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KNIGHTON,G. Licensing Branch 3

SUBJECT: Responds to 830328 request for addl info re adequacy of electric distribution sys voltages per SER (NUREG-0857). Response re adequacy of util info requested within 2 wks.

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Arizona Public Service Company
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June 7, 1983
ANPP-23991 - ACR/JTB

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

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

Reference: 1) Letter from G. Knighton, NRC, to E. E. Van Brunt, Jr., APS, dated March 28, 1983, Subject: Request for Additional Information Palo Verde, Units 1, 2, and 3 (Undervoltage Protection)

2) NUREG-0857, "Safety Evaluation Report", related to the operation of Palo Verde Nuclear Generating Station, Units 1, 2, and 3, dated November, 1981.

Dear Mr. Knighton:

Reference 1 provided a request for specific information required to complete NRC's review of the adequacy of station electric distribution system voltages for the Palo Verde plant.

The three concerns presented in the enclosure to Reference 1 were discussed with Mr. E. Licitra and Mr. O. Chopra of your staff on April 8, 1983. This discussion provided a mutual understanding of the plant configuration and NRC concerns. This attainment of understanding effectively eliminated the Reference 1) items and replaced them with the following three requests, which, when resolved, will close out the NRC staff concerns in the area of undervoltage:

1. APS must assure that the Class IE battery chargers will not be damaged at minimum AC system start voltages.

2. APS must assure that near instantaneous undervoltage excursions to approximately 75% on the plant distribution system will not adversely impact the Class IE systems' abilities to perform their safety function.

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3.a. APS must evaluate the requested "minimum loading with...maximum expected grid voltage" study against actual present plant minimum loading conditions in order to confirm that there are no problems.

b. APS must commit to test the distribution system in accordance with the Branch Technical Position PSB-1 (July, 1981), Item 4.

APS' resolution of these requests are as follows:

1. The battery charger manufacturer, Power Conversion Products, has informed us that there will be no damage to the chargers if operated below the minimum specified imput voltage level of 90%.

2. In considering the effect of distribution system undervoltage on the Class IE system operation, the sources of such undervoltage must be taken into account. There are only two identifiable sources, the effects of which are considered below:

   On-site (including the start-up transformer circuits) - An on-site undervoltage event cannot affect both Class IE 4.16KV busses since they are physically and electrically independent, as required by regulation and explained in the PVNGS FSAR. An undervoltage directly on one of the busses will not prevent the other from safely shutting down the unit. An undervoltage on the non-IE distribution system fed by the unit auxiliary transformers cannot affect either of the Class IE busses, since they are isolated from the non-IE busses, per regulatory requirements. An undervoltage event on one of the non-IE preferred sources of power, out to and including the start-up transformers, cannot affect the Class IE bus fed by the other due to the separation of these two independent sources, per regulatory requirements.

   Off-site (Grid) - Evaluation of the grid has determined that, in worst case first and second contingency incidents, the grid voltage will drop to 94% and 75%, respectively, almost instantaneously, but will recover in both cases to approximately 100% voltage within five or less seconds. Therefore, it is not possible to have a sustained undervoltage event stay in the region of 75% for a significant time. In addition, it is seen that, in the first contingency, under- voltage events are not anticipated to levels less than 94%.

   Therefore, it is not possible to have an undervoltage event occur which would simultaneously keep both Class IE busses and systems from performing their safety function.

3.a. We have performed and evaluated the requested study against the actual present plant conditions which represent lightly loaded conditions.

In order to perform a voltage analysis of the power block to determine if excessive overvoltages could reasonably be expected during periods of light loading such as refueling or cold shutdown, a computer analysis was first performed, conservatively simulating such an event. The data input assumed the following tap settings for the listed transformers:

TABLE I

Start-Up Transformer	-5%
ESF Transformers	-2-1/2%
Normal Service Transformers	-2-1/2%
Load Center Transformers	-5%

Since the equipment which are of the most concern are the Class IE battery chargers connected to 480V motor control centers, the analysis has concentrated most of its effort in this area. The computer printout indicates that during periods of light loading, the maximum voltage expected on Class IE motor control centers would be 1.1371 per unit at nominal grid voltages. Since the battery chargers are designed for operation at 480 volts ± 10%, the goal is to limit the MCC voltage to 1.1 per unit for all expected sustained contingencies.

The next step in the process was to gain a correlation between calculated results and actual results to make an initial assessment during light plant loading after commercial operation. This was performed by a visual walkdown of selected transformers and switchgear corresponding to the computer printout to determine present actual tap settings and voltages. The acutal tap settings were found, by inspection, to be:

TABLE II

Start-Up Transformer	-2-1/2%
ESF Transformers	-0%
Normal Service Transformers	-0%

It was not possible to visually inspect the load center transformers since they were presently energized and the protective panels were not able to be removed. Therefore, they were assumed to be on a -5% tap setting. The actual voltages as indicated on bus voltmeters are shown on Table III on page 6.

