



## Arizona Nuclear Power Project

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December 14, 1984  
ANPP-31464-TDS/TRB

REGION V

U. S. Nuclear Regulatory Commission  
Region V  
1450 Maria Lane - Suite 210  
Walnut Creek, California 94596-5368

Attention: Mr. D. F. Kirsch, Acting Director  
Division of Reactor Safety and Projects

Subject: Final Report - DER 84-74  
A 50.55(e) Reportable Condition Relating To Class 1E Inverters  
Supplied By Elgar.  
File: 84-019-026; D.4.33.2

Reference: (A) Telephone conversation between C. Sorenson and T. Bradish  
on September 28, 1984  
(B) ANPP-31008, dated October 29, 1984 (Interim Report)  
(C) ANPP-31152, dated November 15, 1984 (Time Extension)  
(D) ANPP-31259, dated November 30, 1984 (Time Extension)

Dear Sir:

Attached is our final written report of the deficiency referenced above,  
which has been determined to be Not Reportable under the requirements of  
10CFR50.55(e).

Very truly yours,

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

EEVB/TRB/nj  
Attachment

cc: See Page Two

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Mr. D. F. Kirsch

DER 84-74

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cc: Richard DeYoung, Director  
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U. S. Nuclear Regulatory Commission  
Washington, D. C. 20555

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FINAL REPORT - DER 84-74  
DEFICIENCY EVALUATION 50.55(e)  
ARIZONA PUBLIC SERVICE COMPANY (APS)  
PVNGS UNITS 1, 2, 3

I. Description of Deficiency

During startup testing of the Class 1E 120 VAC inverters, it was observed that the inverters have a tendency to blow a fuse in the A3-A4 bridges of 1EPNA-N11, 1EPNB-N12, type A50P00 shawmut. Subsequent troubleshooting revealed the following problems:

- a. Deformed circuit card guide keys
- b. Loose terminations
- c. Alarm logic circuitboard failures
- d. GEC 364E Silicon Controlled Rectifiers (SCRs) were replaced with GED 384E SCRs
- e. Bridge circuit fuses blew when the inverter output was connected to a Propel load bank and during transfer of the power supply to the associated instrument busses from the regulating transformers to the inverters.

These conditions are documented on the Startup Work Authorization and Nonconformance Reports listed in section IV of this report and are evaluated in the following section of this DER.

Evaluation

The following evaluations are based on the final results of troubleshooting conducted at the PVNGS jobsite.

- a. Deformed Circuit Card Guide Keys

The circuit card guide keys provide guidance to ensure that the circuit card contacts properly engage the associated contact fingers. The guide keys do not provide any support after circuit cards are installed. This problem is not considered to cause bridge circuit fuses to blow during normal operation since degraded connections would result in out of tolerance inverter output. NCR SE-4898 documents that full load distortion levels were less than 2-1/2% with a resistive load bank connected. Additionally, per SWA 25896 deformed guide keys could only have caused malfunctions during unusual transient conditions (transfer of the instrument bus from the regulating transformer output to the inverter output with the associated panel carrying rated inverter load).

b. Loose Terminations

Numerous terminations within the inverters were found to be loosened, however, none of the NCRs indicated that any oxidation due to intermittent or high resistance contact was present.

This problem is not considered to cause bridge circuit fuses to blow during normal operation since degraded connections would likely result in out of tolerance inverter output. NCR SE-4898 documents that full load distortion levels were less than 2-1/2% with a resistive load bank connected. Additionally, per SWA 25896 loose terminations could only have caused malfunctions during unusual transient conditions (transfer of the instrument bus from the regulating transformer output to the inverter output with the associated panel carrying rated inverter load).

