UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
245 PEACHTREE CENTER AVENUE N.E., SUITE 1200
ATLANTA, GEORGIA 30303-1200

July 14, 2022

EA-22-039

Mr. Daniel G. Stoddard
Senior Vice President and Chief Nuclear Officer
Dominion Energy
Innsbrook Technical Center
5000 Dominion Blvd., Floor: IN-2SW
Glenn Allen, VA 23060

SUBJECT: VIRGIL C. SUMMER – NRC INSPECTION REPORT 05000395/2022090 AND PRELIMINARY WHITE FINDING AND APPARENT VIOLATION

Dear Mr. Stoddard:

The enclosed inspection report documents a finding with an associated apparent violation that the NRC has preliminarily determined to be White with low-to-moderate safety significance. This involved an NRC-identified apparent violation of 10 CFR 50, Appendix B, Criterion XVI, which was identified for the licensee failing to correct a condition adverse to quality resulting in the inoperability of the 'B' emergency diesel generator (EDG). We assessed the significance of the finding using the significance determination process (SDP) and readily available information. We are considering escalated enforcement for the apparent violation consistent with our Enforcement Policy, which can be found at http://www.nrc.gov/about-nrc/regulatory/enforcement/enforce-pol.html. Because we have not made a final determination, no notice of violation is being issued at this time. Please be aware that further NRC review may prompt us to modify the number and characterization of the apparent violation.

The NRC's significance determination process is designed to encourage an open dialogue between your staff and the NRC; however, neither the dialogue nor the written information you provide should affect the timeliness of our final determination.

Before we make a final decision on this matter, we are providing you with an opportunity to (1) attend a Regulatory Conference where you can present to the NRC your perspective on the facts and assumptions the NRC used to arrive at the finding and assess its significance, or (2) submit your position on the finding to the NRC in writing. If you request a Regulatory Conference, it should be held within 40 days of the receipt of this letter, and we encourage you to submit supporting documentation at least one week prior to the conference to make the conference more efficient and effective. The focus of the Regulatory Conference is to discuss the significance of the finding and not necessarily the root cause(s) or corrective action(s) associated with the finding. If a Regulatory Conference is held, it will be open for public observation. If you decide to submit only a written response, such submittal should be sent to the NRC within 40 days of your receipt of this letter.

If you choose to send a response, please include your perspective of the significance of the finding along with the related facts and assumptions used to reach your determination. Additionally, your response should be clearly marked as a "Response to an Apparent Violation; (EA-22-039)" and should include for the apparent violation: (1) the reason for the apparent violation or, if contested, the basis for disputing the apparent violation; (2) the corrective steps that have been taken and the results achieved; (3) the corrective steps that will be taken; and (4) the date when full compliance will be achieved. Your response should be submitted under oath or affirmation and may reference or include previously docketed correspondence if the correspondence adequately addresses the required response. Additionally, your response should be sent to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Center, Washington, DC 20555-0001 with a copy to Mr. David E. Dumbacher, U.S. Nuclear Regulatory Commission, Region II, within 40 days of the date of this letter. If an adequate response is not received within the time specified or an extension of time has not been granted by the NRC, the NRC will proceed with its enforcement decision or schedule a Regulatory Conference.

If you decline to request a Regulatory Conference or to submit a written response, you relinquish your right to appeal the final SDP determination, in that by not doing either, you fail to meet the appeal requirements stated in the Prerequisite and Limitation sections of Attachment 2 of NRC Inspection Manual Chapter 0609.

Please contact Mr. David E. Dumbacher at 404-997-4628, and in writing, within 10 days from the issue date of this letter to notify the NRC of your intentions. If we have not heard from you within 10 days, we will continue with our significance determination and enforcement decision. The final resolution of this matter will be conveyed in separate correspondence.

For administrative purposes, this inspection report provides an update to the apparent violation documented in NRC inspection report 05000395/2022001 (Agency Documents Access and Management System (ADAMS) ML22132A192) dated May 12, 2022.

This letter, its enclosure, and your response (if any) will be made available for public inspection and copying at http://www.nrc.gov/reading-rm/adams.html and at the NRC Public Document Room in accordance with Title 10 of the *Code of Federal Regulations* 2.390, “Public Inspections, Exemptions, Requests for Withholding.”

