



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**

REGION III  
2443 WARRENVILLE ROAD, SUITE 210  
LISLE, ILLINOIS 60532-4352

July 19, 2021

Mr. David Rhoades  
Senior VP, Exelon Generation Company, LLC  
President and CNO, Exelon Nuclear  
4300 Winfield Road  
Warrenville, IL 60555

SUBJECT: BRAIDWOOD STATION – TRIENNIAL FIRE PROTECTION INSPECTION  
REPORT 05000456/2021010 AND 05000457/2021010

Dear Mr. Rhoades:

On June 11, 2021, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at Braidwood Station and discussed the results of this inspection with Mr. J. Keenan, Site Vice President and other members of your staff. The results of this inspection are documented in the enclosed report.

No findings or violations of more than minor significance were identified during this inspection.

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/**

Richard A. Skokowski, Chief  
Engineering Branch 3  
Division of Reactor Safety

Docket Nos. 05000456 and 05000457  
License Nos. NPF-72 and NPF-77

Enclosure:  
As stated

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Letter to David Rhoades from Richard A. Skokowski dated July 19, 2021.

SUBJECT: BRAIDWOOD STATION – TRIENNIAL FIRE PROTECTION INSPECTION  
REPORT 05000456/2021010 AND 05000457/2021010

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**U.S. NUCLEAR REGULATORY COMMISSION  
Inspection Report**

Docket Numbers: 05000456 and 05000457

License Numbers: NPF-72 and NPF-77

Report Numbers: 05000456/2021010 and 05000457/2021010

Enterprise Identifier: I-2021-010-0050

Licensee: Exelon Generation Company, LLC

Facility: Braidwood Station

Location: Braceville, IL

Inspection Dates: May 24, 2021 to June 11, 2021

Inspectors: J. Benjamin, Senior Reactor Inspector  
B. Jose, Senior Reactor Inspector  
A. Shaikh, Senior Reactor Inspector

Approved By: Richard A. Skokowski, Chief  
Engineering Branch 3  
Division of Reactor Safety

Enclosure

## SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring the licensee's performance by conducting a triennial fire protection inspection at Braidwood Station, 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

No findings or violations of more than minor significance were identified.

### Additional Tracking Items

Type	Issue Number	Title	Report Section	Status
URI	05000456, 05000457/2021010-01	Potential Protective Device Coordination Issues Associated with Battery Charger Short-Circuit Output	71111.21N.05	Open

## 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. Starting on March 20, 2020, in response to the National Emergency declared by the President of the United States on the public health risks of the coronavirus (COVID-19), inspectors were directed to begin telework. In addition, regional baseline inspections were evaluated to determine if all or a portion of the objectives and requirements stated in the IP could be performed remotely. If the inspections could be performed remotely, they were conducted per the applicable IP. In some cases, portions of an IP were completed remotely and on site. The inspections documented below met the objectives and requirements for completion of the IP.

## REACTOR SAFETY

### 71111.21N.05 - Fire Protection Team Inspection (FPTI)

#### Structures, Systems, and Components (SSCs) Credited for Fire Prevention, Detection, Suppression, or Post-Fire Safe Shutdown Review (IP Section 03.01) (3 Samples)

The inspectors verified that the following systems credited in the approved fire protection program could perform their licensing basis function:

- (1) Fire Detectors in Main Control Room
- (2) Main Control Room Fire Doors
- (3) Division 12 Charging Pump

#### Fire Protection Program Administrative Controls (IP Section 03.02) (1 Sample)

The inspectors verified that the following fire protection program administrative controls were implemented in accordance with the current licensing basis:

- (1) Fire Protection System Impairment Control

#### Fire Protection Program Changes/Modifications (IP Section 03.03) (2 Samples)

The inspectors reviewed the following changes to ensure that they did not constitute an adverse effect on the ability to safely shutdown post-fire and to verify that fire protection program documents and procedures affected by the changes were updated:

- (1) FDRP-28-026; EC 624903 - Installation of Roof Mounted Air Conditioning Units for the Miscellaneous Electrical Equipment Room Rod Control Cabinets
- (2) FDRP-28-023; EC 621772 - Installs Alternate Biocide (Chlorine Dioxide) Water Treatment System Located in The Lake Screen House

