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DOMINION ENERGY SOUTH CAROLINA (DESC)
VIRGIL C. SUMMER NUCLEAR STATION (VCSNS) UNIT 1
RESPONSE TO AN APPARENT VIOLATION; (EA-22-039)

By letter dated May 12, 2022 (Reference 1), the Nuclear Regulatory Commission (NRC) notified Dominion Energy South Carolina (DESC) of an Apparent Violation (AV 05000395/2022001-01) for "Failure to Correct Condition Adverse to Quality Resulting in Inoperable Emergency Diesel Generator." By letter dated July 14, 2022 (Reference 2), the NRC preliminarily determined the finding to be of low to moderate safety significance (White) and provided an opportunity for DESC to submit a pre-decisional response to the AV. By letter dated July 19, 2022, DESC informed the NRC that additional written information would be provided for consideration in making a final determination for the AV (Reference 3).

The additional information is provided as Attachment 1 to this letter. This information provides DESC's perspective of the significance of the finding and related facts used to reach our determination.

Should you have any questions regarding this submittal or require additional information, please contact Mr. Michael Moore, Manager Nuclear Station Licensing at (803) 345-4752.

Sincerely,

Dan Stoddard

Daniel G. Stoddard
Senior Vice President and Chief Nuclear Officer

CRAIG D SLY
Notary Public
Commonwealth of Virginia
Reg. # 7518653
My Commission Expires December 31, 2024

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Daniel G. Stoddard, who is Senior Vice President and Chief Nuclear Officer of Dominion Energy South Carolina. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of that company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 22ND day of August, 2022.

My Commission Expires: 12/31/24

Craig D Sly
Notary Public

References:

1. "Virgil C. Summer – Integrated Inspection Report 05000395/2022001 and Apparent Violation," dated May 12, 2022.
2. "Virgil C. Summer – NRC Inspection Report 05000395/2022090 and Preliminary White Finding and Apparent Violation," dated July 14, 2022.
3. "Virgil C. Summer Nuclear Station (VCSNS) Unit 1 – Pre-Decisional Reply to Apparent Violation 05000395/2022001-01," dated July 19, 2022.

Attachment 1: Response to Apparent Violation 05000395/2022001-01

Commitments contained in this letter: None

cc: G. J. Lindamood – Santee Cooper
L. Dudes – NRC Region II
D. Dumbacher – NRC Region II
G. E. Miller – NRC Project Mgr.
NRC Resident Inspector

Attachment 1

RESPONSE TO APPARENT VIOLATION 05000395/2022001-01

**VIRGIL C. SUMMER NUCLEAR STATION (VCSNS)
DOMINION ENERGY SOUTH CAROLINA, INC. (DESC)
RESPONSE TO APPARENT VIOLATION 05000395/2022001-01**

Apparent Violation 05000395/2022001-01

An NRC-identified Apparent Violation of 10 CFR 50, Appendix B, Criterion XVI, was identified for the licensee failing to correct a condition adverse to quality resulting in the inoperability of the 'B' emergency diesel generator (EDG). Specifically, there were indications of erratic governor performance following the January 2022 maintenance package that were identified during testing January 16, 2022. The governor performance was also erratic during the February 9, 2022, surveillance test, after which the licensee declared the EDG inoperable. As a result of this condition, the 'B' EDG was inoperable for a time in excess of its Technical Specification (TS) allowed outage time.

DESC's Response

Introduction

During post-maintenance testing after a January 15, 2022 'B' EDG maintenance package, erratic oscillations of frequency and kW were determined to have been caused by a detached tachometer signal generator. Following troubleshooting and repair of the signal generator, the oscillations were significantly reduced, and a successful surveillance test was completed on January 16, 2022. Based on field observations and the results of the January 16 surveillance test after the signal generator was repaired, the Shift Manager concluded 'B' EDG was operable with the significantly reduced oscillations.

