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June 27, 1986 REGION V 146
ANPP-37168-EEVB/LAS/DRL-92.11

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
Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, 3
Docket Nos. 50/528, 529, 530

Subject: Final Report - DER 86-19
A 50.55(e) and 10CFR21 Reportable Condition Relating to BOP ESFAS
Cabinets
File: 86-006-216; D.4.33.2

Reference: (A) Telephone Conversation Between A. Hon and D. R. Larkin on
April 24, 1986 (Initial Reportability - DER 86-19)
(B) Telephone Conversation Between R. C. Sorenson and D. R.
Larkin on April 30, 1986 (Initial Notification of 10CFR Part
21, BOP ESFAS Pin Connectors)
(C) ANPP-36467, dated May 2, 1986 (Notification of 10CFR Part 21,
BOP ESFAS Pin Connectors)
(D) ANPP 36651, dated May 21, 1986 (Interim Report - DER 86-19)

Dear Sir:

Attached, is our final written report on the Reportable Deficiency under
10CFR50.55(e) referenced above. The 10CFR21 evaluation is also included.

Very truly yours,

E. E. Van Brunt, Jr.
Executive Vice President
Project Director

EEVBjr/DRL:kp

Attachments

cc: See Page Two

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Acting Director
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Acting Director
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FINAL REPORT - DER 86-19
DEFICIENCY EVALUATION 50.55 (e)
ARIZONA NUCLEAR POWER PROJECT (ANPP)
PVNGS UNITS 1, 2, 3

I. Description of Deficiencies

Several deficient conditions have been identified in the BOP ESFAS digital logic modules:

A. GA/Sorrento Reported Deficiencies

Per Reference A, GA/Sorrento Electronics informed ANPP that several BOP ESFAS digital logic modules repaired at their facility and returned to ANPP during the later part of 1985 and early 1986 were missing a #6 lock washer that should have been installed between the screw head and the TO-3 insulating cover. The cover is designed such that the lock washer provides the electrical connection between the mounting screws and the voltage regulator. Omission of the lock washer may result in the regulated output voltage approaching the unregulated input.

B. PVNGS Reported Deficiencies

While reworking a loose wire found during testing of the Unit 2 BOP ESFAS system, it was determined that the individual module "multimate" (AMP) connector pins in cabinet "A" did not meet the required contact length (Reference B). Further investigation determined that the problem also existed in cabinet "B". Units 1 and 3 have AMP connector pins which were inspected and similar problems were identified.

As a result of the problem with connector pins, a review of the work history documentation determined that several broken wires have been found in the internal wiring of the BOP ESFAS cabinets over the past year (Reference C). In each case the wires broke at the crimped socket contacts of the AMP connectors that the modules plug into.

While the modules were being inspected for missing lock washers, a problem was found with regard to the physical size of the voltage regulator heat sink on two of the spare modules and two of the Unit 1 modules (Reference D). The size of these heat sinks prevents the chip from fully inserting into the socket, however it is held firmly in place by the mounting hardware.

Also the shoulders on the socket for the voltage regulators do not properly mate with (a) the holes in the module case, and (b) the socket that the voltage regulator plugs into. Neither of these items affect operability.

Evaluation

A. GA/Sorrento Reported Deficiencies

Notification from GA/Sorrento Electronics initiated EER 86-SA-008 to investigate for missing lock washers on the logic modules. The insulating cover is designed such that the lock washer provides the electrical connection between the mounting screws and the collector (ground) of the transistor. Basically, the omission of the lock washer, with the cover installed, could result in 28Vdc being applied to the input of all IC's in the module, resulting in module failure. Factory testing determined that the insulating cover and lock washers were not required for the module to function.

All modules (Units 1, 2, and 3, and spares) have been returned to GA/Sorrento Electronics. The voltage regulator covers and lock washers have been removed by GA/Sorrento via Reference F, which determined that the lock washers are not necessary for a ground path when the insulating covers are removed. Unit 1 and 2 modules, plus spares have been returned from GA/Sorrento and have been retested.

B. PVNGS Reported Deficiencies

On April 28, 1986, an inadvertent actuation of an LOP/LS module occurred while a QC inspector was verifying a wire/connector socket reinstallation in the Train "A" BOP ESFAS cabinet. The actuation occurred when wires connected to the cabinet side of the connector were moved. EER 86-SA-013 was initiated to investigate this problem. The investigation revealed that on the back plane where the socket connectors are mounted there existed a slight bow condition at the center area of the panel. This created a gap between the mating face of the "M" series connectors. Further, dimensional analysis revealed marginal contact engagement using the shallow "M" series connector. The pins on the male end (module side) of the multi-mate connectors were replaced with pins of correct length while the modules were at GA/Sorrento. This was done for all modules (Units 1, 2, 3, and spares).

The removal and reinstallation for Unit 1 and 2 modules was performed per W.O. 151092 and 151198, Unit 1 and W.O. 151062 for Unit 2. Socket rework was completed via W.O. 151871, Unit 1 and W.O. 151877 for Unit 2.

Several broken wires have been discovered on the Unit 2 BOP ESFAS cabinet. The wires broke at the socket of the AMP connector pin. Also, where two wires were crimped in a socket, the socket size appeared larger than required. These problems were evaluated under EER 86-SA-010, 86-SA-018 and EER 86-SA-019.

