MISSOURI PUBLIC SERVICE COMMISSION

STAFF REPORT

COST OF SERVICE

APPENDIX 3

Other Staff Schedules

UNION ELECTRIC COMPANY,
d/b/a Ameren Missouri

CASE NO. ER-2021-0240

Jefferson City, Missouri
September 2021

** Denotes Confidential Information **

BJC Solar

In-Service Test Criteria Evaluation

Completed by Staff Witness Claire M. Eubanks, P.E.

1. All major construction work is complete.

   ** [redacted] **

   I visited the site on January 15, 2020. I also reviewed the remaining punch list items prepared by the contractor. ** [redacted] ** *The Capacity Testing was completed on February 23, 2020 and provided to Staff in Response to Data Request 747, in ER-2021-0240.*

   Criterion 1 has been met.

2. All preoperational tests have been successfully completed.

   I reviewed the Start-up report for BJC solar, ** [redacted] ** *which demonstrates that preoperational tests have successfully been completed as of* ** [redacted] **

   Criterion 2 has been met.

3. Facility successfully meets contract operational guarantees that are necessary for satisfactory completion of all other items in this list.

   ** [redacted] ** *requires a Capacity Test, the results are discussed under Criterion 5.*

   Criterion 3 has been met.

4. Upon observation of the facility for 72 consecutive hours the facility will have demonstrated that when sunlight was shining on it during that period it produced power in a standard operating mode.

** [redacted] ** [1]

Criterion 4 has been met.

5. Facility shall meet at least 95% of the guaranteed capacity (in MW AC) based on the Capacity Test in Exhibit 1. The Capacity Test shall determine the facility's Corrected Capacity at the Design Point Conditions.

Ameren Missouri supplied data from January 27, 2020 to February 23, 2020 which determined the facility's average corrected capacity to be 1.41 MW. The facility's corrected capacity is over 95% of the guaranteed capacity of 1.45 MW AC.[2]

Criterion 5 has been met.

6. Sufficient transmission/distribution interconnection facilities shall exist for the total plant design net electrical capacity at the time the facility is declared fully operational and used for service.

Ameren Missouri reviewed the existing load conditions on the circuit, the current carrying capabilities of the circuit conductors, and evaluated the transformer sizing. "The full-load capability of the BJC-Ameren Solar facility is 73 amps at 12,470 volts amounting to 16.3% of the full-load capabilities of the circuit. At full generating capacity from the solar array and the historic peak load demand, the circuit would experience 66.1% of the full-load capability." ** [redacted] **

[1] Data Provided in response to Staff Data Request 747 "mpsc 0747s1 07 intervaldata 01062020125841 bjcrec conf (1).xlsx" and public "mpsc 0747 attach bjc cap verif datasheet revised.xlsx".

[2] Data Provided in response to Staff Data Request 747 "mpsc 747s1 04 bjc solar cap verif datasheet raw data conf.xlsx".

Ameren Missouri physically interconnected the BJC solar facility to its distribution system on September 12, 2019.[3]

Criterion 6 has been met.

7. Sufficient transmission/distribution facilities shall exist for the total plant design net electrical capacity into the utility service territory at the time the facility is declared fully operational and used for service.

Ameren Missouri reviewed the existing load conditions on the circuit, the current carrying capabilities of the circuit conductors, and evaluated the transformer sizing. "The full-load capability of the BJC-Ameren Solar facility is 73 amps at 12,470 volts amounting to 16.3% of the full-load capabilities of the circuit. At full generating capacity from the solar array and the historic peak load demand, the circuit would experience 66.1% of the full-load capability." ** [redacted] **

Ameren Missouri physically interconnected the BJC solar facility to its distribution system on September 12, 2019.[4]

Criterion 7 has been met.

[3] Response to Staff Data Request 747.
[4] Response to Staff Data Request 747.

Exhibit 1 - Capacity Test

Definitions:

"Corrected Capacity" means the most recent actual tested Capacity, in MW, corrected to Design Point Conditions (DPC) as described herein.

"Design Point Conditions" (DPC) means a set of ambient reference conditions, which include a solar irradiance of 1050 watts per meter square, module cell temperature of forty-five degrees (45°) Celsius, atmospheric air mass of 1.5 or less and wind speed of one (1) meter per second.

"POA" means plane of array irradiance.

The Capacity Test shall determine the Corrected Capacity at the Design Point Conditions. Capacity Test will be based on the relevant environmental conditions in the field at the time of such test, including field irradiance and temperature. The measured Capacity shall then be "corrected" to the Design Point Conditions and the resulting Corrected Capacity shall be compared to the Guaranteed Capacity as set forth herein.

The Capacity Test data shall consist of a minimum of 50, 15 minute blocks of average Plane of Array Irradiance (POA) solar irradiance data; where POA is at least 500 W/m2.

a. **Calculations Procedures:**

(1) $T_{cell} = T_{module} + 1.5$

(2) $W_{COR} = Wmeas * (IRR_{DPC} / IRR\ ) * (1/(1 + TCOEFF(Tcell - T_{DPC})))$

(3) $Wguar = \frac{W_{COR}}{W_{GUAR}}$

Where…

- W_{MEAS} = Measured AC capacity in [MW]
- W_{COR} = Corrected AC capacity at Design Point Condition (DPC) in [MW]
- IRR_{DPC} = Direct normal irradiance at DPC (1050 W/m^2) in [W/m^2]
- IRR = Measured irradiance in [W/m^2]

- TCOEFF = Temperature coefficient of maximum power of installed panel (-0.0036/°C) [/°C]
- T_{module} = Measured module temperature in [°C]
- T_{cell} = Measured cell temperature in [°C]
- T_{DPC} = Temperature at DPC (45°C) in [°C]
- W_{GUAR} = Guaranteed AC capacity of the system (1.45 MW-AC) in [MW]

Note: Cell temperature is calculated based on the module temperature readings taken from a T-type thermocouple placed on the underside and center of the DUT. A correction factor of 1.5°C is assumed for backsheet to cell temperature as per the standard practice of glass and backsheet constructed c-Si modules.

Licensee Event Report 2020-006-00 "Reactor Trip Due to Main Generator Ground Fault"

NRC Accession Number ML20330A267

NRC FORM 366 (08-2020) | U.S. NUCLEAR REGULATORY COMMISSION | APPROVED BY OMB: NO. 3150-0104 | EXPIRES: 08/31/2023

LICENSEE EVENT REPORT (LER)

(See Page 3 for required number of digits/characters for each block)

(See NUREG-1022, R.3 for instruction and guidance for completing this form https://www.nrc.gov/reading-rm/doc-collections/nureges/staff/sr1022/r3/)

1. Facility Name	2. Docket Number	3. Page
Callaway Plant, Unit No. 1	05000483	1 OF 3

4. Title
Reactor Trip due to Main Generator Ground Fault

5. Event Date			6. LER Number			7. Report Date			8. Other Facilities Involved	
Month	Day	Year	Year	Sequential Number	Revision No.	Month	Day	Year	Facility Name	Docket Number
										05000
09	27	2020	2020	- 006 -	00	11	25	2020	Facility Name	Docket Number
										05000

9. Operating Mode	10. Power Level
MODE 1	98%

11. This Report is Submitted Pursuant to the Requirements of 10 CFR §: *(Check all that apply)*

10 CFR Part 20	☐ 20.2203(a)(2)(vi)	☐ 50.36(c)(2)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(A)	**10 CFR Part 73**
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.69(g)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(4)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(i)	**10 CFR Part 21**	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	☐ 73.77(a)(1)(i)
☐ 20.2203(a)(2)(ii)	☐ 21.2(c)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)	☐ 73.77(a)(2)(i)
☐ 20.2203(a)(2)(iii)	**10 CFR Part 50**	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)	☐ 73.77(a)(2)(ii)
☐ 20.2203(a)(2)(iv)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)	
☐ 20.2203(a)(2)(v)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)	

☐ **Other** (Specify here, in Abstract, or in NRC 366A).

12. Licensee Contact for this LER

Licensee Contact	Phone Number (Include Area Code)
T. B. Elwood, Supervising Engineer, Regulatory Affairs and Licensing	314-225-1905

13. Complete One Line for each Component Failure Described in this Report

Cause	System	Component	Manufacturer	Reportable To IRIS	Cause	System	Component	Manufacturer	Reportable To IRIS

14. Supplemental Report Expected		15. Expected Submission Date	Month	Day	Year
☒ No	☐ Yes (If yes, complete 15. Expected Submission Date)				

16. Abstract (Limit to 1560 spaces, i.e., approximately 15 single-spaced typewritten lines)

On September 27, 2020 at 0203 with the reactor at 98% power during the cycle 24 coastdown, a main generator fault occurred that lead to a turbine trip and reactor trip. Safety systems functioned as required, including actuation of the auxiliary feedwater system, and the Operations staff responded to the event in accordance with applicable plant procedures. The post trip investigation indicated that a fault in the 25-kV portion of the generator output actuated the main generator protection system, which in turn caused the turbine trip (with reactor power above the P-9 setpoint) and an automatic reactor trip.

An ENS notification (ENS 54916) was made for this event.

The cause of the generator fault was due to a detached section of a flexible link in the B phase of the isophase bus ductwork.

All flexible links were inspected during refueling outage 24 and repairs completed.

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Callaway Plant, Unit No. 1	05000-483	2020	- 006	- 00

NARRATIVE

1. DESCRIPTION OF STRUCTURE(S), SYSTEM(S),AND COMPONENT(S):

The systems and components affected by this event include the reactor trip system and the unit main generator.

The reactor trip system at Callaway Plant initiates a unit shutdown, based on the values of selected unit parameters, to protect against violating the core fuel design limits and reactor coolant system pressure boundary during anticipated operational occurrences and to assist the Engineered Safety Features systems in mitigating accidents.

The main generator has a number of trips in order to protect this asset from irreparable damage. The main generator isophase buses transport electrical power from the main generator to the main step-up transformers, unit auxiliary transformer, and excitation transformer.

2. INITIAL PLANT CONDITIONS

Callaway was at 98% Power/Mode 1 performing the cycle 24 coastdown at the time of this event.

3. EVENT DESCRIPTION

On September 27, 2020 at 0203 with the reactor at 98% power during the cycle 24 coastdown, the reactor was automatically tripped from a turbine trip caused by a main generator fault. Safety systems functioned as expected. The Operations staff responded to the event in accordance with applicable plant procedures. An ENS notification (EN 54916) was made for this event at 0416 on September 27, 2020.

The post trip relay positions indicated that a main generator fault in the 25-kV portion of the generator output caused a main generator trip, which in turn caused the turbine trip. Initial walkdowns did not identify any obvious damage to the main generator or isolated phase (isophase) bus system. Review of the relay data identified that the fault occurred in the B phase. Closer inspection of the isolated phase bus system identified a detached piece of a laminated sheet-style flexible link that was located inside the bus duct within the turbine building.

The initiating cause of the main generator/reactor trip was a laminated sheet on the 5B flexible link became detached and caused a phase-to-ground fault on B phase of the 25-kV isophase bus system. This actuated the main generator protection system, which resulted in a turbine trip (with reactor power above the P-9 setpoint) and an automatic reactor trip.

Per plant design, an auxiliary feedwater system actuation occurred as expected in response to the reactor trip.

4. ASSESSMENT OF SAFETY CONSEQUENCES:

There were no actual nuclear, radiological, or personnel safety impacts associated with this event. The potential impact was on nuclear safety with respect to challenging the reactor trip system as well as any potential challenges to the plant due to the transient associated with a reactor trip. However, all safety systems functioned as designed, and the reactor automatically tripped (i.e., shut down) per design when the main generator ground fault was detected.

5. REPORTING REQUIREMENTS

This LER is submitted pursuant to 50.73(a)(2)(iv)(A) to report a reactor protection system actuation during startup and an auxiliary feedwater actuation.