During a subsequent monthly surveillance test on February 9, 2022, the 'B' EDG again met the TS surveillance test criteria, although the number of minor oscillations experienced during the February 9 'B' EDG run had increased when compared to the oscillations experienced during the January 16 surveillance test. After reviewing the information from the February 9 surveillance test, Engineering did not support a recommendation of continued operability and the Shift Manager declared the 'B' EDG inoperable based on that recommendation. A broken Amphenol connection was subsequently identified as the cause of the oscillations and repaired.

An independent third-party engineering firm specializing in EDG analysis was contracted to review data from the February 2022 test to determine if the 'B' EDG could have provided emergency power to the 1E onsite busses during a loss of offsite power in the as-found condition. The resulting evaluation (Reference 1) concludes that the 'B' EDG transient performance limits in Regulatory Guide 1.9 (RG 1.9) were maintained, and the oscillations did not have an adverse impact on the safety function of the 'B' EDG or on its connected safety-related loads.

Background

On January 10, 2022, the 'B' EDG was removed from service for a significant maintenance package and was originally scheduled to return to service on January 13, 2022. The restoration of 'B' EDG was delayed until January 16, 2022, due to a number of conditions as noted below:

- CR-22-00134: The 'B' EDG had erratic indications of frequency and kW. [Dated January 15, 2022, at 03:55]
- CR-22-00136: The 'B' EDG mechanical overspeed trip device did not reset properly resulting in an engine trip. [Dated January 15, 2022, at 07:44]
- CR-22-00139: The 'B' EDG signal generator came off the governor tachometer drive shaft. [Dated January 15, 2022, at 19:20]

On January 15, during performance of a post-major maintenance test per SOP-306, "EMERGENCY DIESEL GENERATOR," Operations noted abnormal frequency oscillations and large kW swings at the 1,000 kW and 2,300 kW load plateaus. Figure 1, "'B' EDG Maintenance Run - January 15, 2022," provides an illustration of the kW oscillations. As a result, Operations secured the diesel after about 30 minutes and generated CR-22-00134.

On January 16, the cause of the abnormal frequency and kW condition identified in CR-22-00134 was identified as being due to the 'B' EDG tachometer signal generator becoming disconnected due to inadequate clamping force on its bushing. The condition was corrected by reattaching the 'B' EDG tachometer signal generator using a satisfactory bushing. The 'B' EDG was then operated on the mechanical governor to allow adjustment of the governor high-speed setting and venting of any air that may have been in the governor.

On January 16, 2022, at 03:50, after completion of the high-speed setting adjustment run, Operations started 'B' EDG per SOP-306. During this 3-hour test, there were no oscillations identified by field personnel. However, Operators in the Control Room observing the main control board noted minor oscillations occurred during the fully loaded portion of the test. Figure 2, "'B' EDG Loaded Maintenance Run - January 16, 2022," provides an illustration of the oscillations. The results of the January 16 test showed that the significant oscillations noted during the January 15 test were mostly eliminated and supported a conclusion that the issue in CR-22-00134 had been identified and corrected by reattaching the tachometer signal generator using a satisfactory bushing. The minor oscillations observed during this test were attributed to winter weather causing grid disturbances and potentially small amounts of air venting from the governor after maintenance.

On January 16, 2022, at 21:29, Operations started 'B' EDG per STP-125.002B, "DIESEL GENERATOR B OPERABILITY TEST". During this surveillance test, the Control Room operators noted minor fluctuations in 'B' EDG kW output on the main control board. Additionally, field personnel observed occasional movements in the fuel rack, although much less severe and with different characteristics than the condition identified in CR-22-00134. These fluctuations were believed to be due to winter weather causing grid disturbances and potential governor air venting as described above. The same Shift Manager who ordered the EDG secured and

declared the EDG inoperable on January 15 during the post-major maintenance test, had no operability concern after this surveillance test. The 'B' EDG met the STP-125.002B acceptance criteria during this test, including the criteria described below associated with the kW load-range and frequency deviations.

- Step 8.1.e: The Diesel Generator must be able to accept a load of between 4150 kW and 4250 kW and operate for at least 60 minutes within this band (T.S. 4.8.1.1.2.a.4). IYR01805, EMERGENCY DIESEL GEN B RW1, (XCP-6221) power data averaged over a ten-minute period is used to monitor this requirement; instantaneous readings are not required to be in this band.
- Step 8.4.e: Steady-state, no-load, frequency deviations are 0.2 hertz or less from the average isochronous speed by both Local and MCB indication.