Sincerely,

/RA/

Mark S. Miller, Director
Division of Reactor Projects

Docket No. 05000395
License No. NPF-12

Enclosure:
Inspection Report 05000395/2022090
w/Attachment: B-EDG Load Instability
Detailed Risk Evaluation

cc w/ encl: Distribution via LISTSERV

SUBJECT: VIRGIL C. SUMMER – NRC INSPECTION REPORT 05000395/2022090 AND PRELIMINARY WHITE AND APPARENT VIOLATION – dated July 14, 2022

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NAME	D. Dumbacher	M. Miller			
DATE	7/6/2022	7/14/2022			

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U.S. NUCLEAR REGULATORY COMMISSION
Inspection Report

Docket Number:	05000395
License Number:	NPF-12
Report Number:	05000395/2022090
Enterprise Identifier:	I-2022-090-0003
Licensee:	Dominion Energy
Facility:	Virgil C. Summer
Location:	Jenkinsville, SC
Inspection Dates:	May 13, 2022 to June 22, 2022
Inspectors:	M. Read, Senior Resident Inspector S. Sandal, Senior Reactor Analyst
Approved By:	David E. Dumbacher, Chief Reactor Projects Branch 3 Division of Reactor Projects

Enclosure

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring the licensee's performance by conducting an NRC inspection at Virgil C. Summer, in accordance with the Reactor Oversight Process. The Reactor Oversight Process is the NRC's program for overseeing the safe operation of commercial nuclear power reactors. Refer to https://www.nrc.gov/reactors/operating/oversight.html for more information.

List of Findings and Violations

Failure to Correct Condition Adverse to Quality Resulting in Inoperable Emergency Diesel Generator			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Mitigating Systems	Preliminary White AV 05000395/2022001-01 Open EA-22-039	[P.1] - Identification	71111.15
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.			

Additional Tracking Items

None.

INSPECTION SCOPES

Inspections were conducted using the appropriate portions of the inspection procedures (IPs) in effect at the beginning of the inspection unless otherwise noted. Currently approved IPs with their attached revision histories are located on the public website at http://www.nrc.gov/reading-rm/doc-collections/insp-manual/inspection-procedure/index.html. Samples were declared complete when the IP requirements most appropriate to the inspection activity were met consistent with Inspection Manual Chapter (IMC) 2515, "Light-Water Reactor Inspection Program - Operations Phase." The inspectors reviewed selected procedures and records, observed activities, and interviewed personnel to assess licensee performance and compliance with Commission rules and regulations, license conditions, site procedures, and standards.

INSPECTION RESULTS

Failure to Correct Condition Adverse to Quality Resulting in Inoperable Emergency Diesel Generator			
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Description: In January 2022, the licensee performed preventative maintenance on the 'B' EDG. During testing on January 15, the licensee identified power spikes when testing the EDG, indicating a governor performance issue. Condition Report (CR) CR-22-00134 was written to address the power spikes. Repairs were performed on the electronic governor speed switch transmitter after it detached from the engine during one of the tests. During the January 16 surveillance test, data available on the plant computer system and reports from Operations indicated that the erratic governor performance had not been corrected. Despite the condition, Operations declared the 'B' EDG operable based on meeting the acceptance criteria of the surveillance test. NRC inspectors identified that Operations had informed Engineering of the load swings that were noticed from the field and in the main control room during the test but recommended that Engineering monitor future EDG testing for an adverse trend. The issues identified during the January 16 surveillance test were not documented in the licensee's corrective action program. On February 9, 2022, the licensee conducted a routine monthly surveillance test on the 'B' EDG. During this test, governor oscillations worsened in magnitude and frequency. Operations declared the 'B' EDG operable based on meeting the acceptance criteria of the surveillance test, but Operations generated condition report CR1191016 for the oscillations. Engineering reviewed the testing data later that day and recommended declaring the EDG inoperable since they did not have reasonable assurance that the EDG could			

perform its function based on a qualitative assessment of the oscillations.

The licensee identified the cause of the governor behavior as a broken pin on an amphenol connector which connects the speed switch transmitter to the governor. The licensee repaired the connector, tested the EDG, and did not identify any power spikes.

Based on plant computer data from the January 16, 2022, surveillance test and witnesses from Operations, inspectors determined that the condition existed from January 16, 2022, until it was repaired on February 11, 2022.