Specifically, 10 CFR 50.73(a)(2)(iv)(A) states in part, "The licensee shall report:

(A) Any event or condition that resulted in manual or automatic actuation of any of the systems listed in paragraph (a)(2)(iv)(B) of this section…

(B) The systems to which the requirements of paragraph (a)(2)(iv)(A) of this section are:

(1) Reactor protection system (RPS) including: reactor scram or reactor trip….
(6) PWR auxiliary or emergency feedwater system

The RPS was actuated on September 27, 2020 at 0203, during the cycle 24 coastdown. This fulfills the reporting requirement of 10 CFR 50.73(a)(2)(iv)(A) by actuation of the system specified in 10 CFR 50.73(a)(2)(iv)(B)(1).

A valid auxiliary feedwater system actuation was initiated after the reactor trip. This fulfills the reporting requirement of 10 CFR 50.73(a)(2)(iv)(A) by actuation of the system specified in 10 CFR 50.73(a)(2)(iv)(B)(6).

6. CAUSE OF THE EVENT

A main generator fault in the 25-kV portion of the generator output caused a main generator trip, which in turn caused the turbine trip/reactor trip. Inspection of the isolated phase bus system identified a detached piece of a laminated sheet-style flexible link that was located inside the bus duct. The laminated sheet on the 5B flexible link became detached and caused a phase-to-ground fault on B phase of the 25-kV isophase bus system. This actuated the main generator protection system, which resulted in a turbine trip (with reactor power above the P-9 setpoint) and an automatic reactor trip.

7. CORRECTIVE ACTIONS

All isophase flexible link locations were inspected and repaired, as necessary. Callaway continues to consider additional actions that may be taken to improve the flexible link design configuration. Additional plant changes that may be pursued will be provided in a supplement to this LER as warranted.

8. PREVIOUS SIMILAR EVENTS

On July 26, 2013, electrical faults caused damage to the isophase bus in the auxiliary transformer and main generator neutral connection box which caused a generator trip and subsequent reactor trip. See LER 2013-008.

On December 3, 2014 a turbine trip occurred, when the main generator excitation transformer faulted to ground. This resulted in a reactor trip classified as uncomplicated and safety systems performed as designed. See LER 2014-006.

Callaway Plant - Integrated Inspection Report and Assessment Follow-up Letter (05000483/2020004)

NRC Accession Number ML21040A410

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

February 10, 2021

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

SUBJECT: CALLAWAY PLANT – INTEGRATED INSPECTION REPORT AND ASSESSMENT FOLLOW-UP LETTER (05000483/2020004)

Dear Mr. Diya:

On December 31, 2020, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at the Callaway Plant. On January 6, 2021, the NRC inspectors discussed the results of this inspection with Mr. B. Cox, Site Vice President and other members of your staff. The results of this inspection are documented in the enclosed report.

Two findings of very low safety significance (Green) are documented in this report. Neither of these findings involved a violation of NRC requirements.

A licensee-identified violation which was determined to be of very low safety significance is documented in this report. We are treating this violation as a non-cited violation (NCV) consistent with Section 2.3.2 of the Enforcement Policy.

As a result of its quarterly review of plant performance, which was completed on January 25, 2021, the NRC updated its assessment of Callaway Plant. The NRC's evaluation consisted of a review of performance indicators and inspection results. This letter informs you of the NRC's assessment of and its plans for a future inspection at your facility. This letter supplements, but does not supersede, the annual assessment letter issued on March 3, 2020. (ADAMS Accession No. ML20055E107)

The NRC's review of Callaway Plant identified that the Unplanned Scrams per 7,000 Critical Hours performance indicator has crossed the Green-White threshold. This White performance indicator is the result of having three unplanned scrams during the second through fourth quarter of 2020 combined with having lower than normal hours of critical operation for the year. Each of the scrams involved equipment failures that led to automatic reactor trips.

The NRC determined the performance at Callaway Plant Unit 1 to be in the Regulatory Response Column (i.e., Column 2) of the Reactor Oversight Process Action Matrix beginning in the fourth quarter of 2020. Therefore, the NRC plans to conduct a supplemental inspection in

accordance with Inspection Procedure 95001, "Supplemental Inspection Response to Action Matrix Column 2 (Regulatory Response) Inputs." We will schedule this inspection after you notify the NRC of your readiness for this inspection in writing. The objectives of the supplemental inspection procedure are to: (1) to ensure that the root and contributing causes of individual and collective White performance issues are understood; (2) to independently assess and ensure that the extent of condition and extent of cause of individual and collective White performance issues are identified; (3) to ensure that completed corrective actions to address and preclude repetition of White performance issues are prompt and effective; and (4) to ensure that pending corrective action plans direct prompt and effective actions to address and preclude repetition of White performance issues.

If you contest the violation or the significance or severity of the violation documented in this inspection report, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001; with copies to the Regional Administrator, Region IV; the Director, Office of Enforcement; and the NRC Resident Inspector at the Callaway Plant.

If you disagree with a cross-cutting aspect assignment or a finding not associated with a regulatory requirement in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your disagreement, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001; with copies to the Regional Administrator, Region IV; and the NRC Resident Inspector at the Callaway Plant.

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,

Anton Vegel, Director
Division of Reactor Projects

Docket No. 05000483
License No. NPF-30

Enclosure:
As stated

cc w/ encl: Distribution via LISTSERV®

CALLAWAY PLANT – INTEGRATED INSPECTION REPORT 05000483/2020004 – DATED February 10, 2021

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ADAMS ACCESSION NUMBER: ML21040A410

■ SUNSI Review		■ Non-Sensitive ☐ Sensitive		■ Publicly Available ☐ Non-Publicly Available	
OFFICE	SRI/DRP/B	RI/DRP/B	TL:DRS/IPAT	C:DRS/EB1	C:DRS/EB2
NAME	DBradley	SJanicki	AAgrawal ANA	VGaddy vgg	CYoung chy
DATE	2/1/21	2/2/2021	1/28/21	1/29/2021	2/2/2021
OFFICE	C:DRS/RCB	C:DRS/OB	C:DNMS/RxIB	SPE/DRP/B	C:DRP/B
NAME	MHaire	GWerner / GEW	GWarnick GGW	DProulx *DLP*	NO'Keefe
DATE	01/28/2021	01/28/2021	02/01/2021	2/3/2021	2/4/2021
OFFICE	RIV/DRP/D				
NAME	TVegel				
DATE	02/09/2021				

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U.S. NUCLEAR REGULATORY COMMISSION
Inspection Report

Docket Number:	05000483
License Number:	NPF-30
Report Number:	05000483/2020004
Enterprise Identifier:	I-2020-004-0007
Licensee:	Ameren Missouri
Facility:	Callaway Plant
Location:	Steedman, MO
Inspection Dates:	October 1 to December 31, 2020
Inspectors:	D. Bradley, Senior Resident Inspector S. Janicki, Resident Inspector B. Baca, Health Physicist J. Drake, Senior Reactor Inspector
Approved By:	Neil F. O'Keefe, Chief Reactor Projects Branch B Division of Reactor Projects

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring the licensee's performance by conducting an integrated inspection at the Callaway Plant, 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. A licensee-identified non-cited violation is documented in report section: 71153.

List of Findings and Violations

Untimely Corrective Actions for Isophase Bus Degradation			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Initiating Events	Green FIN 05000483/2020004-02 Open/Closed	[H.11] - Challenge the Unknown	71153
The inspectors reviewed a self-revealed Green finding for the licensee's failure to correct degradation in high voltage flexible links connecting different segments of the isophase bus in a timely manner. Specifically, starting in 2013, the licensee identified damage to main generator isophase flexible links and did not correct the condition until a fragment caused a ground fault on September 27, 2020. This resulted in a turbine trip and automatic reactor trip.			

Failure to Evaluate the Adequacy of a Design Change for Main Feedwater Regulating Valve Positioner			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Initiating Events	Green FIN 05000483/2020004-01 Open/Closed	[H.3] - Change Management	71153
The inspectors reviewed a self-revealed Green finding for the licensee's failure to adequately evaluate the failure modes of the main feedwater regulating valve positioner as part of a design change process. Specifically, the development and installation of a replacement main feedwater control system required a Failure Modes and Effects Analysis. The licensee failed to recognize and evaluate the failure mode and effects of placing a local keylock switch to control swapping between the primary and backup MFRV positioners. As a result, the plant experienced an automatic reactor trip when the primary main feedwater regulating valve positioners failed and the secondary positioner could not be quickly placed into service due to the addition of this feature.			

Additional Tracking Items

Type	Issue Number	Title	Report Section	Status
LER	05000483/2020-004-00	Violation of Technical Specification 3.8.1, "ACSources - Operating	71153	Closed
LER	05000483/2020-006-00	Reactor Trip Due to Main Generator Ground Fault	71153	Closed
LER	05000483/2020-002-00	Reactor Trip and Auxiliary Feedwater Actuation Following Spurious MFRV Closure	71153	Closed

PLANT STATUS

Callaway Plant began the inspection period shut down for a planned refueling outage. The licensee commenced a reactor startup on December 19, 2020, and connected the main generator to the electric grid on December 22. On December 24 at 90 percent reactor power, the licensee experienced an automatic turbine and reactor trip from an electrial fault in the main generator. The licensee remained shut down through the end of the inspection period.

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 performed plant status activities described in IMC 2515, Appendix D, "Plant Status," and conducted routine reviews using Inspection Procedure (IP) 71152, "Problem Identification and Resolution." 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 Disease 2019 (COVID-19), resident inspectors were directed to begin telework and to remotely access licensee information using available technology During this time, the resident inspectors performed periodic site visits each week; conducted plant status activities as described in IMC 2515, Appendix D, "Plant Status," observed risk-significant activities; and completed on-site portions of IPs. In addition, resident and regional baseline inspections were evaluated to determine if all or portions 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

71111.04 - Equipment Alignment

Partial Walkdown Sample (IP Section 03.01) (2 Samples)

The inspectors evaluated system configurations during partial walkdowns of the following systems/trains:

(1) Emergency diesel generator B on October 23, 2020
(2) Residual heat removal B after planned major work window on October 26, 2020

71111.05 - Fire Protection

Fire Area Walkdown and Inspection Sample (IP Section 03.01) (4 Samples)

The inspectors evaluated the implementation of the fire protection program by conducting a walkdown and performing a review to verify program compliance, equipment functionality, material condition, and operational readiness of the following fire areas:

(1) Auxiliary building 2000' elevation including the volume control tank room and valve compartment, fire area A-8, on October 11, 2020
(2) Auxiliary Building 2047' elevation, fire area A-19 on October 27, 2020
(3) Turbine Building 2065' elevation during main generator repairs, fire area TB-1 on November 17, 2020
(4) Control building 2016' elevation, fire areas C-14 and C-16, on November 23, 2020

71111.08P - Inservice Inspection Activities (PWR)

PWR Inservice Inspection Activities Sample (IP Section 03.01) (1 Sample)

(1) The inspectors verified that the reactor coolant system boundary, steam generator tubes, reactor vessel internals, risk-significant piping system boundaries, and containment boundary are appropriately monitored for degradation and that repairs and replacements were appropriately fabricated, examined and accepted by reviewing the following activities from October 13 to October 27, 2020:

03.01.a - Nondestructive Examination and Welding Activities.

The inspectors evaluated non-destructive examination activities by reviewing the following records:

1) Ultrasonic Examinations

a) Reactor Coolant System, BB-036-BCA, 2-BB-06-F001 Circumferential Weld

b) Reactor Coolant System, BB-036-BCA, 2-BB-06-F006 Pipe to Cap

c) Reactor Coolant System BB-056-BCA 2-BB-01-S401-10, Nozzle to reducer

d) Reactor Coolant System, BB-05-BCA, BB-005-BCA, Weld 2-EM-03-FW235

2) VT-3 Examinations

a) Main Steam System AB-0220-EBD-8, FW-04, Plate to pipe

b) Main Steam System AB-0220-EBD-8, FW-03, Plate to Angle iron

3) Magnetic Particle Examinations

a) Component Cooling Water, Base Metal Repair near M1 manway, FW-01

The inspectors evaluated welding activities by reviewing the following records:

1) Gas Tungsten Arc Welding

a) Weld FW-01, Safety Injection Accumulator Tank C Vent Valve

b) Weld FW-02, Safety Injection Accumulator Tank C Vent Valve

03.01.c – Pressurized Water Reactor Boric Acid Corrosion Control Activities.