## INSPECTION RESULTS

Unresolved Item (Open)	Potential Protective Device Coordination Issues Associated with Battery Charger Short-Circuit Output URI 05000456,05000457/2021010-01	71111.21 N.05
<p><u>Description:</u></p> <p>NRC Information Notice (IN) 2017-06, "Battery and Battery Charger Short-Circuit Current Contributions to a Fault on the Direct Current Distribution System," was issued to inform addressees of the results of a NRC-led battery testing program, which was documented in NUREG/CR-7229, "Testing to Evaluate Battery and Battery Charger Short-Circuit Current Contributions to a Fault on the DC Distribution System."</p> <p>The licensee's battery chargers are silicon-controlled rectifier (SCR) type battery chargers and the testing described in NRC IN 2017-06 demonstrated SCR-type battery chargers produced significantly higher currents than expected. NRC IN 2017-06 stated, "The testing validated that the initial fault current contribution to a downstream fault from a battery charger (specifically the SCR-type chargers vs. the CF-type) is much higher—in the range of 7 to 10 times the battery charger full load ampere rating—during the first 100 milliseconds than what is currently stated as 150 percent of battery charger full load rating in IEEE Standard 946-2004. The test results indicated that the initial short circuit contribution from the charger is not limited when connected in parallel with the battery."</p> <p>The inspectors reviewed the licensee's operating experience evaluation for NRC IN 2017-06 and found that the licensee acknowledged the potentially higher short-circuit contribution from a battery charger but justified not performing any additional actions. The licensee's justification was based, in part, on their use of conservative short-circuit current data as calculational inputs and the belief that existing calculations contained significant margin to station breaker interrupting ratings (Ref: Issue Report (IR) 4066205, IR 4083304).</p> <p>The inspectors reviewed calculations BRW-97-0473 (VYR-97-225), "125 VDC System Short Circuit Calculation," Rev 2; BRW-97-0474-E, "125 VDC System Short Circuit Calculation," Rev 3; and BRW-97-0475, "125 VDC Fuse Sizing and Coordination," Rev 5. These calculations credit 125 VDC battery charger current limit feature to maintain coordination between the battery charger output breaker and multiple downstream protective devices. Downstream protective devices included individual load breakers and a pair of fuses on the safety-related 125 VDC bus. The two fuses, which were arranged in series, connected the safety-related bus to the non-safety related bus and were credited as isolation devices. The inspectors could not find a technical basis supporting the licensee's conclusion that their battery chargers would limit current fast enough to maintain protective device coordination.</p> <p>The inspectors reviewed the time-current characteristics curve for the battery charger output breaker and found that it could open at current levels as low as 3 times the battery charger full load ampere rating if the battery charger failed to limit current during the first 100 milliseconds of a fault. The inspectors noted that faults on 125 VDC cables or equipment could cause the loss of a battery charger that was not already considered in the licensee's analyses for events such as fire, flood, high energy line breaks (HELB) or other similar events.</p> <p>The inspectors also reviewed Brookhaven National Laboratory Technical Report</p>		

BNL-107800-2015-IR, "Evaluation of Battery and Battery Charger Short-Circuit Current Contributions to a Fault on the DC Distribution System at a Nuclear Power Plant – Task 1 Report: Literature Review," which was performed to support the NRC-led battery testing. The report reviewed and summarized literature dealing with current contributions from the station battery and battery charger(s). The inspectors' review of Section b., "Journal Articles and Conference Proceedings – (Testing Related)," found that it discussed multiple test results where the internal SCR fuses blew open during short-circuit testing on battery chargers. Additionally, the inspectors noted that for the event that prompted NRC IN 2017-06, specifically the Palisades event, on September 25, 2011, the event started from a fault on a DC distribution panel, one of the battery charger SCR fuses also blew open. The complete details of the Palisades event are provided in the SIT Report (ADAMS Accession No. ML113330802). Since the licensee was unable locate the time-current characteristic curve for the charger SCRs to prior to the end of the inspection, the inspectors were unable to review this information to understand if the licensee was vulnerable to losing battery charger functionality during faults on downstream branch circuits. Furthermore, indications were that fuses may be the original fuses provide by the charger vendor and are no longer manufactured.

The inspectors reviewed a sample of the components powered from the 125 VDC distribution system and assessed where their associated DC power cables where routed and located. The inspectors did identify examples where a fire in one room, which disables the operation of a safety-related 125 VDC bus, also contained cables from the opposite train 125 VDC bus. The inspectors found that if the fire caused a large fault on the cables associated with the opposite train, the battery charger output breaker or possibly the SCR fuses could open, should the battery charger fault currents not be limited fast enough to maintain coordination. This could result in the only remaining DC bus for the Unit being powered from its discharging battery. If the battery charger output breaker opened, the licensee would receive an alarm in the control room and operators may be able to reclose the output breaker if the original fault was cleared by the downstream protective device. However, if the internal SCR fuses blew open, maintenance would be required to replace the bolt-in fuses.

