verde Nuclear Generating Station site in Maricopa County, Arizona, approximately 50 miles west of central Phoenix. Permits to construct the units, each of which has a rated output of 1,270 megawatts of electrical power, were issued in May, 1976.[1/]

In addition to the Applicants and Staff, the parties to this proceeding are the Attorney General for the State of New Mexico and Patricia Lee Hourihan (Intervenor). The New Mexico Attorney General did not take any position respecting the application, raise any issues or participate in the hearings.

The Board originally approved the admission of five contentions for litigation purposes and provided the

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1/ 41 Fed. Reg. 22897.

Intervenor the opportunity to file additional contentions respecting emergency planning at such time(s) as the emergency plans were prepared.[2/] Subsequently, the Intervenor withdrew two of the admitted contentions and did not seek to file a contention respecting emergency planning.[3/] Applicants filed motions for summary disposition of each of the remaining three contentions. The Board granted the motions for summary disposition respecting two of such contentions,[4/] and, as a result, one contention respecting the adequacy of the supply of condenser cooling water remained at issue for the hearing.[5/]

The Board conducted two prehearing sessions, as well as several telephone conferences on certain specific procedural issues. Limited appearance statements were re-

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2/ See Board Memorandum and Order, April 16, 1981.

3/ As to one of the contentions withdrawn by Intervenor, the Board directed Applicants and Staff to address the subject matter of the contention by affidavits. See Board Memorandum and Order, December 11, 1981. Following consideration of the affidavits filed in response to such direction, the Board ordered the contention withdrawn as an issue in controversy. See Board Memorandum and Order, March 3, 1982.

4/ See Board Memorandum and Order, March 17, 1982.

5/ One March 29, 1982, about one month before the start of the evidentiary hearing and shortly after the Commission amended its regulations to eliminate consideration of "need for power" issues in operating license proceedings, Intervenor requested leave to file an additional contention respecting such matters. The Board ruled during the course of a telephone conference on April 6, 1982, that such contention was not justiciable.

ceived from members of the public on April 27 and April 28, 1982. Presentation of evidence commenced on April 28, 1982, and continued during the course of three hearing sessions, comprising 11 days in total. The record was closed on June 25, 1982. The decisional record of this proceeding consists of (a) the Commission's Notice of Hearing;[6/] (b) the petitions and pleadings filed by the parties; (c) the transcripts of the hearing; and (d) the exhibits received into evidence.

This Board's jurisdiction is limited to a determination of findings of fact and conclusions of law on matters put into controversy by the parties to the proceeding or found by the Board to involve a serious safety, environmental or common defense and security question.[7/] The Board has made no such additional determinations in this case.

II. CONTENTIONS

Contention No. 5, in its original form stipulated by the parties and admitted by the Board for litigation purposes, challenged the adequacy of the supply and the suitability of effluent to permit the operation of Palo Verde Unit 3 during its first five years of operation. Sub-

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6/ 47 Fed Reg. 12888.

7/ 10 CFR 2.760(a).

sequently, during the course of discovery on this issue, the Intervenor withdrew her challenge respecting the suitability or quality of the effluent except to the extent that effluent quality might impact the quantity of effluent required for condenser cooling.

By a letter to the Board, dated February 10, 1982, Mr. Bill Stephens, Executive Director of the Arizona Municipal Water Users Association (AMWUA), raised questions respecting the potential interruption of the major source of effluent for all three Palo Verde units.[8/] Subsequently, on the eve of the evidentiary hearing, the Intervenor sought to amend her contention in a manner which would have expanded its scope to apply to all units rather than only to Unit 3. Counsel for the Applicants acknowledged during the course of a telephone conference on April 6, 1982, relating to Intervenor's request for postponement of the evidentiary hearing and again at the outset of the hearing that the Board's response to Stephens' letter in its order denying summary disposition of the effluent contention had been interpreted as

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8/ AMWUA is an organization that represents five of the six municipalities who are parties to Agreement No. 13904 under which the major source of effluent for operation of PVNGS will be supplied. Stephens' letter recited, among other things, that the renegotiation of Agreement No. 13904 was in progress, including the issue of the right of the cities to refuse to deliver effluent for Palo Verde Units 1, 2 and 3 when a critical need for water exists in the cities. The questions presented by this letter constituted the principal reason for the Board's denial of Applicants' motion for summary disposition of the effluent contention.

expanding the scope of the issue presented to this Board to cover all three Palo Verde units and that, accordingly, Applicants were prepared to present evidence on the expanded issue. (Tr. at 334). The Board ruled that Intervenor's amended contention was untimely filed and with the concurrence of the parties adopted an interpretation of the contention which expanded its scope to apply to all Palo Verde units and to the quality of the effluent to the extent that quality affected the amount of effluent required. (Tr. at 347-48). Accordingly, the hearing proceeded to try the issue --

> Is there an adequate supply of effluent to support the operation of all three Palo Verde units during the first five years of their operation?

Intervenor also sought to amend her contention at the last hour to include the issue of whether or not the supply of effluent was critical to the safety of operation of the Palo Verde units, including the safe shutdown of the units under either normal or abnormal conditions. The Board also deferred its ruling on this late filed contention upon the affirmation of counsel for the Applicants that their witnesses would address this issue and be available for cross-examination. (Tr. at 345-50).

The effluent required for condenser cooling water makeup at Palo Verde is purchased under two contracts: Agreement No. 13904 and the Tolleson Agreement. (See Findings 4-5, 11). Intervenor has sought to expand the scope of the contention to include the question of the validity of the contract for the major source of effluent, i.e., Agreement No. 13904, dated April 23, 1973. In essence, the Intervenor would allege that Agreement No. 13904 is invalid or, in the alternative, that its validity is uncertain, because it contravenes or may contravene certain reclamation laws of the United States as alleged in a complaint filed in the federal district court for the District of Columbia by the Salt River Pima-Maricopa Indian Community against the Department of Interior and the Secretary of the Interior. The existence of this potential issue was first brought to the attention of the Board by counsel for the NRC Staff who submitted, first, a copy of the complaint and subsequently copies of the answer filed by the Department of Justice on behalf of the Department of the Interior and Secretary to the complaint and the Secretary's motion for change of venue. The Indian Community's complaint in essence seeks an augmented supply of water through a variety of means. The specific relief requested is that the Secretary be required to make certain determinations under several reclamation laws and that the court review such determinations. Among the determinations which the Secretary is asked to make is

that Agreement No. 13904 is invalid under the reclamation laws of the United States and that the cities who are parties to such agreement do not have the authority to sell wastewater effluent derived from water captured under such laws.

Intervenor by motions to defer issuance of a notice of hearing and for postponement of the hearing sought to inject the substance of the Indian Community's complaint into this proceeding. The Board ruled, however, that the issue of the validity of Agreement No. 13904 would not be accepted in this proceeding.[9/] Oral rulings were made on April 27 and May 14, 1982, denying the admissibility of evidence respecting the Indian Community's claim. The bases for such ruling are set forth in the Board's June 14, 1982 Memorandum and Order. Intervenor requested certification of this question to the Appeal Board on June 21, 1982, which request was denied [granted] by the Board's Memorandum and Order of _____ ____, 1982.

While the Board considers that its June 4, 1982 Memorandum and Order is dispositive of the issue, the following observations are relevant. As noted, the Board is aware that the Department of the Interior and the Secretary are contesting the Indian Community's claims. Under such circumstances it is improper for this Board to entertain a

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9/ See Board Memorandum and Order, April 13, 1982.

collateral attack upon any action or inaction of sister federal agencies on a matter over which the NRC is totally devoid of any jurisdiction. Similarly, it is improper for this Board to make any determination or take any action which directly or implicitly acknowledges that the Department's and Secretary's position or their past or present actions are incorrect or that there is doubt or uncertainty respecting the propriety thereof.

It is also pertinent that several bureaus of the Department of the Interior and other federal agencies have taken or propose to take several major actions, each of which subsumes the validity of Agreement No. 13904. Thus, the Bureau of Reclamation has proposed allocations of Central Arizona Project (CAP) water for Indian and non-Indian uses on the assumption that the effluent contracted for in the amount of 140,000 acre-feet/year would be used for electric generation. (Finding 72). Similarly, the Fish and Wildlife Service of the Department of the Interior has adopted a plan to clear a 1,000-foot channel in the Salt and Gila River from 91st Avenue to the Gillespie Dam on the basis that the contracted amount of effluent (140,000 acre-feet per year) would be diverted from the rivers.[10/]

10/ Final Environmental Impact Statement - Clearing of Phreatophytic Vegetation From The Salt And Gila Rivers - Ninety-First Avenue to Gillespie Dam - Maricopa County, Arizona, November 1981

Further, the Environmental Protection Agency in connection with its responsibilities under the Clean Water Act has acknowledged and assumed the validity of Agreement No. 13904. (JA Ex. KK).

Similarly, at the state and local levels, the Arizona Department of Water Resources in making its recommended allocations of CAP water for non-Indian uses has assumed the implementation of Agreement No. 13904. (Steiner, Tr. at 758). The Maricopa Association of Governments, with the approval of the Governor of Arizona and the Arizona Department of Health Services, has adopted and is implementing plans for the development and enlargement of sewage treatment plants throughout the Phoenix metropolitan area on the premise of the reuse of effluent pursuant to Agreement No. 13904. (JA Ex. MM, p. VIII-18).

Further, even if speculation as to the outcome of the Indian Community's litigation were to be entertained, it is not certain that all or part of the wastewater effluent from the 91st Avenue Plant would be lost to Palo Verde. First, a portion of the sewage influent to the 91st Avenue Plant is derived from sources not subject to the federal reclamation laws or to the jurisdiction of the Secretary. Second, from the evidence in the record in this proceeding, it apparently is not practical to transport effluent from the 91st Avenue Plant to the Indian reservations (Finding 78) and the Indians do not seem to want it in any case.

(Finding 74). Under such circumstances, even if it were decided that the cities who are parties to Agreement No. 13904 (Multi-Cities) did not have authority to sell effluent derived from reclamation water without the approval of the Secretary of the Interior, such ruling would not invalidate Agreement No. 13904 as to effluent derived from non-reclamation waters. Nor would such a ruling necessarily preclude the Secretary from either approving the present agreement or entering into a new agreement providing for sale of effluent for use at Palo Verde.

Accordingly, the Board affirms its prior rulings that the validity of Agreement No. 13904 is not a justiciable issue in this proceeding, because (a) it does not have jurisdiction to resolve such matter, (b) comity requires the NRC to accept the position taken by its sister federal agencies as well as by other state and local governmental authorities, (c) the issue is pending in litigation before the federal district court, (d) the outcome of such litigation and its effect, if any, on the operation of one or more of the Palo Verde units is speculative and conjectural, and (e) if it is ultimately concluded some time in the future that alternate sources of condenser cooling water are required to permit operation of all Palo Verde units at their full capacities, the Commission will have ample opportunity to evaluate and weigh the environmental impacts and cost-benefits of utilizing such alternate sources.

Applicants' Position

The Applicants' position with respect to Intervenor's contention simply stated is that --

(1) They have existing contractual commitments for the supply of wastewater effluent from three sewage treatment plants (Multi-Cities 91st Avenue Plant, City of Phoenix 23rd Avenue Plant and the City of Tolleson Plant) in the maximum aggregate amount of approximately 149,000 acre-feet/year, or 133 million gallons/day (MGD).

(2) The condenser cooling water requirements for operation of the three Palo Verde units at an annual capacity factor of 87% are estimated to be approximately 64,000 acre-feet/year, or 57.2 MGD.

(3) If the Palo Verde units operate at the annual capacity factor utilized in the cost - benefit analysis found in the Final Environmental Statement for Palo Verde (i.e., 60%) (Staff Ex. 1, pp. 2-2, 6-4), the effluent usage for the three units would be reduced to the neighbor-

hood of 43.5 MGD, or 48,000 acre-feet/year.[11/] Thus, there is a very significant margin between the estimated effluent requirements at 87% annual capacity factor and the amount required at the capacity factor at which operation of the Palo Verde units has been determined to be cost-beneficial.

(4) In 1981 the 91st Avenue Plant produced 115,300 acre-feet (102.95 MGD) of effluent of which 78,000 acre-feet (69.6 MGD) was available and committed to meet Palo Verde requirements after satisfaction of prior commitments.

(5) The Tolleson Sewage Treatment Plant currently is operating at about 6.0 MGD, or 6,400 acre-feet/year, of which a minimum of 3.6 MGD, or about 4,000 acre-feet/year, is committed to Palo Verde.

11/ The amounts shown, i.e., 43.5 MGD and 48,000 acre feet/year, were derived from Table 3.4-6 of the Palo Verde Environmental Report - Operating License Stage, referred to by witness Bingham (Tr. at 1072). Amounts are stated in such table, in units of GPM for each month, for 50% and 75% capacity factors. Such amounts were converted to MGD, averaged for a year, and then the 60% capacity factor amounts were computed by interpolation.

(6) Thus, the total amount of (i) effluent produced at the 91st Avenue Plant in 1981 and (ii) effluent currently being produced at the Tolleson Plant available for use at Palo Verde (i.e. 3.6 MGD) is 106.55 MGD, or 82,000 acre-feet/year.

(7) Such amount of effluent to is 28% more than that required to permit operation of the three Palo Verde units at annual capacity factors of 87%.

(8) The projections of effluent to be produced at the 91st Avenue Plant made in 1979 by the Corps of Engineers and adopted by the Environmental Protection Agency and the Maricopa Association of Governments, together with the projected production of effluent at the Tolleson Plant show that there will be sufficient effluent available in 1986 to permit operation of all units at 95% capacity each month of such year.

(9) All other projections, including those made in 1979 and 1981 by the City of Phoenix (which the Intervenor's witness McCain acknowledged to be reasonably accurate) and those made by MAG in Sep-

tember, 1981, and May, 1982, predict without exception that there will be more effluent available for Palo Verde than indicated by the 1979 MAG projections.

Intervenor's Position

Intervenor's basic approach to this issue has been to attempt to establish uncertainties both as to the availability of effluent and the effluent requirements.

The law is well established that NEPA does not preclude agencies from authorizing a project until all uncertainties are removed and every potential environmental effect is known. See Alaska v. Andrus, 580 F.2d 465, 473 (D.C. Cir. 1978), vacated in part sub. nom.; Western Oil & Gas Association v. Alaska, 439 U.S. 922 (1978); Natural Resources Defense Council, Inc. v. Morton, 458 F.2d 827, 837-38 (D.C. Cir. 1972). Uncertainty is simply one of the costs that must be weighed by the agency. Alaska v. Andrus, 580 F.2d at 473.