On February 9, 2022, during the monthly STP-125.002B test of 'B' EDG, kW oscillations were noted in the Control Room while the 'B' EDG was synchronized with the grid. Figure 3: "'B' EDG Surveillance Run - February 9, 2022," provides an illustration of the kW oscillations. The magnitude of the oscillations and quick recovery to normal appeared to be similar to the January 16 STP-125.002B test. Oscillations increased in frequency at the end of the test but were not considered by the Shift Manager to be a substantial concern or a challenge to diesel operability. Local field observation noted normal engine operation, other than periodic fuel rack movement similar to the January 16 test. The 'B' EDG again met all STP-125.002B acceptance criteria. The Shift Manager determined there was reasonable assurance the diesel could perform its design basis function and was operable. Operations generated CR1191016 to document intermittent 'B' EDG kW oscillations and requested an Operability review from Engineering.

Engineering reviewed the test data, observed the increase in the frequency of kW oscillations, and communicated to Operations that they did not have reasonable assurance that the 'B' EDG could perform its function at that time due to the increasing number and magnitude of the oscillations. This was a judgement call from the Diesel Generator System Engineer based on qualitative analysis of the data.

Subsequent troubleshooting confirmed the 'B' EDG load oscillations were caused by an intermittent open circuit and variable high resistance condition due to a mechanical fatigue fracture of the solder contact at the Pin B location within an Amphenol 90-degree angle plug connector. The broken pin was interrupting the electronic governor 2301A control output signal to the engine-mounted EGB-50P proportional governor/actuator. The broken pin was in the Pin B location, which provides the return path for the electronic governor signal to the actuator. After installation of a new Amphenol connector, the 'B' EDG tested satisfactorily.

Due to concerns related to the 'B' EDG, DESC contracted a third-party engineering firm, specializing in EDG analysis, to evaluate the impact of the intermittent governor electrical connection.

Reason for the Violation

Determination of Operability

The 'B' EDG oscillations experienced during testing on January 16, 2022, did not result in the 'B' EDG being declared inoperable. The Shift Manager determined that the 'B' EDG was operable on January 16 after performance of STP-125.002B due to the following:

- The significant load and frequency oscillations due to the disconnected tachometer signal generator had been corrected on January 16.
- The 'B' EDG met the acceptance criteria of STP-125.002B
- The load and frequency oscillations were not substantive in comparison to the STP-125.002B acceptance criteria and review of operational parameters. Additionally, the oscillations were believed to be due to winter weather at this time causing grid disturbances and potentially small amounts of air venting from the governor after maintenance.

The Shift Manager's perspective was the 'B' EDG oscillations were minor and without adverse impacts, providing reasonable assurance of operability. Therefore, based on the judgement of the Shift Manager, 'B' EDG was declared operable on January 16 after performance of STP-125.002B and a CR was not deemed to be required. DESC believes that this conclusion was reasonable considering the information available to the Shift Manager and the engineering organization after the completion of STP-125.002B on January 16, 2022.

NOTE: The trend graph referenced in Apparent Violation 05000395/2022001-01 is from the plant computer system, which is reviewed for information only. This trend graph is not part of STP-125.002B, is not reviewed by the Shift Manager, and therefore not required for EDG operability.

Amphenol Connector Pin Failure

After the EDG was declared inoperable on February 9, 2022, troubleshooting confirmed the 'B' EDG load oscillations were caused by an intermittent open circuit and variable high resistance condition (referred to as "disturbances") due to a mechanical fatigue fracture of the solder contact at the Pin B location within an Amphenol 90-degree angle plug connector. This solder contact had been subjected to long-term alternating stress because of a design configuration that included no strain relief for the two 16-gauge wires utilized for governor control signal circuit DGU17B.