The inspectors reviewed the following condition reports and associated boric acid evaluations:

- 202005121
- 202005127
- 202005306
- 202004846
- 201901976
- 201901977
- 201902013
- 201902052
- 201902091
- 201902183
- 201902190
- 201902267
- 201902269
- 201902288
- 201902331

The inspectors evaluated a sample of 32 condition reports associated with inservice inspection activities. The inspectors did not identify any findings or violations of more than minor significance.

71111.11Q - Licensed Operator Requalification Program and Licensed Operator Performance

Licensed Operator Performance in the Actual Plant/Main Control Room (IP Section 03.01) (1 Sample)

(1) The inspectors observed and evaluated licensed operator performance in the control room during Mode 4, including filling of steam generators with auxiliary feed, on November 23, 2020

Licensed Operator Requalification Training/Examinations (IP Section 03.02) (1 Sample)

(1) The inspectors observed and evaluated simulator training, including just-in-time training for the refueling outage, on November 6, 2020

71111.12 - Maintenance Effectiveness

Maintenance Effectiveness (IP Section 03.01) (2 Samples)

The inspectors evaluated the effectiveness of maintenance to ensure the following structures, systems, and components (SSCs) remain capable of performing their intended function:

(1) Auxiliary building ventilation systems including fan belt failures on November 15, 2020
(2) Low voltage circuit breakers including preventative maintenance and breaker obsolescence issues on December 11, 2020

71111.13 - Maintenance Risk Assessments and Emergent Work Control

Risk Assessment and Management Sample (IP Section 03.01) (4 Samples)

The inspectors evaluated the accuracy and completeness of risk assessments for the following planned and emergent work activities to ensure configuration changes and appropriate work controls were addressed:

(1) Planned elevated risk during lowered reactor coolant system (RCS) inventory for reactor disassembly on October 7, 2020
(2) Planned elevated risk while moving fuel and during B safety train work window on October 10, 2020
(3) Planned elevated risk during A safety train outage with containment restrictions on October 28, 2020
(4) Planned elevated risk during lowered RCS inventory for reactor reassembly on November 5, 2020

71111.15 - Operability Determinations and Functionality Assessments

Operability Determination or Functionality Assessment (IP Section 03.01) (2 Samples)

The inspectors evaluated the licensee's justifications and actions associated with the following operability determinations and functionality assessments:

(1) Essential service water check valve degradation, Condition Report 202005988, on November 3, 2020
(2) Circuit breaker settings for residual heat removal containment sump suction valve, Condition Report 202006217, on November 4, 2020

71111.18 - Plant Modifications

Temporary Modifications and/or Permanent Modifications (IP Section 03.01 and/or 03.02) (2 Samples)

The inspectors evaluated the following temporary or permanent modifications:

(1) Permanent modification for auxiliary feedwater (AFW) pumps under modification package MP 19-0017, "Inboard/Outboard Mechanical Seal Orifice Re-design for AFW Pumps," on November 1, 2020.

(2) Permanent modification for solid state protection system under modification package MP 18-0074, "Remove Single Point Vulnerability from Universal Logic Board and Safeguards Driver Boards," on December 7, 2020.

71111.19 - Post-Maintenance Testing

Post-Maintenance Test Sample (IP Section 03.01) (5 Samples)

The inspectors evaluated the following post-maintenance test activities to verify system operability and functionality:

(1) Emergency diesel generator B following planned maintenance including internal tank inspections on October 22, 2020
(2) Component cooling water train B following planned maintenance including heat exchanger inspections and cleaning on October 26, 2020
(3) Essential service water train B following planned maintenance including motor-operated valve refurbishment on October 28, 2020
(4) Condensate storage tank following planned maintenance including floating cover seal replacement on October 28, 2020
(5) Reactor coolant pump B following planned maintenance to replace the third stage seal on December 7, 2020

71111.20 - Refueling and Other Outage Activities

Refueling/Other Outage Sample (IP Section 03.01) (1 Sample)

(1) The inspectors evaluated Refueling Outage 24 activities from October 1 to December 24, 2020.

71111.22 - Surveillance Testing

The inspectors evaluated the following surveillance tests:

Surveillance Tests (other) (IP Section 03.01) (4 Samples)

(1) Safety injection comprehensive pump test, on October 14, 2020
(2) Residual heat removal check valve and safety injection recirculation mode test on October 15, 2020
(3) Residual heat removal containment sump suction valve test on October 26, 2020
(4) Turbine--driven auxiliary feedwater pump check valve test on November 17, 2020

OTHER ACTIVITIES – BASELINE

71151 - Performance Indicator Verification

The inspectors verified licensee performance indicators submittals listed below:

MS07: High Pressure Injection Systems (IP Section 02.06) (1 Sample)

(1) October 1, 2019, through September 30, 2020

MS09: Residual Heat Removal Systems (IP Section 02.08) (1 Sample)

(1) October 1, 2019, through September 30, 2020

OR01: Occupational Exposure Control Effectiveness Sample (IP Section 02.15) (1 Sample)

(1) April 1, 2019, through September 30, 2020

PR01: Radiological Effluent Technical Specifications/Offsite Dose Calculation Manual Radiological Effluent Occurrences (RETS/ODCM) Radiological Effluent Occurrences Sample (IP Section 02.16) (1 Sample)

(1) April 1, 2019, through September 30, 2020

71152 - Problem Identification and Resolution

Semiannual Trend Review (IP Section 02.02) (1 Sample)

(1) The inspectors reviewed the licensee's corrective action program for potential adverse trends in non-safety onsite electrical power distribution that might be indicative of a more significant safety issue.

71153 – Follow-up of Events and Notices of Enforcement Discretion

Event Report (IP Section 03.02) (3 Samples)

The inspectors evaluated the following licensee event reports (LERs):

(1) LER 2020-004-00, Violation of Technical Specification 3.8.1, "AC Sources - Operating" (ADAMS Accession No. ML20310A328). The inspection conclusions associated with this LER are documented in this report under the Inspection Results Section. This LER is closed.
(2) LER 2020-006-00, Reactor Trip Due to Main Generator Ground Fault (ADAMS Accession No. ML20330A267). The inspection conclusions associated with this LER are documented in this report under the Inspection Results Section. This LER is closed.
(3) LER 2020-002-00, Reactor Trip and AFW Actuation Following Spurious MFRV Closure (ADAMS Accession No. ML20155K873). The inspection conclusions associated with this LER are documented in this report under the Inspection Results Section. This LER is closed.

Personnel Performance (IP Section 03.03) (1 Sample)

(1) The inspectors evaluated an unplanned reactor trip due to a main generator fault and the licensee's performance on December 24, 2020.

INSPECTION RESULTS

Observation: Semi-Annual Trend Review	71152
The inspectors reviewed the licensee's corrective action program, performance indicators, system health reports, and other documentation to identify trends that might indicate the existence of a more significant safety issue related to the non-safety onsite power distribution	

system. Specifically, the 100-, 200- and 300-series power loops provide power to support buildings and non-safety systems located outside the protected area. The majority of the cables are routed underground in manholes and have many splices to create branches. These loops are interconnected for redundancy.

Background

The following condition reports and plant health issues related to non-safety onsite power distribution were identified by the inspectors as relevant:

Condition Report or Health Issue	Subject	Maintenance Rule Evaluation Assigned
202004227	Switchyard circuit breaker MD522 tripped open due to a ground fault on a failed splice in manhole 59-17 associated with the 200 series power loop requiring complicated repairs and temporary power for over a month	No
202000586	Cable diagnostics vendor assessed cable splice thermography results as having severe degradation	N/A
201907079	Configuration management gap on manhole/cable drawings and cable schedule identified	N/A
201904463	Circuit breaker MD522 tripped from an unknown cause. Possibilities included a short on the 300 series loop due to rainfall.	No
2018013	System health issue created to address the unknown status of splices from prior water submersion damage	N/A
201803524	Adverse trend on the 300 series loop splices identified	N/A
201803237	Circuit breaker MD522 tripped from a fault on the 300 series loop (splice)	Yes
201801981	Circuit breaker MD522 tripped from a fault on the 300 series loop (splice)	Yes
201704538	Manhole 59-17 splices not properly supported and twisting/sagging. Thermography of splices in the intermediate advisory range. Splices are associated with 100 and 200 series power loops.	N/A
201606688	Fire pump house 480V load center did not cross tie when 200 series power was lost	Yes
2015009	System health issue created to add an additional circuit breaker for the 100 series loop for fault separation	N/A
2014018	Health issue identified to correct cable splices that are subject to prolonged submersion in water and was resolved by adding sump pumps to the affected manholes.	N/A

Callaway identified multiple indications of degraded cables leading up to the August 26, 2020, cable splice failure. Health issue 2014018 was identified in 2014 to correct cable splices that are subject to prolonged submersion in water and was closed by adding sump pumps to the affected manholes. The inspectors noted that this did not directly address the damage already caused to the cables from submersion. Health issue 2015009 was created in 2015 to add an additional circuit breaker for the 100 series loop for fault separation but had not yet been implemented at the time of this inspection.

In 2017, a visual inspection of cables in manhole 59-17 found multiple twisted and sagging cables due to a lack of cabling supports which caused the degraded cables to droop. Several cables had sagged to the point where the splices were resting on the bottom of the manhole, which was subject to frequent water intrusion, resulting in submersion. Thermography of the degraded cables was performed which identified multiple cable splices with elevated temperature in or above the advisory range.

Following the 2017 inspection for manhole 59-17, Callaway wrote Job 17003677 to correct the degraded cabling. Callaway then performed a self-assessment of the cable program and considered replacing degraded splices with a new design under Condition Report action 201704781-002. The licensee, however, later determined they would have difficulty obtaining the parts, concluding "more time is needed to determine resolution...there is no risk to the plant."

In 2018, Callaway identified a trend for multiple splice and cable failures for the 300 series loop. The inspectors noted that by limiting the scope of the review to the 300 series, the licensee had a missed opportunity to include the 100 and 200 series loops based on the similarities between them in design and fault history. In this trend review, the licensee concluded that plant health issues would address any concerns on the 100 and 200 series loops. Health issue 2018013 was identified in 2018 to address the unknown status of splices from prior water submersion damage and would have driven cable replacements by 2021.

In 2019, the licensee was planning a job to replace several corroded cable supports in manholes throughout the site. Workers in the field identified a configuration management discrepancy where the cables installed in the field failed to match the system drawings for the non-safety 100/200/300 series power loops. The loss of configuration control created a potential safety hazard, complicated the job planning and manhole work, and added additional delays to the long-term resolution of the degraded cabling and splices.

In January 2020, a cable vendor conducted diagnostics on the 200 series power loop and reported that severe degradation existed and failure could be expected. In response, the licensee identified the degraded 200 series power loop as a plant health issue. In September 2020, the licensee experienced a failure of the 200 series power loop that could not easily be isolated or repaired. As a result, the licensee performed a reactive and complicated repair plan that lasted over a month, required several temporary diesel generators to power non-safety buildings, and required several new cables to be installed because the degree of cable degradation made it inadvisable to splice into.

Assessment

The inspectors concluded the licensee's management of the degradation in the non-safety onsite power distribution system was ineffective. Although the issues were documented in the corrective action program and elevated to senior plant leadership via the Plant Health

process, the licensee's strategy for resolving issues in the non-safety electrical system has relied on system redundancies to maintain system functionality and the reactive performance of corrective maintenance when failures do occur. In September 2020, the fault and repair plan resulted in the station being unable to use several non-safety buildings for workspace when an unrelated reactor trip occurred with the non-safety power loop repairs in-progress. This resulted in, for example, the outage control center being relocated to the technical support center building due to needing an adequately sized space with diesel-power and internet connections.

