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November 13, 2013

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555-0001

Subject: 10CFR21 Reporting of Defects and Non-Compliance -
Engine Systems, Inc. Report No. 10CFR21-0110, Rev. 0

CR7 Diode Wiring Reversed: AVR Panel P/N D72-12200-100-PVNGS

Dear Sir:

The enclosed report addresses a reportable notification on a CR7 diode wiring reversed on the automatic voltage regulator (AVR) panels for APS-Palo Verde, P/N D72-12200-100-PVNGS.

A copy of the report has been mailed to our affected nuclear customer.

Please sign below, acknowledging receipt of this report, and return a copy to the attention of Document Control at the address above (or, fax to number 252/446-1134) within 10 working days after receipt.

Yours very truly,

ENGINE SYSTEMS, INC.

Susan Woolard
Document Control

Please let us know if ANY of your mailing information changes - name of recipient, name of company/facility, address, etc. Mark the changes on this acknowledgment form and send to us by mail or FAX to the number above.

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RECEIVED: _____

DATE: _____

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Report No. 10CFR21-0110

Rev. 0: 11/12/13

**10CFR21 REPORTING OF DEFECTS
AND NON-COMPLIANCE**

COMPONENT: CR7 diode wiring reversed
AVR panels for APS-Palo Verde
P/N: D72-12200-100-PVNGS

SYSTEM: Emergency Diesel Generator (APS-Palo Verde)

CONCLUSION: Reportable in Accordance With 10CFR21

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Engineering Manager

Date: 11/12/13

Reviewed By: *Shannon*
Quality Assurance Manager

Date: 11-12-13

| REV | DATE | PAGE | DESCRIPTION |
|-----|----------|------|----------------|
| 0 | 11/12/13 | | Initial issue. |

Component:

Diode CR7 wiring reversed: AVR panel P/N D72-12200-100-PVNGS

Summary:

Engine Systems Inc. (ESI) began a 10CFR21 evaluation on 10/25/2013 after receiving notification from APS-Palo Verde Nuclear Generating Station that diode CR7 on their automatic voltage regulator (AVR) panels had the wiring connections reversed. During installation of the AVR panels, generator output voltage buildup was observed to be longer than expected during fast start testing. The slow voltage buildup was determined to be caused by a lack of generator field flashing. Troubleshooting revealed that the field flash diode CR7 wiring was reversed.

The evaluation was concluded on 11/11/2013 and it was determined that this issue is a reportable defect as defined by 10CFR21. The incorrect wiring of diode CR7 prevents field flashing of the generator. Lack of generator field flashing can result in failure of generator voltage buildup, or excessive voltage buildup time, during starting of the emergency diesel generator (EDG). This condition could therefore have impacted operability of the EDG and prevented it from performing its safety related function.

Discussion:

The AVR panel, part number D72-12200-100-PVNGS, is part of the overall static excitation system for the Palo Verde EDGs. Diode CR7 is wired in series with the field flash resistor and a normally open contact from the field flash contactor (FFC) to the generator field (F+) connection. This circuit is only active during startup of the EDG as the generator field is flashed (via an external 125 VDC supply) to initiate generator voltage buildup. CR7 conducts in the forward direction during field flashing to excite the generator field and it prevents reverse current flow when the exciter output begins to increase as the generator comes up to nominal voltage. An electrical schematic of the field flash circuitry is shown below in Figure 1.