Corrective Actions: Condition report CR-22-00134 was created following the January 15, 2022, testing which identified power spikes while the EDG was synchronized to the grid. The licensee made repairs to the speed switch sensor. Condition report CR1191016 was created following the February 9, 2022, testing which identified the power spikes were present and more frequent than the January testing. The licensee repaired a broken pin on an amphenol connector to resolve the governor performance issues.

Corrective Action References: CR-22-00134, CR1191016

Performance Assessment:

Performance Deficiency: The licensee's failure to evaluate and correct a condition adverse to quality on the 'B' emergency generator during testing on January 16, 2022 and comply with the technical specification allowed outage time was within the licensee's ability to foresee and correct and was a performance deficiency.

Screening: The inspectors determined the performance deficiency was more than minor because it was associated with the Equipment Performance attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, the condition affected the reliability of the 'B' emergency diesel generator to perform its design basis function.

Significance: The inspectors assessed the significance of the finding using Appendix A, "The Significance Determination Process (SDP) for Findings At-Power." The affected cornerstone was Mitigating Systems, as determined by IMC 0609, Attachment 4, "Initial Characterization of Findings." The inspectors screened the performance deficiency using Exhibit 2 of Appendix A and determined a detailed risk evaluation was required because the degraded condition represented a loss of the PRA function of one train of a multi-train TS system for greater than its TS allowed outage time.

A Region II Senior Reactor Analyst performed a detailed risk evaluation. The finding was preliminarily determined to be of low to moderate safety significance (White). The preliminary risk estimate was obtained by performing a condition analysis of the B-train emergency diesel generator (EDG) using a 26-day exposure period. The dominant internal event core damage sequences were associated with grid-related loss of offsite power initiators followed by failure of emergency feedwater, unavailability or failure of the A-train EDG, and operator failure to recover emergency or offsite electrical power sources. The dominant fire core damage sequences were fire initiating events in the station transformer area, A-train switchgear room, and turbine building switchgear room. These fire initiators resulted in a plant trip with fire damage accompanied by operator failure to restore power from the 13.8 kV source, failure to control the emergency feedwater turbine driven pump following battery depletion and failure

of the A-train EDG. Dominant seismic core damage sequences included induced grid-related loss of offsite power (LOOP) events with plant damage accompanied by failure of the vital battery chargers and the failure to control the emergency feedwater turbine driven pump after battery depletion. See Attachment, “B-EDG LOAD INSTABILITY DETAILED RISK EVALUATION,” for a summary of the preliminary risk determination analysis.

Cross-Cutting Aspect: P.1 - Identification: The organization implements a corrective action program with a low threshold for identifying issues. Individuals identify issues completely, accurately, and in a timely manner in accordance with the program. Specifically, the licensee had information following the January 16, 2022, test indicating governor performance issues and failed to document the issue in their Corrective Action Program.

Enforcement:

Violation: 10 CFR 50, Appendix B, Criterion XVI establishes the requirements for the licensee’s quality assurance program and requires, in part, “measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected.” The licensee complies with 10 CFR 50, Appendix B, Criterion XVI through DOM-QA-1, "Nuclear Facility Quality Assurance Program Description," Section XVI, which states, “Company procedures assure that corrective action is documented and initiated following the determination of a condition adverse to quality (such as a nonconformance, failure, malfunction, deficiency, deviation, adverse trend, and defective material and equipment) in accordance with regulatory guidance and industry quality standards.” This is accomplished through fleet procedure PI-AA-200, "Corrective Action," which “establishes measures to be taken to assure that conditions adverse to quality (e.g., failures malfunctions, deficiencies, defective material and equipment, and nonconformances) are promptly identified and corrected.”

Technical Specification (TS) 3.8.1.1 Action b.4 allows up to 72 hours to restore one inoperable EDG.

Contrary to the above, the licensee inadequately assessed erratic governor behavior during the testing on January 16, 2022, and failed to correct the condition, resulting in the inoperability of the ‘B’ EDG from January 16, 2022, until it was repaired on February 11, 2022, a time in excess of its 72 hour TS allowed outage time.

Enforcement Action: This violation is being treated as an apparent violation pending a final significance (enforcement) determination.

EXIT MEETINGS AND DEBRIEFS

The inspectors verified no proprietary information was retained or documented in this report.

- On July 7, 2022, the inspectors presented the NRC inspection results to David Wilson and other members of the licensee staff.