With respect to the uncertainties that Intervenor has attempted to establish in this proceeding, the recent case of Public Service Company of Oklahoma, et al. (Black Fox Station, Units 1 and 2), ALAB-573, 10 NRC 775 (1979), bears some similarity. In that case, as in the present case, the Intervenors challenged the adequacy of a contract

between the City of Tulsa and the applicant pursuant to which the applicant was to acquire sewage effluent for use at Black Fox. The contract provided that the city could, on twelve months notice, interrupt or terminate the agreement if it was determined that Tulsa required the water for its own use. The Licensing Board found that the contract provided "reasonable assurance of adequate water supply for [Black Fox]." Public Service Company of Oklahoma, et al. (Black Fox Station, Units 1 and 2), (LBP-78-26, 8 NRC 102, 120 (1978) (emphasis added). The Appeal Board saw no reason to disagree with the Licensing Board's finding. 10 NRC at 802. Thus, in Black Fox, neither the Licensing Board nor the Appeal Board required that the water supply be guaranteed. It was sufficient that there be reasonable assurance of an adequate supply.

This Board likewise does not consider it necessary that the delivery of effluent under Agreement 13904 and the Tolleson Agreement be guaranteed. It is sufficient if there is reasonable assurance that the effluent will be delivered.

A. Alleged Uncertainties in Availability of Effluent

1. Projections Respecting Effluent Availability in 1986 and Subsequent Years

No serious attack has been made on the amount of effluent currently being produced nor the projections of effluent predicted to be available in 1985 and subsequent years. On the contrary, her own witness McCain acknowledged

that the 1981 projections made by the City of Phoenix of the quantity of effluent predicted to be available in 1985 were reasonably accurate. He also expressed the opinion that the 91st Avenue Plant would produce enough effluent for the operation of all three Palo Verde units. (Finding 35).

2. Diversion of Effluent From 91st Avenue Plant

Intervenor did, however, attempt to establish some uncertainty in the effluent supply resulting from (i) the construction of new regional and local or satellite sewage treatment plants that could divert sewage from treatment at the 91st Avenue Plant and (ii) exchanges of effluent for Indian allotments of Central Arizona Project (CAP) water. However, in light of the testimony of her own witness, McCain, such attempts are not persuasive.

First, the evidence shows that the May, 1982 MAG Update (JA Ex. LL) calls for the further expansion of the 91st Avenue Plant to a capacity of 150 MGD by 1986 and expansion of the 23rd Avenue Plant from 37.2 MGD to 50 MGD shortly thereafter. It also includes two new local or satellite sewage plants (Arrowhead and Scottsdale CAP plants). McCain's testimony states that Phoenix plans to expand the 91st Avenue Plant to 150 MGD, confirming the testimony of witness Steytler, Assistant Water and Sewer Director of the City of Phoenix, that the expansion to 150 MGD is scheduled for completion by 1986.

Second, with respect to new regional plants which might divert sewage from the 91st Avenue Plant (Northeast Plant and East Mesa Plant),[12] McCain testified that there were no plans to construct such plants, that they were merely topics of conversation among municipalities and that they would not be necessary until the turn of the century. In any event, the May, 1982 MAG Update indicates that, even if such regional plants were in existence in 1985, there would be a need for further expansion of the 91st Avenue Plant and more than enough effluent available at such plant to meet Palo Verde requirements. (Finding 37).

With respect to potential exchanges of effluent for Indian CAP water, McCain testified that (1) the probability that such exchanges would be necessary before the turn of the century was low, (2) the exchanges would require the construction of sewage treatment plants on or near the Indian reservations where effluent could be used, (3) the use of the proposed exchange ratio of 2-to-1 until 2005 would impede the development of exchanges prior to that time

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12/ The Northeast Plant would be located on or near the Salt River Indian Reservation so that the exchange of effluent for Indian CAP water would be feasible. (McCain Tr. 2193; JA Ex. LL, p. VI-4). The East Mesa Plant would be located so that effluent could be exchanged for agricultural water of the Roosevelt Water Conservation District. (McCain Tr. 2351; JA Ex. LL, p. VI-247). Juetten and McCain also testified that consideration has been given to the exchange of effluent from the existing 23rd Avenue Plant for SRP agricultural water of the Roosevelt Irrigation District. (Juetten Tr. 670-1; McCain Tr. 2184, 2352-7).

and (4) if, as proposed, the additional CAP water obtained from exchanges for effluent by any one municipality is to be shared by all allotees of M & I CAP water, the incentive for any municipality to effectuate exchanges is significantly reduced. (Finding 76). Further, the record is clear that the provisions in the allocation program of CAP assume that effluent in the amount of 140,000 acre-feet/year will be used for power generation.

In light of such evidence, the Board is of the opinion that neither the potential construction of regional plants nor the potential exchange of effluent for Indian CAP water will jeopardize the supply of effluent to Palo Verde from the 91st Avenue Plant. On the contrary, the Board considers that construction of the regional plants which have been discussed for the stated purposes of exchange of effluent for either CAP water or agricultural water would in fact enhance the security of supply of effluent to Palo Verde since the exchanges would serve to reduce the risk of critical water shortages.

B. Alleged Uncertainties in Sources of Water

Intervenor also sought to establish uncertainties respecting the sources of water available to the Multi-Cities who are parties to Agreement No. 13904. The basis for this challenge to the availability of effluent stems from Section 21 of Agreement No. 13904. Section 21 permits

the Multi-Cities to interrupt the delivery of effluent, but not to terminate the contract:

> (a) If there exists in the cities a critical need for water for domestic purposes.
>
> (b) If all reasonable sources of water, including the use of excess wastewater effluent, have been exhausted;
>
> (c) If reasonable steps have been taken to conserve the water supply in the cities; and
>
> (d) If reasonable notice of the critical need has been given.

When the critical need expires or other reasonable sources of water become available, the cities must resume the delivery of effluent. (Finding 42).

Intervenor argues that there is no "assured" supply of effluent because of the risk of critical water shortages (which might trigger Section 21) due to either the reductions or inadequacy of surface water supplies or to contamination of underground water.

The Board recognizes that there are some elements of Section 21 which require legal interpretation. For example, must a "critical need for water" exist in all of the cities or if it exists in only one of the cities, is

that sufficient? Or, can one city by itself, irrespective of its contributions to the 91st Avenue Plant, force the interruption in the delivery of effluent even if all the others do not wish to do so, and, if so, how much effluent is to be interrupted? This Board does not have jurisdiction to interpret contracts and should not undertake to do so. If and when the issue arises, the parties will resolve the questions themselves, or if they are unable to do so, perhaps a court of competent jurisdiction will do so. Nevertheless, the Board may on the basis of the record in this proceeding make determinations of fact as to the likelihood that a critical need for water for domestic purposes will occur.

1. Water Sources Available in the Phoenix Metropolitan Area

The major part of the Phoenix metropolitan area is situated in the Salt River Valley above the confluence of the Salt and Gila Rivers. The major water source for the valley is the watersheds of the Salt River and the Verde River which join the Salt a few miles east of the area. Four dams have been constructed on the Salt River and two on the Verde to capture and store runoff in the watersheds. The dams were constructed and financed by the federal government for irrigation of the "member lands" within an area known as the Salt River Reservoir District (SRRD). The "member lands" are those lands whose owners joined the Salt

River Water Users Association (SRWUA) organized in 1903, and pledged their lands for the repayment of the cost of the dams and other facilities constructed by the federal government. The Salt River Project Agricultural Improvement and Power District (SRP) was subsequently organized to serve as the operating arm of SRWUA and is responsible for the operation and maintenance of the dams, the development, operation and maintenance of the underground water sources within the SRRD, the operation and maintenance of the hydroelectric facilities associated with the dams and the other elements in the SRP electric power system.

The water resources within the SRRD consist of the (i) surface waters collected in the Salt and Verde watersheds, comprising approximately 13,000 square miles and (ii) developed water consisting of groundwater within SRRD and pumped by 249 deep-well pumps owned and operated by SRP. The surface waters constitute approximately 60% of the water resources of SRP and developed water approximately 40%. (Finding 48).

The total acreage of the member lands is about 238,000 acres, all of which was originally devoted to commercial agriculture. However, at the present time, only about 100,000 acres are still being used for commercial agriculture, the balance having been urbanized and for the most part incorporated into the cities of Phoenix, Glendale, Peoria, Tempe, Mesa, Scottsdale, Chandler, Gilbert and

Tolleson. Cities which have member lands within their boundaries purchase and receive surface and developed waters from SRP for distribution to the population occupying such lands. However, such cities are not permitted to use SRP water to serve areas outside SRRD. (Findings 47, 49).

The City of Tempe is located entirely within the SRRD, and, consequently, its principal source of water is SRP water. However, it does have several wells of its own to serve its needs. (Finding 50).

Each of the cities of Glendale, Mesa and Scottsdale lies partly within and partly outside the SRRD boundaries and its water resources consist of both SRP water and city owned wells located both inside and outside the SRRD. (Findings 51-53).

The situation of the City of Phoenix is the same, except that in addition to its wells used to serve areas outside the SRRD boundaries, Phoenix has acquired rights to surface waters accumulated behind gates installed at Phoenix's expense on SRP's Horshoe Dam on the Verde River. The quantity of water stored behind the gates, after allowances for evaporative losses and silting, is recorded and accounted for as "gate water credits." The water represented by gate water credits is declared to be City of Phoenix flood waters, not SRP water, and, accordingly, may be used by the City either inside or outside the SRRD. (Finding 54).

The quantity of water available to Phoenix from this source varies from time to time depending principally upon runoffs from precipitation in the Verde watershed and the amounts used by Phoenix to meet its needs. Thus, in any year when the City's usage exceeds accumulations behind the gates, the balance of gate water credits is diminished. Such a situation existed for several years prior to 1982 when runoff from the Verde watershed was below normal and there was some concern the City's gate water credits would be exhausted in the summer of 1982. However, storms and runoff occurring in February and March of 1982 resulted in the restoration of the City's gate water credits to a balance in excess of the storage capacity of the gates. (Finding 54).

In addition to the SRP surface and groundwater supplies available to the five principal cities situated within the SRRD, there are numerous privately-owned wells (i.e., wells not owned and operated by SRP), including a large number of wells owned and operated by the principal cities. (Findings 50-54).

With respect to those portions or sections of the five principal cities situated within the SRRD, the evidence shows that none of the cities are currently utilizing in full their respective SRP entitlements. (Finding 62). Moreover, as the remaining 100,000 acres of SRP member lands are urbanized, the prospect for the future is that use of

groundwater in the SRRD will diminish over time and reach a balance where replenishment will equal withdrawals. (Finding 71). Accordingly, it is concluded that it is unlikely that water shortages will occur within the SRRD which could serve to trigger Section 21 or Agreement No. 13904 and interrupt delivery of effluent to Palo Verde.

With respect to those areas of the cities lying outside the SRRD boundaries, the evidence is undisputed that Glendale, Mesa and Scottsdale have sufficient excess capacity from existing wells to meet the demands for water in such areas through 1986. (Findings 51-53). The evidence is also undisputed that the municipalities have the right to drill such additional wells within their service areas as they deem necessary to meet their water requirements and permits for such wells must be issued by the Arizona Department of Water Resources (ADWR). (Finding 56). With respect to the water requirements of those portions of Phoenix outside the SRRD, the evidence shows that the city has implemented a plan to install several new wells to serve such areas and a conservation program to reduce per capita consumption. In addition, there are other programs which can serve to augment the supply of water to the areas of Phoenix. The evidence further shows that with the implementation of these several programs, Phoenix will be able to meet it demands and still have a credit balance in its gate water credit account at the end of 1986, assuming that no

additional runoff is available during such period to augment the gate water credit balance. (Finding 55).

Accordingly, it is concluded that it is very unlikely that water shortages will occur during the period through 1986 in areas served by the Multi-Cities outside the SRRD which could serve to trigger Section 21 of Agreement No. 13904 and interrupt deliveries to Palo Verde.

2. Central Arizona Project

In 1985, it is planned and expected that the sources of water to serve the non-SRP areas of the Multi-Cities will be augmented by water from the Central Arizona Project (CAP). CAP is a federal reclamation project under construction which will bring to central Arizona most of the state's remaining entitlement to Colorado River water. The principal elements of the project consist of three aqueducts: (1) the Granite Reef Aqueduct which extends from Lake Havasu on the Colorado River to a point near the Granite Reef Dam (the Granite Reef Dam is a diversion facility by which water in the Salt River is diverted into the Arizona and Southern Canals of SRP) on the Salt River east of Phoenix; (2) the Salt-Gila Aqueduct which reaches from the Granite Reef Dam to Picacho Reservoir about half way between Phoenix and Tucson; and (3) the Tucson Aqueduct which extends from the reservoir to the Tucson area. Adjunctive facilities include generation facilities which are required to furnish power for pumping CAP water through

the aqueducts and which have been completed, regulatory storage reservoirs, and distribution systems. (Findings 63-64).

Construction of the Granite Reef Aqueduct is scheduled for completion in 1985. Nine of the twelve reaches comprising the aqueduct and the remaining three reaches are under construction. The three pumping plants along the aqueduct are also under construction. CAP water is expected to be available for use in the Phoenix area in 1985. (Finding 64).

Agricultural users are required to reduce their underground pumping in an amount equal to the amount of CAP water they receive. (JA Ex. Q, p. 66) This restraint, however, does not apply to municipalities, who may withdraw as much water as they need under the Groundwater Management Code. (Tr. 2371).

On the basis of water supply studies conducted by the Arizona Department of Water Resources (ADWR), it is expected that there will be at least 1,600,000 acre-feet of CAP water available to the Phoenix area in 1985. This estimate is based on the amount of water in storage at Glen Canyon and Lake Mead (65 million acre-feet) and the present inability of the Upper basin states (New Mexico, Utah, Colorado and Wyoming) to fully utilize their Colorado River entitlements. When the upper basin states fully utilize the balance of their entitlements to Colorado River water,

1,300,000 acre-feet/year will be available for CAP under average supply conditions. The probability of having 1.6 million acre-fee available to CAP during each year from 1985 to 1990 is at least 90%. Over the long term, however, probability studies indicate that 800,000 acre-feet/year will be available to CAP two out of three years and that a minimum of 630,000 acre-feet each and every year would be available under the worst conditions of historic runoff. This amount is called the firm or dependable supply. (Finding 68).