Additional stress to the solder contacts would likely have occurred during the January 2022 performance of MMP-180.039 (EDG Engine Dynamic Check of Overspeed Governor) and troubleshooting associated with the separate frequency and kW oscillation condition identified on January 15 and documented in CR-22-00134. These maintenance activities were performed properly and with proper care; however, they potentially imparted sufficient additional stress to the fatigue weakened Pin B solder contact to result in the final fast fracture of the solder contact.

After the solder contact fractured, it was prevented from permanently separating by the physical constraints within the Amphenol connector as well as the constant preload provided by the governor control circuit conduit. This condition resulted in kW oscillations at high loads during subsequent engine runs.

Third Party Analysis

An independent third-party engineering firm specializing in EDG analysis was contracted to determine if the 'B' EDG could have provided emergency power to the 1E onsite busses during a loss of offsite power in the as-found condition. The resulting evaluation determined that the disturbances associated with the broken connector pin were of short duration and it is appropriate to consider the transient performance limits in Regulatory Guide 1.9.

The resulting evaluation determined that EDG 'B' transient performance limits in Regulatory Guide 1.9 (RG 1.9) for frequency (between 57 Hz and 64.5 Hz) and recovery time to within the required transient recovery band (+/- 1.2 Hz of nominal within 40 percent of the load sequence time) were maintained. The evaluation concludes that the transients (oscillations) caused by the short-duration Pin B disturbances did not have an adverse impact on the safety function of the 'B' EDG or on its connected safety-related loads (Reference 1). Reference 1 will be made available to the NRC for review.

Review of Third Party Analysis and EDG Mission Time

DESC performed an owner's review of Reference 1 and concurred with the conservative methodology and conclusions regarding the capability of the EDG to perform its safety function in the as-found condition following the February 9, 2022, surveillance test (Reference 2). The transient analysis was performed using a revised and validated ETAP model which utilized disturbance durations derived from the February 9 troubleshooting oscilloscope data that were considered representative and bounding for the condition, even when postulated throughout the 24-hour MSPI mission time.

Model simulation results confirmed 'B' EDG frequency would remain within Reg. Guide 1.9 transient limits throughout all accident and load ranges with simulation results indicating margin to allow for a 194% increase in the duration of an open circuit. The model simulations assumed disturbances occurred at the most adverse conditions (i.e., lower loads and maximum frequency response for Open Circuit, and higher loads and minimum frequency response for Non-Open Circuit) to ensure analysis results provided the most conservative EDG frequency response. The simulation results show frequency oscillations would not challenge the engine overspeed trip setting at any point in time.

The duration of the disturbances increasing beyond the stated margin level is not considered credible given the governor control circuit was providing constant preload to prevent a significant increase in the duration of disturbances or permanent separation of the degraded Amphenol Connector Pin. This conclusion is supported by a total of approximately 9 hours of 'B' EDG operation across the entire load spectrum (0-100%) prior to the condition being corrected, and during which the fractured Governor Amphenol Connector Pin B did not permanently separate.

Furthermore, extrapolating the load oscillations over the 24-hour mission time indicates the transient load oscillations would not have exceeded the engine's manufacturer & design ratings. In summary, analysis results confirm the 'B' EDG would have remained in continuous operation without interruption by an overspeed trip or degradation detrimental to its operation and would have provided AC power to the required ESF loads throughout the duration of the 24-hour mission time.

Conclusions

DESC cites the information above as a basis for disputing the apparent violation and the preliminary risk significance determination contained in the Attachment to the apparent violation (White). In summary, DESC provides the following discussion for disputing the apparent violation and risk evaluation results:

1. The Shift Manager conclusion that 'B' EDG remained operable on January 16, 2022, and that initiation of a condition report was not necessary was a reasonable conclusion considering the information available to the Shift Manager and Engineering organization after the completion of STP-125.002B on January 16, 2022. The Shift Manager determination of operability on January 16 is supported by the third-party analysis, which concludes the transients caused by the short-duration disturbances associated with the broken connector pin did not have an adverse impact on the safety function of the 'B' EDG or on its connected safety-related loads. This analysis provides a high degree of confidence the 'B' EDG was operable during the period from January 16, 2022, through February 9, 2022, and was in full compliance with RG 1.9, and the VCS TS.