DOCUMENTS REVIEWED

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
71111.15	Corrective Action Documents	CR-22-00134		01/15/2022
		CR-22-00136		01/15/2022
		CR1191016		02/09/2022
	Drawings	E-206-012	Electrical One Line and Relay Diagram Engineered Safety Features Power System	33
	Procedures	AOP-304.1B	Loss of Bus 1DB with the Diesel not Available	4
		EOP-1.0	E-0, Reactor Trip or Safety Injection	32
		EOP-6.0	ECA-0.0, Loss of All ESF AC Power	41
		SOP-304	115KV/7.2KV Operations	14

ATTACHMENT: B-EDG LOAD INSTABILITY DETAILED RISK EVALUATION

SUMMARY

The total increase in core damage frequency (CDF) for the performance deficiency was estimated to be Preliminary White, a finding of low to moderate safety significance. Based on a best estimate considering the effect of the degraded condition on the B-train emergency diesel generator for an assumed exposure time, the estimated change in CDF was determined to be 5E-6/yr. This value reflected the lower end of various sensitivity analyses performed for the issue.

BACKGROUND

In January 2022, the licensee performed preventative maintenance on the B-train emergency diesel generator (EDG). During testing on January 15, the licensee identified load fluctuations and excessive fuel rack movement when testing the EDG, indicating a governor performance issue. The licensee initiated condition report CR-22-00134 to address the load fluctuations. Repairs were performed on the electronic governor speed switch transmitter after it detached from the engine during one of the tests. During the final surveillance test on January 16, prior to returning the B-train EDG to standby service, data available on the plant computer system and reports from operations indicated that load fluctuations were still occurring. Despite the condition, Operations declared the B-train EDG operable based on meeting the requirements of the surveillance test which did not have acceptance criteria for load stability. The load stability issues identified during the final January 16 surveillance test were not documented in the licensee's corrective action program.

On February 9, 2022, the licensee conducted a routine monthly surveillance test on the B-train EDG. During this test, load oscillations were observed that increased in magnitude and frequency. Operations declared the B-train EDG operable based on meeting the acceptance criteria of the monthly surveillance test, but Operations generated Condition Report CR1191016 for the oscillations. Engineering reviewed the testing data later that day and recommended declaring the EDG inoperable since they did not have reasonable assurance that the EDG could perform its function based on a qualitative assessment of the oscillations.

The licensee identified the cause of the governor behavior as intermittent electrical continuity due to a broken pin on an amphenol connector which connects the speed switch transmitter to the governor. The licensee repaired the connector, tested the EDG, and did not identify any further load oscillations. Inspectors reviewed test data for the B-train EDG for the tests prior to the January maintenance activities and noted that there were no indications of load oscillation prior to the January maintenance activities. Based on plant computer data and observations from the January 16, 2022, surveillance test, inspectors concluded that the degraded condition existed from January 16, 2022, until the amphenol connector was repaired and the B-train EDG was returned to service on February 11, 2022.

EXPOSURE TIME

The exposure time began on January 16, 2022, when the B-train EDG completed its final surveillance test before being returned to service with observed load oscillations/instability. The 26-day exposure period ended following the completion of repairs to the governor amphenol connector on February 11, 2022.

SAFETY IMPACT

The broken amphenol connector pin for B-train EDG resulted in the EDG's inability to maintain constant loading during operation while paralleled with the grid. Because the EDG is required to operate under emergency conditions in isochronous mode, those load fluctuations would be expected to manifest as more significant voltage and frequency oscillations without the benefit of the grid to dampen and compensate for governor-induced load instability. Excessive voltage and frequency oscillations could cause protective tripping of the EDG output breaker or damage/fault/lockout of B-train connected loads and prevent the EDG to provide emergency AC power in response to a loss of offsite power to the B-train associated electrical busses.

RISK ANALYSIS/CONSIDERATIONS

1. A 26-day exposure period was used for the analysis.
2. The most vulnerable period would be expected to occur during emergency load sequencing following the start of the EDG while the governor is operating in isochronous mode and without the benefit of the grid to dampen voltage and frequency oscillations caused by erratic governor behavior. Therefore, the B-train EDG was assumed to fail at or near time of demand and modeled as fail-to-start during the 26-day exposure period. This assumption is supported by evidence of load swings and excessive fuel rack movement that were observed while the EDG was operated in parallel with the grid during the exposure period.
3. The Standardized Plant Analysis Risk (SPAR) model was adjusted to include an additional 13.8 kV underground, normally energized offsite power source that was available to V.C. Summer from the Parr Hydroelectric Switchyard (Parr hydro unit) during the exposure period. Due to the underground path and physical separation from other offsite power sources, this feed was assumed to be available for all LOOP initiators except for grid-centered LOOP events. No credit was provided in the analysis for start-up and operation of the Parr hydro unit as an alternate source of electrical power.
4. FLEX mitigating strategies and equipment were credited in the analysis. FLEX equipment reliability was modeled using information contained in PWROG-18042-NP, Revision 1, "FLEX Equipment Data Collection and Analysis," (ADAMS ML22123A259). A sensitivity case with no FLEX credit was also performed.