The inspectors noted that cable aging is a cumulative effect that can significantly alter the cable's material condition prior to obvious signs of failure. For example, IEEE Standards 323-1974 and 383-1974 recommend that cable splices are treated as an integral part of each system and that an aging management program is needed to maintain reliable performance.

The inspectors also concluded that the assignment of Maintenance Rule evaluations for non-safety power failures has been inconsistent for failures that were quite similar. Specifically, recent failures under Condition Reports 202004463 and 202004227 were not formally evaluated unlike the previous examples under Condition Reports 201803237 and 201801981. Instead of having an action assigned after condition report screening, the staff pre-screened the 2020 condition reports as not having an impact to the Maintenance Rule function and partially based that decision on the similarities to the 2018 condition reports. This practice can reduce the visibility of the issues to plant management and lead to errors when dissimilar failures are incorrectly convolved outside a formal evaluation.

The inspectors noted that the licensee's slow response to the cable degradation appeared to be influenced by an incomplete assessment of the potential impacts to plant operation. While the system provided multiple sources of power to most loads, the design did not guarantee power to all locations in the event of faults. The licensee did not consider the impact to plant operations or emergency response capabilities from maintenance configurations in the event of certain failures, nor did they appear to recognize that some failures could impact plant risk from fire because pumps and valves needed for fire response could lose power.

In response to the September 2020 cable fault, the licensee created several condition reports and actions within those condition reports to address the above issues. For example, Condition Report 202004227 captures the corrective actions and condition monitoring plan for the degraded non-safety cables and splices. The licensee has also generated several roll-up condition reports to address their gaps to excellence in leadership and trends in plant performance including Condition Reports 202007036, 202007042, and 202007175.

The inspectors did not identify any additional trends or concerns that might be indicative of a more significant issue. The inspectors concluded that no more than minor performance deficiency existed.

Untimely Corrective Actions for Isophase Bus Degradation			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Initiating Events	Green FIN 05000483/2020004-02 Open/Closed	[H.11] - Challenge the Unknown	71153

The inspectors reviewed a self-revealed Green finding for the licensee's failure to correct degradation in high voltage flexible links connecting different segments of the isophase bus in a timely manner. Specifically, starting in 2013, the licensee identified damage to main generator isophase flexible links and did not correct the condition until a fragment caused a ground fault on September 27, 2020. This resulted in a turbine trip and automatic reactor trip.

Description: On September 27, 2020, the licensee was operating at 98 percent reactor power and coasting down into their planned refueling outage with no significant evolutions in progress and no significant equipment out of service. The control room received a reactor trip due to a main turbine generator trip with several alarms on the main generator. The operators entered E-0 "Reactor Trip or Safety Injection," confirmed systems responded as expected without complications, and transitioned into normal shutdown procedures with the plant stabilized in Mode 3. This event was reported under Licensee Event Report (LER) 2020-006-00, "Reactor Trip Due to Main Generator Ground Fault." (ADAMS Accession Number ML20330A267)

The electrical output of the main generator is routed to the main transformers through metal bus bars. There are three phases, each of which is routed individually through metal bus ducts. The bus bars are supported in the center of their associated duct by insulated supports. The specifically sized air gap is needed to prevent an electrical arc between the bus bars and the ducts. Bus bar segments are connected by flexible links to allow the bus bars to expand due to heating when they conduct electric current. In Callaway's system, the flexible links are made of thin sheets of metal laminated together and bolted at each end to adjacent bus bars. The links are shaped like the Greek letter omega (Ω) with each "foot" bolted to a different bus bar to allow flexing.

The initial troubleshooting determined that there had been a fault in the 25kV main generator output. Once the plant was cooled down, the licensee inspected the isophase bus system which provides the path for electricity from the main generator to the main transformer. The licensee then identified a metallic leaf had broken from a flexible link on the B phase of the isophase bus, fallen from the energized isophase bus, and briefly provided a fault pathway across the air gap from the bus bars to the ducting which ultimately caused the trip

The licensee documented the plant trip and the condition of the flexible link in a condition report and formed a cause evaluation team. In parallel, the inspectors independently reviewed the condition report history of the isophase bus system and associated corrective actions.

In 2013, the licensee first identified damage to the flexible link at the 5B inspection point on the B phase of the isophase bus under Condition Report 201306251. This condition included separation of layers, or the flexible link leaves, from each other and some bending of leaves. At the time, the licensee added an additional inspection requirement to future inspections but concluded a separated lamination "would be trapped inside the isophase causing no damage." In 2016, the licensee found another portion of flexible links with damage and again concluded that a separation would not lead to a fault under Condition Report 201603032. In 2017 and 2019, the licensee monitored the 5B inspection point on the B phase of the isophase bus flexible link without generating condition reports and without implementing corrective action under jobs 16505654 and 17514010. In each case, the degradation was deemed acceptable and not significant enough to warrant a new condition report.

In contrast, the licensee did correct a flexible link issue on the C phase of the isophase bus in 2019 under Condition Report 201902559. Specifically, the flexible link, as a whole, had

shifted so that it was no longer meeting the required minimum air gap between the bus and ducting such that there was a risk of an electrical short. The licensee recognized the unacceptable distance and corrected the issue.

Finally, in September 2020, the B phase isophase bus flexible link leaves separated enough such that one leaf became separated from bus due to cooling air flow and fatigue failure, created an electrical short from the bus to the ducting, and tripped the main generator and reactor.

The inspectors determined the licensee failed to correct the degraded flexible link associated with the isophase bus in a timely manner. The licensee describes timely corrective actions in procedure APA-ZZ-00500, Appendix 15, "Adverse Condition – Significance Level 4," including revisions 15 through 33 that were in effect since 2013. Specifically, timely corrective actions are "prompt" and consider "impact on plant operation," "risk of recurrence," and "significance of recurrence." Although the licensee did correct a flexible link configuration that was clearly unacceptable in 2019, the licensee failed to adequately consider a failure where the flexible link continues to perform its intended function but damaged portions separate and become conducting debris in the insulating air gap with the potential to cause a fault and a plant transient. As a result, the licensee failed to recognize the need for prompt corrective action and the degraded conditions on flexible links were allowed to exist for seven years until a failure occurred which caused a reactor trip.

Corrective Actions: The licensee stabilized the plant in Mode 3, performed troubleshooting to identify the cause of the turbine and reactor trip, performed inspections of the isophase bus duct system, repaired the damaged flexible links but continued to monitor other degraded links, and generated a condition report.

Corrective Action References: Condition Report 202004895

Performance Assessment: Performance Deficiency: The failure to correct degraded flexible links used to connect isophase bus segments in a timely manner is 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 Initiating Events Cornerstone and adversely affected the cornerstone objective to limit the likelihood of events that upset plant stability and challenge critical safety functions during shutdown as well as power operations. Specifically, the performance deficiency resulted in the main turbine generator automatically tripping on an electrical fault and the reactor automatically tripping from the turbine trip.

Significance: The inspectors assessed the significance of the finding using Appendix A, "The Significance Determination Process (SDP) for Findings At-Power." The finding was determined to be of very low safety significance (Green) because it caused a reactor trip but did not cause a loss of mitigating equipment relied on to transition the plant from the onset of a trip to a stable shutdown condition.

Cross-Cutting Aspect: H.11 - Challenge the Unknown: Individuals stop when faced with uncertain conditions. Risks are evaluated and managed before proceeding. The finding had a human performance cross-cutting aspect associated with challenging the unknown, in that the licensee only corrected isophase flexible links that were clearly unacceptable during a complete inspection of the isophase bus in 2019 and allowed other degradations to remain

uncorrected. Specifically, the licensee corrected a flexible link on the C phase due to its unacceptable proximity to the duct in the 2019 refueling outage but did not adequately evaluate and manage the risk from the degradation on the B phase. As a result, the licensee monitored the B phase degradation to failure and a portion of the link became separated and electrically faulted the main generator in September 2020 causing a reactor trip.

Enforcement: Inspectors did not identify a violation of regulatory requirements associated with this finding.

Failure to Evaluate the Adequacy of a Design Change for Main Feedwater Regulating Valve Positioner			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Initiating Events	Green FIN 05000483/2020004-01 Open/Closed	[H.3] - Change Management	71153

The inspectors reviewed a self-revealed Green finding for the licensee's failure to adequately evaluate the failure modes of the main feedwater regulating valve positioner as part of a design change process. Specifically, the development and installation of a replacement main feedwater control system required a Failure Modes and Effects Analysis. The licensee failed to recognize and evaluate the failure mode and the implications of installing a local keylock switch to control swapping between the primary and backup MFRV positioners.
As a result, the plant experienced an automatic reactor trip when the primary main feedwater regulating valve positioner failed and the backup positioner could not be quickly placed into service.

Description: On April 4, 2020, the Callaway Plant was operating at 100 percent power and experienced an automatic reactor trip due to a low steam generator water level signal. Prior to the reactor trip, the control room received a digital feedwater trouble alarm and noted a lowering level in the C steam generator and the C main feedwater regulating valve (MFRV) unexpectedly going closed. Operators placed the C MFRV in manual control and attempted to restore the steam generator water level to the program band. When the control room staff recognized that the C MFRV was not responding to manual control, the control room supervisor directed a manual reactor trip. Prior to manually tripping the reactor, the steam generator C water level dropped to 17 percent, causing an automatic reactor trip. After the trip, systems responded as expected for the event and the plant was stabilized in Mode 3. This event was reported under Licensee Event Report (LER) 2020-002-00, "Reactor Trip and AFW Actuation Following Spurious MFRV Closure." (ADAMS Accession Number ML20155K873)

After stabilizing the plant, the licensee conducted interviews, performed plant walkdowns, and commenced troubleshooting to determine the cause for the loss of steam generator water level control. The licensee determined the loss of level control was caused by a failure of the C MFRV primary positioner in a manner that prevented the backup positioner from being able to control the MFRV position. A local inspection of the MFRV controller indicated that the fault did not allow enough time for operators to transfer control to the backup positioner when the primary positioner failed. As a result, the failed primary positioner could not respond to automatic or manual control signals which led to the decrease in C steam generator water level.

As background, each MFRV has electropneumatic primary and backup positioners that control air pressure to move the MFRV. The positioners were modified and installed in April 2013 as part of MP 03-1002, "Main Feedwater Pump Turbine Control System Replacement," Revision 2. A Failure Modes and Effects Analysis (FMEA) was performed as part of the required plant modification design review process to identify and mitigate potential design flaws. The MFRV control system was designed to rely on the primary positioner with the backup positioner in standby. Intended to be fault-tolerant, the MFRV control system allows the backup positioner to take control for some failure modes of the primary positioner such as loss of air. The licensee, however, was later concerned that the control system could hunt between positioners for some failure modes and added a local manual key switch. If this key switch is turned, it forces the control system to select only one positioner for input. As a result, the design requires operations staff to respond to the MFRV positioner locally in some failure modes such as an internal failure of a positioner to swap which positioner is in control. Because the primary positioner failed in a way that sent a large close signal to the MFRV, the backup could not compensate and operations did not have enough time to allow operators to locally force the backup positioner into control via the key switch.

The licensee's cause evaluation team for the April 2020 reactor trip reviewed this design to explore the reason why the MFRV controller failed to swap between positioners. Ultimately, the licensee's cause review determined that the 2013 FMEA failed to identify a plausible scenario where a fault in the primary positioner would prevent locally transferring MFRV control to the backup positioner fast enough to avoid a plant transient. As a result, the MFRV control system had an unrecognized latent single point vulnerability (SPV).

The inspectors independently reviewed the licensee's cause work, the main feedwater control system modification package, and the corrective action history. Procedure EDP-ZZ-01131, "Plant Health and Performance Monitoring Program," describes health issues as significant or long-standing equipment issues including SPVs and directs the identification and prioritization of addressing them. Appendix O, "Single Point Vulnerabilities," of that procedure states that "redundant components should be evaluated as single point vulnerabilities because there are failure modes that can defeat design." The inspectors noted that the pre-2013 MFRV controls utilized a single positioner, that this was previously identified as an SPV, and MP 03-1002 was intended to improve the design for the positioners to include dual channels of control. The inspectors concluded that the lack of a robust failure modes analysis in 2013 did not allow the new design, with a dual positioner approach, to be identified as containing a SPV. As a result, actions were not put in place to eliminate or mitigate the design vulnerability.