2. The NRC Risk Evaluation assumptions are overly conservative when compared to the conclusions of Reference 1 and discussion above. Reference 1 concludes the disturbances associated with the broken connector pin were of short duration and did not have an adverse impact on the safety function of the 'B' EDG or on its connected safety-related loads. The NRC Risk Evaluation assumes that the broken pin would have resulted in the EDG's inability to maintain constant loading in isochronous mode.

The Corrective Steps that have been Taken and Results Achieved

Following the February 9, 2022, surveillance test, CR1191016 was written for the observed 'B' EDG oscillations and to create an action for engineering's review. An initial corrective action to perform a common cause on the 'A' EDG (CA10894246) determined there was no concern that the kW oscillation condition for 'B' EDG was also present on the 'A' EDG. Therefore, there was no requirement to start the 'A' EDG per TS 3.8.1.1, Action b.2. However, Operations conservatively decided to perform a start of the 'A' EDG to verify it did not have a similar condition. Engineering also observed the start of the 'A' EDG, per STP-125.002A, to support the common cause determination. There were no abnormalities observed during this surveillance test. Observations included fuel rack movement, local panel frequency indication,

and governor oil level before and during the run. Additionally, CA10984866 was written to perform a level of effort evaluation to determine the cause of the 'B' EDG oscillations.

To repair the 'B' EDG kW oscillating condition, Work Order 88201648997 was written and successfully implemented on February 10, 2022, to replace the Amphenol connector. To prevent a potential similar condition on the 'A' EDG, Work Order 88201667470 was implemented on May 23, 2022, to replace the same Amphenol connector.

Corrective Steps that will be Taken

To prevent recurrence, several corrective actions (CA) were initiated as part of the causal evaluation (CA10984866). CA11178458 was initiated for Engineering to present an EDG Amphenol Strain Relief Plant Health Working Group Presentation requesting approval to develop and issue a design change that incorporates strain relief on the governor control signal wires for the 'A' and 'B' EDG mechanical governor Amphenol connectors. This was presented to the Plant Health Work Group on July 18, 2022, and Plant Health Steering Committee on August 9, 2022. CA11178463 and CA11178465 were initiated to track implementation of the 'B' and 'A' EDG strain relief design changes, respectively. Both actions have a current due date of June 1, 2023.

Additionally, Department Tracking Items (DTI), which are not corrective actions, were initiated as program enhancements. One DTI is to revise the DG System Monitoring Plan to incorporate kW and KVAR trending during EDG monthly surveillance testing, including acceptance bands and trigger values for taking action per ER-AA-SYS-1003 (CA11178468 is due November 16, 2022). Another DTI was initiated to share this Operating Experience event with I&C and Electrical Maintenance technicians (CA11178469).

Date when Full Compliance will be Achieved

Full compliance with RG 1.9 and VCS TS was maintained throughout the time frame of January 16, 2022, through February 9, 2022. The vendor's report supports this operability determination.

References:

1. MPR Report 0310-0049-RPT-001, "Evaluation of the Impact of Degraded Governor Electrical Connection on B-EDG Voltage and Frequency," Revision 1 (Proprietary).
2. CR1191016, MSPI Evaluation, PAMS Assignment CA 10997282

