



UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
1600 EAST LAMAR BOULEVARD
ARLINGTON, TEXAS 76011-4511

October 16, 2018

Mr. Fadi Diya, Senior Vice President
and Chief Nuclear Officer
Ameren Missouri
Callaway Plant
8315 County Road 459
Stedman, MO 65077

SUBJECT: CALLAWAY PLANT, UNIT 1 – NRC INSPECTION OF TEMPORARY
INSTRUCTION 2515/194, INSPECTION REPORT 05000483/2018011

Dear Mr. Diya:

On September 13, 2018, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your Callaway Plant. On September 18, 2018, the inspector discussed the results of this inspection with Mr. Roger Wink, Regulatory Affairs Manager, and other members of your staff. The results of this inspection are documented in the enclosed report.

The NRC inspector did not identify any findings or violations of more than minor significance.

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 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding."

Sincerely,

/RA Gregory Pick Acting for/

Gregory E. Werner, Chief
Engineering Branch 2
Division of Reactor Safety

Docket Nos. 50-483
License Nos. NPF-30

Enclosure:
Inspection Report 05000483/2018011
w/ Attachment: TI 2515/194 Inspection
Documentation Request

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

Docket Number(s): 05000483

License Number(s): NPF-30

Report Number(s): 05000483/2018011

Enterprise Identifier: I-2018-011-0050

Licensee: Union Electric Company

Facility: Callaway Plant

Location: Steedman, Missouri

Inspection Dates: September 10, 2018, to September 13, 2018

Inspectors: B. Correll, Reactor Inspector

Approved By: Gregory E. Werner, Chief
Engineering Branch 2
Division of Reactor Safety

Enclosure

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring licensee's performance by conducting Temporary Instruction 2515/194, "Inspection of the Licensees' Implementation of Industry Initiative Associated with the Open Phase Condition Design Vulnerabilities in Electric Power Systems (NRC Bulletin 2012-01)," at Callaway Plant, in accordance with the Reactor Oversight Process. The Reactor Oversight Process is the Nuclear Regulatory Commission 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 were identified.

Additional Tracking Items

None.

INSPECTION SCOPE

This inspection was conducted using Temporary Instruction 2515/194 (ADAMS Accession No. ML17137A416), dated October 31, 2017. The inspectors reviewed the licensee's implementation of Nuclear Energy Institute voluntary industry initiative in compliance with Commission guidance. The inspector discussed the licensee's open phase condition system design and ongoing implementation plans with plant staff. The inspector reviewed licensee and vendor documentation, and performed system walk downs to verify that the installed equipment was supported by the design documentation. The inspector verified that the licensee had completed the installation and testing of equipment (with the exception of the tripping functions), installed and tested alarming circuits both local and in the control room, and analyzed potential impacts associated with the design implementation on the current licensing basis.

OTHER ACTIVITIES – TEMPORARY INSTRUCTIONS, INFREQUENT AND ABNORMAL

Temporary Instruction 2515/194 - Inspection of the Licensees' Implementation of Industry Initiative Associated With the Open Phase Condition Design Vulnerabilities in Electric Power Systems (NRC BULLETIN 2012-01)

The objective of Temporary Instruction 2515/194 is to verify that licensees have appropriately implemented the Nuclear Energy Institute voluntary industry initiative (ADAMS Accession No. ML15075A454), dated March 16, 2015, including updating their licensing basis to reflect the need to protect against open phase conditions.

Temporary Instruction 2515/194-03.01 - Voluntary Industry Initiative (Part 1)

Callaway Plant selected a hybrid design using safety-related negative sequence relays and the open phase detection system designed and manufactured by Power System Sentinel Technologies, LLC. At the end of this inspection the system was still in the monitoring mode of operation to facilitate continued data gathering of grid perturbations for evaluation of alarm and trip setpoints. The open phase condition equipment was installed on the safety-related 4160 Vac buses (NB01 and NB02), and the Power System Sentinel Technologies, LLC equipment installed on Safeguards Transformer A (XMDV24). The licensee is scheduled to transition the negative sequence relays to full implementation (tripping functions enabled) by December 31, 2018. The licensee was preparing associated documentation for this transition, however they were not available for review at the time of inspection.

INSPECTION RESULTS – OBSERVATIONS/ASSESSMENT

Based on discussions with the licensee staff, review of available design, testing, grid data trending results documentation, and walk downs of installed equipment, the inspector had reasonable assurance the licensee appropriately implemented the voluntary industry initiative.