Further, the inspectors noted that, when the licensee decided to install a local key lock switch on the MFRV controller to prevent the system from cycling between controllers, plant leadership did not adequately consider the potential consequences. Specifically, failure modes requiring manual operator action can prevent swapping controllers in a timely manner in the event of a failure that caused the MFRV to rapidly open or shut because the keylock switch is located near the valve out in the plant.

The inspectors further noted that, since the implementation of MP 03-1002, Callaway had experienced several positioner failures. For example, in 2017, the licensee experienced a sluggish response on one positioner for the A MFRV as documented in Condition Report 201702962. In this case, the licensee had adequate time to respond to the transient, shift controllers, and regain automatic control of the A MFRV using the backup controller. Following the 2017 failure, Callaway generated a plant health issue to monitor the positioner's performance based the history of failures including Condition Reports 201602773,

201603418, 201702370, and 201702962. As part of the system health review, the licensee performed a review of the original design modification package and information from the vendor including the new failure analysis. To improve positioner performance, the licensee added additional maintenance and design items related to system air quality. For example, the licensee began replacing air filters, air regulators, and all primary positioners every outage due to their concerns about reliability. The plant health review process, however, failed to identify the MFRV positioner as a component with the potential to be a SPV. This represented a second missed opportunity to identify the failure mode.

Corrective Actions: After stabilizing the plant, the licensee conducted interviews, performed a plant walkdown, and commenced troubleshooting to determine the cause for the loss of steam generator water level control. Additionally, the licensee replaced the valve positioners for all four MFRVs and generated a condition report.

Corrective Action References: Condition Report 202001783

Performance Assessment:

Performance Deficiency: The failure to identify and mitigate a failure mode of the replacement main feedwater regulating valve positioner during the design change process that made a plant transient more likely is 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 Initiating Events Cornerstone and adversely affected the cornerstone objective to limit the likelihood of events that upset plant stability and challenge critical safety functions during shutdown as well as power operations. Specifically, the performance deficiency resulted in the lowering steam generator water level control and an automatic reactor trip.

Significance: The inspectors assessed the significance of the finding using Appendix A, "The Significance Determination Process (SDP) for Findings At-Power." The finding was determined to be of very low safety significance (Green) because it caused a reactor trip but did not cause a loss of mitigating equipment relied on to transition the plant from the onset of a trip to a stable shutdown condition. Specifically, plant systems automatically responded to the trip and the licensee was able to transition into normal shutdown procedures.

Cross-Cutting Aspect: H.3 - Change Management: Leaders use a systematic process for evaluating and implementing change so that nuclear safety remains the overriding priority. The finding had a human performance cross-cutting aspect associated with Change Management in that plant leadership did not maintain a clear focus on nuclear safety when planning, communicating, and executing major changes. Specifically, in 2017 and following MFRV positioner failures, the licensee initiated plant health issues to improve the MFRV positioner performance. Station leadership did not ensure the timeliness, scope, and depth of the review and associated actions such that significant unintended consequences were avoided. As a result, the licensee did not identify the failure to swap to the backup positioner in a timely manner as a potential SPV and a plant trip occurred.

Enforcement: Inspectors did not identify a violation of regulatory requirements associated with this finding.

Licensee-Identified Non-Cited Violation	71153

This violation of very low safety significance associated with a failure to properly preplan maintenance that can affect the performance of safety-related equipment was identified by the licensee, has been entered into the licensee corrective action program, and is being treated as a non-cited violation, consistent with Section 2.3.2 of the Enforcement Policy.

Violation: Callaway Plant Technical Specification 5.4.1, "Procedures," requires, in part, that written procedures shall be established, implemented, and maintained covering the applicable procedures recommended in Regulatory Guide 1.33, Revision 2, Appendix A, February 1978. Regulatory Guide 1.33, Revision 2, Appendix A, Section 9, "Procedures for Performing Maintenance," states, in part, that maintenance that can affect the performance of safety-related equipment should be properly preplanned and performed in accordance with written procedures, documented instructions, or drawings appropriate to the circumstances.

Contrary to the above, from August 5 to September 9, 2020, the licensee failed to properly preplan and perform maintenance that can affect the performance of safety-related equipment in accordance with written procedures, documented instructions, or drawings appropriate to the circumstances. Specifically, documented instructions for planned work on the A train emergency diesel generator utilized a gagged-open jacket water relief valve as a worker protection tagout boundary. When restoring from maintenance, the licensee did not ensure the relief valve properly reseated in the closed position and, instead, the valve was left partially open due to foreign material in its seat. As a result, the jacket water system experienced leakage through the partially open relief valve was undetected for 35 days, which rendered the associated emergency diesel generator inoperable. This was reported in Licensee Event Report (LER) 2020-004-00, Violation of Technical Specification 3.8.1, "AC Sources – Operating" (ADAMS Accession Number ML20310A328).

Significance/Severity: Green. The inspectors determined the finding needed a detailed risk evaluation, per the Mitigating Systems Screening Questions in IMC 0609, Appendix A, Exhibit 2, since the inoperability of the A train emergency diesel generator represented a loss of the Probabilistic Risk Assessment function of one train of a multi-train technical specification system for greater than its technical specification allowed outage time. Based on the information provided in LER 2020-004-00 and from direct inspection performed by the resident inspectors, the Senior Risk Analyst made the following assumptions:

1. This performance deficiency impacted the ability of Emergency Diesel Generator A to provide power for its intended run time during an exposure time (EXP) of 35.5 days;

2. At the calculated leakage rate, Emergency Diesel Generator A would have run on demand for 3.8 days (Run Time) without intervention;

3. The failure to maintain the relief valve closed would not affect diesel generator availability if the nonsafety-related makeup system continued to run;

4. Based on Assumption 3, this performance deficiency would only impact the plant during a complete loss of offsite power;

5. During an actual long-term loss of offsite power, plant procedures would provide for increased attention to the running diesel generator and its operating parameters;

6. With a leak this slow, control room annunciation would alert operators to a low level in the jacket water storage tank long before failure of the diesel generator; and

7. Based on Assumptions 5 and 6, there is a likelihood that operators would observe and mitigate the leak from the relief valve prior to diesel failure.

Using the site-specific Standardized Plant Analysis Risk (SPAR) model, the analyst quantified the following parameters:

- The frequency of a total loss of offsite power (P_{LOOP}) was 3.24E-02/year.
- The probability of not recovering offsite power within the 3.8 days that the diesel would run (P_{NR}) was 1.61E-02.
- The failure of Emergency Diesel Generator B to start (P_{FTS}) was 2.86E-03.
- The failure of Emergency Diesel Generator B to run for 23 hours plus 3.8 days (P_{FTR}) was 1.71E-01

Using the parameters above, the analyst calculated the probability that: a total loss of offsite power would occur over a 35.5 day exposure period; Emergency Diesel Generator B would fail; and offsite power would not be recovered in 3.8 days resulting in a station blackout (P_{SBO}). This calculation performed was as follows:

$P_{SBO} = (P_{LOOP} \div 365) * EXP * P_{NR} * (P_{FTS} + P_{FTR})$

$= (3.24E\text{-}02/year \div 365\ days/year) * 35.5\ days * 1.61E\text{-}02 * (2.86E\text{-}03 + 1.71E\text{-}01)$

$= 8.82E\text{-}06$

The analyst used the SPAR model to quantify the conditional core damage probability for a station blackout with no offsite power recovery. The parameter value was 1.50E-02. The dominant core-damage sequence was:

- Grid-related Loss of Offsite Power
- Both Emergency Diesel Generators fail to run
- No recovery of offsite power
- Failure of operators to align alternate ac power
- Nonrecovery of the Emergency Power Supply system

Multiplying the station blackout probability and the conditional core damage probability resulted in an incremental conditional core damage probability of 1.32E-07. The analyst noted that, given Assumption 7, some level of specific recovery for Emergency Diesel Generator A would be appropriate in this evaluation. Therefore, qualitatively, the analyst determined that the incremental conditional core damage probability was less than 1.0E-07. As a result, the analyst determined that neither an external events review nor an assessment of large-early release frequency was warranted. Given the

incremental conditional core damage probability (ΔCDF) of less than 1.0E-07, the analyst determined that the performance deficiency was of very low safety significance (Green).

Corrective Action References: Condition Report 202004518

EXIT MEETINGS AND DEBRIEFS

The inspectors confirmed that proprietary information was controlled to protect from public disclosure.

- On October 30, 2020, the inspectors presented the inservice inspection results to B. Cox, Site Vice President and other members of the licensee staff.
- On January 6, 2021, the inspectors presented the integrated inspection results to Mr. B. Cox, Site Vice President and other members of the licensee staff.

DOCUMENTS REVIEWED

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
71111.04	Corrective Action Documents	Condition Reports	201602500, 201603131, 201707731, 201807138, 201907538, 202005057, 202005262, 202005582, 202005603, 202005647, 202005749	
	Miscellaneous	EJ-40, Addendum 1	Updated Residual Heat Removal Flow Instrument Uncertainty For EOPs	0
		M-22MEJ01	Piping and Instrumentation Diagram Residual Heat Removal System - FSAR Figure 5.4-7	62
	Procedures	OSP-EJ-00001	Residual Heat Removal Suction Valve Automatic Actuation Test	17
		OSP-EJ-V001B	Train B Residual Heat Removal Valve Inservice Test	7
		OSP-SA-24133	Train A Diesel Generator and Sequencer Testing	10
		OTN-NE-0001B	Standby Diesel Generation System – Train B	56
71111.05	Miscellaneous		Fire Pre-Plan	Various
		RFR 14421	Approval of Temporary Fire Extinguishers	0
71111.08P	Corrective Action Documents	Condition Reports	201805684, 201805691, 201805713, 201805716, 201805856, 201805898, 201805908, 201805909, 201805987, 201806090, 201806138, 201806140, 201806250, 201806475, 201806492, 201806564, 201806706, 201807312, 201808417, 201807312, 201900495, 201900726, 201900727, 2019-0729, 201901402, 201901664, 201901687, 201901694, 201901697, 201901869, 201902249, 202000051, 202000906, 202001083, 202001457, 202003385	
	Corrective Action Documents Resulting from Inspection	Condition Reports	202006108, 202006137, 202006138, 202006139	
	Miscellaneous	1-8002354/450	EPHV8950D / Safety Injection Accumulator Tank C Vent Valve, WPS-0808T01	
		19004144/530	Main Steam System AB-0220-EBD-8, FW-04, Plate to Pipe, FW-03, Plate to Angle Iron	

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		20003319/500	Component Cooling Water Heat Exchanger, FW-01, Base Metal Repair	
	Procedures	APA-ZZ-00500 Appendix 1	Operability Determinations	35
		APA-ZZ-00500, Appendix 3	Past Operability and Reportability Evaluations (REPO)	26
		APA-ZZ-00661	Administration of Welding	17
		EDP-ZZ-01004	Boric Acid Corrosion Control Program Procedure	23
		LMT-08-PDI-UT-1	Ultrasonic Examination of Ferritic Piping Welds	0
		LMT-08-PDI-UT-2	Ultrasonic Examination of Austenitic Piping Welds	0
		LMT-08-PDI-UT-3	Ultrasonic Through Wall Sizing in Piping	0
		LMT-08-UT-004	Ultrasonic Examination of Vessel Welds and Adjacent Base Metal > 2.0" in Thickness	1
		LMT-08-UT-119	Conventional Ultrasonic Instrument Linearity	1
		MDP-ZZ-LM001	FLM (Fluid Leak Management Procedure	19
		MTW-ZZ-WP002	Welder Performance Qualification	27
		PDI-ISI-254	Remote Inservice Examination of Reactor Vessel Shell Welds	
		QCP-ZZ-05048	Quality Control Boric Acid Walkdown for Reactor Coolant System Pressure Boundary	14
		QCP-ZZ-05049	Quality Control Reactor Pressure Vessel Head Bare Metal Examination	6
71111.11Q	Corrective Action Documents	Condition Reports	201903787, 201903820	
	Procedures	APA-ZZ-00703	Fire Protection Operability Criteria and Surveillance Requirements	30
		ISP-SM-LL0L2	Containment Equipment Hatch Leak Rate Test	9
		ODP-ZZ-00001, Addendum 3	Crew Performance Improvement and Qualifications	49
		ODP-ZZ-00014	Operational Mode Change Requirements	55
		OSP-EF-0002B	Essential Service Water Train B Flow Verification	14
		OSP-EJ-00002	RCS/RHR Suction Valve Automatic Actuation Test	16
		OSP-SA-00004	Visual Inspection of Containment for Loose Debris	26