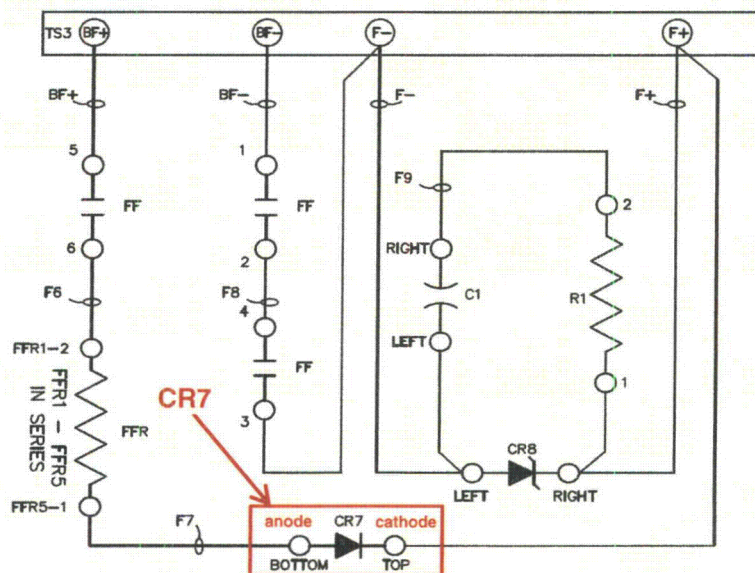


Figure 1 – Generator Field Flash Schematic

APS-Palo Verde determined during installation testing of the AVR panel that the CR7 diode was installed incorrectly; specifically, the wiring to the anode and cathode was reversed. The CR7 diode assembly consists of a standard power diode (where the mounting stud is the cathode and the terminal end is the anode) mounted on a heat sink. With the diode mounted to the heat sink via the diode stud, the heat sink becomes the diode cathode. A screw installed in the heat sink provides a mounting stud for the CR7 cathode wiring connection(s). The diode anode is wired to another stud at the other end of the heat sink; this stud is electrically isolated from the heat sink and is utilized for the CR7 anode wiring connection(s). Location of CR7 on the AVR panel is shown below in Figure 2.

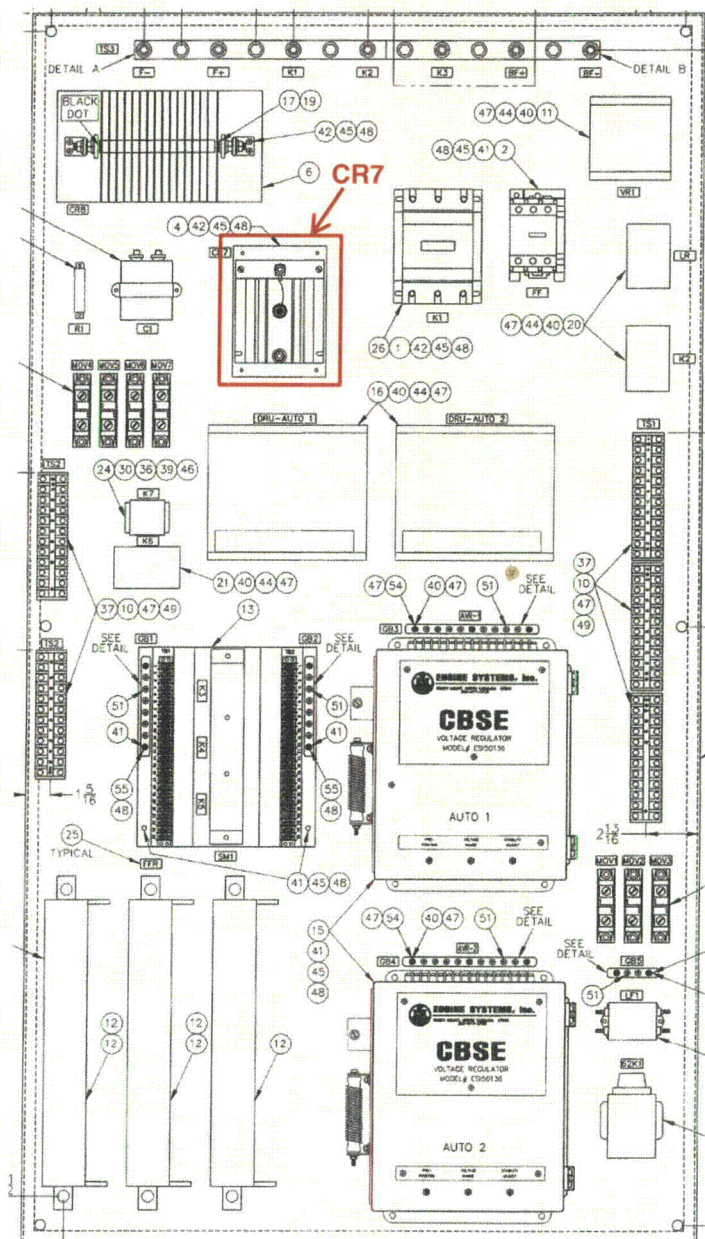


Figure 2 – AVR Panel Component Layout

Root cause evaluation:

The AVR panel layout drawing (8000654-01) conflicts with the AVR panel electrical schematic and wiring diagram. The layout drawing has CR7 oriented such that the anode connection is on the top and the cathode connection is on the bottom; both the electrical schematic (8000654-02) and the wiring diagram (8000654-11) show the CR7 anode wiring as the “bottom” and the cathode wiring as the “top”. With the layout showing the anode at the top, the CR7 wiring was installed reversed.