The actual and assumed tap settings along with a 1.0 per unit grid voltage were used as input data into the computer program assuming a worse case, no load condition. This input data is intended to simulate the present plant conditions in order to provide a correlation in the analysis. The actual and predicted voltages can be compared on Table III.

It is noted that for all busses, the calculated per unit voltages are slightly higher than the actual per unit voltages, the differences ranging from 0.0183 per unit to 0.04 per unit except on the 480 volt busses, which go all the way up to 0.0837. Since the voltage on busses 1-E-NAN-S03 was read as 13.6KV and the voltage on bus 1-E-NAN-S05 and 1-E-NAN-S01, on either side of S03, were both 13.9KV, it is assumed that the voltmeter was slightly off and the actual voltage is 13.9KV. Therefore, the differences between the calculated and actual voltages range from 0.0184 to 0.0279 per unit. Also, since the voltage difference from nominal on load center 1-E-PGA-L31 was 0.0837, we can conclude that the tap setting on the transformer was actually at 0% instead of the assumed -5% which accounts for the 0.05 per unit plus a correction factor of approximately 0.0255 to account for the higher calculated results.

As previously discussed, the calculated results for the tap settings in Table I indicates that the voltage on 1-E-PHA-M31 is 1.1371. Based upon engineering judgement, this value suggests that a -5% tap setting on the load center transformer is too high and not necessary. If the transformer tap is kept at 0% and the most conservative correction factor from Table I, of 0.0183 is applied to compensate for the higher calculated voltages over the actual voltages, we can reasonably expect the following per unit voltage on the motor control centers:

1.1371	E-PHA-M31
-0.05	Tap Change to 0%
-0.0183	Voltage Correction Factor
1.0684	Expected Per Unit Voltage

This per unit value would therefore be within the design voltage operating range of the battery chargers as well as all other connected equipment during light loading.

The changing of the load center transformer taps will have no effect on the reactor coolant pump start times or the under-voltage relay settings, since these transformers are downstream from the 4.16KV Class IE busses. This will only have the effect of adjusting the voltage levels slightly on the 480V system.

We have also looked at the potential effects of lowering the load center taps to 0% on the analysis performed for a 0.95 per unit grid voltage. This was done on the 480 volt tap setting by subtracting the sum of the tap correction factor of 0.05 per unit plus the most conservative calculation versus actual correction factor of 0.0183 per unit, which equals 0.0684, from the per unit values generated on the 0.95 grid voltage calculation.

For the Unit 3 running ESF loads, all values remain at or above the 75% voltage levels for which the motors are designed to start and accelerate under full load. The Unit 1 ESF 480V load centers do fall below the 75% level. However, during start-up, no major motor loads are running and the load voltage levels taken on the motor base (460V) remain above the 75% level and the stall voltages for loads which may be running. The 125V dc and 120V ac systems will be unaffected during the anticipated voltage drops because the battery banks to which the chargers are connected will maintain the voltage at a nominal 125V dc even if the output dc voltage drops slightly on the battery chargers, which, as discussed previously, would not be damaged at these levels.

TABLE III

BUS	Calculated Per Unit Voltage	Calculated Voltage	Actual Voltage	Actual Per Unit Voltage	Per Unit Difference Calculated Minus Actual
1-E-NAN-S03	1.0255	14.15KV	13.6KV (13.9KV)	0.9855 (1.0072)	0.04 (0.0184)
1-E-NAN-S05	1.0256	14.15KV	13.9KV	1.0072	0.0184
1-E-PBA-S03	1.0255	4.27KV	4.16KV	1.0000	0.0255
1-E-NBN-S01	1.0255	4.27KV	4.15KV	0.9976	0.0279
1-E-PGA-L31	1.0795	518V	478V	0.9958	0.0837
1-E-PHA-M31	1.0795	518V	478V	0.9958	0.0837
1-E-NAN-S01	1.0255	14.15KV	13.9KV	1.0072	0.0183

Therefore, we have identified no major problems in this evaluation and have found several areas of minor adjustment that can be made to optimize system performance. We conclude that the PVNGS design is satisfactory.

b. APS has committed to verify the analytical data used in the voltage analyses as referenced in our response to PVNGS FSAR Question 8A.15 (Pg. 8A-27, 28).

Based on this discussion, we believe that sufficient information has been provided to the NRC staff and that such information supports the conclusion that the PVNGS design is satisfactory. We consider it appropriate to promptly establish whether the NRC staff has such sufficient information and understanding to close Section 8.4.7 of the PVNGS Safety Evaluation Report, Reference 2. We ask that you respond as to whether this information is sufficient within two weeks of receipt of this letter.

If you have any questions, please contact me.

Very truly yours,

E. E. Van Brunt

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

EEVB/JTB/wp

cc: E. Licitra
O. Chopra
A. C. Gehr