The Secretary of the Interior has the authority to allocate CAP water to various categories of use. He has exercised such authority for use by Indians for both agricultural and non-agricultural purposes and has allocated approximately 310,000 acre-feet/year for Indian uses. A portion (about 52,000 acre-feet/year) of this allocated amount is subject to reduction in periods of shortage and another portion (estimated at 100,000 acre-fee/year by 2034) is subject to exchange for effluent other than effluent required to meet existing contracts. (Findings 65, 69).

With respect to non-Indian uses, the Secretary has asked the State of Arizona to recommend allocations of the remaining amount of CAP water. The State has done so, and its recommendations are reflected in the Bureau of Reclamation's Final Environmental Impact Statement on Water Allocations and Water Service Contracting for the Central Arizona

Project (CAP FEIS) (JA Ex. Q) as the "proposed agency action." The proposed allocations to all M&I users amount to about 639,000 acre-feet/year, including 100,000 acre-feet obtained in exchange for effluent. The balance of the CAP water has been allocated for non-Indian agriculture and miscellaneous uses. (Findings 65, 69).

During periods when the amount of CAP water available is less than the average supply conditions (1,300,000 acre-feet/year), the allocations are subject to reduction depending upon a system of priority classifications. Non-Indian agriculture and miscellaneous uses have the lowest priority and, therefore, are subject to reduction first. Approximately 20% of the total amount allocated for Indian uses have been given the next lowest priority. The balance of the Indian allocations and M&I allocations (not in excess of 510,000 acre-feet/year) have the highest and equal priorities. Thus, allocations to these two categories are subject to reduction only after uses in all lower priorities has been eliminated. In such an event, the allocations to these two categories will be subject to reduction on an equal percentage basis. (Finding 70).

The total amount allocated to all non-Indian M&I users (639,000 acre-feet/year) was based on the availability of 800,000 acre-feet/year of CAP water (expected to be available two out of three years), and deducting therefrom the amount of the CAP allocation to Indian uses not subject

to reduction and allowance for exchanges. Of the total CAP allocations for all M&I users, the proposed allocations for all of the Multi-Cities are 174,848 acre-feet/year, of which the Phoenix allotment is 116,239 acre-feet/year. (Finding 69).

Such allocations were made only for those areas of the Multi-Cities which lie outside SRP boundaries. This was done, because as lands within SRP boundaries are urbanized, the need to mine groundwater will decrease, and the surface water supply from SRP and the sustainable yield from the SRP groundwater basin will be at least equal to the demands on that supply, even with substantial amounts of effluent leaving the area. (Finding 71).

The allocations among municipalities in the M&I user classification were based on official state population projections developed by the Arizona Department of Economic Security. It is not expected that the allocations will impact projected population growth of any of the Multi-Cities or other communities in the Phoenix metropolitan area. (Finding 73).

The Board has determined that with the completion of CAP to the Phoenix area in 1985 the evidence is conclusive that the water available to the Multi-Cities during the first five years of operation of all three Palo Verde units, i.e., 1986-1990, makes it extremely unlikely that any of the Multi-Cities will face a critical water shortage during that

period which could trigger the implementation of Section 21 of Agreement No. 13904. Indeed, under the worst-case scenario the earliest date for the onset of shortage conditions of CAP water is 1992. (JA Exhibit Q, p. 11) It is recognized that there is some uncertainty that the construction of the CAP Granite Reef Aqueduct will be completed in 1985. Nonetheless, that project is currently more than 75% complete and construction of all remaining segments is currently in progress. Under such circumstances it is not unreasonable to conclude, as every witness who testified on the matter did, that CAP water will be available to the Phoenix area in 1985. In this connection it should be noted that there is also some uncertainty that Palo Verde Unit 3 will be completed in 1986 as scheduled. Nonetheless, this proceeding and all analyses conducted in respect thereof, including estimates of Palo Verde water requirements, have been premised upon the scheduled date of commercial operation of Unit 3 in 1986.

We would also observe that the uncertainties of completion of the remainder of CAP on schedule (i.e., the Salt-Gila Aqueduct scheduled for 1986, and the Tucson Aqueduct scheduled for 1989-90) are greater than the uncertainties of completing the Granite Reef Aqueduct simply because of the longer time span involved if for no other reason. However, these uncertainties only serve to enhance

the probabilities that more CAP water will be available in the Phoenix area than will be needed.

Similarly, there is some uncertainty that the Multi-Cities will take in a timely manner the steps necessary to receive and treat the CAP water to which they are entitled.[13/] However, such an uncertainty is more than balanced by the fact that failure to do so decreases their ability to maintain that they have taken all reasonable steps to develop sources of water available to them -- a prerequisite condition which must be met before Section 21 may be implemented.

Beyond the 1985-90 time period the Board concludes that (i) it is very remote that shortages of CAP water would occur that would impact the Multi-Cities until sometime subsequent to 2010, and (ii) even when there is a shortage condition of CAP water, it is unlikely that a critical water shortage would be incurred by the Multi-Cities which would trigger Section 21.

The first of these conclusions is based on the fact that (1) the M & I allotments are predicated upon projected populations in the year 2034, and (2) the need for the use of such allotments will not exist until such pro-

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13/ There is some testimony in the record respecting uncertainties in the funding and construction of distribution facilities for non-Indian agricultural users. Any such uncertainty, however, would not impact the Multi-Cities, because they have a higher priority CAP water.

jected population is actually reached. If it is assumed that the population growth in the CAP service area occurs in equal numerical increments over the 50-year period of projections (i.e., at steadily decreasing percentages), then the requirements of municipal M & I users in 25 years (2009) will be only one-half their requirements in 50 years (2034), which under the proposed allotments will be slightly less than 495,000 acre-feet/year. (JA Ex. Q, p. 35) Thus, in the year 2009, the CAP requirements of municipal M&I users would be only about 247,000 acre-feet/year. Assuming all other M&I users are then using their full allotments, or about 144,000 acre-feet/year (JA Ex. Q, pp. 35-6) then the total M & I usage would be about 391,000 acre-feet. Assuming also that the Indians are also then using their full allotments of 310,000 acre-feet/year without any exchanges, of which approximately 52,000 acre-feet has a lower priority than M & I users, the total usage of first priority CAP water would be 659,000 acre-feet/year. Assuming, as Intervenors suggest, that the regional plants are constructed by 2010 (the Northeast Plant for exchange for Indian CAP water and the East Mesa Plant for exchange for firm agricultural water) (Finding 29), the net effect of reduction of Indian priority CAP water and substitution of firm agricultural water would be to reduce CAP usage by about 23.2 MGD, or 26,000 acre-feet/year (JA Ex. LL, p. VI-3) or from 659,000 to 633,000 acre-feet/year -- an amount which is within 1/2

of 1% of the firm, dependable supply of CAP water under the worst historic conditions of 630,000 acre-feet per year. (Finding 68).

The Board's conclusion that, even when there is a shortage condition of CAP water, it is unlikely that a critical water shortage would be incurred that would trigger Section 21 is based upon the following analysis.

The record is unmistakably clear that CAP water is not the sole source of water for the Multi-Cities. Within the SRRD the availability and adequacy of SRP water, both surface and developed, and groundwater developed by the Multi-Cities have been discussed. (supra, pp. 19 et seq.). Outside the SRRD, the Multi-Cities have the right under the Groundwater Management Code to drill wells anywhere within their service areas and withdraw and overdraft groundwater (Finding 56; JA Ex. Q, pp. 14, C-8). Urbanization of agricultural lands will provide sources of water. Additionally, the cities may purchase and retire agricultural land and acquire the grandfather rights to groundwater associated therewith and may take other measures to acquire water. (JA Ex. Q, p. C-2) The use of these sources was assumed in the preparation and development of the proposed CAP allocations. (JA Ex. Q, p. C-2).

Thus, a shortage of CAP water from time to time would not a fortiorari entitle the Multi-Cities to implement Section 21. Section 21 is not tied to CAP water alone nor

to any other single source; rather, it requires that all reasonable sources be exhausted. Section 21 explicitly includes among the "reasonable sources" the use of excess effluent, and there exists today a supply of unused excess effluent at the 23rd Avenue Plant in an amount of more than 40,000 acre-feet/year. Further, all projections show that the quantity of excess effluent at both the 91st and 23rd Avenue Plants will continue to grow. (Finding 38; Tr. 2394-5). In 2010, it appears that 118.7 MGD (133,000 acre-feet) of effluent will be available from those plants in excess of Palo Verde requirements and all prior commitments. (JA Ex. LL, Table IV-2).

Finally, the fact that the Multi-Cities are on notice that periodically there will be shortages of CAP water imposes a duty to be prepared to meet that condition whether it be maintaining excess well capacity or otherwise. McCain recognized this when he testified to the effect that when exchanges with Indians become necessary, means will be found to effectuate them. (Tr. 2369)

3. Alleged Uncertainties of Supply of Effluent Due to Groundwater Contamination

Intervenor maintains that the contamination of several wells owned by the Multi-Cities which has been discovered in recent years is indicative of the risks and uncertainties of reliance upon groundwater sources, which adds to the risk of critical water shortages. Swanson testified

that in all nine wells (two owned by Phoenix; two by Scottsdale; three by Tempe; one by Glendale; and one by Mesa) have been found to be contaminated above acceptable levels with TCE or DBCP. Of these nine wells, six have been shut down and two wells have remained in operation. The output of one well is being exchanged for SRP water. (Findings 58-59).

Clearly, such occurrences do reveal some risks in reliance upon groundwater sources, but, in the Board's view, the risk is far from overwhelming. Certainly contamination of sources of potable water is not unique to Arizona. It is a problem or risk that is confronting many communities throughout the United States and reveals the need for improvements in the disposal and monitoring of wastes. Hopefully, the improvements in technology, the growing awareness of the problems of hazardous wastes and the increasing amount of governmental oversight in the waste disposal arena will serve to reduce the contamination of groundwater.

In any event, the shutdown of six out of 193 wells owned by the Cities (Finding 57), not counting the 249 SRP wells which serve the Phoenix area (Finding 48), does not raise an alarm of a critical water shortage. After all, five of the six shutdown wells belong to Mesa, Glendale, Tempe and Scottsdale, each of whom have a demonstrated excess of well capacity. (Findings 50-53). Intervenor's

witness Swanson acknowledged the validity of this conclusion when he testified that the result of the shutdowns was a reduction to some degree of the cities' flexibility in operating their water systems. (Finding 60).

This conclusion is buttressed by the facts that the contaminants found are susceptible to treatment or acceptable levels can be achieved by blending. Additionally, it has been demonstrated that the contaminated well water is suitable for agricultural irrigation and consequently can be exchanged for acceptable water to forestall a critical water shortage. (Findings 58 and 59).

Additionally, Intervenor's witness Lemmon testified about the potential contamination from existing landfills located in the flood plain of the Salt River. Without benefit of any hydrological studies, he estimated that there was a risk that a large amount of groundwater within two miles on each side of the river would become contaminated and would require treatment prior to use.

Apart from the question of the credibility of his opinion, there appear to be only four city wells within his four-mile band, and there is no evidence in the record that they have become contaminated. And, if they are contaminated, he acknowledged that the contamination could be treated. (Finding 61).

For the foregoing reasons and based upon the evidence in the record, the Board concludes that the present

levels of known groundwater contamination and the possibility that further contamination may be discovered is not sufficient to find that critical water shortages will occur from such causes.

C. Alleged Uncertainties as to Palo Verde Effluent Requirements

Intervenor has contended that the Applicants have or may have underestimated their effluent requirements. Her principal challenges have been addressed to (i) the capability and reliability of the Palo Verde Water Reclamation Plant (WRP) and (ii) the ability to achieve 15 "cycles" of concentration. Intervenor's witness Robinson also questioned the prudence of proceeding with the design of, and selection of materials for, the circulating water system without resorting to prototype testing on a larger scale than had been done. (Tr. at 1615, 1622, 1689).

The WRP is a facility which provides tertiary treatment to the effluent received from the 91st Avenue and Tolleson Plants where it has received primary and secondary treatment. The nature of the treatment provided by the WRP is described in Findings 85-89. Essentially, however, the WRP is a very large water softener designed to remove dissolved solids from the effluent with additional filtration for removal of suspended solids and chlorination for biological growth control. None of the processes involved is unique. (Robinson, Tr. at 1612-13, 1737, 1751, 1758-59).

The primary purpose of the WRP is to remove dissolved and suspended solids to a degree which will permit the use of the processed effluent until the concentrations of solids in the effluent in the circulating water system (CWS) have been increased by a factor of 15 before blowdown to the evaporation ponds (i.e., in the engineering vernacular - "15 cycles of concentration"). Effluent requirements vary inversely with factor of concentration. Thus, operation of a unit at any given load or capacity factor will use less effluent as higher factors of concentration are achieved. (Findings 22, 84, 102).

Before design of the WRP and CWS was initiated, extensive testing was conducted over a 15-month period and the tests were thoroughly documented in JA Ex. BB. The tests included operation of prototypes of the WRP and CWS with effluent from the 91st Avenue Plant. In addition, extensive laboratory bench scale tests were conducted. The testing identified (i) the problem constituents found in the effluent, (ii) the means to reduce their concentrations in the WRP, and (iii) the further treatment required to control them in the CWS. The testing was also utilized in the selection of materials for the CWS which would enhance the reliability of operation. After completion of the tests, monitoring of the quality of the effluent from the 91st Avenue Plant continued to provide assurance that significant changes in effluent quality had not occurred. (Findings 95, 97-99).

The net result of this test program was that it permitted the WRP to be designed with sufficient flexibility to accommodate a broad range of fluctuations in effluent quality and still meet the quality specifications for influent to the CWS desired to assist in achieving 15 cycles of concentrations. (Finding 91).

Additionally, a reliability study of the original conceptual design, which study was performed as an integral part of the test program, led to basic changes in the conceptual design with significant improvements in reliability and flexibility. (Finding 92).

The operation conducted with the circulating water test facility (CWTF), which closely simulated a typical circulating system, demonstrated that the CWS could operate at 15 to 20 cycles of concentrations without corrosion, pitting or scale formation with proper control of pH and chlorine. (Findings 103-12).

The criticism by witness Robinson that the CWTF was too small to properly test such major plant components which could seriously effect the reliability of operation of a large generating unit is unwarranted. Circulating water systems are an integral part of all steam electric generating plants and a wealth of experience has been gained in their design. In any event, the record shows that operating experience of other plants using effluent for condenser cooling water or using similar materials has confirmed the

validity or the CWTF and Bench Scale tests. (Findings 113-16).