The inspector determined that:

Detection, Alarms, and General Criteria	TI 2515/194-03.01 - Voluntary Industry Initiative (Part 1)
<p>(1) Open phase conditions will be detected and alarmed in the control room for each unit on the common annunciator panel.</p> <p>(2) Detection circuits will be sensitive enough to identify an open phase condition for all credited loading conditions.</p> <p>(3) No Class-1E circuits were being replaced with non-Class 1E circuits in the design.</p>	

Protective Actions Criteria	TI 2515/194-03.01 - Voluntary Industry Initiative (Part 1)
<p>(1) One transformer was susceptible to an open phase condition and the licensee was implementing design changes to mitigate the effects.</p> <p>(2) With an open phase condition present and no accident condition signal, the open phase design would not adversely affect the function of important-to-safety systems, structures, or components. The licensee's open phase condition design solution added two safety-related negative sequence relays on the safety-related 4160 Vac buses, and a Power System Sentinel Technologies system on the Safeguards B transformer for alarm only. This addition added a new tripping condition (open phase) to safety-related bus incoming supply breakers. The credited plant response was unaffected and would be the same regardless of the conditions that generated the isolation of the transformer.</p>	

No findings were identified.

The inspector identified the following exceptions to the Temporary Instruction criteria resulting from the incomplete design modifications:

Detection, Alarms and General Criteria Exceptions	TI 2515/194-03.01 - Voluntary Industry Initiative (Part 1)
<p>(1) The licensee’s design was operating in the monitoring mode with established setpoints enabled to gather data to ensure the open phase condition design and protective schemes would minimize misoperation, or spurious actions in the range of voltage unbalance normally expected in the transmission system. Because actual demonstration of this criterion requires the system to be in operation with final trip setpoints established, the inspector was not able to fully verify this criterion. After discussions with licensee staff, design document and test results reviews, the inspector had reasonable assurance that the actuation circuit design would not result in lower overall plant reliability. The inspector did not identify any issues of concern.</p> <p>(2) The Final Safety Analysis Report (FSAR) had not been updated to include information related to open phase conditions at the conclusion of the onsite inspection. The licensee provided the inspector with proposed changes to the licensing basis that discussed the system requirements related to the effects of, and protection for, any open phase condition design vulnerability. The licensee continued to modify and update the proposed changes during the onsite portion of the inspection. The inspector verified the proposed change process is being tracked under License Document Change Notice, LDCN 17-0012 for the completion of the FSAR updates. The inspector did not identify any issues of concern.</p>	

Protective Actions Criteria Exceptions	TI 2515/194-03.01 - Voluntary Industry Initiative (Part 1)
<p>(1) The licensee’s open phase condition design solution uses safety-related negative sequence relays on the 4160 Vac safety buses in a 2-out-of-2 coincidence logic for protection. A voltage unbalance of sufficient magnitude will actuate both negative sequence relays. The relays are designed to trip open the normal and alternate supply breakers to the associated safety bus, causing a loss of voltage to the bus. The existing undervoltage relays will operate as designed to initiate starting of the emergency diesel generator to restore power to the bus.</p> <p>The tripping function of the incoming breakers remained disabled during the onsite portion of the inspection and was not able to be demonstrated to perform the designed function. This action was being tracked in the modification package MP 15-0008. Through review of design documents and discussions with licensee staff, the inspector had reasonable assurance that with an open phase condition present and with and without an accident condition signal, the open phase design would isolate the affected bus and cause an automatic restoration of power from the emergency diesel generators. Due to the configuration of Callaway Plant’s electrical distribution system, a loss of phase on one transformer would only affect one train of equipment, and loads required to mitigate postulated accidents would be available on the non-affected train, ensuring that safety functions are preserved as required by the current licensing bases. The inspector did not identify any issues of significance.</p> <p>(2) At the time of this inspection, the licensee had not finalized documentation for periodic tests, calibrations, setpoint verifications, or inspection procedures associated with the</p>	

Power System Sentinel Technologies, LLC at the time of this inspection. This action was being tracked in the modification package MP 15-0008. The inspector held discussions with licensee staff and identified that plans were in place to establish contracts with the vendor to provide maintenance and support activities for the Power System Sentinel Technologies, LLC equipment.