Systems Analysis Program for Hands-On Integrated Reliability Evaluations (SAPHIRE) software version 8.2.6 and V.C. Summer SPAR model version 8.69 was used for the evaluation.

1. (Nominal and Conditional cases) The SPAR model was modified with the assistance of Idaho National Lab to account for the capability of powering the A- or B-train 7.2 kV Engineered Safety Features (ESF) bus from the 13.8 kV section of the Parr hydro unit switchyard. This offsite power supply is an underground feed via transformer XTF-5052 that has the capability of providing power to either ESF bus and does not require manning or start-up of the Parr hydro unit. No credit was provided in the analysis for start-up and operation of the Parr hydro unit as an alternate source of electrical power. In addition, the SPAR model was also modified to account for the ability of both the A- and B-train emergency auxiliary transformers (XTF-31 and XTF-4) to supply offsite power to both ESF busses.

2. (Nominal and Conditional cases) The following SPAR model basic events were adjusted to

account for best-estimate reliability of FLEX equipment using industry failure data. Where industry failure data was unavailable for SPAR modeled basic events (i.e., 'load run'), the SPAR model change set multiplier of 3x was used to model those failure basic events. A sensitivity case was also performed giving no credit for FLEX mitigation of the performance deficiency. These adjusted values were used for both the nominal and conditional case as the performance deficiency did not impact FLEX strategies.

3. (Nominal and Conditional cases) Two new human error probability (HEP) basic events were created to model operator actions to recover offsite power supplies. The first HEP (ACP-XHE-XM-PARRHYDRO) estimates the failure to manually align the 13.8 kV offsite source from Parr hydro switchyard to either the A- or B-train 7.2 kV ESF bus. The second HEP (ACP-XHE-XA-ALT1DA(B)) estimates the failure to manually align either XTF-31 to the B- and A-train ESF busses or XTF-4 to the A- and B-train ESF busses. Development of the HEPs was performed using SPAR-H.

   ACP-XHE-XM-PARRHYDRO = 4.4E-02
   ACP-XHE-XA-ALT1DA(B) = 5.40E-03

4. (Nominal and Conditional cases) The following SAPHIRE event sequences were used in evaluating the nominal and conditional cases:

   LOOP*
   INTERNAL EVENTS (other than LOOP)
   FIRE
   SEISMIC
   HIGH WINDS
   TORNADO
   INTERNAL FLOODING

   *LOOP sequences are expected to be dominant and were broken out separately from other internal event sequences during quantification

5. (Conditional case) Change set B_EDG_FTS_NO_REC was used to evaluate the failure of the B EDG. The change set also accounts for the increased likelihood of failed recovery of the emergency power system (EPS) function due to failure-induced nonrecovery of the B-train EDG as a result of the performance deficiency. The change set modified the following basic events:

Basic Event	Nominal Case	Conditional Case
EPS-DGN-FS-1B	2.86E-03	TRUE
EPS-XHE-XL-NR01H	0.8875	0.9421
EPS-XHE-XL-NR02H	0.8237	0.9076
EPS-XHE-XL-NR04H	0.7296	0.8542
EPS-XHE-XL-NR14H	0.4684	0.6844
EPS-XHE-XL-NR24H	0.3307	0.5751

6. SAPHIRE condition assessments using the Events and Conditions Assessment (ECA) module were performed using conditional case change set B_EDG_FTS_NO_REC and exposure period of 26-days. The fail-to-start and operator recovery basic events for the

EDGs were modified as described above for the conditional case. Significant sequence contributors to core damage frequency included FIRE, LOOP, and SEISMIC initiating events. These sequences were included in the sensitivity cases considered for the analysis.