Accordingly, the Board is of the opinion that Applicants' estimate of the effluent requirements to operate the Palo Verde units at 95% capacity factor 11 months of a year with one month out for refueling, equivalent to an annual capacity factor of 87%, is reasonable and does not understate the needs for effluent. (Findings 117-19).

D. Relationship between Effluent Supply and the Ultimate Heat Sink.

Intervenor has raised the question whether or not the supply of effluent is critical to the safe shutdown of the Palo Verde units under either normal or accident conditions. Some of the confusion respecting this matter may stem from Amendment 8 to the Palo Verde Final Safety Analysis Report (FSAR) (JA Ex. W; see also Int. Ex. XIV) filed in March, 1982. This amendment changed the section of the FSAR (§9.2.5.4) which deals with the safety evaluation of the ultimate heat sink for each Palo Verde unit and stated in effect that the domestic water system, supplied with water from on-site wells, was the primary source for makeup to the essential spray ponds and that the reservoir holding treated effluent was a backup source. The change also stated that procedures for utilizing these sources would be available 60 days prior to fuel load.

This change apparently did not address all of the Staff's concerns (Int. Ex. XXXV; Tr. 2482), and in May, 1982, the Staff requested Applicants to identify sources of water, rather than systems, that can be used when the ultimate heat sink is depleted, together with other information on the availability of the identified sources. (Finding 123).

By letter, dated June 17, 1982, APS advised the Staff that "[t]his source of water for makeup to the UHS [ultimate heat sink] of each of the PVNGS units is the regional aquifer." (Int. Ex. XXXV) Sources of information respecting the aquifer were also identified and actions required to utilize this source were described ad committed to by APS. Staff witness Gonzales testified that "this time they have addressed all our concerns" and that he is in a position to recommend to his management that the June 17 letter be accepted. (Tr. 2488).

Thus, while final review by the Staff is not yet complete, the evidence in the record indicates that Applicants have complied with the applicable regulatory guide, Regulatory Guide 1.27 (Int. Ex. XII). It also is unmistakably clear from the June 17 letter that neither the reservoir nor treated effluent is a source of makeup water when the ultimate heat sink is depleted. Accordingly, the only permissible conclusion from the record is that effluent is not required for safe shutdown of the Palo Verde units. (Findings 126-27, 129).

CONCLUSION

On the basis of the evidence of record the Board finds that there is reasonable assurance that there will be a sufficient supply of effluent from the 91st Avenue and the Tolleson Plants to meet the operational requirements of the Palo Verde units, that there is reasonable assurance that the sources of water available to the Multi-Cities during the first five years of operation of all Palo Verde units and beyond are sufficient so that the occurrence of an event which could trigger Section 21 of Agreement No. 13904 is very remote, that the estimated requirements of effluent for condenser cooling are not understated and that effluent is not required for the safe shutdown of the Palo Verde units.

The matters examined during the evidentiary hearing which are not discussed in this Opinion were considered by the Board and found either to be without merit or not to affect our decision herein. Findings of fact and conclusions of law which are annexed hereto are incorporated in the Opinion. In preparing its findings of fact and conclusions of law, the Board reviewed and considered the entire record and the findings of fact and conclusions of law proposed by the parties. Those proposed findings not incorporated directly or inferentially in this Initial Decision are rejected as being unsupported by the record of the case or as being unnecessary to the rendering of this decision.

Accordingly, for all the foregoing reasons, it is this date, _____, ordered that the Director of Nuclear Reactor Regulation is authorized to issue operating licenses to the Applicants for Units 1, 2 and 3 at the Palo Verde Nuclear Generating Station.

FINDINGS OF FACT

1. Contention No. 5, as accepted for litigation in this proceeding, reads as follows:

> "Applicants will not have an assured supply of usable treated municipal effluent for cooling purposes for Unit 3 of PVNGS during months of peak reactor need for the first five years of operation."

2. During the course of the proceeding, the scope of Contention 5 was expanded to include all three units, the impact of effluent quality on the quantity of effluent required, and the relationship, if any, between safety and the treated effluent to be used for condenser cooling. (Tr. at 329-31, 333-34, 337, 345-58).

3. Extensive testimony was presented during the hearing dealing with the supply of treated effluent for cooling purposes at PVNGS.[14/]

14/ Joint Applicants' witnesses were: Russell D. Hulse, Vice President of Resources Planning for Arizona Public Service Company; Richard Leo Juetten, Manager of Water Resources and Services for the Salt River Project Agricultural Improvement and Power District; Wesley E. Steiner, Director of the State of Arizona Department of Water Resources; John Schaper, attorney for Buckeye Irrigation Company and Buckeye Water Conservation and Drainage District; Robert B. Steytler, Assistant Director of the Water and Sewer Department for the City of Phoenix; William G. Bingham, Project Engineering Manager for Bechtel Power Corporation; and Jack Muir, Director of Wastewater Utilities for the City of Tolleson. Intervenor's witnesses were: William L. Lorah, Vice President of Wright Water Engineers;

(footnote continued on next page)

A. Cooling Water Sources

4. The source of condenser cooling water for PVNGS is treated sewage effluent from the Multi-City 91st Avenue Sewage Treatment Plant ("91st Avenue Plant")[15] and from the City of Tolleson Wastewater Treatment Plant ("Tolleson Plant"). Sewage effluent from the 91st Avenue Plant and the Tolleson Plant will be conveyed to PVNGS via a 36.5-mile underground pipeline originating at the 91st Avenue Plant. (Hulse, ff. Tr. 404, p. 2). Effluent from the City of Phoenix 23rd Avenue Sewage Treatment Plant ("23rd Avenue Plant") has been contracted for and could provide a back-up source, but no pipeline for the transport of effluent from the 23rd Avenue Plant to the 91st Avenue Plant has been constructed.

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[14] (footnote continued from previous page)

William Paul Robinson, Executive Director and Environmental Analyst for the Southwest Research and Information Center; Edwin K. Swanson, Manager of the Ambient Water Quality Unit of the Bureau of Water Quality Control for the Arizona Department of Health Services; James L. Lemmon, Hydrologist with the Bureau of Waste Control of the Arizona Department of Health Services, Edwin E. Van Brunt, Vice President, Nuclear Projects Management of the Arizona Public Service Company as an adverse witness; and John Robert McCain, Staff Director of Arizona Municipal Water Users Association. The NRC Staff's witnesses were: Emanuel Licitra, Project Manager, Division of Licensing, U. S. Nuclear Regulatory Commission; and Raymond O. Gonzales, Hydraulic Engineer, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission.

[15] The ownership of the 91st Avenue Plant is shared by the Cities of Phoenix, Glendale, Mesa, Scottsdale, Tempe and the Town of Youngtown. The City of Phoenix operates the 91st Avenue Plant and also owns and operates the 23rd Avenue Plant. (JA Ex. H, Section 2.1).

5. Effluent from the 91st Avenue Plant will be obtained for PVNGS pursuant to "Agreement No. 13904, Option and Purchase of Effluent," dated April 23, 1973, among the Cities of Phoenix, Glendale, Mesa, Scottsdale, Tempe and the Town of Youngtown ("Multi-Cities"), Arizona Public Service Company ("APS") and Salt River Project Agricultural Improvement and Power District ("SRP") ("Agreement 13904"). Pursuant to Agreement 13904, APS and SRP may purchase up to 140,000 acre-feet/year from the 91st Avenue Plant, when available after satisfaction of specific prior commitments,[16/] and, when not available at the 91st Avenue Plant, from the 23rd Avenue Plant. (Id., see JA Ex. H).

6. Agreement 13904 is an option agreement pursuant to which APS and SRP may acquire up to 35,000 acre-feet/unit for a maximum of four units of the Arizona Nuclear Power Project. (Hulse, Tr at 463). Agreement 13904 provides, however, that APS and SRP may unilaterally transfer any portion of the option effluent not required for any of the four units to any other electric generating unit wherever located. (JA Ex. H, Section 6.1) The contract is basically a requirements type of contract. APS and SRP are entitled under the contract to take whatever quantity of effluent is required for the operation of the power produc-

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16/ The prior commitments are identified in Board Finding 31, infra.

tion facilities, up to a maximum of 140,000 acre-feet/year. (Hulse, Tr. at 464).

7. Under the terms of Agreement 13904, the Multi-Cities obligated themselves not to construct any other sewage treatment plant within a specified area until such time as the combined capacities of, and the effluent available from, the 91st and 23rd Avenue Plants are sufficient to meet their obligations under Agreement 13904. (Id., Section 7.3). The latest available projections of effluent from the 91st and 23rd Avenue Plants indicate that the effluent available will exceed all current contractual requirements by approximately 1995. (JA Ex. LL, p. IV-3, Table IV-1). Accordingly, the contractual constraint on the development of other sewage treatment plants is projected to be eliminated by that time.

8. The price for effluent obtained pursuant to Agreement 13904 consists of annual option payments of $1 per acre-foot for the quantity of effluent actually available for sale during the prior year until such time as construction permits for the electric generating units are issued. At such time as construction is authorized, the annual option payments are increased to $2 per acre-foot. The price for effluent actually delivered under the options is 40% of the price established for Central Arizona Project ("CAP") water sold for municipal and industrial uses ("M&I Water"), but not less than $20 per acre-foot, nor more than

$30 per acre-foot. If effluent is delivered prior to the establishment of the price for CAP M&I Water, the price for such effluent is $20 per acre-foot. (JA Ex. H, Sections 6.5, 6.6, 8.2).

9. By its terms Agreement 13904 will terminate 40 years after the last generating unit for which the effluent is purchased, or December 31, 2040, whichever occurs first. (JA Ex H, Section 4). Option payments have been made to the Multi-Cities in the amount of $1,200,000. (Hulse, Tr. at 466). Effluent is currently being delivered to PVNGS for construction purposes. (Id. at 468). Agreement 13904 has been and is currently being treated by the parties thereto as a valid and subsisting contract.

10. The design capacity of the 91st Avenue Plant is 90 million gallons per day ("mgd"), and it has treated successfully up to 120 mgd. The design capacity of the 23rd Avenue Plant is 37.2 mgd, and it has treated successfully 40 mgd. (Steytler, Tr. at 846; McCain, Tr. at 2278; JA Ex. LL, p. III-13). The capacity of the 91st Avenue Plant is currently being expanded to 120 mgd. (Steytler, Tr. at 847; McCain, Tr. at 2275). The expansion is scheduled to be operational in the summer of 1982. (Steytler, Tr. at 847). An additional expansion to 150 mgd is planned and scheduled for completion by 1986. (Steytler, Tr. at 847; JA Ex. LL, p. III-20).

11. On June 12, 1981, the City of Tolleson, APS and SRP entered into an "Agreement for the Sale and Purchase of Wastewater Effluent" ("Tolleson Agreement"). Under the Tolleson Agreement, APS and SRP are obligated to purchase and accept (a) all of the sewage effluent produced through the operation of the Tolleson Plant in excess of the sum of 2.0 mgd (i.e., 186 acre-feet/month) committed for the production of sod adjacent to the Tolleson Plant ("Committed Effluent") and 10 percent of the amount of effluent in excess of the 2.0 mgd reserved by Tolleson ("Reserved Effluent") and (b) any amounts of the Committed Effluent not actually sold, and of the Reserved Effluent not actually used or otherwise disposed of by Tolleson, but not to exceed 8.3 mgd, or 9,300 acre-feet/year. The obligation to purchase does not apply to effluent from the Tolleson Plant that does not meet minimum quality requirements specified in Tolleson's NPDES discharge permit issued by the Environmental Protection Agency or other requirements imposed by law. The Tolleson Agreement was amended on November 12, 1981. (Hulse, ff. Tr. 404, pp. 5-6; see JA Ex. J, pp. 1-3, 7; JA Ex. K).

12. The price for effluent obtained under the Tolleson Agreement is the greater of (i) $35 per acre-foot, plus an adjustment as defined in the Tolleson Agreement, (ii) 45% of the price per acre-foot for CAP M&I Water, or (iii) 100% of the price per acre-foot paid under Agreement

13904. (JA Ex. J, Section 2.1). There is no ceiling or maximum price as in Agreement 13904.

13. The design capacity of the Tolleson Plant is 8.3 mgd, or 9,300 acre-feet/year. The Tolleson Plant is currently treating 6 mgd, or 6,400 acre-feet/year. (Muir, Tr. at 1034-35).

14. APS and SRP have dedicated to the operation of PVNGS as much of their entitlement under Agreement 13904 as is required for such operation. (Hulse, ff. Tr. 404, p. 2). APS and SRP have also dedicated their entitlement under the Tolleson Agreement to the operation of PVNGS. (Id. at 6). Accordingly, the Applicants have existing contractural commitments for the supply of wastewater effluent in the maximum aggregate amount of approximately 149,000 acre-feet/year, or 133 mgd.

15. Effluent has been delivered to the PVNGS site from both the 91st Avenue Plant and the Tolleson Plant via the 36.5-mile underground pipeline originating at the 91st Avenue Plant. (Bingham, Tr. at 1296-97).

B. Cooling Water Requirements

16. The condenser cooling water requirements for each unit at PVNGS have been estimated to be 21,350 acre-feet/year (19.0 mgd), or 64,050 acre-feet/year (57.2 mgd) for all three units. This estimated requirement is based on the use of average ambient meteorological conditions and the assumptions that (a) each PVNGS unit will operate at a

capacity factor of 95% of rated power for 11 months each year and will experience a one-month outage each year in December[17] for refueling and maintenance,[18] (b) there will be no treatment of the cooling water blowdown from the circulating water system, (c) cooling water losses will be as defined in Figure 3.3-1 of the Environmental Report-Operating License Stage ("ER-OL") for PVNGS (JA Ex. X)[19] and (d) concentrations of dissolved solids in the influent to the circulating water system will be permitted to be increased by a factor of 15. (Bingham, ff., Tr. 920, p. 2; see JA Ex. T, p. WGB-3).

17. The assumption that each PVNGS unit will operate at a capacity factor of 95% of rated power for 11 months each year and will experience a one-month outage each year for refueling and maintenance is a conservative assumption for purposes of determining cooling water requirements. (Hulse, Tr. at 408).

17/ December was selected as the month for the refueling outage because, under average ambient meteorological conditions, effluent requirements would be lowest in that month. If refueling occurs in any other month, annual requirements for condenser cooling would be reduced. (Bingham, Tr. at 926-27; JA Ex. T, p. WGB-3).