Planned Closure Actions: The inspectors plan to review the licensee's updated evaluation of NRC IN 2017-06 and determine if any performance deficiencies exist, whether the performance deficiencies are more than minor, and if a violation of NRC requirements occurred.

Licensee Actions: The licensee intends to reevaluate their operating experience conclusions for NRC IN 2017-06 related to the coordination of the battery charger output breaker or internal SCR fuses and downstream safety and non-safety related protective devices. The licensee entered the issue related to coordination between the battery charger output breaker and the downstream isolation fuses into their corrective action program as IR 4419717.

Corrective Action References: IR 4419717, "Braidwood Applicability of Byron on NRC IN 2017-06"

## **EXIT MEETINGS AND DEBRIEFS**

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

- On June 11, 2021, the inspectors presented the triennial fire protection inspection results to Mr. J. Keenan, Site Vice President and other members of the licensee staff.

**DOCUMENTS REVIEWED**

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
71111.21N.05	Calculations	BRW-97-0473-E	125 VDC System Short Circuit Calculation	2
		BRW-97-0475-E	125 VDC Fuse Sizing and Coordination	5
	Corrective Action Documents	IR 4066205	Braidwood Station Opex Level 3 Review - NRC IN 2017-06	10/24/2017
		IR 4419717	Braidwood Applicability of Byron URI on NRC IN 2017-06	04/28/2021
	Corrective Action Documents Resulting from Inspection	IR 4083304	DC System Short Circuit Calculation Update	12/12/2017
	Drawings	20E-1-4030CV10	Schematic Diagram Volume Control Tank Outlet Isolation Valves 1CV112B and 1CV112C	O
		20E-1-4030CV11	Schematic Diagram Charging Pumps from Refueling Water Storage Tank Suction Valves 1CV112D and 1CV112E	R
	Engineering Changes	624903	Installation of Roof Mounted Air Conditioning Units for the Miscellaneous Electric Equipment Room Rod Control Cabinets	2
		FDRP 28-023/EC 621772	Installation of Alternate Biocide Treatment at Lake Screen House	000
	Engineering Evaluations	U-2 AEER-FA.5.5-2	Unit 2 Auxiliary Electric Equipment Room Safe Shutdown Analysis	3
	Miscellaneous	KAA-500 Tron Fuse	Time Opening for KAA TRON Rectifier Fuses	00/00/0000
	Procedures	0BwOSFP.2.1.M-2	Motor Driven Fire Pump Monthly Surveillance	3
		0BwOSFP.2.2.M-2	Diesel Driven Fire Pump Monthly Surveillance	18
		BwHS 4009-056	Surveillance of Unit 2 Fire Detection Zones 2D-16 and 19 Through 21	3
		BwISR3.3.1.10-M237	Operational Test and Channel Verification/Calibration for Loop P-0455, Pressurizer Pressure Protection Channel I Cabinet 1	25



Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		BwMS FP-SA4	Halon Fire Extinguisher Maintenance Surveillance	6
		BwMS FP.7.1. E-1A2	Fire Rated Assemblies Visual Inspection Unit 2 VCT Room	2
		BwOP FP-100T38	Main Control Room Smoke Detector Surveillance	12
		CC-AA-206	Fuse Control	11
		MA-AA-723-325	Molded Case Circuit Breaker Testing	19
		NOD-OP16	Nuclear Operations Directive - DC Grounds Action Requirements	2
		OP-AA-102-106 Attachment 1	Operator Response Time Validation Sheet - TCA #11	11/30/2020
		OP-BR-102-106	Operator Response Time Program at Braidwood Station	10
	Self-Assessments	NOSA-BRW-15-09	Fire Protection Audit Report	10/07/2015
		NOSA-BRW-17-09	Fire Protection Audit Report	10/13/2017
	Work Orders	01436728	MSO Scenario 10, 11 & 12 - PMT for 1CV112C/CV112E Interlock	05/02/2012
		01508723	MSO Scenario 10, 11 & 12 - PMT for 1CV112B/1CV112D Interlock	05/02/2012
		01926497	Grout Removal/Installation for Fire Pump Diesel Room Wall	09/27/2017
		04666249-01	Perform Fire Protection Detector Surveillance on All Smoke Detectors in the Control Room	05/28/2019
		04857194	2CV01PB - Perform PMT Functional Run	04/30/2020
		05083441	ASME Surveillance for 2CV01PB	11/16/2020