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		OTS-AP-00001	Non-Safety Auxiliary Feedwater Pump Testing and Operations	11
	Work Orders		19595961, 19505091, 1950658, 19506837	
71111.12	Corrective Action Documents	Condition Reports	201904396, 202000878, 202001464, 202001844, 202002287, 202004273, 202002569, 202004979, 202005388, 202005936, 202005955, 202006148, 202006408, 202006502	
	Miscellaneous	NUMARC 93-01	Industry Guidelines for the Monitoring the Effectiveness of Maintenance	4F
	Procedures	APA-ZZ-00500	Corrective Action Program	71
		APA-ZZ-00549, Appendix B	Guidelines Used to Determine Functional Importance of a Component	13
		EDP-ZZ-01128	Maintenance Rule Program	29
		EDP-ZZ-01128, Appendix 4	Maintenance Rule System Functions	22 and 24
71111.13	Corrective Action Documents	Condition Reports	201207322, 201707612, 201803059, 202000019, 202007007	
	Miscellaneous		RF24 Shutdown Safety Management Plan	7
		NUMARC 93-01	Industry Guidelines for Monitoring the Effectiveness of maintenance at Nuclear Power Plants	4F
	Procedures	APA-ZZ-00322, Appendix F	Online Work Integrated Risk Management	18
		APA-ZZ-01250	Operational Decision Making	18
		EDP-ZZ-01128, Appendix 1	SSCs in the Scope of the Maintenance Rule at Callaway	11
		ODP-ZZ-00002	Equipment Status Control	95
		ODP-ZZ-00002, Appendix 2	Risk Management Actions for Planned Risk Significant Activities	19
		ODP-ZZ-0002, Appendix 2	Risk management Actions for Planned Risk Significant Activities	17
71111.15	Corrective Action Documents	Condition Reports	202005988, 20206088, 202006217	
	Procedures	APA-ZZ-00340	Surveillance Program Administration	37

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		APA-ZZ-00500, Appendix 1	Operability Determinations	35
		APA-ZZ-01250	Operational Decision Making	19
		OSP-EF-P0001B	Essential Service Water Train B Inservice Test	72
71111.18	Corrective Action Documents	Condition Reports	201803497, 201907579, 202001404, 202001427, 202001428, 202002796, 202003932, 202003965, 202003966	
	Miscellaneous	MP 19-0017	Inboard/Outboard Mechanical Seal Orifice Re-design for AFW Pumps	
		RFR 180077		
		RFR 180206		
	Work Orders		19003559, 19003560	
71111.19	Corrective Action Documents	Condition Reports	201904103, 202005407, 202005562, 202005857, 202006872, 202006893	
	Miscellaneous	Job 15507242	C Reactor Coolant Pump Seal	
	Procedures	MPM-BB-QP001	Reactor Coolant Pump Seal Removal and Replacement	44
		OTN-NE-0001B	Standby Diesel Generation System – Train B	56
	Work Orders		06118053, 12002428, 17512578, 17513064, 18503659, 18504224, 19505985, 19506119	
71111.20	Corrective Action Documents	Condition Reports	202004179, 202004659, 202005271, 202005461, 202005379, 202006659	
	Procedures	ITL-BB-0L53B	RCS Loop 4 Hot Leg Midloop Level Loop Calibration	14
		ITL-BB-L53BB	RCS Loop Level (CTMT Vented) Calibration	8
	Work Orders		19504054, 19504059, 19504257	
71111.22	Corrective Action Documents	Condition Reports	201009642, 201401615, 201408598, 202005349, 202006088	
	Miscellaneous	Job 19506491	Turbine Driven Auxiliary Feedwater Pump Inservice Test	
	Procedures	MPM-BG-QP02A	Centrifugal Charging Pump Mechanical Seal Replacement	10
		MPM-BG-QP02B	Centrifugal Charging Pump Mechanical Seal Rebuild	4
		OSP-AL-PV005	Train A and Train B Safety Injection Comprehensive Pump Test	26
		OSP-EJ-V002A	RHR Pump Containment Sump Suction and RWST Suction Inservice Test	32

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		OSP-EM-P0002	Train A and Train B Safety Injection Comprehensive Pump Test	11
		OSP-EM-V0004	RHR Check Valve and SI Pump Recirc Valve Inservice Test	23
		OTN-EJ-00002, Addendum 1	A RHR Pump Drain and Refill	13
	Work Orders		19504365, 19505005, 19505276, 20203212, 20003215, 20003559,	
71124.01	Corrective Action Documents	Condition Reports	201901659, 201901995, 201902542, 201902688, 201903079, 201903205, 201903222, 201903396, 201903716, 201903831, 201904139, 201904693, 201904719, 201905171, 202000248, 202000951, 202002405, 202004719, 202004932, 202005042, 202007039	
71124.02	Corrective Action Documents	Condition Reports	201902603, 201902652, 201903116, 201904604, 202000012	
71151	Corrective Action Documents	Condition Reports	201902139, 201903512, 201907189, 201901249, 201902202, 201904331, 201905229, 202004658, 202004693, 202002486, 202003459	
	Miscellaneous		Access Control Dose 100 mRem or Greater Report: 04/08/2019 - 10/20/2020	
			Callaway Energy Center 2019 Annual Radioactive Effluent Release Report	1
		PM0911004	Dose Assessment from Liquid Effluents Reports for periods ending: 03/31/2020, 06/30/2020, and 09/30/2020	
		PM0911009	Dose Assessment from Noble Gases Reports for periods ending: 03/31/2020, 06/30/2020, and 09/30/2020	
		PM0911010	Dose Assessment from Radioiodine and Particulates Reports for periods ending: 03/31/2020, 06/30/2020, and 09/30/2020	
	Procedures		MSPI Basis Document	18
		APA-ZZ-01111	Mitigating Systems Performance Index Program Administration	4
		KDP-ZZ-020000	NRC Performance Indicator Data Collection	10

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		RP-DTI-PERFORMANCE INDICATORS	Radiation Protection Performance Indicators	3
		RRA-ZZ-00001	NRC Performance Indicator Program	12
71152	Corrective Action Documents	Condition Reports	199502137, 199803439, 200002670, 200407114, 200601140, 200601141, 200100865, 201006478, 201203474, 201604298, 201606685, 201704538, 201907079, 201907612, 202000586, 202004273, 202007612,	
	Procedures		Maintenance Rule Scope Evaluation (PA, PG, PO, MD)	1
71153	Corrective Action Documents	Condition Reports	202001783, 202004368, 202004518, 202004895, 202007410	
	Miscellaneous	M-11759-00009	Digital Feedwater System - Main Feedwater Regulating Valve and Bypass Valve	1
		M-22AE01	P&ID Feedwater System	0
	Procedures	APA-ZZ-00500	Corrective Action Program	72
		APA-ZZ-00500, Appendix 12	Significant Adverse Condition – ADCN-1	38
		APA-ZZ-00500, Appendix 15	Adverse Condition – ADCN-4	35
		MDPZZ-TR001	Planning and Execution of Formal Troubleshooting Activities	24

Licensee Event Report 2020-008-00 "Reactor Trip Due to Main Generator Ground Fault"

NRC Accession Number ML21049A109

Ameren MISSOURI

Callaway Plant

February 18, 2021

ULNRC-06638

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

10 CFR 50.73

Ladies and Gentlemen:

DOCKET NUMBER 50-483
CALLAWAY PLANT UNIT 1
UNION ELECTRIC COMPANY
RENEWED FACILITY OPERATING LICENSE NPF-30
LICENSEE EVENT REPORT 2020-08-00
REACTOR TRIP DUE TO MAIN GENERATOR ELECTRICAL FAULT

The enclosed license event report is submitted in accordance with 10 CFR 50.73(a)(2)(iv)(A) to report a reactor protection system and auxiliary feedwater actuation.

This letter does not contain any new commitments.

Sincerely,

Frederick Blanco
Senior Director, Nuclear Operations

Enclosure:
LER 2020-008-00

cc: Mr. Scott A. Morris
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
1600 East Lamar Boulevard
Arlington, TX 76011-4511

Senior Resident Inspector
Callaway Resident Office
U.S. Nuclear Regulatory Commission
8201 NRC Road
Steedman, MO 65077

Mr. M. Chawla
Project Manager, Callaway Plant
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Mail Stop 08B1A
Washington, DC 20555-0001

Index and send hardcopy to QA File A160.0761

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NRC FORM 366 (08-2020) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 08/31/2023

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Library, and Information Collections Branch (T-6 A10M), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollects.Resource@nrc.gov, and the OMB reviewer at: OMB Office of Information and Regulatory Affairs, (3150-0104), Attn: Desk at: oira_submission@omb.eop.gov. The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

LICENSEE EVENT REPORT (LER)

(See Page 3 for required number of digits/characters for each block)

(See NUREG-1022, R.3 for instruction and guidance for completing this form https://www.nrc.gov/reading-rm/doc-collections/nureg/staff/sr1022/r3/)

1. Facility Name	2. Docket Number	3. Page
Callaway Plant, Unit No. 1	05000483	1 OF 4

4. Title
Reactor Trip due to Main Generator Ground Fault

5. Event Date			6. LER Number			7. Report Date			8. Other Facilities Involved	
Month	Day	Year	Year	Sequential Number	Revision No.	Month	Day	Year	Facility Name	Docket Number
										05000
12	24	2020	2020	- 008 -	00	02	17	2021	Facility Name	Docket Number
										05000

9. Operating Mode	10. Power Level
MODE 1	90%

11. This Report is Submitted Pursuant to the Requirements of 10 CFR §: *(Check all that apply)*

10 CFR Part 20	☐ 20.2203(a)(2)(vi)	☐ 50.36(c)(2)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(A)	**10 CFR Part 73**
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.69(g)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(4)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(i)	**10 CFR Part 21**	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	☐ 73.77(a)(1)(i)
☐ 20.2203(a)(2)(ii)	☐ 21.2(c)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)	☐ 73.77(a)(2)(i)
☐ 20.2203(a)(2)(iii)	**10 CFR Part 50**	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)	☐ 73.77(a)(2)(ii)
☐ 20.2203(a)(2)(iv)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)	
☐ 20.2203(a)(2)(v)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)	

☐ Other (Specify here, in Abstract, or in NRC 366A).

12. Licensee Contact for this LER

Licensee Contact	Phone Number (Include Area Code)
T. B. Elwood, Supervising Engineer, Regulatory Affairs and Licensing	314-225-1905

13. Complete One Line for each Component Failure Described in this Report

Cause	System	Component	Manufacturer	Reportable To IRIS	Cause	System	Component	Manufacturer	Reportable To IRIS
B	TB	GEN	G080	Y					

14. Supplemental Report Expected		15. Expected Submission Date	Month	Day	Year
☒ No	☐ Yes (If yes, complete 15. Expected Submission Date)				

16. Abstract (Limit to 1560 spaces, i.e., approximately 15 single-spaced typewritten lines)

On December 24, 2020 at 1235 with the reactor at approximately 90% rated thermal power, a main generator fault occurred that led to a turbine trip and reactor trip. Safety systems functioned as required, including actuation of the auxiliary feedwater system and a main feedwater isolation due to a valid feedwater isolation signal. Operations staff responded to the event in accordance with applicable plant procedures. The post-trip investigation indicated that a fault internal to the main generator actuated the main generator protection system, which in turn caused the turbine trip and an automatic reactor trip since reactor power was above the P-9 setpoint.