18/ The annual capacity factor would be approximately 87%. (Hulse, Tr. at 408).

19/ The reservoir loss due to evaporation is shown in the ER-OL as 180 gpm. (JA Ex. X, Figure 3.3-1, sheet 2 of 4). The actual evaporation loss for the reservoir is .387 mgd, or 269 gpm. (Bingham, Tr. at 2591-92).

18. Effluent requirements for PVNGS will be greatest during the summer months when evaporation rates are highest. Historically, June is the month when atmospheric conditions result in the highest evaporation rates. (Gonzales, ff. Tr. 2522, p. 2; see JA Ex. X, Section 3.4.1; JA Ex. T, p. WGB-3).

19. Effluent requirements for PVNGS were calculated using monthly averages of consumptive use based on average monthly meteorological conditions. The summation of the monthly averages of consumptive use was used to calculate an annual average effluent requirement. (Bingham, Tr. at 923; see JA Ex. T, p. WGB-3).

20. Average ambient meteorological conditions were determined by calculating arithmetic daily averages from measured data and then calculating an arithmetic monthly average from the daily averages. Such meteorological monthly averages were used to calculate the condenser cooling requirements for each month. (Bingham, Tr. at 923-24).

21. The average air temperature for the month of June used to determine makeup requirements for that month was 88°F based on onsite data for the years 1974 and 1975. This average temperature results in a makeup requirement of 2123 acre-feet at 95% load. (Bingham, Tr. at 928; see JA Ex. T, p. WGB-4). This figure was one of the highest average temperature figures for the month of June that were re-

viewed by Joint Applicants, and led to an approximately 20% higher comsumptive use than would be calculated using 60 years of data from Buckeye, 30 years of data from Phoenix, 40 years of data from Litchfield Park, 60 years of data from Gila Bend, and 8 years of onsite data. (Bingham, Tr. at 1205, 1212-13). Makeup requirements for June are higher than in any other month of the year. (JA Ex. T, p. WGB-3).

22. The quantity of makeup required for the Circulating Water System ("CWS") is also dependent on the cycles of concentration of the constituents in the water in the CWS. (Bingham, Tr. at 936; see JA Ex. U Revised, p. WGB-6 (Revised 5/24/82)). Under steady state conditions the relationship is:

$$\text{MU flow} = \frac{C}{C-1} \text{ (59,100 acre-feet/year)}$$

where:

MU flow = makeup flow for all three PVNGS units in acre-feet/year,

C = cycles of concentration of the constituents in the water in the CWS, and

59,100 acre-feet/year = evaporation plus drift (three units, 95% power, one month shutdown in December).

(Int. Ex. IX, Bingham, Tr. at 1147-48, 1183-84). This relationship is graphically shown on page WGB-6 of Joint Applicants' Exhibit U Revised.

C. Effluent Projections

23. In 1979, the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency prepared projec-

tions of effluent production at the 91st Avenue Plant and the 23rd Avenue Plant in connection with the Final Environmental Impact Statement for the Maricopa Association of Governments ("MAG") Point Source Metro Phoenix 208 Wastewater Management Plan (hereinafter referred to as "1979 MAG projections"). (Hulse, ff. Tr. 404, p. 3; Gonzales, ff. Tr. 2522, pp. 3-4; see JA Ex. B).

24. The 1979 MAG projections estimate the effluent availability from the 91st Avenue Plant for the years 1980, 1983, 1985, 1990, 1995 and 2000. (Gonzales, ff. Tr. 2522, pp. 3-4; see JA Ex. B, p. C-1). Monthly estimates corresponding to the 1979 MAG projections are available for the years 1980 through 1986 from the City of Phoenix 23rd and 91st Avenue Wastewater Treatment Plants Draft Residuals Management Facility Plan, Volume 5 - Phase C, Effluent Discharge Assessment, by Arthur Beard Engineers and Camp Dresser & McKee, Inc. (August 1980), Exhibit C, Effluent Flow Projections, by Greeley and Hansen (January 1980) (JA Ex. C). (Hulse, ff. Tr. 404, p. 4; Hulse, Tr. at 417-21; Gonzales, ff. Tr. 2522, pp. 8-9; see JA Ex. C, pp. C-5 to C-7).

25. The City of Phoenix in 1979 also made projections of effluent flow from the 91st Avenue Plant. (Hulse, ff. Tr. 404, p. 3; Gonzales, ff. Tr. 2522, p. 4). The City of Phoenix 1979 projections are higher than the 1979 MAG projections for corresponding years. (Gonzales, ff. Tr. 2522, p. 4).

26. In 1981, the City of Phoenix prepared revised effluent projections for both the 91st Avenue Plant and the 23rd Avenue Plant for the years 1981, 1985, 1990, 1995 and 2000. (Steytler, Tr. at 849-56; Gonzales, ff. Tr. 2522, p. 5; see JA Ex. D). The estimates for 1981 were prepared based on actual flow for the first six months plus an estimate, based on historical patterns, for the last six months. (Steytler, Tr. at 854). Estimates for the years 1985, 1990, 1995 and 2000 were based upon a regression analysis. (Steytler, Tr. at 855). The 1981 City of Phoenix effluent projections for the 91st Avenue Plant are higher than the 1979 MAG projections for corresponding years. (Gonzales, ff. Tr. 2522, p. 5).

27. In September 1981, MAG revised its effluent projections. The 1981 MAG projections show more effluent being processed at the 91st Avenue Plant than the 1979 MAG projections. (Gonzales, ff. Tr. 2522, p. 5).

28. In May, 1982, MAG published a Draft Point Source Plan Update for the 208 Water Quality Management Program providing for additional sewage treatment facilities based upon further revised effluent projections. (Hulse, Tr. at 441-42; JA Exs. F & LL). The update was prepared due to (a) increased population projections by the MAG Transportation Planning Office, (b) passage of the Arizona Groundwater Management Act which places emphasis on water conservation, (c) changes in planning area for some communi-

ties, (d) identification of specific developments which require specific wastewater planning, and (e) proposed Central Arizona Project ("CAP") allocations which encourage the trading of effluent for CAP water. (JA Ex. LL, p. I-1). The selected point source plan for the Multi-City and Tolleson/Peoria Sub Regional Operating Groups described in the update includes a further expansion of the 91st Avenue Plant from 120 mgd to 150 mgd by 1985-87 and an expansion of the 23rd Avenue Plant to 42.5 mgd initially, with a further expansion to approximately 50 mgd by 1985-1990. (Id. at III-1 to -2, III-9 to -13, III-20). The City of Phoenix is planning to expand the 91st Avenue Plant to 150 mgd in light of the 1982 MAG projections, and would be expected to operate the 91st Avenue Plant at its full capacity. (McCain, Tr. at 2304-05, 2426-27). The selected point source plan includes two satellite sewage treatment plants at Arrowhead Ranch and North Scottsdale. (JA Ex. LL, pp. III-19, III-20). The projections of effluent from the 91st Avenue Plant under the selected plan (id., p. IV-3, Table IV-1) are higher than the 1979 MAG projections (JA Ex. B, Table C-1) for corresponding years.

29. The 1982 MAG update also considered wastewater treatment plants in East Mesa and the Northeast area in addition to the expansion of the 91st Avenue Plant and the 23rd Avenue Plant. (JA Ex. LL, pp. IV-2, IV-4, Table IV-2). The completion date and estimated cost of each of

such plants were not given in the 1982 update because the plants were not part of the selected point source plan. (Id., p. III-23; McCain, Tr. at 2309-10). Projections of effluent from the 91st Avenue Plant, assuming such plants are constructed, were prepared and included in the 1982 update. (JA Ex. LL, p. IV-4, Table IV-2).

30. In 1986 it is anticipated that 7.5 mgd, or 8,400 acre-feet/year, or 700 acre-feet/month, will be processed through the Tolleson Plant. This projection is based on population projections for the City of Tolleson, usage of 75 gallons per capita per day for domestic wastewater, plus existing contracts for the treatment of both domestic and industrial wastes. (Muir, Tr. at 1035). Based on this projection, the minimum amount available at the Tolleson Plant for use at PVNGS is 4.95 mgd, or 5,540 acre-feet/year.

D. Effluent Availability for PVNGS

31. The existing commitments for effluent discharged from the 91st Avenue Plant are 30,000 acre-feet/year, or 26.8 mgd, for the Buckeye Irrigation Company ("BIC"), 7,300 acre-feet/ year, or 6.5 mgd, for the Arizona Department of Game and Fish ("ADGF"), and 140,000 acre-feet/year for PVNGS. (Hulse, ff. Tr. 404, p.4; see JA Ex. H, p. A-1; JA Ex. LL, p. IV-4, Table IV-1). On a monthly basis, these commitments are 2500 acre-feet/month for BIC and 600 acre-feet/month for ADGF. (Hulse, Tr. at 438-39; Schaper, Tr. at 806-07).

32. A prior commitment of 1,200 acre-feet/year to the U.S. Water Conservation Laboratory ("WCL") has not been used since 1978 when the laboratory's research facilities at Flushing Meadows were washed out by flood waters. WCL has since moved its facilities and is no longer taking any effluent from the 91st Avenue Plant. (Hulse, ff. Tr. 404, p. 4).

33. The sum of the estimated amount of effluent available at the 91st Avenue Plant based on the 1979 MAG projections, less the commitments to BIC and ADGF, and the estimated amount of effluent available at the Tolleson Plant, is greater than the estimated requirements for all three PVNGS units for each month beginning in May, 1986, the month when the last of the three PVNGS units commences operation, based on an annual capacity factor of 87%. (Hulse, Tr. at 409-10, 420-21; JA Ex. A).

34. The amount of effluent available at the 91st Avenue Plant and the Tolleson Plant for use at PVNGS under either the 1981 MAG projections, the 1982 MAG projections for the selected point source plan, or the 1981 City of Phoenix projections is greater than the amount available under the 1979 MAG projections. (Hulse, Tr. at 431, 443-45; Gonzales, ff. Tr. 2522, pp. 5, 9).

35. The 1981 effluent projections of the City of Phoenix for the year 1985 are considered to be generally accurate by Intervenor's witness McCain. (McCain, Tr. at

2326). The 1981 Phoenix effluent projection for the 91st Avenue Plant for 1985 is 128.1 mgd. (Id. at 2327; see JA Ex. D). After satisfaction of the prior commitments to ADGF of 6.5 mgd and to BIC of 26.8 mgd, the amount left for PVNGS is 94.8 mgd, which is 36.8 mgd, or 63% in excess of the amount of effluent of approximately 58 mgd required to operate all three PVNGS units. (McCain, Tr. at 2330, 2332-34). Mr. McCain testified that the 91st Avenue Plant would produce enough effluent for the operation of all three PVNGS units. (Id. at 2334).

36. Under the 1982 MAG projections for the selected point source plan, in 1985, after satisfaction of the prior commitments for effluent from the 91st Avenue Plant,[20] the amount of effluent available at the 91st Avenue Plant for use at PVNGS exceeds the estimated requirements of PVNGS with all three units operating by 14.3 mgd, or 24%.[21] (JA Ex. LL, p. IV-3, Table IV-1).

37. Under the 1982 MAG projections which consider wastewater treatment plants at East Mesa and in the Northeast area, the amount of effluent available at the 91st Avenue Plant for use at PVNGS, in 1985, after satisfaction

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[20] See Board Finding 31.

[21] The total projected amount of effluent available from the 91st Avenue Plant in 1985 is 105.6 mgd. Prior commitments for effluent from the 91st Avenue Plant total 33.3 mgd. The amount available for use at PVNGS is 105.6 - 33.3, or 72.3 mgd. The estimated requirements of PVNGS with all units operating are approximately 58 mgd.

of prior commitments, exceeds the estimated requirements of PVNGS with all three units operating by 4.9 mgd, or 8%. (Id., p. IV-4, Table IV-2).

38. Based on the 1982 MAG projections with wastewater treatment plants at East Mesa and in the Northeast Area, the excess effluent available at the 91st and 23rd Avenue Plants, after satisfaction of PVNGS actual requirements and prior commitments, is as follows:

Year	Effluent Available at 91st and 23rd Avenue Plants (mgd)	PVNGS Actual Requirements plus Prior Commitments (mgd)	Excess Effluent (mgd)
1985	138.6	72.0	66.6
1990	149.7	91.3	58.4
1995	162.8	91.3	71.5
2000	177.9	91.3	86.6
2010	210.0	91.3	118.7

(JA Ex. LL, p. IV-4, Table IV-2).

The column captioned "Excess Effluent" is the same as the last column in Table IV-2 of Joint Applicants' Exhibit LL for corresponding years.

39. The effluent discharged from the 91st Avenue Plant in 1981 was 102.95 mgd, or 115,300 acre-feet. (JA Ex. E; Hulse, Tr. at 433-34). The effluent discharged from the 91st Avenue Plant in June, 1981, was 94.8 mgd, or 8,863 acre-feet. (JA Ex. E; Hulse, Tr. at 438). After deducting the prior commitments of 2500 acre-feet for BIC and 600 acre-feet for ADGF from the amount discharged, and adding to the balance the amount of 700 acre-feet from the Tolleson Plant,

the total effluent available for use at PVNGS would be 6463 acre-feet, or 2154 acre-feet/unit. (Hulse, Tr. at 438-40). The cooling water requirement for June for each PVNGS unit is 2123 acre-feet. (Board Finding 21).

40. PVNGS has an onsite reservoir containing a nominal 2300 acre-feet of water. (JA Ex. X, p. 3.3-1). The capacity of the reservoir provides a minimum seven days of water supply for the three PVNGS units under adverse demand. (Id., p. 3A-11).

41. The Board finds that under any and all of the effluent projections for the 91st Avenue Plant and the Tolleson Plant contained in the record, the amount of effluent available for use at PVNGS, after satisfaction of prior commitments, will be sufficient to operate all three PVNGS units based on the condenser cooling requirements identified in Board Finding 16.

E. Section 21 of Agreement 13904

42. Section 21 of Agreement 13904 provides as follows:

> "INTERRUPTION OF DELIVERY OF EFFLUENT:
>
> 21.1 Cities shall have the right to refuse to deliver Effluent under the terms of this Agreement when the following occurs:
>
> (a) There exists in the Cities a critical need for water to be used for domestic purposes;
>
> (b) All other reasonable sources of water, including any

Uncommitted Effluent in excess of the Option Effluent, have been exhausted;

(c) Reasonable steps have been taken to conserve the water supply in the Cities; and

(d) Reasonable notice of the critical need has been given to Participants.