Functional test procedure 8000654-FTP-1 for the AVR panel verified operation of the field flash contactor FF but did not include checks to verify proper installation of diode CR7. The pre-operational tests of ESI field test procedure 8001720-TP should have discovered the reversed CR7 connections because it required verification of field flash voltage at AVR terminals TS3(F+) and TS3(F-); apparently these steps were not performed or were not performed correctly during the installation process.

Evaluation of previous shipments:

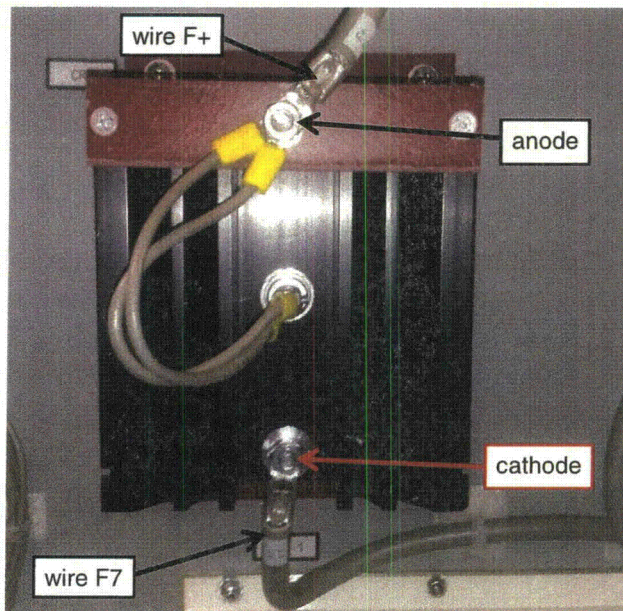
Drawings for AVR panels supplied previously by ESI have been reviewed and the CR7 diode wiring has been verified to be correct. The CR7 reversed wiring condition only applies to the AVR panels (P/N D72-12200-100-PVNGS) shipped to Palo Verde.

Affected Customers:

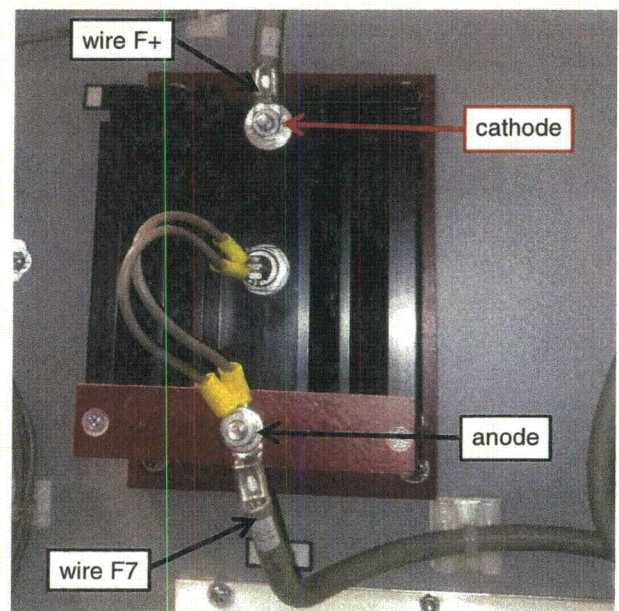
APS-Palo Verde is the only affected customer. This reversed CR7 wiring condition only applies to the five (5) AVR panels (P/N D72-12200-100-PVNGS) shipped to Palo Verde on ESI sales order 8001720 (4 panels shipped in May 2013 and 1 panel shipped in June 2013).

Corrective Action:

- Diode assembly CR7 shall be removed from the AVR subpanel, rotated 180 degrees and re-installed using the same mounting holes and mounting hardware. The existing panel wiring to CR7 shall then be connected in the same physical location, thereby connecting wire F+ to the cathode and wire F7 to the anode as shown in the photographs below. This shall be performed on all five (5) AVR panels shipped to APS-Palo Verde (reference ESI sales order 8001720).



**CR7 Diode Assembly - Not Correct
(as-shipped)**



**CR7 Diode Assembly - Correct
(rotated 180°)**

- To prevent recurrence of this issue, the following is being implemented:
 - AVR panel layout drawing 8000654-01 has been revised to rotate diode CR7 180 degrees. This will change the anode connection from the top to the bottom orientation.
 - The AVR panel factory test procedure 8000654-FTP-1 has been revised to include steps to verify proper connection of diode CR7 within the field flash circuitry.