SENSITIVITIES

Sensitivity 1 – Complicated Recovery of B-train Loads

Due to the nature of the performance deficiency, electrical loads powered by the B-train ESF bus from the affected EDG may be subjected to significant variations in bus voltage and frequency while operating in isochronous mode. This has the potential to increase the likelihood of failure (or complicate recovery) of individual loads powered from the B train ESF bus. To evaluate the sensitivity of analysis results with respect to this impact, basic events for operator actions to recover offsite electrical power were modified for the conditional case using class-type change set OFFSITE_REC. The change set increase the failure likelihood of recovery terms with the name mask of "OEP-XHE-XL-NR*" by a factor of 2.

ECA condition assessments utilizing a 26-day exposure period were performed with conditional change sets B_EDG_FTS_NO_REC and OFFSITE_REC.

Sensitivity 2 – No FLEX Credit

To evaluate the sensitivity of analysis results with respect to crediting of FLEX mitigation strategies, the basic event for operator failure to enter extended loss of AC power procedures was set to 1.0 for both the nominal and conditional cases.

FLX-XHE-XE-ELAP = 1.0

ECA condition assessments utilizing a 26-day exposure period were performed with conditional change set B_EDG_FTS_NO_REC.

Sensitivity 3 – Operator Actions to Align 13.8 kV Offsite

To evaluate the sensitivity of analysis results with respect to operator actions for alignment of the Parr hydro 13.8 kV offsite power supply, the basic event for operator failure (ACP-XHE-XM-PARRHYDRO) was increased by a factor of 2 for both the nominal and conditional cases.

ACP-XHE-XM-PARRHYDRO = 8.8E-02

ECA condition assessments utilizing a 26-day exposure period were performed with conditional change sets B_EDG_FTS_NO_REC and OFFSITE_REC.

Sensitivity 4 – Condition Exposure Period

To address potential uncertainty in the analysis with respect to exposure period, the analysis included a sensitivity case that considers that the inception time of the amphenol connector degradation could have occurred prior to the January 2022 maintenance window. The sensitivity utilized the approach discussed in Section 2.5 of the Risk Assessment Standardization Project (RASP) manual. The run history of the EDG prior to the January

maintenance window was used to determine the binning of accumulated run time for the 24-hour PRA mission time (condition inception time assumed unknown for the sensitivity).

The fault tree logic for the B EDG was modified to split the fail to run basic event into two separate events so that adjustments could be made to credit successful operation time prior to EDG failure. The SAPHIRE convolution mapping tool was then used to update model convolution events using the new fault tree logic.

Because recovery at 1 and 4 hours were dominant in the analysis cutsets, these recoveries were evaluated and adjusted in the conditional case to account for operation of the EDG for an interval time prior to its failure. To make these adjustments, additional basic events were used to model recovery of the B EDG and offsite electrical power that were adjusted for hours of good operation of the B EDG prior to failure. Calculations were performed directly in the event sequences by linking the sequence of interest and solving for the nominal and conditional case. Dominant event sequences FIRE, LOOP and SEISMIC were utilized for the sensitivity.

For the conditional case, the model was adjusted using change set B_EDG_FTR_NO_B_REC which set event EPS-DGN-FR-1B to TRUE so that the fail-to-run common cause change would be calculated by SAPHIRE. The change set also set the new basic event EPS-DGN-FR-1BEXT to 1.0 so the failure would show up in cutsets for post-processing adjustment made for credited EDG run time. The conditional case also included a change set for each time interval (B_EDG_FTR_1BT2_(2,4,7,11,14,16,18,20,22)_HRS) to adjust FTR mission time for EPS-DGN-FR-1BT2 based on credited EDG run time for the interval being assessed. The conditional case for each time interval also included event tree post-processing to look for B EDG FTR basic event EPS-DGN-FR-1BEXT in the cutsets and substitute the appropriate recovery terms based on credited EDG operation. A conditional case was performed for every interval bin and the results were summed to determine the overall risk estimate.

CALCULATIONS

SAPHIRE ECA condition assessments were performed using conditional case change set B_EDG_FTS_NO_REC and exposure period of 26-days to estimate the change in risk attributed to the performance deficiency. Significant sequence contributors to core damage included FIRE, LOOP, and SEISMIC initiating events. Considering that the ECA module of SAPHIRE calculates the difference in core damage probability over a given exposure time, and that changes in CDF over the same period are numerically equivalent, the change in CDF due to the finding would be on the order of 5.24E-06/year.