When the critical need expires, or when other reasonable sources of water become available, Cities can no longer refuse to deliver Effluent under the terms of this Agreement. The Cities shall use their best efforts to resume deliveries of Effluent hereunder at the earliest practical time in the event such deliveries are interrupted in accordance with this Section 21." (JA Ex. H, Section 21).

43. Section 21 has at no time been invoked by the Multi-Cities which are parties to Agreement 13904. (Hulse, Tr. at 474; McCain, Tr. at 2237).

44. The Multi-Cities which are parties to Agreement 13904, prior to any interruption in the supply of effluent under Section 21, must exhaust all reasonable sources of water, including any uncommitted effluent in excess of the effluent required at PVNGS. (Hulse, Tr. at 471, see JA Ex. H, Section 21.1(b)). There is currently excess effluent available at the 23rd Avenue Plant in the amount of 38,000 to 40,000 acre-feet/year. (Hulse, Tr. at 471-73).

45. If a critical need develops, the five cities which are both members of the Arizona Municipal Water Users

Association ("AMWUA") and parties to Agreement 13904[22/] would consider invoking Section 21. (McCain, Tr. at 2232, 2235-36). Based on the amount of water available over the next 50 years to the cities of Phoenix, Tempe, Mesa, Scottsdale, and Glendale, the various projections of effluent availability, the effluent requirements for PVNGS, and the quantity of excess effluent available to the cities, the possibility that Section 21 will ever be invoked is considered highly remote. (Hulse, Tr. at 479-80; Board Findings 38, 83).

F. Water Resources for Cities

46. The Salt River Valley Water Users Association ("SRVWUA") was incorporated in 1903. Its purpose was to contract with the Federal Government for the repayment of certain reclamation facilities that were constructed by the Federal Government. The owners of land within the SRVWUA are the beneficiaries of the reclamation facilities constructed by the Federal Government. The Salt River Project Agricultural Improvement and Power District ("SRP") is responsible for operating these reclamation facilities. (Juetten, Tr. at 624-25).

47. The boundaries of the SRVWUA (shown in green on JA Ex. M) lie within the boundaries of the Salt River

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22/ The Town of Youngtown is a party to Agreement 13904 but is not a member of AMWUA. (McCain, Tr. at 2197).

Reservoir District ("SRRD") (shown in red on JA Ex. M).[23] Within the boundaries of the SRVWUA are approximately 238,000 acres (referred to as "member lands"), approximately 100,000 of which are currently in commerical agricultural production, and the balance of which have been urbanized and for the most part incorporated into the cities of Phoenix, Glendale, Peoria, Tempe, Mesa, Chandler, Gilbert and Tolleson. (Juetten, Tr. at 633-34).

48. Surface waters available to the Salt River Project originate in a 13,000 square mile drainage basin. These surface waters are collected and stored in six reservoirs, two along the Verde River, and four along the Salt River. The waters are diverted at Granite Reef Dam into the Arizona Canal and the South Canal for distribution within the SRRD. The capacity of the six reservoirs is slightly over 2,000,000 acre-feet. (Id. at 636-37). The developed water resources available to the Salt River Project consists of groundwater pumped by 249 deep-well pumps. (Id. at 637). Approximately 60% of the water delivered by SRP is surface waters; the remaining 40% is developed water.

49. Cities which have member lands within their boundaries receive surface and developed waters from SRP for distribution within such member lands. (Id. at 645-46).

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[23] The term Salt River Project is used interchangeably with the SRRD. (Juetten, Tr. at 643).

Cities which have expanded outside the boundaries of the SRRD must develop their own water supplies to serve such areas. (Id. at. 644).

50. The City of Tempe lies entirely inside the SRRD. Besides surface water and developed water received from SRP, Tempe also has several wells. (Id. at 645, 652; McCain, Tr. at 2179).

51. The City of Mesa lies both inside and outside the boundaries of the SRRD. (Juetten, Tr. at 640). The water resources for the area of Mesa inside the SRRD are city wells and surface and developed waters received from SRP. (Id. at 653; McCain, Tr. at 2179). The water resources for the area of Mesa outside the SRRD are wells owned by Mesa and water supplies from private water companies (Juetten, Tr. at 654). The water resources for the area of Mesa lying outside the SRRD are considered adequate over the next five years based on the delivery by Mesa of excess water developed outside the SRRD to inside the SRRD. Mesa has not used its full entitlement to the surface water or developed water of SRP. (Id.)

52. The City of Glendale lies both inside and outside the boundaries of the SRRD (Id. at 644, 654-55). The water resources of Glendale inside the SRRD consist of city wells and surface and developed waters received from SRP. (Id. at 654-55, McCain, Tr. at 2179). The water resources of Glendale outside the SRRD are wells. (Juetten,

Tr. at 654-55). The water resources of Glendale outside the SRRD are adequate over the short term, that is, until the arrival of Central Arizona Project water, based on the excess capacity of Glendale's wells located outside the SRRD. (Id. at 655, 573).

53. The City of Scottsdale lies both inside and outside the boundaries of the SRRD. (Id. at 656-57). That portion of Scottsdale inside the SRRD is served by the City of Phoenix and by Scottsdale wells and SRP wells. (Id at 656-57; see McCain, Tr. at 2179, 2379). The water resources of Scottsdale outside the SRRD are wells. (Juetten, Tr. at 657). The water resources of Scottsdale outside the SRRD are adequate over the short term based on the excess capacity of its wells. (Id. at 657-58).

54. The City of Phoenix is located both inside and outside the SRRD. (Id. at 640). The water resources for Phoenix inside the SRRD are surface waters received from SRP and wells located on member and non-member lands. The water resources for Phoenix outside the SRRD are city wells and gate water credits. Between 1948 and 1952, gates were installed on Horseshoe Dam. (Id. at 691). Phoenix paid $800,000 for the construction of these gates and by contract acquired rights to the water that accumulates behind the gates. (Id. at 660, 683). The storage capacity behind the gates is 73,032 acre-feet. (Id. at 687). The amount of water stored against the gates is recorded and the record is

termed "gate water credits." (Id. at 659-61). Gate water may be used by Phoenix either inside or outside the SRRD. (Id. at 663). The quantity of water available to Phoenix from the gate water credits varies from time to time and is dependent on runoffs from precipitation on the Verde River watershed. (Id. at 661, 684-85). Gate water credits declined throughout the summer of 1981 and stood at approximately 16,000 acre-feet at the end of January, 1982. (Id. at 664). Storms and runoff occurring in March of 1982 resulted in an accumulation of gate water credits such that Phoenix had approximately 85,000 acre-feet of gate water as of May 1, 1982. (Id. at 671).

55. Joint Applicants' Exhibit O is an estimate of the gate water balance for the City of Phoenix at the end of each year through 1985 based on the city's annual demand, existing wells, plans for new wells, plans for conservation and implementation of certain SRP programs. (JA Ex. O, Juetten, Tr. at 665-73). The City of Phoenix will be constructing several new wells within the next five years. (Juetten, Tr. at 662; McCain, Tr. at 2179). Phoenix will also be reducing its per capita consumption through conservation. (McCain, Tr. at 2180). Significant conservation savings can be made through improved domestic irrigation practices. (McCain, Tr. at 2324). Such measures should have no impact upon sewage flows. (Id. at 2325). The SRP programs refer to several programs being implemented by SRP

and Phoenix to assist the city with its water supply to areas outside the SRRD. (Juetten, Tr. at 668). With the new wells, conservation and implementation of SRP programs, Phoenix will be able to meet its demand and still have a credit balance in its gate water account at the end of 1986, assuming that no additional gate water credits are accumulated. (Id. at 673).

56. In order to drill a new well, the city must obtain a permit from the Arizona Department of Water Resources ("ADWR"). (Juetten, Tr. at 696; Steiner, Tr. at 787; McCain, Tr. at 2211-12). ADWR has no authority to deny a permit to a city as long as the city is drilling the new well within its service area. (Steiner, Tr. at 787). There have been no denials of service area permits by ADWR with respect to Phoenix, Glendale, Scottsdale, Tempe and Mesa. (McCain, Tr. at 2212).

57. The City of Phoenix operates approximately 130 wells, Scottsdale operates 19 wells, Tempe operates 9 wells, Mesa operates 22 wells and Glendale operates 22 wells. (McCain, Tr. at 2350).

58. Groundwater pollution has resulted in the closure of some existing wells. The Arizona Department of Health Services ("ADHS") found two wells in Phoenix, two wells in Scottsdale and three wells in Tempe to have levels of trichloroethylene ("TCE") above state action levels. (Int. Ex XXX, at 5). The two wells in Scottsdale and two of

the three wells in Tempe have been shut down due to the TCE contamination. (Swanson, Tr. at 1849; Int. Ex. XXX, Attachment A, p. 11). One of the Phoenix wells is being used as an exchange well with SRP, whereby the water from the Phoenix well is being traded to SRP for use as agricultural irrigation water in exchange for an equal amount of water, less an allowance for conveyance losses, suitable for use by Phoenix. (Swanson, Tr. at 1849, 1881-83; Int. Ex. XXX, Attachment A, p. 21). The other Phoenix well is still operating by blending its production with other water. (Swanson, Tr. at 1849-50; Int. Ex. XXX, p. 6). In addition to exchanges with SRP, there are several other alternatives available to the cities for use of wells with TCE concentrations higher than the state action level. (See Int. Ex. XXX, Attachment A, p. 43).

59. ADHS has also found some wells contaminated with dibromochloropropane ("DBCP") in citrus growing areas. One Mesa well and one Glendale well have been disconnected from the respective city's service system due to DBCP contamination. (Int. Ex. XXX, pp. 6-8; Int. Ex. XXX, Attachment C, pp. 12-16). DBCP is now banned from use in the United States. (Swanson, Tr. at 1869). As with TCE, treatment techniques exist for removal of DBCP. (Swanson, Tr. at 1853-54). Water contaminated with DBCP is also suitable for irrigation. (Swanson, Tr. at 1854).

60. TCE and DBCP groundwater contamination problems have reduced somewhat the flexibility of the affected

cities to deliver water of acceptable quality. (Swanson, Tr. at 1850). However, the cities have been able to meet consumer demand. (Id. at 1849-51; see Id. at 1881).

61. Intervenor's witness Lemmon testified about groundwater contamination from existing landfills along the Salt River. Based on numerous assumptions, Mr. Lemmon estimated that 700,000 to 800,000 acre-feet of groundwater within two miles of each side of the Salt River along a 20-mile length could be contaminated over the next 20 years. (Int. Ex. XXXIII, pp. 4-7; Lemmon, Tr. at 1984-89). The City of Phoenix apparently had three wells within the four-mile band which were operational in 1980, and the City of Scottsdale apparently had a standby well within such band. (Lemmon, Tr. at 1919-21). Groundwater which may be contaminated from existing landfills could be made useable for drinking water with proper treatment. (Id. at 1922).

62. In 1981, the cities of Tempe, Mesa, Glendale, Scottsdale and Phoenix collectively used 255,156 acre-feet of water received from SRP. The quantity of water available to such cities during that period was 266,787 acre-feet plus 71,220 acre-feet of special pump rights. None of the cities used its full SRP entitlement in 1981. (Id. at 676-77, JA Ex. P). The condition of excess resources over usage for those areas of the five cities lying within the SRRD is expected to continue as the cities continue to urbanize the agricultural areas. (Juetten, Tr. at 677; Steiner, Tr. at 754-55; McCain, Tr. at 2216).

G. Central Arizona Project

1. Allocations

63. The Central Arizona Project ("CAP") is a federal reclamation project. The purpose of the CAP is to develop and bring into central Arizona most of the State of Arizona's remaining entitlement to Colorado River water. (Steiner, Tr. at 741).

64. The CAP consists of basically three aqueducts and associated pumping facilities and reservoirs. The aqueduct from the Colorado River to Phoenix is known as the Granite Reef Aqueduct and will extend from Lake Havasu at the Colorado River to a point just east of the Phoenix area near the Granite Reef Dam. The Salt-Gila aqueduct extends from Granite Reef Dam to the Picacho Reservoir 20 miles south of Coolidge between Phoenix and Tucson, and is expected to be completed in 1986. The Tucson aqueduct extends from the Picacho Reservoir to the Tucson area, and is expected to be completed in 1989-90. (Id. at 743-44; JA Ex. Q, p. 1). The Granite Reef Aqueduct is divided into 12 reaches. Nine of those reaches have been completed. The remaining three reaches are under construction. The three pumping plants along the Granite Reef Aqueduct are under construction. The Granite Reef Aqueduct is expected to be completed and able to deliver water by 1985. (Steiner, Tr. at 743). It is expected that CAP water will be used in the Phoenix area beginning in 1985. (Id. at 744-45; McCain, Tr. at 2179, 2199-20).

65. CAP waters are to be allocated to Indian uses, non-Indian municipal-industrial ("M&I") uses, including uses for mines and electric generating stations, and non-Indian agricultural uses (Steiner, Tr. at 746; see id. at 773-74). The Secretary of Interior has the responsibility to decide how the allocations are to be made. Each Secretary of Interior since 1969 has requested the State of Arizona to recommend the allocations, except as to Indian uses. The State has done so, and it is expected that the Secretary of Interior will rely on the Arizona recommendations. (Id. at 746-48).

66. The Bureau of Reclamation has completed and issued a Final Environmental Impact Statement on Water Allocations and Water Service Contracting for the CAP ("CAP FEIS"). (Steiner, Tr. at 747; JA Ex. Q). The proposed agency action identified in the CAP FEIS incorporates the Arizona recommendations sent to the Secretary of Interior in January, 1982. (Steiner, Tr. at 748; JA Ex. Q, pp. 9,15).

67. The Arizona recommendations for M&I uses included allocation figures only for the year 2034, the last year for repayment of CAP costs by CAP water users. However, M&I users will be permitted to take some or all of their 2034 allocation as early as 1985 as determined by agreement among the cities, Secretary of Interior, and Central Arizona Water Conservation District. In general, M&I users are not expected to require their full entitlement until around 2010. (Id. at 749-50; see id. at 794-95).