This reactor trip was reported by Event Notification 55049 in accordance with 10 CFR 50.72(b)(2)(iv)(B) and 50.72(b)(3)(iv)(A).

The cause of the generator fault was due to failure of the connection rings on the main generator stator. Both the collector end connection ring (i.e., phase ring) and the turbine end connection ring (i.e., serial ring) failed, resulting in an electrical path from the generator stator to ground. This electrical path resulted in a generator protection fault that was detected by the generator neutral ground overcurrent relay resulting in a generator trip and turbine trip.

Corrective actions involve restoration of the main generator to its original design, including replacement of the connection rings. Generator support systems are being refurbished as necessary.

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Callaway Plant, Unit No. 1	05000-483	2020	- 008	- 00

NARRATIVE

1. DESCRIPTION OF STRUCTURE(S), SYSTEM(S), AND COMPONENT(S):

The systems and components affected by this event include the reactor protection system and the main generator.

The reactor protection system at Callaway Plant initiates a unit shutdown, based on the values of selected unit parameters, to protect against violating the core fuel design limits and reactor coolant system pressure boundary design limits during anticipated operational occurrences and to assist the Engineered Safety Features systems in mitigating accidents.

The main generator is a non-safety related component that converts the rotational kinetic energy generated by the turbine into electrical energy. The turbine receives high pressure steam from the main steam system and converts a portion of its thermal energy into rotational kinetic energy. The main generator has a number of trips in order to protect this asset from irreparable damage. Internal to the main generator are connection rings that connect groups of windings in the stator in a sequential pattern to create a sinusoidal electrical wave form when subjected to an electrical field produced by the rotor. The main generator was originally manufactured by General Electric as model number 180X732. EIIS System Code: TB; Function Code: GEN

2. INITIAL PLANT CONDITIONS:

Callaway was in MODE 1 at approximately 90% rated thermal power at the time of this event. Power ascension was in progress following a return to service from a refueling outage that had ended on December 22, 2020. No major safety related systems were out of service.

3. EVENT DESCRIPTION:

On December 24, 2020 at 1235 with the reactor at approximately 90% rated thermal power, the reactor automatically tripped as a result of a turbine trip caused by a main generator fault. Safety systems functioned as expected. The Operations staff responded to the event in accordance with applicable plant procedures. An ENS notification (ENS 55049) was made for this event at 1514 hours on December 24, 2020.

Prior to the event, operators had been raising power while returning the unit to service following a refueling outage. The generator had been placed in service on December 22, 2020. Preceding the reactor trip, annunciators associated with the generator monitoring instrumentation and generator auxiliary systems were received. Following receipt of the annunciators, the reactor power ascension was stopped and non-licensed operators were dispatched to investigate local annunciators and the operation of generator auxiliary systems. In addition to the annunciators, indication of abnormal stator cooling water system conductivity and decreasing main generator hydrogen pressure were observed. During the investigation of the cause of the annunciator, the automatic reactor trip occurred as a result of the actuation of generator protective relaying.

The cause of the generator fault was due to failure of the connection rings on the main generator stator. Both the collector end connection ring (i.e., phase ring) and the turbine end connection ring (i.e., serial ring) failed, resulting in an electrical path from the generator stator to ground. This electrical path resulted in a generator protection fault that was detected by the generator neutral ground overcurrent relay resulting in a generator trip and turbine trip. The underlying cause of the connection ring failure is still under investigation and will be determined during the course of the generator disassembly and repair.

Per plant design, an auxiliary feedwater system actuation occurred as expected in response to the reactor trip. Also, consistent with plant response to a reactor trip from a high power level, a main feedwater isolation signal was generated.

Following the reactor trip, an erratic position indication was observed for one feedwater isolation valve, but the valve was subsequently confirmed to be closed. In addition, one intermediate range nuclear instrumentation channel failed. Other nuclear instrumentation channels functioned correctly to indicate the shutdown state of the reactor. These failures did not complicate the operators response to the event.

4. ASSESSMENT OF SAFETY CONSEQUENCES:

There were no actual nuclear, radiological, or personnel safety impacts associated with this event. The potential impact was on nuclear safety with respect to challenging the reactor trip system as well as any potential challenges to the plant due to the transient associated with a reactor trip. However, all safety systems functioned as designed, and the reactor automatically tripped (i.e., shut down) per design when the main generator ground fault was detected.

5. REPORTING REQUIREMENTS:

This LER is submitted pursuant to 50.73(a)(2)(iv)(A) to report a reactor protection system actuation during startup and an auxiliary feedwater actuation. Specifically, 10 CFR 50.73(a)(2)(iv)(A) states in part, "The licensee shall report:

(A) Any event or condition that resulted in manual or automatic actuation of any of the systems listed in paragraph (a)(2)(iv)(B) of this section...

(B) The systems to which the requirements of paragraph (a)(2)(iv)(A) of this section are:

(1) Reactor protection system (RPS) including: reactor scram or reactor trip....
(6) PWR auxiliary or emergency feedwater system

The RPS was actuated on December 24, 2020 at 1235. This fulfills the reporting requirement of 10 CFR 50.73(a)(2)(iv)(A) by actuation of the system specified in 10 CFR 50.73(a)(2)(iv)(B)(1).

A valid auxiliary feedwater system actuation was initiated after the reactor trip. This fulfills the reporting requirement of 10 CFR 50.73(a)(2)(iv)(A) by actuation of the system specified in 10 CFR 50.73(a)(2)(iv)(B)(6).

6. CAUSE OF THE EVENT:

The cause of the generator fault was due to failure of the connection rings on the main generator stator. Both the collector end connection ring (i.e., phase ring) and the turbine end connection ring (i.e., serial ring) failed resulting in an electrical path from the generator stator to ground. This electrical path resulted in a generator protection fault that was detected by the generator neutral ground overcurrent relay resulting in a generator trip and turbine trip. The underlying failure mechanism affecting the connection rings will be determined and addressed during the course of the generator disassembly and repair.

7. CORRECTIVE ACTIONS:

Corrective actions involve restoration of the main generator to its original design, including replacement of the connection rings. Generator support systems are being refurbished as necessary.

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Callaway Plant, Unit No. 1	05000-483	2020	- 008	- 00

8. PREVIOUS SIMILAR EVENTS:

No previous occurrences of a main generator trip due to an electrical fault internal to the generator have occurred at Callaway Plant. Three occurrences of a reactor trip of a similar nature due to main generator protective relaying actuation are identified and summarized below.

On July 26, 2013, a turbine trip occurred when electrical faults caused damage to the isophase bus in the auxiliary transformer and main generator neutral connection box. The turbine trip resulted in a reactor trip. See LER 2013-008. (Ameren Missouri letter ULNRC-06042, ML13268A112).

On December 3, 2014, a turbine trip occurred when the main generator excitation transformer faulted to ground. The turbine trip resulted in a reactor trip. See LER 2014-006. (Ameren Missouri letter ULNRC-06178, ML15033A215).

On September 27, 2020, a turbine trip occurred due to a main generator fault that was the result of a piece of a laminated-style flexible link located in an isophase bus duct becoming detached and causing a phase-to-ground fault. The turbine trip resulted in a reactor trip. See LER 2020-006. (Ameren Missouri letter ULNRC-06620, ML20330A266).

Callaway Plant – Integrated Inspection Report 05000483/2021002 and
Independent Spent Fuel Storage Installation Inspection Report 07201045/2021001

NRC Accession Number ML21216A312

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

August 5, 2021

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

SUBJECT: CALLAWAY PLANT – INTEGRATED INSPECTION REPORT 05000483/2021002 AND INDEPENDENT SPENT FUEL STORAGE INSTALLATION INSPECTION REPORT 07201045/2021001

Dear Mr. Diya:

On June 30, 2021, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at Callaway Plant. On July 7, 2021, the NRC inspectors discussed the results of this inspection with Mr. B. Cox, Site Vice President, and other members of your staff. The results of this inspection are documented in the enclosed report.

One finding of very low safety significance (Green) is documented in this report. This finding involved a violation of NRC requirements. We are treating this violation as a non-cited violation (NCV) consistent with Section 2.3.2 of the Enforcement Policy.

If you contest the violation or the significance or severity of the violation documented in this inspection report, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001; with copies to the Regional Administrator, Region IV; the Director, Office of Enforcement; and the NRC Resident Inspector at the Callaway Plant.

If you disagree with a cross-cutting aspect assignment in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your disagreement, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001; with copies to the Regional Administrator, Region IV; and the NRC Resident Inspector at the Callaway Plant.

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,

Neil F. O'Keefe, Chief
Reactor Projects Branch
Division of Reactor Projects

Docket No. 05000483 and 07201045
License No. NPF-30

Enclosure:
As stated

cc w/ encl: Distribution via LISTSERV®

CALLAWAY PLANT – INTEGRATED INSPECTION REPORT 05000483/2021002 AND INDEPENDENT SPENT FUEL STORAGE INSTALLATION INSPECTION REPORT 07201045/2021001 – DATED AUGUST 5, 2021

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U.S. NUCLEAR REGULATORY COMMISSION
Inspection Report

Docket Number:	05000483 and 07201045
License Number:	NPF-30
Report Number:	05000483/2021002 and 07201045/2021001
Enterprise Identifier:	I-2021-002-0045 and I-2021-001-0170
Licensee:	Ameren Missouri
Facility:	Callaway Plant
Location:	Steedman, MO
Inspection Dates:	April 1 to June 30, 2021
Inspectors:	D. Bradley, Senior Resident Inspector J. Braisted, Reactor Inspector L. Brookhart, Senior Spent Fuel Storage Inspector S. Janicki, Resident Inspector R. Kopriva, Senior Reactor Inspector J. Melfi, Project Engineer C. Smith, Health Physicist F. Thomas, Reactor Inspector
Approved By:	Neil F. O'Keefe, Chief Reactor Projects Branch B Division of Reactor Projects

SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) continued monitoring the licensee's performance by conducting an integrated inspection at Callaway Plant, 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

Reactor Trip Due to Design and Maintenance Failures Associated with the Main Generator			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Initiating Events	Green NCV 05000483/2021002-01 Open/Closed	[H.14] - Conservative Bias	71153
The inspectors reviewed a self-revealing, Green finding and associated a non-cited violation of Technical Specification 5.4.1.a, "Procedures," for the licensee's failure to properly pre-plan and perform maintenance on the main generator that affected safety-related components. Specifically, the scope of planned work changed significantly as new problems were discovered, errors occurred, and planning inadequacies became apparent. The licensee did not implement appropriate risk mitigating actions such as providing additional vendor oversight or obtaining third party expertise. As a result, the main generator experienced an electrical fault at 90 percent power, the reactor tripped, and safety-systems responded to stabilize the plant in Mode 3.			

Additional Tracking Items

Type	Issue Number	Title	Report Section	Status
LER	05000483/2020-001-01	Emergency Exhaust Train Inoperable Due to Fan Belt Degradation and Failure	71153	Closed
LER	05000483/2020-002-01	Reactor Trip and Auxiliary Feedwater Actuation Following Spurious Main Feedwater Regulating Valve Closure	71153	Closed
LER	05000483/2020-007-00	"B" Pressurizer Power-Operated Relief Valve Inoperable Due to Nonconformance with Environmental Qualification Requirements	71153	Closed
LER	05000483/2020-008-00	Reactor Trip due to Main Generator Electrical Fault	71153	Closed
LER	05000483/2021-001-00	Manual Actuation of Essential Service Water System	71153	Closed

PLANT STATUS

Callaway Plant began the inspection period shut down for an unplanned outage caused by a fault in the non-safety related main generator and remained shut down through the end of the inspection period.