Figure 1: 'B' EDG Maintenance Run - January 15, 2022

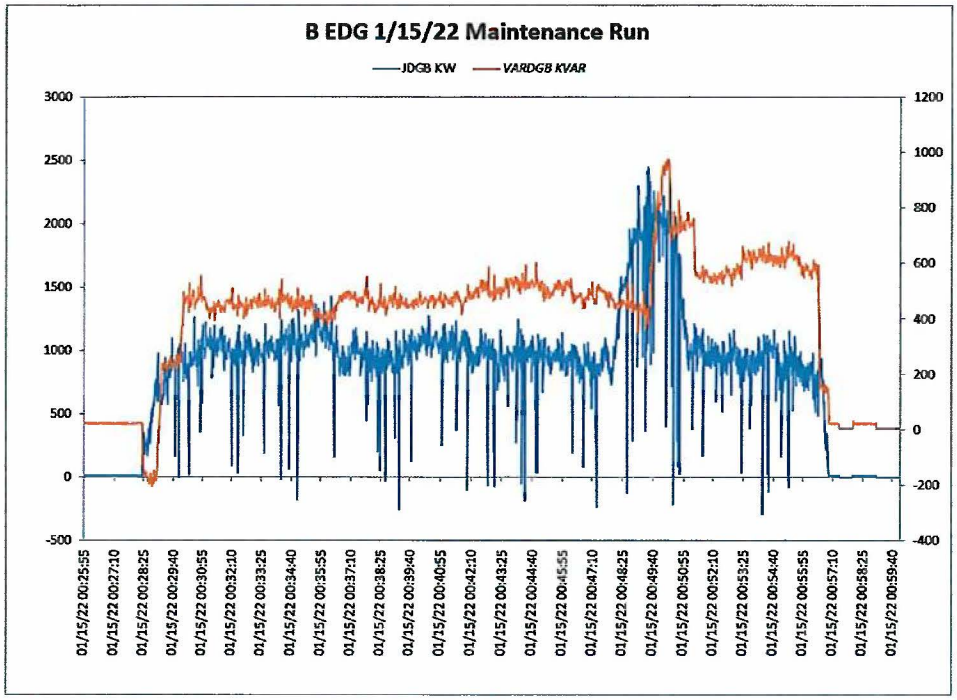

Figure 2: 'B' EDG Loaded Maintenance Run - January 16, 2022

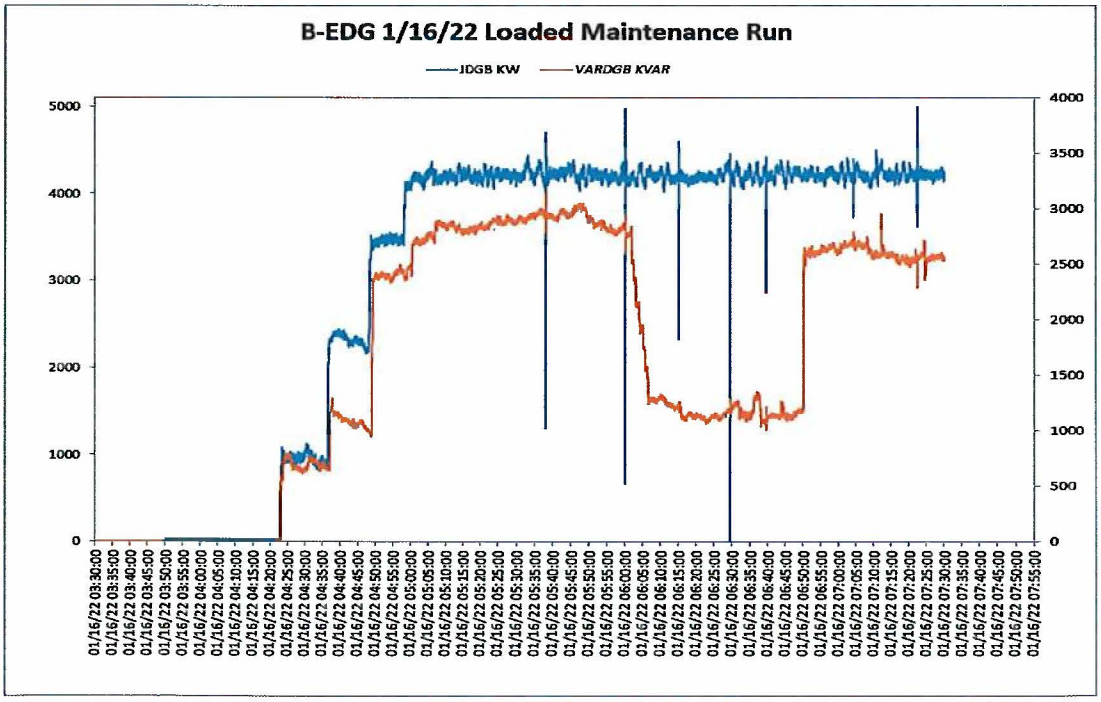

Figure 3: B EDG Surveillance Run - February 9, 2022