68. In developing the Arizona recommendation for the Secretary of Interior, the Arizona Department of Water Resources ("ADWR") conducted water supply studies and concluded that there would be at least 1,600,000 acre-feet of CAP water available in 1985 and in each of the early years of the CAP under average water supply conditions on the Colorado River. As the upper basin states of New Mexico, Utah, Colorado and Wyoming take their additional entitlements, the CAP water available under average water supply conditions will decrease from 1,600,000 to 1,300,000 in 2034. ADWR determined from its probability studies that, during shortages, 800,000 acre-feet would be available to the CAP two out of every three years, and that a minimum of 630,000 acre-feet would be available each year under the worst conditions of historic runoff as a firm supply. (Id. at 751-52). In the early years of the CAP, based on the amount of water in storage in the reservoir system, primarily Glen Canyon and Lake Mead, it would take a series of five years or so of drought runoff before 1,600,000 acre-feet/year would not be available to the CAP. (Id. at 776-80). The probability of 1,600,000 acre-feet being available to CAP users in each year from 1985 to 1990 is at least 90%. (Id. at 796).

69. ADWR allocated about 640,000 acre-feet/year for all non-Indian M&I uses. This allocation was based upon the availability of 800,000 acre-feet/year of CAP water

(630,000 acre-feet of firm supply and 170,000 acre-feet of non-firm supply), and deducting therefrom the amount of the CAP allocation to Indian uses not subject to reduction and allowances for exchanges.[24/] ADWR estimates that M&I users could have a maximum shortage of CAP deliveries of 20% in some years. (Id. at 752-54). In those years where shortages in CAP deliveries may occur, there would be increased groundwater withdrawals to meet M&I demand. (JA Ex. Q, p. C-20). CAP water in excess of the Indian and non-Indian M&I uses has been allocated to non-Indian agriculture. (Id. at 754). The CAP allocation for the Multi-Cities is 174,848 acre-feet/year, of which the Phoenix allotment is 116,239 acre-feet/year. (JA Ex. Q, pp. 34-35).

70. During shortages, CAP deliveries would first be reduced until exhausted to all non-Indian agricultural and miscellaneous uses. If further reductions are necessary, 25% of the Gila River Indian Tribe and 10% of other Indian agricultural uses would be reduced until exhausted. Finally, the remaining Indian agricultural uses would be reduced pro-rata with no more than 510,000 acre-feet of M&I uses. (JA Ex. Q, p. 20, Table 2, fn. 6; Steiner, Tr. at 754, 774-76).

24/ The Secretary of Interior has allocated approximately 310,000 acre-feet/year for Indian uses, both agricultural and non-agricultural. (Steiner, Tr. at 742-43). A portion (about 52,000 acre-feet/year) of this allocated amount is subject to reduction in periods of shortages prior to reductions in non-Indian M&I uses, and another portion (estimated to reach 100,000 acre-feet/year by 2034) is subject to exchange for effluent other than effluent required to meet existing contracts. (See Board Findings 70, 74-78).

71. For cities in the Phoenix area, M&I allocations were made only for the areas of those cities lying outside the SRP boundaries. This was done because as lands within the SRP boundaries are urbanized, the need to mine groundwater will decrease, and the surface water supply from the SRP and the sustainable yield from the groundwater basin will be at least equal to the demand on that supply, even with substantial amounts of effluent leaving the area. (Id. at 752-55).

72. An allocation of 55,400 acre-feet/year commencing in the year 2005 was made to APS and SRP for power generation. This allocation will be reduced to 43,218 acre-feet/year by the year 2034. ADWR allocations for power production were made based upon the assumption that 140,000 acre-feet of wastewater effluent would be available for generation of electricity and would be sufficient for power requirements through 2005. (Id. at 756).

73. The allocations made by ADWR were based on official state population projections developed by the Arizona Department of Economic Security. (Id. at 755). It is not expected that the allocation will impact projected population growth of any of the Multi-Cities or other communities in the Phoenix metropolitan area. (JA Ex. Q, p. C-20).

2. Effluent Exchanges

74. The proposed agency action in the CAP FEIS assumes treated effluent exchanges with the Indians of at

least 100,000 acre-feet per year by the year 2034. Because Indians without exception are opposed to exchanges of effluent for CAP water, the Secretary of the Interior has reserved the right to require the Indians to accept such exchanges if certain requirements are met. (JA Ex. Q, pp. 71-72).

75. The 100,000 acre-feet specified for effluent exchanges would not start in the first year of the CAP, but would build up in increments during the 50-year period ending in 2034. (Steiner, Tr. at 757-58). Prior to 2005, effluent exchanges would be made on the basis of two acre-feet of effluent for one acre-foot of CAP water. After 2005, the exchanges would be made on a one-to-one basis. (McCain, Tr. at 2185-86, 2424, 2429). The probability of exchanges of effluent for Indian CAP water by 1992 is low, but will become high by 2005-2010. (Id. at 2189-90; Steiner, Tr. at 757-58).

76. CAP water received in exchange for effluent will be shared by all M&I users of CAP water, regardless of which municipality(ies) supplied the effluent for exchange (McCain, Tr at 2185-86, 2190).

77. The 100,000 acre-feet specified for effluent exchanges is not to infringe on existing contracts. Such exchanges are assumed to be after and in addition to the delivery of 140,000 acre-feet of effluent contracted for by APS and SRP. (Steiner, Tr. at 757-58).

78. It appears to be impractical to transport effluent from the 91st Avenue Plant to the Indian Reservations in exchange for CAP water (McCain, Tr. at 2430-31). In order to effect effluent exchanges, it is likely that new treatment plants would have to be built near or on Indian Reservations. (Id. at 2190-92, 2430-31).

3. Sufficiency of Water Resources

79. The amount of water available in the Phoenix area from SRP, CAP and groundwater supplies will be adequate, when combined with the conservation program required by the Arizona groundwater law, to meet the M&I needs of the area for the next 50 years. (Steiner, Tr. at 758).

80. No CAP allocations were made for M&I uses within the SRRD because the water resources available to such areas from the SRP and groundwater supplies are considered adequate to meet the demand in such areas.

81. The Board finds that the existing water supplies available to those areas of the cities of Mesa, Scottsdale, and Glendale outside the SRRD are adequate to meet the needs of such areas until 1985. The Board also finds that the water supplies available to that portion of the City of Phoenix located outside the SRRD from existing wells, new wells, conservation, the implementation of other programs and gain water credits are adequate to meet the need in such area until 1985.

82. The Board finds that the water supplies available to those portions of the Cities of Phoenix, Mesa,

Scottsdale, and Glendale located outside the SRRD from the CAP, groundwater, gate water credits, and conservation will be adequate to meet the needs of the such areas from 1985 through 2034.

83. The Board finds that the amount of water available to the cities of Phoenix, Tempe, Mesa, Scottsdale, and Glendale over the next 50 years will be sufficient to meet the needs of those cities over such period.

H. Water Reclamation Plant

84. Effluent from the 91st Avenue Plant and the Tolleson Plant will be further processed at the Water Reclamation Plant ("WRP") located at PVNGS prior to being stored in the onsite reservoir for use as makeup to the Circulating Water System ("CWS"). (Bingham, ff. Tr. 920, p. 2; see JA Ex. X, p. 3.6-5).

85. The wastewater effluent is processed through the WRP in four stages of treatment: biological nitrification, lime treatment, filtration and chlorination. (Bingham, ff. Tr. 920, pp. 3-4; JA Ex. X, p. 3.6-5).

86. For nitrification, trickling filters are provided to reduce ammonia which reduces chlorination requirements, corrosion potential and sludge production. (Bingham, ff. Tr. 920, p. 4; see JA Ex. X, pp. 3.6-6B to 3.6-7).

87. Following nitrification, the effluent is passed through a two-stage lime treatment process to reduce

the concentrations of calcium, phosphate, silica and magnesium. (Bingham, ff. Tr. 920, pp. 3-4; JA Ex. X, p. 3.6-7).

88. Gravity filters are provided to remove residual amounts of suspended phosphorus, calcium and other solids. (Bingham, ff. Tr. 920, p. 4; JA Ex. X, p. 3.6-8).

89. Chlorination of the reclaimed water is provided for biological growth control of the water prior to storage in the reservoir. (Bingham, ff. Tr. 920, p. 4; JA Ex. X, p. 3.6-8).

90. The WRP has been designed and constructed with the active components in a parallel arrangement. The active components are sized to permit the design capacity of the WRP to be realized with any one of the parallel paths out of service. (Bingham, ff. Tr. 2585, pp. 19-20). A schematic diagram of the WRP is shown in Joint Applicants' Exhibit FF.

91. The WRP is designed for variable process flow rates, variable chemical addition rates, and variable recycle processing. A broad range (a factor of two) of inlet constituent concentrations can be accommodated while still achieving the quality specifications for the treated effluent being supplied as makeup to the CWS. (Bingham, ff. Tr. 2585, pp. 18-19).

92. Part 7A of Joint Applicants' Ex. BB (Int. Ex. XXV) is a reliability study of the WRP as described in Joint Applicants' Ex. BB. The reliability of the WRP as con-

structed is not the same as the reliability of the WRP described in Joint Applicants' Exhibit BB because the design of the WRP was modified from a modular design to a parallel arrangement of active components. (Bingham, ff. Tr. 2585, pp. 19-20). All clarifiers have redundant sludge pumps; spare pumps have been installed in the chemical feed systems; and automatic valves have bypass connections. Also, there are redundant power supplies and a spare centrifuge has been installed. (Bingham, Tr. at 1295, 2681). These modifications to the WRP have greatly improved the reliability of the WRP reported in Part 7A of Joint Applicants' Exhibit BB. (Bingham, Tr. at 2588).

I. Circulating Water System

93. The CWS is provided to remove thermal energy which has not been converted to electrical energy. The CWS consists of the main condenser, cooling towers, circulating water pumps, a chemical injection system, and a makeup and blowdown system. (JA Ex. X, p. 3.4-1).

94. Heat from the turbine exhaust steam is transferred to the circulating water in the CWS via the main condenser. The condenser has titanium tubes and an aluminum bronze tubesheet. (Bingham, ff. Tr. 2585, p. 9; JA Ex. X, pp. 3.4-1 to 3.4-2). The transferred heat is dissipated to the atmosphere in round, mechanical draft cooling towers. (JA Ex. X, p. 3.4-1). Chlorine, sulfuric acid, a foam control agent, and a dispersant can be added to the CWS via the

chemical injection system. Chlorine is added as sodium hypochlorite to control biological growth, sulfuric acid is added to reduce pH and control corrosion and scaling, and the dispersant is added to inhibit scaling of the heat exchange surfaces. (Id. at 3.4-4). Makeup to the CWS is required due to evaporation and drift from the cooling towers and blowdown. Makeup is taken from the treated effluent stored in the onsite reservoir. Blowdown from the CWS is directed to the onsite evaporation ponds. (Id.).

J. Water Reclamation Studies

95. During the period from August 1973 to September 1974, Joint Applicants conducted analyses of the effluent discharged from the 91st Avenue Plant and established and operated a demonstration water reclamation plant incorporating the principal relevant features of the proposed WRP and a circulating water test facility ("CWTF") at the 91st Avenue Plant. (Bingham, ff. Tr. 920, p. 3). Such analyses, operation, and testing were conducted to select the WRP and CWS water treatments and materials necessary to permit the CWS to operate at 20 cycles of concentration using treated wastewater effluent from the 91st Avenue Plant without excessive fouling, scaling, corrosion or biological growth. (Id. at 2-4).

96. Joint Applicants determined from the analyses and testing conducted in 1973 and 1974 that the principal constituents in the effluent discharged from the 91st Avenue

Plant which could cause scale formation, fouling, corrosion and contribute to biological growths were calcium, magnesium, silica, phosphorus and ammonia (hereinafter collectively referred to as "problem constituents"). (Id. at 3; see JA Ex. Y).

97. During 1973-74, approximately 1000 samples of 91st Avenue Plant effluent were taken and tested for the problem constituents. The average concentrations of the problem constituents obtained from those tests in mg/l were 52.9 for calcium (as Ca), 22.9 for magnesium (as Mg), 28.8 for silica (as SiO_2), 22.1 for phosphate (as PO_4) and 30.9 for ammonia (as N). (Bingham, Tr. at 1078; JA Ex. U Revised, p. WGB-5).

98. From 1976 on, samples of 91st Avenue Plant effluent have been analyzed by Controls for Environmental Pollution ("CEP"), consultant for Joint Applicants. (Bingham, Tr. at 941). The concentrations of the problem constituents as measured by CEP through December 1980 in mg/l were between 40 and 50 for calcium (as Ca), between 20 and 30 for magnesium (as Mg), about 33 for silica (as SiO_2), about 7.0 to 7.5 for phosphate (as P) and from about 20 to 30 for ammonia (as N). (Bingham, Tr. at 943, 945, 950, 951; JA Ex. U Revised, pp. WGB-12, WGB-14, WGB-16, WGB-18, WGB-20). The average values of the analyses made from 1976 to 1980 in mg/l were 46 for calcium (as Ca), 24 for magnesium (as Mg), 28 for silica (as SiO_2), 22 for phosphate

(as PO_4) and 18 for ammonia (as N). (JA Ex. U Revised, p. WGB-6 (Revised 5/24/82)).

99. Water quality tests similar to the tests performed on the 91st Avenue Plant effluent were conducted in March and April, 1982, on Tolleson Plant effluent. (Bingham, Tr. at 1234). Concentrations of the problem constituents as measured from these tests in mg/l were 38 to 46 for calcium (as Ca), 13.7 to 24 for magnesium (as Mg), 11 to 50 for silica (as SiO_2), 6 to 6.9 for phosphate (as P), and 1.8 to 18 for ammonia (as N). (Bingham, Tr. at 1237-38, 1297).

100. The average quality of the output from the demonstration water reclamation plant was 66.0 ppm for calcium (as $CaCO_3$), 6.0 ppm for magnesium (as $CaCO_3$), 8.0 ppm for silica as SiO_2), 0.1 ppm for phosphate (as P), and 5.0 ppm for ammonia (as N). (JA Ex. BB, Part 5, p. 5-6).

101. The performance warranty limits for influent to the WRP in mg/l are 64 for calcium (as Ca), 28 for magnesium (as Mg), 40 for silica (as SiO_2), 56 for phosphate (as PO_4), and 35 for ammonia (as N). (Bingham, Tr. at 940, 1099; JA Ex. U Revised, p. WGB-6 (Revised 5/24/82)). The performance warranty limits are not design limits. (Bingham, Tr. at 1099, 1219). The design limits for the WRP can be obtained by increasing the performance warranty limits for each of the problem constituents by at least a factor of 2. (Bingham, Tr. at 1219-21).