An inspection found that the wires, crimped in the sockets, had an insulation diameter larger than the barrel of the socket. This prevented full insertion of the stripped wire and insulation. The crimp was intended to provide electrical connection and strain relief.

A review of the two 22AWG wires crimped in a 14AWG socket was made. It was determined that the equivalent size of these two wires is 19AWG and that the correct socket size is 16-18AWG. Tests were performed at the AMP facility and it was verified that this combination provided the best fit and electrical connection. All the connections on the female (cabinet side) end were resocketed, to assure a good connection, at the PVNGS. The Corrective Action for Unit 1 was completed by GA/Sorrento, Unit 2 C/A was completed by ANPP, and Unit 3 will be completed per NCR-SJ-6456.

To alleviate any wire strain that may occur on these connections, a strain relief bracket has been installed to support the field wiring harnesses. This work has been completed for Units 1 and 2 per T-mod 1-86-SA-035 and T-mod 2-86-SA-024. The Unit 3 work will be completed under SWA 10435.

GA/Sorrento evaluated the size of the heat sink used on the voltage regulator. It was determined that the heat sinks differ only in metal thickness. The heat sinks were procured from two subsuppliers under the same part number. Neither size heat sink would prevent the transistor from operating. To prevent the mix-up of heat sinks, all future procurement of this item will be made from one supplier.

GA/Sorrento evaluated the shoulder size on the sockets for mounting the voltage regulators. The socket is provided in the TO-3 mounting kit. Small dimensional variations exist between kits. Installation of heat sinks of correct size and replacement of misfitting voltage regulator sockets has also been done on the applicable modules while they were at GA/Sorrento.

For operability concerns see LER Nos. 86-011-00 and 86-020-00.

C. Root Cause

- ° The root cause of missing lock washers was a failure by the Vendor (GA/Sorrento) to ensure that all parts had been installed, as required, following repair.
- ° The root cause for the connector pin to socket contact engagement problem was an inadequate design review, by GA/Sorrento, and an inadequate pin selection. This resulted in broken wires due to frequent manual movement by personnel trying to achieve a good electrical connection.
- ° The root cause of the larger size heat sink for the voltage regulator and incorrect fitting of voltage regulator hardware was the result of inattention to detail by GA/Sorrento.

D. Transportability

As a result of finding short pins in the BOP ESFAS connectors, FER 86-XI-005 was generated to determine if similar AMP connectors (series M) used elsewhere throughout Units 1, 2, and 3 also have short pins and/or broken wires. The other problems i.e., missing lock washers, heat sink size and misfitting sockets, are unique to BOP ESFAS modules.

No similar problems with AMP connectors were discovered during a search and inspection through all project procurement documents and related documentation. This search covered 50 equipment suppliers. Of these, 10 required walkdown inspections. The BOP ESFAS system is the only system supplied to ANPP by General Atomic - Sorrento Electronics.

E. Safety Assessment

Module failure due to broken wires, missing lock washers and connectors not making adequate pin contact would most likely result in spurious actuation of the associated BOP ESFAS function. However, it is possible that any of these failures could cause certain modules to fail to automatically actuate under circumstances requiring an actuation and in the case of the missing lock washers and connector pins, a potential for a common failure mode exists.

Since the problems associated with voltage regulator heat sinks and voltage regulator mounting do not affect operability, there is no affect on safety.

II. Analysis of Safety Implications

Based on the above, these conditions are considered Reportable under the requirements of 10CFR50.55(e) since, if these deficiencies were to remain uncorrected they could adversely affect the safe operation of the plant.

The project has also evaluated these conditions as Reportable under 10CFR21. This report addresses the reporting requirements of 10CFR21.21(b)(3) with the exception of sub part (vi), regarding the number and location of such components supplied to other facilities.

III. Corrective Action

All work in Unit 1 and 2 has been completed. The Unit 3 modules were removed and returned to GA/Sorrento Electronics for replacment of pins in the connector under SWA 10160 and NCR SJ-6456 and have a scheduled completion date of June 27, 1986. The covers and lock washers were also removed by Field Change Order (FCO) 201 and the correct size heat sink was installed at the same time. This work was completed on May 29, 1986.

Socket rework for the Unit 3 AMP connectors will be completed under SWA 10377 and W.O. 152428 with a scheduled completion date of July 3, 1986. The wiring strain relief bracket was installed under SWA 10435 and W.O. 153039 on June 9, 1986.

A copy of this report will be sent to GA/Sorrento Electronics for their review for reportability.

References

- A. Sorrento (S. Coppock) Letter to ANPP (D. Legg). No date, received April 7, 1986
- B. SFR 3SA-009, converted to NCR SJ-6456, May 9, 1986
- C. EER 86-SA-010, April 29, 1986
- D. Communication Record between Sorrento Electronics and ANPP, dated April 24, 1986
- E. EER 86-XI-005, April 30, 1986
- F. G.A. Sorrento Field Change Order (FCO-201), dated April 28, 1986
- G. EER 86-SA-008, April 8, 1986
- H. EER 86-SA-013, April 2, 1986
- I. SWA 10160, May 1, 1986
- J. EER 86-SA-018, May 7, 1986
- K. EER 86-SA-019, May 9, 1986