NOTE: The loose terminations (paragraph b.) and deformed guide keys (paragraph a.) are expected to have resulted from a combination of initial component assembly, shipping vibration, inverter installation, and previous testing.

c. Alarm Logic Circuit Board Failures

Per NCR SE-4898, the alarm logic circuit board failure occurred during manual transfer of the instrument bus from the regulating transformer output to the inverter output with the associated panel carrying rated inverter load from a Propel load bank. The failure was likely caused by a combination of high inrush currents during the load transfer and resonance between filter networks of the inverter and the load bank.

d. Replacement of GEC 364E SCRs with GEC 384E SCRs

Per an Elgar telex dated October 29, 1984, SCRs were changed to GEC 384E to eliminate the possibility that the fuses could have blown due to bad SCRs and not because the SCRs were shown to be defective and therefore caused the fuses to blow. The results of work order 53636 (attached to the disposition of NCR SE-5233) support this conclusion since both SCR types are identified as acceptable.

e. Blown Bridge Circuit Fuses

Per NCR SE-4898, the blown fuses which occurred during testing with the Propel load bank connected were due to large peak currents resulting from interaction between the load bank and inverter filter networks and also some high distortion due to incompatibility of this nonlinear solid state load bank and the Elgar inverters. These conditions will not occur during normal operation with the inverter providing power to its normal connected load.

Preliminary troubleshooting results indicated that one or more of the above problems may have caused bridge circuit fuses to blow. However, based on the fact that the inverters started successfully numerous times during testing without any of the above problems having been corrected and inverter bridge circuit fuses continued to blow after all of the above problems were corrected, the root cause of blown bridge circuit fuses is attributed to inrush currents when the manual transfer switch is actuated from the maintenance position (120V AC regulating transformer is connected to the Class 1E instrument bus) to the normal operating position.

Subsequent to the above testing, one bridge circuit fuse on inverter 1E-PED-W14 blew during normal operation. This failure is considered an isolated instance which was the result of the fuse being in a degraded condition due to the cumulative effect of successive high inrush currents occurring during transfer switch operations.

II. Analysis of Safety Implications

Based on the above analysis, the bridge circuit fuses blew due to inrush currents resulting from a manual transfer of the 120V AC Class 1E instrument bus from the maintenance power supply to the normal power supply positions. Per the Tech Specs., this operation only occurs prior to plant startup. Therefore, this condition is evaluated as not reportable under 10CFR Part 21 and 10CFR50.55(e). This condition does not represent a substantial safety hazard which, if left uncorrected, would have an adverse effect on plant or public safety.

III. Corrective Action

- a. Per NCR SE-4898, Unit 1 connections were inspected and tightened as required and damaged guide keys were removed. Unit 2 work will be completed per SWA 11213 prior to issuance of an operating license. An NCR will be issued to complete Unit 3 work per ICM E-11839 prior to issuance of an operating license.



A Bechtel revision to the Elgar instruction manual has been initiated to include inspection/retightening as required of all inverter connections each time the inverters are returned to service from a maintenance or testing outage.

- b. Failed alarm logic circuit boards were replaced per NCR SE-4898.
- c. GEC 364E SCRs were replaced with GEC 384 SCRs in Unit 1 and will be replaced in Units 2 and 3 per NCRs SE-5233 and SE-5234 prior to operating license for each Unit.
- d. To ensure that none of the installed fuses are in a degraded condition due to the accumulative effect of successive high inrush currents occurring during the testing, all inverter fuses have been replaced in Unit 1 per NCR SE-5395.
- e. Procedure Change Notice 02 to APS' procedure 410P-1PW01, Rev. 3, was issued to require unloading of the 120V AC Class IE instrument bus prior to operation of the manual transfer switch from the maintenance to the normal operation positions.

#### IV. References

- a. Elgar Instruction Manual DDC log 13-EM-054-71
- b. Elgar letter dated October 23, 1984 (MIC234474)
- c. Elgar telex dated October 29, 1984 (MIC234644)
- d. Elgar letter dated November 29, 1984 (MIC236038)
- e. IOM Bingham to Stubblefield, ICH-E-11719, dated October 22, 1984 (MOC346894)
- f. IOM Bingham to Stubblefield, IOM-E-11839, dated November 16, 1984 (MOC352232)
- g. NCRs SE-5234, 4898, 5233, 5395, and 5235.
- h. Work Orders 27531, 24654, 53636, and 25896
- i. Elgar letter dated December 13, 1984 (MIC 236743)