102. Design concentrations of the problem constituents in the output of the WRP in mg/l are 70 for calcium (as $CaCO_3$), 8 for magnesium (as $CaCO_3$), 10 for silica (as SiO_2), 0.5 for phosphate (as PO_4) and 10.0 for ammonia (as N). (JA Ex. BB, Part 4, Table 3-2, p. 4-17).

103. The circulating water test studies conducted by Joint Applicants had four objectives:

> "[1] Verify the practicality of operating the plant circulating water systems at 15 cycles using the specified reclaimed wastewater,
>
> [2] Identify potential plant operational problems associated with this level of operation,
>
> [3] Determine the in-cycle treatment requirements for the plant circulating water system, and
>
> [4] Determine relative corrosion rates for candidate condenser tube and tube sheet materials." (JA Ex. BB, Part 5, p. 5-1; Bingham, ff. Tr. 2585, p. 1).

104. Two types of circulating water test programs were conducted. One program employed the CWTF located at the 91st Avenue Plant. The other program employed a Bench Scale testing apparatus. (Bingham, ff. Tr. 2585, p.4).

105. The CWTF contained the essential components of a typical power plant circulating water system, including a heat source, heat exchanger, cooling tower, circulating water pump, piping, and controls for operation, makeup and blowdown. (Id. at 4-5; see JA Ex. BB, Part 5, p. 5-14). In the CWTF tests, the treated wastewater was concentrated and

circulated through the heat exchangers and the cooling tower. A series of tests was run at varying cycles of concentration and with varying scale inhibitors, corrosion inhibitors, and ammonia content. Two different types of heat exchanger materials--admiralty and titanium--were used in the tests. Coupon and galvanic series tests for a number of materials were included to provide corrosion data. (Bingham, ff. Tr. 2585, p.5).

106. The CWTF simulated the CWS with respect to tube flow velocity, temperature rise of the circulating water in the condenser, and circulating water chemistry. The CWTF was configured in a manner similar to the tube/tubesheet arrangement found in typical condensers. (Id. at 7-9).

107. A series of 10 tests was performed with the CWTF. The first three tests were each of one week duration; the last seven tests were each of two weeks duration. The cycles of concentration was 15 for the first five tests and 20 for the last five tests. Admiralty tubed heat exchangers were used in the first six tests, and titanium tubed heat exchangers were used in the last four tests. (See id. at 10-13; JA Ex. BB, Part 5, p. 5-19).

108. Operation of the CWTF during the initial three tests showed no pitting, corrosion or hard scaling of the admiralty tube heat exchangers; a persistent condition of sludging was observed, however. Following the fourth

test, it was concluded that occasional low pH conditions and inadequate chlorination control were responsible for the sludge problem. The fifth and sixth tests using improved control of pH and chlorine led to minimal fouling and sludging problems. No pitting or corrosion of the titanium tubes was observed during inspections following the seventh through tenth tests. There also was no sludge formation. (Bingham, ff. Tr. 2585, pp. 10-12). Titanium is ranked at the top of condenser tube materials. (Bingham, Tr. at 2587).

109. Analysis of all corrosion test data acquired during the CWTF test program showed corrosion for concentrated treated wastewater to be similar to that for seawater. (Bingham, ff. Tr. 2585, p. 9).

110. The Bench Scale tests confirmed the CWTF field test results in terms of water chemistry, control of sludge formation, tube scaling and corrosion. (Id., p. 14).

111. The Nalco Chemical Company performed an independent review or the testing methodology and results of the CWTF and Bench Scale test programs. Nalco concluded that the CWTF and Bench Scale programs were adequate to represent the circulating water at 15 and 20 cycles of concentration as compared to the specified makeup, and that the CWTF testing was adequate to evaluate corrosion and the use of chlorination to control slime and microbiological fouling organisms. (Id. at 14-15; see JA Ex. DD).

112. The CWTF and Bench Scale tests were excellent, demonstrating that the CWS will operate at up to 20 cycles of concentration without excessive scaling, fouling or corrosion. (Bingham, Tr. at 2587).

K. Operating Experience

113. Joint Applicants' Exhibit EE and page 1 of Staff Exhibit 8 compare the estimated concentrations of the problem constituents in the CWS for PVNGS to those of many other electric generating plants. The estimated concentrations for PVNGS are the same as the actual concentrations of the problem constituents measured during the CWTF testing and recorded at Table 4-2 of Part 5 of Joint Applicants' Exhibit BB. Although none of the plants identified in Joint Applicants' Exhibit EE and page 1 of Staff Exhibit 8 use treated effluent for condenser cooling, there are nine power stations now operating with municipal wastewater as the condenser cooling water. (Bingham, Tr. at 2676-77; Staff Ex. 8, p. 2). Inspection of the operational data shows that the estimated PVNGS CWS chemistry is well within the envelope of the concentrations of the problem constituents and total dissolved solids for the other operating plants listed in Joint Applicants' Exhibit EE and page 1 of Staff Exhibit 8 except for phosphate. Phosphate is not expected to present any operational concerns based on operating experience with municipal wastewater at Southwestern Public Service Company and Burbank as shown in Tables C-8-2 and C-8-3, pages C-8-4

and C-8-7, respectively, of Appendix C of Joint Applicants' Exhibit BB. The projected concentration of phosphate for PVNGS is below the phosphate concentrations for these two plants. (Bingham, ff. Tr. 2585, pp. 16-17).

114. Nearly 90 years of titanium tube condenser operation have been accumulated. Approximately 10 years of experience with titanium tubes and aluminum bronze tube-sheets have been accumulated at the Arthur Kill Station without corrosion. (Bingham, Tr. at 2588; see Staff Ex. 8. pp. 3-5).

115. Intervenor identified from the literature a limitation of 500,000 for the product of the concentrations of calcium and sulfate, and a limitation of 41,600 for the product of calcium and alkalinity. (Robinson, Tr. at 1667-70; see Int. Ex. XXVII, Table WPR-3). Both limitations were established with respect to a concern about scaling. (Robinson, Tr. at 1669-71). However, the limitation for calcium and sulfate is characterized as a "rule of thumb" in the literature. (Int. Ex. XXVIII, p. 27). The product of the concentrations of calcium and sulfate for PVNGS is estimated at 2×10^6 by Joint Applicants and Intervenor based on CWTF data reported in Table 4-2 of Part 5 of Joint Applicants' Exhibit BB. (Bingham, ff. Tr. 2585, p. 18; JA Ex. EE; Int. Ex. XXVII, WPR Table 3). This product is below those encountered at the other 13 operating plants identified in Joint Applicants' Exhibit EE and page 1 of Staff

Exhibit 8. (See Bingham, ff. Tr. 2585, p. 18; Bingham, Tr. at 2678). The product of the concentrations of calcium and alkalinity for PVNGS is estimated at 32,000 by Joint Applicants and Intervenor based on CWTF data reported in Table 4-2 of Part 5 of Joint Applicants' Exhibit BB. (JA Ex. EE; Int. Ex. XXVII, WPR Table 3). This product is below the limitation identified by Intervenor. In addition, the 13 other plants identified in Joint Applicants' Exhibit EE and page 1 of Staff Exhibit 8 operate substantially above this value. (See Bingham, ff. Tr. 2585, p. 18).

116. Based on the extensive operating experience achieved at cycles of concentration of 10 to 40, the extensive operation with titanium tubes, the flexibility available for operating the CWS, and the circulating water tests performed in 1973-74, that the PVNGS CWS is more than adequate to reliably operate at cycles of concentration of 20 without excessive scaling, fouling or corrosion of system components and heat exchangers. (Bingham, Tr. at 2587-89).

117. The Board finds that the PVNGS CWS will operate reliably with an increase in the concentrations of the constituents in the influent to the CWS by a factor of 20.

118. The Board finds that the assumptions and basis underlying the calculation of condenser cooling water requirements as set forth in Board Finding 10 are reasonable.

119. The Board finds that Joint Applicants have provided for a sufficient quantity of useable treated effluent to operate all three PVNGS units.

L. Relationship Between Effluent and Safety

120. An ultimate heat sink is provided for each PVNGS unit, consisting of two independent essential spray ponds which provide cooling water for the essential spray pond system during a normal shutdown or during accident conditions, with no other water source available. (JA Ex. W, p. 9.2-63). The essential spray pond system removes heat from engineered safety features and safety-related components. (Id. at 9.2-1). Each PVNGS unit is provided with a separate individual ultimate heat sink. (Id. at 9.2-63).

121. The combined available water inventory of the two essential spray ponds is sufficient to provide the necessary cooling following a design basis loss of coolant accident for at least 27 days without water makeup under the most adverse meteorological conditions consistent with the criteria of Regulatory Guide 1.27. (Id. at 9.2-88).

122. Regulatory Guide 1.27 (Int. Ex. XII) provides:

> "A cooling capacity of less than 30 days may be acceptable if it can be demonstrated that replenishment or use of an alternate water supply can be effected to assure the continuous capability of the sink to perform its safety functions . . . ." (Int. Ex. XII, p. 1.27-4).

123. In a written summary dated May 10, 1982, of a meeting between Joint Applicants and the NRC Staff on December 8, 1981, the NRC Staff Project Manager stated that the staff agreed that a 26-28 day water supply in the ultimate heat sink pond is acceptable provided that:

> "a) the staff review concurs with this calculation;
>
> b) APS identifies other sources of water that can be used after the spray pond is depleted, including a discussion of the effects of the initiating event on the availability of those sources of water; and
>
> c) APS establishes operating and maintenance procedures that provide assurance that these additional sources of water can be used in the event they are needed."

APS agreed to document the above information. (Int. Ex. XV, p.2).

124. Joint Applicants have demonstrated that they have a 26-28 day supply in the essential spray ponds under adverse conditions. (Licitra, Tr. at 2463).

125. By letter dated June 17, 1982, (Int. Ex. XXXV), Joint Applicants responded to the May 10, 1982, meeting summary (Int. Ex. XV). (Van Brunt, Tr. at 2099-2100, 2103). Joint Applicants' response is being evaluated by the Staff. (Id. at 2110). The Staff has indicated that they will be satisfied if Joint Applicants demonstrate that a source of water will be available after the initiating event referred to in paragraph (b) of Intervenor's Exhibit XV to provide

makeup to and thereby ensure the continued capability of the spray ponds beyond the 26-28 day period. (Licitra, Tr. at 2463-65; see Van Brunt, Tr. at 2107).

126. The source of water which Joint Applicants are relying on beyond the 26-28 day period is the regional aquifer. (Id. at 2107, 2109; JA Ex. XXXV, p. 2). The regional aquifer has an area over 400 square miles. Yields from irrigation wells tapping this aquifer range from 400 to 2800 gpm. Depths to water range from 150 to 250 feet below the ground surface. Water from this regional aquifer is presently tapped by two PVNGS production wells which serve the domestic water system and by a standby well. Each of these wells has the capability to pump at 1400 gpm or more. During a pump test, one of the production wells was pumped continuously for 4 days at a constant rate of 2360 gpm. The results indicated that this aquifer can sustain a pumping rate in excess of the 225 gpm makeup requirement to the ultimate heat sink for each PVNGS unit after 27 days of ultimate heat sink operation. (Int. Ex. XXXV, pp. 2-3).

127. In the event a postulated safe shutdown earthquake renders each of the PVNGS wells inoperable, work would be initiated to place the three wells in service. If it is determined within a pre-determined time after the safe shutdown earthquake that none of these wells could be restored to service within 27 days, action would be initiated to construct a new well. A study conducted by a consultant

for Applicants demonstrates that a well or combination of wells capable of delivering 1200 gpm could deliver water to the ultimate heat sink within 15 days of the initial decision that additional water supplies would be necessary. (Id. at 3).

128. Staff witness Gonzales testified that he was in a position to recommend that the proposal in Applicants' June 17, 1982, letter is acceptable. (Gonzales, Tr. at 2488).

129. The Board finds that Joint Applicants are not relying on the treated effluent stored in the onsite reservoir to serve any safety function and that the treated effluent has no relationship to the safe operation or shutdown of PVNGS.

CONCLUSIONS OF LAW

130. The Board has considered all of the evidence submitted by the parties and the entire record of this proceeding. Based on the findings of fact set forth herein, which are supported by reliable, probative and substantial evidence in the record, this Board, having decided all matters in controversy, concludes that, pursuant to 10 CFR §2.760a and 10 CFR §50.57, the Director of Nuclear Regulation should be authorized to issue to the Joint Applicants, upon making requisite findings with respect to matters not embraced in this Initial Decision, licenses

that authorize full-power operation of the Palo Verde Nuclear Generating Station, Units 1, 2 and 3.

ORDER

131. Wherefore, it is ordered that the Director of Nuclear Reactor Regulation is authorized, upon making requisite findings with respect to matters not embraced in this Initial Decision, in accordance with the Commission's regulations, to issue to Applicants, operating licenses for a term of not more than forty (40) years, authorizing operation of the Palo Verde Nuclear Generating Station, Units 1, 2 and 3 at a reactor steady-state power level not to exceed 3800 megawatts thermal. Such licenses may be in such form and content as is appropriate in light of such findings, provided that such licenses are consistent with the conclusions of the Licensing Board herein.

132. It is further ordered that this Initial Decision shall constitute the final action of the Commission forty-five (45) days after the issuance thereof, subject to any review pursuant to 10 CFR §§2.760, 2.762, 2.764, 2.785, and 2.786.

133. Exceptions to this Initial Decision may be filed within ten (10) days after its service. A brief in support of the exceptions shall be filed within thirty (30) days thereafter and forty (40) days in the case of the Staff. Within thirty (30) days of the filing and service of

the brief of any appellant, and forty (40) days in the case of the Staff, any other party may file a brief in support of, or in opposition to, the exceptions.

FOR THE ATOMIC SAFETY AND
LICENSING BOARD

_____
Dixon Callihan
ADMINISTRATIVE JUDGE

_____
Richard F. Cole
ADMINISTRATIVE JUDGE

_____
Robert M. Lazo, Chairman
ADMINISTRATIVE JUDGE

Dated at Bethesda,
Maryland, this _____
day of _____,
1982.

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
ARIZONA PUBLIC SERVICE COMPANY, et al.	)	Docket Nos. STN 50-528 STN 50-529 STN 50-530
	)	
(Palo Verde Nuclear Generating Station, Units 1, 2 and 3)	)	
	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of "Proposed Initial Decision Prepared and Submitted by Joint Applicants" have been served upon the following listed persons by deposit in the United States mail, properly addressed and with postage prepaid, this 26th day of April, 1982.

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Chairman, Maricopa County Board of Supervisors
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