The licensee established maintenance activities for the safety-related portion of the open phase condition design, and the inspector verified the activities were appropriate. Existing plant equipment will continue to be maintained according to the licensee's current preventative maintenance program. The inspector did not identify any issues of concern.

EXIT MEETINGS AND DEBRIEFS

On September 18, 2018, the inspector conducted a telephonic exit to present the Temporary Instruction 2515/194 inspection results to Mr. R. Wink, Regulatory Affairs Manager, and other members of the licensee staff. The inspector verified no proprietary information was retained.

DOCUMENTS REVIEWED

Inspection Procedure TI 2515/194

Condition Reports

201707350	201707586	201802205	201802672
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Drawings

Number	Title	Revision
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8618-X-94076	Metering and Relaying 345-13.8KV Safeguard Transformers POSN-V22 and V24	8
8618-X-94091	345-13.8KV SFGD XFMR-B AC Portion	11
8618-X-94726	Annunciator -1 Sheet -2 Drop -51 Thru 96, 98, & 100	18
8618-X-94760	Alarms and Metering to Plant Unit-1 ANN., BOP Computer and Site Related Panel	22
8618-X-95741	345-13.8KV SFGD XFMR-B DC Portion	11
E-21001	Main Single Line Diagram	25
E-21023	Relay Setting Tabulations and Coordination Curves System NB	27
E-21NB01	Lower Medium Voltage System Class 1E 4.16KV Single Line Meter and Relay Diagram	11
E-21NB02	Lower Medium Voltage System Class 1E 4.16KV Single Line Meter and Relay Diagram	17
E-23NB01	Lower Medium Voltage System Class 1E 4.16KV Three Line Meter and Relay Diagram	9
E-23NB03	Lower Medium Voltage System Class 1E 4.16KV Three Line Meter and Relay Diagram	18
E-23NB04	Lower Medium Voltage System Class 1E 4.16KV Three Line Meter and Relay Diagram	8
E-23NB06	Lower Medium Voltage System Class 1E 4.16KV Three Line Meter and Relay Diagram	10
E-23NB12	Class 1E Bus NB01 Feeder Brkr 152NB0112	12
E-23NB13	Class 1E Bus NB01 Feeder Brkr 152NB0109	11
E-23NB14	Class 1E Bus NB02 Feeder Brkr 152NB0209	13
E-23NB15	Class 1E Bus NB02 Feeder Brkr 152NB0212	12

Engineering Studies Number	Title	Revision
MP 15-0008	Engineering Disposition – Modification Open Phase Condition Protection	007
NB-05	System NB Protective Relay Setpoints	004, Addendum 05
ZZ-561	Open Phase Fault Study for the Callaway Energy Center	000

Miscellaneous Documents Number	Title	Revision or Date
DCN: IEGR-DD-1672	Open Phase Protection (OPP) System Non-Class 1E OPP Protection Settings, Ameren-Callaway SFGD-B	0.0.1
DCN: ITST-TP-1704	Open Phase Protection (OPP) System Site Acceptance Test (SAT) Plan Single Channel Analog System for the Callaway Nuclear Plant	0.0.2
TSTF	Evaluation of Inclusion of Open Phase Condition Equipment Requirements in the Technical Specifications	October 8, 2015
LOCT/NLOCT T61.0810 8/T61.0740 8 Cycle 18-1	Large Transformers	January 25, 2018

Modification Number	Title	Revision
MP 15-0008	Open Phase Condition Protection	000

Procedures Number	Title	Revision
MPE-ZZ-QY055	Inspection, Test and Calibration of Protective Negative Sequence Overvoltage Relays, ABB Type 60Q	000
MPE-ZZ-QY109	Operational Test Sequence of 4.16KV Bus NB01 Main Air Circuit Breaker 152NB0109	011
MPE-ZZ-QY112	Operational Test Sequence of 4.16KV Bus NB01 Main Air Circuit Breaker 152NB0112	011
MPE-ZZ-QY126	Operational Test Sequence of 4.16KV Bus NB02 Main Air Circuit Breaker 152NB0209	013
MPE-ZZ-QY129	Operational Test Sequence of 4.16KV Bus NB02 Main Air Circuit Breaker 152NB0212	011

