



SOLIDSTATE CONTROLS

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

Attention: Document Control Desk
Subject: Final 10CFR21 Report of a Potential Defect, Vishay Diodes. Reference Interim Report ML21092A129 Issued April 1, 2021

Product: Vishay/ International Rectifier Clamp, Diodes 300V, 250A, forward and reverse bias. Ametek part numbers 07-600250-00 and 07-600251-00.

Ametek Solidstate Controls is submitting the following notification of a Potential Defect in accordance with the requirements of 10CFR21. This notification is currently applicable to equipment model number 85-VC0250-41 provided to Tennessee Valley Authority at Watts Bar Power Station.

TVA has experienced multiple failures of diodes in the pieces of equipment provided below. The failures have occurred between 2017 and 2021. The failure was caused by electrical overstress, but the specific root cause is indeterminate.

The attached document provides details on the potential problem, causes, effect, and actions required. Please contact me with any further questions or comments.

Sincerely,

Ethan Salsbury
Director of Quality
AMETEK Solidstate Controls



COMPONENT DESCRIPTION:

300V, 250 A clamp diodes, forward and reverse bias, with Vishay/International Rectifier part numbers IN3737 and IN3737R and Ametek part numbers 07-600250-00 and 07-600251-00, respectively. The two failed diodes returned for evaluation were manufactured in India in 2004.

Diodes were installed in 20kVA Inverters at TVA, Ametek model number 85-VC0200-41 with serial numbers C84733-0211, C84733-0411, and C84733-0511. Approximately 65 similar model numbers – 85-VC0200-XX or 85-VC0250-XX with suffix -01 through -50 – have been built. These pieces of equipment would utilize the same components.

INSTANCES OF FAILURE:

TVA has experienced multiple failures of diodes in three specific pieces of equipment, provided below. The failures have occurred between 2017 and 2021. Evaluation of the failures and root cause has been indeterminate through this point. Initial notification of these failures was provided to AMETEK in roughly November of 2020. Two of the failed diodes were returned 2/1/2021 for analysis.

C84733-0211(TVA number 1-IV):

- 11/18/17 - diode D4 was shorted. Main control room received alarm for abnormal conditions. Local alarms lit were fan failure, inverter fuse blown, inverter failure, and static switch transferred to Bypass.
- 10/31/2020 - diode D5 was shorted. Main control room received alarm for abnormal conditions. Local alarms lit were fan failure, inverter fuse blown, inverter failure, and static switch transferred to Bypass.
- 3/10/2021 – D2 shorted no alarm details provided.

C84733-0511 (TVA number 1-II):

- 4/6/2019 - diode D5 was shorted and SCR Q1 was "degraded". Main control room received alarm for abnormal conditions. Local alarms lit were fan failure, inverter fuse blown, inverter failure, and static switch transferred to Bypass.
- 10/5/2019 - diode D4 was shorted. Main control room received alarm for abnormal conditions. Local alarms lit were fan failure, inverter fuse blown, inverter failure, and static switch transferred to Bypass.
- 4/15/2021 – D3 shorted

C84733-0411

- 10/26/2021 – Reported a failure on of another diode, no other details provided.

PROBLEM YOU COULD SEE:

A diode failure could occur and will result in the equipment transferring to bypass, a loss of output voltage, blown fuses, and unexpected alarms such as fan failure, inverter fuse blown, and inverter failure alarms. There are no conclusive warning signs that a failure is imminent, or detection method for predicting an approaching failure.

CAUSE

Diodes that failed in the TVA equipment were shorted according to the summaries provided by TVA. Only two of the shorted diodes were sent to AMETEK SCI for evaluation. The condition of all other diodes is unknown.



While the precise cause of this failure is unknown, diode failures are generally attributed to transient voltage spikes and overheating. TVA did indicate there have not been any transient events on the DC bus that could have caused this failure. Additionally, AMETEK sent a representative to the site to review the equipment and operating conditions. The field service technician concluded that there were no abnormalities apparent in the operating conditions or the equipment itself.

According to TVA, the inverters at TVA are loaded below 50%. The AMETEK field service representative determined load was at 25% of full load during the site visit in August of 2021. This could contribute to increased heat and stress on the diodes due to increased current draw. However, there was no indication of overheating of the diode at no load or 25% of unit C84733-0511 (1-II). All diodes were within acceptable temperature conditions on the equipment evaluated.

EFFECT ON SYSTEM PERFORMANCE

Failures described above could result in loss of output voltage and transfer of the static switch to the bypass source which could result in potential loss of load.

ACTION REQUIRED

AMETEK Solidstate Controls recommends that each facility evaluate the potential risk and performs replacement as determined necessary. Evaluation could include oscilloscope measurements across the diodes and temperature measurements of the diodes and the equipment. Voltage readings from the oscilloscope measurement should not exceed the rating of the diode. Temperatures should be compared to original test data and should not exceed 100° C.

Recent evaluations have been unable to pinpoint a failure mode and there are no conclusive connections to previous failures. Only the failures provided in this report have surfaced for the subject part numbers and the failure rate has been low.

AMETEK SOLIDSTATE CONTROLS CORRECTIVE ACTION:

AMETEK Solidstate Controls will work with you to arrange replacements and spare parts for your application as needed. Please contact our Client Services group at 1-800-222-9079 or 1-614-846-7500, extension 1.