Dominant LOOP cutsets were associated with a grid-related LOOP initiator accompanied by emergency feedwater turbine driven pump failure to run, unavailability or failure of the A-train EDG, and operator failure to recover the emergency diesel generator or offsite electrical power sources.

Dominant FIRE cutsets were associated with fire initiating events in the station transformer area, A-train switchgear room, and turbine building switchgear room. These fire initiators result in a plant trip with fire damage accompanied by operator failure to restore power from the 13.8 kV source, failure to control the emergency feedwater turbine driven pump following battery depletion and failure of the A-train EDG.

Dominant SEISMIC cutsets were associated with induced grid-related LOOP events. These seismic initiators result in plant damage accompanied by failure of the vital battery chargers and the failure to control the emergency feedwater turbine driven pump after battery depletion.

EVENT SEQUENCE	Best Estimate delta-CDP	Sensitivity #1 delta-CDP	Sensitivity #2 delta-CDP+	Sensitivity #3 delta-CDP+	Sensitivity #4 delta-CDP+
FIRE	1.92E-06	1.92E-06	1.93E-06	3.04E-06	1.45E-05
LOOP	1.74E-06	2.77E-06	5.27E-06	3.09E-06	3.64E-06
SEISMIC	1.37E-06	8.82E-07	1.44E-06	8.85E-07	2.47E-06
HIGH WINDS	1.96E-07	3.10E-07	-	-	-
INTERNAL EVENTS	1.74E-08	3.14E-08	-	-	-
TORNADO	4.13E-10	5.31E-10	-	-	-
INTERNAL FLOODING	1.73E-11	3.50E-11	-	-	-
TOTAL	5.24E-06	5.91E-06	8.64E-06	7.02E-06	2.65E-05*

* This value assumed a condition inception time that is unknown and represented the increase in risk while crediting past EDG operation until the 24-hour PRA mission time was fulfilled. This value was added to the estimate for fail-to-start exposure period of 26-days (2.06E-05 + 5.24E-06 = 2.65E-05).

+FIRE, LOOP and SEISMIC event sequences were determined to be the significant SPAR model risk contributors and dominant accident sequences. The risk attributed to other initiators may result in a slight increase in the risk estimates for Sensitivities #2-4 but would not be sufficient to alter overall conclusions for the analyses.

For Sensitivities #1, 2 and 3 (Complicated Recovery of B-train Loads, No FLEX Credit, and Operator Actions to Align 13.8 kV Offsite), the results remained within the E-06 range and did not alter the overall conclusions of the analysis when compared to the best estimate case. The sensitivities quantified the upper range of impact to the estimated risk. The analyst noted that because the best estimate results were in the mid-E-06 range, additional sensitivities to assess lower bound of risk estimates would also not likely alter conclusions of the analysis when compared to the best estimate case.

For Sensitivity #4 (Condition Exposure Period), the quantified upper estimate was greater than E-06 (2.65E-05) and therefore had the potential to impact overall analysis conclusions. The analyst noted significant evidence that the condition start time began during the January maintenance window as indicated by the lack of load oscillations and instability during the last prior monthly surveillance test in December. In addition, the January maintenance activities involved disconnecting and reconnecting the affected amphenol connector several times. The analyst determined that an exposure period of 26-days where the B-train EDG would have failed to start during isochronous operation was most appropriate to the circumstances.

EXTERNAL EVENTS CONSIDERATIONS

Internal event estimates were greater than 1E-06, therefore external events were included in the preliminary risk assessment. FIRE and SEISMIC event sequences were determined to be significant contributors to the estimated risk and were also included in sensitivity evaluations.

LARGE EARLY RELEASE FREQUENCY IMPACT

The finding was evaluated in accordance with IMC 0609, Appendix H, “Containment Integrity Significance Determination Process,” as a Type A finding. Although the estimated change in core damage frequency (delta-CDF) was greater than 1E-07/year, the dominant accident sequences did not involve steam generator tube rupture or interfacing system LOCAs. Therefore, the issue associated with load instability on the B-train EDG would not be expected to be a significant contributor to an increase in large early release frequency (delta-LERF) risk. Delta-CDF was determined to be the risk metric of interest for this preliminary risk evaluation.

CONCLUSIONS/RECOMMENDATIONS

The preliminary estimated risk increase (delta-CDF) over the nominal case for the inoperability of the B-train EDG was 5.24E-06/year, which was consistent with a finding of low to moderate (WHITE) significance.