Procedures Number	Title	Revision
OTA-RK-00016, Addendum 21B	NB02 Bus Undervoltage	000
OTA-RK-00016, Addendum 21D	NB02 Undervoltage Relay 1/4	001
OTA-RK-00016, Addendum 22E	NB02 Bus Degraded Voltage or Phase Imbalance	003
OTA-ZZ-00SA1, Addendum 77	Safeguards Transformer B Open Phase Trouble	002
OTO-NB-00002	Loss of Power to NB02	031
Vendor Document Number	Title	Revision
IB 7.4.1.7-3	ABB Phase Unbalance Relay	Issue C

TI 2515/194 Inspection Documentation Request

Please provide the following documentation (Items 1 – 8) to the lead inspector prior to the onsite inspection date, preferably no later than August 27, 2018. Whenever practical, please provide copies electronically (IMS/CERTREC is preferred). Please provide an index of the requested documents which includes a brief description of the document and the numerical heading associated with the request (i.e., where it can be found in the list of documents requested).

Brian Correll, Lead Inspector
RIV/DRS/EB2
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1. Copies of any calculations, analyses, and/or test reports performed to support the implementation of your open phase condition (OPC) solution. If, in your implementation, OPCs are not detected and alarmed in the control room please include documentation that:
 - a. Demonstrates the OPC will not prevent functioning of important-to-safety SSCs; AND
 - b. Detection of an OPC will occur within a short period of time (e.g., 24 hours).
2. Copies of any modification packages, including 10 CFR 50.59 evaluations if performed, used for or planned for the implementation of your OPC solution.
3. Copies of periodic maintenance, surveillance, setpoint calibration, and/or test procedures implemented or planned, for your OPC solution.
4. Copies of your licensing basis changes to Updated Final Safety Analysis Report (UFSAR) and/or Technical Specifications (TS), as applicable, which discuss the design features and analyses related to the effects of, and protection for, any open phase condition design vulnerability. If these documents have not been updated, provide documentation of your plans to do so.
5. Copies of any procurement specifications and acceptance testing documents related to the installation of your OPC solution.
6. Copies of any site training the team will need to accomplish to gain access to areas with, or planned, major electrical equipment used in your OPC solution (i.e. switchyard).
7. Provide documentation showing that with an OPC occurrence and no accident condition signal present, either:
 - a. An OPC does not adversely affect the function of important-to-safety SSCs, OR
 - b. TS LCOs are maintained or the TS actions are met without entry into TS LCO 3.0.3 AND
 - i. Important-to-safety equipment is not damaged by the OPC, AND
 - ii. Shutdown safety is not compromised

8. With OPC occurrence and an accident condition signal present:
 - a. Provide documentation showing that automatic detection and actuation will transfer loads required to mitigate postulated accidents to an alternate source and ensure that safety functions are preserved, as required by the current licensing bases, OR
 - b. Provide documentation showing that all design basis accident acceptance criteria are met with the OPC, given other plant design features. Accident assumptions must include licensing provisions associated with single failures. Typically, licensing bases will not permit consideration of the OPC as the single failure since this failure is a non-safety system.

Please provide the following documentation to the team when they arrive onsite. Whenever practical, please provide copies electronically, except for drawings. Drawings should be provided as paper copies of sufficient size (ANSI "C" or "D") such that all details are legible.

9. A brief presentation describing your electric power system design and typical electrical transmission and distribution system alignments; OPC design schemes installed to detect, alarm and actuate; bus transfer schemes; and maintenance and surveillance requirements. This presentation should be a general overview of your system. Please schedule the overview shortly after the entrance meeting.
10. Plant layout and equipment drawings for areas that identify: (a) the physical plant locations of major electrical equipment used in your open phase condition solution; (b) the locations of detection and indication equipment used in the open phase condition sensing circuits.
11. If OPC actuation circuits are required, provide documentation that demonstrates continued coordination with the other protective devices in both the offsite electrical system (within Callaway Plant area of responsibility) and the onsite electrical systems.
12. Access to locations in which open phase condition equipment is installed or planned (i.e. switchyard, etc.)

Copies of documentation or testing that demonstrates your OPC solution minimizes spurious actuation or misoperation in the range of voltage imbalance normally expected in the transmission system that could cause undesired separation from an operable off-site power source.

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CALLAWAY PLANT, UNIT 1 – NRC INSPECTION OF TEMPORARY INSTRUCTION 2515/194,
INSPECTION REPORT 05000483/2018011 – OCTOBER 16, 2018

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