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), resident and regional inspectors were directed to begin telework and to remotely access licensee information using available technology. During this time, the resident inspectors performed periodic site visits each week, increasing the amount of time on site as local COVID-19 conditions permitted. As part of their onsite activities, resident inspectors conducted plant status activities as described in IMC 2515, Appendix D; observed risk significant activities; and completed on site portions of IPs. In addition, resident and 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

71111.01 - Adverse Weather Protection

Seasonal Extreme Weather Sample (IP Section 03.01) (1 Sample)

(1) The inspectors evaluated readiness for seasonal extreme weather conditions prior to the onset of seasonal warm temperatures and summer readiness for the following systems on June 22, 2021:
- main switchyard and offsite power
- vital DC power
- essential service water
- emergency diesel generators

71111.04 - Equipment Alignment

Partial Walkdown Sample (IP Section 03.01) (4 Samples)

The inspectors evaluated system configurations during partial walkdowns of the following systems/trains:

(1) Train A protected train walkdown during planned train B emergency diesel generator and essential service water maintenance on April 14, 2021
(2) Train A class 1E electrical equipment air conditioning unit SGK05A on May 3, 2021
(3) Train B safety injection system following scheduled maintenance on May 18, 2021
(4) Technical support center diesel generator and ventilation following scheduled maintenance on June 16, 2021

71111.05 - Fire Protection

Fire Area Walkdown and Inspection Sample (IP Section 03.01) (4 Samples)

The inspectors evaluated the implementation of the fire protection program by conducting a walkdown and performing a review to verify program compliance, equipment functionality, material condition, and operational readiness of the following fire areas:

(1) Control building 1974' pipe space, fire area C-1 on April 8, 2021
(2) Auxiliary building 1974' elevation including train A centrifugal charging pump room and train A boric acid storage tank, fire areas A-3, A-4, and A-6 on May 4, 2021
(3) Control building cable chases on various elevations and the lower cable spreading room, fire areas C-11, C-12, C-17, C-19, C-21, C-23, C-25, C-26, C-33, C-34, C-36, and C-37 on May 14, 2021
(4) Main control room boards and panels, fire area C-27 on May 28, 2021

71111.06 - Flood Protection Measures

Inspection Activities - Internal Flooding (IP Section 03.01) (1 Sample)

The inspectors evaluated internal flooding mitigation protections in the:

(1) Auxiliary building 1974' elevation, ultimate heat sink cooling tower, and essential service water pumphouse including flood doors on April 20, 2021

Cable Degradation (IP Section 03.02) (1 Sample)

(1) Switchyard cable trenches and site manholes on May 13, 2021

71111.11Q - Licensed Operator Requalification Program and Licensed Operator Performance

Licensed Operator Performance in the Actual Plant/Main Control Room (IP Section 03.01) (1 Sample)

(1) The inspectors observed and evaluated licensed operator performance in the control room during plant heat-up in Mode 3 and surveillance testing on June 12, 2021

Licensed Operator Requalification Training/Examinations (IP Section 03.02) (1 Sample)

(1) The inspectors observed and evaluated licensed operator training in the simulator including mode ascension, plant heat-up, and off-normal procedure response on June 4, 2021

71111.12 - Maintenance Effectiveness

Maintenance Effectiveness (IP Section 03.01) (2 Samples)

The inspectors evaluated the effectiveness of maintenance to ensure the following structures, systems, and components remain capable of performing their intended function:

(1) Control of temporary alterations to support maintenance during planned non-safety service water lube water maintenance on May 3, 2021
(2) Essential service water supply valves to auxiliary feedwater, including associated valves used in emergency procedures on May 6, 2021

71111.13 - Maintenance Risk Assessments and Emergent Work Control

Risk Assessment and Management Sample (IP Section 03.01) (4 Samples)

The inspectors evaluated the accuracy and completeness of risk assessments for the following planned and emergent work activities to ensure configuration changes and appropriate work controls were addressed:

(1) Elevated risk during scheduled 125 VDC battery maintenance on April 5, 2021
(2) Elevated risk during work on train A components including essential service water, emergency diesel generator, and engineered safety feature transformer on April 12, planned 2021
(3) Elevated risk during scheduled fire protection system flow testing on April 27, 2021
(4) Elevated risk during scheduled partial offsite power line outage and system restoration on June 15, 2021

71111.15 - Operability Determinations and Functionality Assessments

Operability Determination or Functionality Assessment (IP Section 03.01) (4 Samples)

The inspectors evaluated the licensee's justifications and actions associated with the following operability determinations and functionality assessments:

(1) Ultimate heat sink cooling fan inspection results on April 14, 2021
(2) Essential service water valve handwheel inspection results on April 19, 2021
(3) Permanent scaffold in contact with residual heat removal piping on April 19, 2021
(4) Main steam isolation valve stroke timing on May 20, 2021

71111.17T - Evaluations of Changes, Tests, and Experiments

Sample Selection (IP Section 02.01) (30 Samples)

The inspectors reviewed the following evaluations, screenings, and/or applicability determinations for 10 CFR 50.59 from June 21-25, 2021.

(1) Corrective action (CA) CA2510/condition report (CR) 202001155, License Document Change Request (LDCR) for Tables 6.2.2-3 and 16.3-2 as described in Condition Report 201903261 and its corresponding actions
(2) CA2510/CTP-ZZ-02590/053, primary to secondary leak rate determination

(3) CA2510/ESP-ZZ-01016/009, ASME Section XI IWE containment pressure boundary inspection
(4) CA2510/MSM-ZZ-QV006/000, generic inspection of swing check valves
(5) CA2510/OSP-BB-LL022/012, containment isolation valve leak rate test
(6) CA2510/OSP-EF-V001A/051, essential service water train A valve operability
(7) CA2511/E-0, reactor trip or safety injection
(8) CA2511/OTN-AL-00001, auxiliary feedwater system
(9) CA2511/OTN-GK-00001, control building HVAC system
(10) CA2511/LDCN 20-0026, LDCR for Tables 6.2.2-3 and 16.3-2 as described in Condition Report 201903261 and its corresponding actions
(11) CA2512/20-02, Cycle 25 core reload design modification package for core reload and reactor coolant system heat-up
(12) CA2512/20-05, use of Tornado Missile Risk Evaluator (TMRE) methodology to resolve tornado missile protection nonconformances
(13) CA2512/20-06, Modification Package (MP) 19-0007, inboard/outboard mechanical seal orifice re-design for auxiliary feedwater pumps (Use of AutoPIPE)
(14) 2018-07-13, aligning essential service water to auxiliary feedwater suction
(15) 2019-02-14, essential service water train A inservice test
(16) 2018-06-01, train A emergency diesel generator fuel oil system inservice tests
(17) 2019-03-25, essential service water system water hammer mitigation modification
(18) 2019-03-26, contingency modification for reactor pressure vessel stuck stud removal
(19) 2020-02-18, essential service water system water hammer mitigation Phase 2
(20) 13-01, Revision 1, main feedwater control system
(21) 17-01, essential service water system water hammer mitigation modification
(22) 19-02, hot leg recirculation valve position change
(23) 17-03, MP 15-0008, open phase condition protection
(24) 18-05, Request for Resolution (RFR) 190015, temperature requirements for Ultimate Heat Sink (UHS) freeze protection
(25) CA2510/01391, Surveillance Test Risk-Informed Documented Evaluation (STRIDE) 19-05, Callaway 18-month NK battery and battery charger surveillances
(26) CA2510/01466, replace isophase bus welded flexible links
(27) CA2511/19005216.250, re-energizing NN03 bus via NN13 bypass source (with NN13S1, maintenance bypass switch, in bypass position)
(28) CA2511, MP 15-0008, open phase condition protection
(29) CA2511/OTO-SA-00001, Engineered Safety Features Actuation System (ESFAS) verification and restoration
(30) CA2511/01082, MP 16-0032, replace ESFAS and SB069 status panels

71111.18 - Plant Modifications

Temporary Modifications and/or Permanent Modifications (IP Section 03.01 and/or 03.02) (1 Sample)

The inspectors evaluated the following permanent modifications:

(1) Main generator (MA01) modifications on June 12, 2021

71111.19 – Post-Maintenance Testing

Post--Maintenance Test Sample (IP Section 03.01) (5 Samples)

The inspectors evaluated the following post-maintenance test activities to verify system operability and functionality:

(1) Essential service water to service water cross-connect valve testing under Job 20002062 on April 4, 2021
(2) Alternate emergency power supply (AEPS) pull box inspection under Job 20504923 on May 10, 2021
(3) Steam generator steam pressure transmitter ABPT0534, replacement under Job 10502135 on May 17, 2021
(4) Residual heat removal train B suction valve EJHV8701B, motor replacement under Job 21002135 on June 3, 2021
(5) Fire protection Halon function test under Job 20503422 on June 28, 2021

71111.20 - Refueling and Other Outage Activities

Refueling/Other Outage Sample (IP Section 03.01) (1 Partial)

(1) The inspectors evaluated the main generator forced outage activities from April 1 to June 30, 2021

71111.22 - Surveillance Testing

The inspectors evaluated the following surveillance tests:

Surveillance Tests (other) (IP Section 03.01) (4 Samples)

(1) Steam generator blowdown system surveillance testing on April 3, 2021
(2) Mode 5 surveillances for the reactor coolant system including residual heat removal system venting under Procedure OSP-SA-00003 on April 7, 2021
(3) Reactor building exterior inspection under Job 17504654 on April 18, 2021
(4) Floor drain valve testing under Procedure OSP-LF-00001 on April 30, 2021

Inservice Testing (IP Section 03.01) (1 Sample)

(1) Residual heat removal and reactor coolant system check valve inservice test under Procedure OSP-EJ-PV04A, on April 27, 2021

OTHER ACTIVITIES – BASELINE

71151 - Performance Indicator Verification

The inspectors verified licensee performance indicators submittals listed below:

MS05: Safety System Functional Failures (SSFFs) Sample (IP Section 03.04) (1 Sample)

(1) April 1, 2020, through March 31, 2021

MS08: Heat Removal Systems (IP Section 03.07) (1 Sample)

(1) April 1, 2020, through March 31, 2021

BI01: Reactor Coolant System (RCS) Specific Activity Sample (IP Section 03.10) (1 Sample)

(1) April 1, 2020 through March 31, 2021

71152 - Problem Identification and Resolution

Semiannual Trend Review (IP Section 02.02) (1 Sample)

(1) The inspectors reviewed the licensee's corrective action program for potential adverse trends in the containment spray pumps and motors that might be indicative of a more significant safety issue.

Annual Follow-up of Selected Issues (IP Section 02.03) (1 Sample)

The inspectors reviewed the licensee's implementation of its corrective action program related to the following issues:

(1) Thermal overload setpoints on the train B containment spray pump room cooler and train C containment cooling fan under Condition Reports 202102615 and 202102802 on May 6, 2021

71153 – Follow-up of Events and Notices of Enforcement Discretion

Event Report (IP Section 03.02) (5 Samples)

The inspectors evaluated the following licensee event reports (LERs):

(1) LER 05000483/2020-001-01, Emergency Exhaust Train Inoperable Due to Fan Belt Degradation and Failure (ADAMS Accession No. ML21040A515). The inspectors reviewed the updated LER submittal. The previous LER submittal was reviewed in Inspection Report 05000483/2020004 and the circumstances surrounding this LER were previously documented in the Inspection Results section of that report. This LER is closed.
(2) LER 2020-002-01, Reactor Trip and [auxiliary feedwater] AFW Actuation Following Spurious Main Feedwater Regulating Valve Closure (ADAMS Accession No. ML21040A521). The inspectors reviewed the updated LER submittal. The previous LER submittal was reviewed in Inspection Report 05000483/2020004 and the inspection conclusions are documented in the Inspection Results section of that report. This LER is closed.
(3) LER 05000483/2020-007-00, "B" Pressurizer Power-Operated Relief Valve Inoperable Due to Nonconformance with [environmental qualification] EQ Requirements (ADAMS Accession No ML20366A103). The inspectors reviewed the LER submittal. The inspectors determined that the cause of the condition described in the LER was not reasonably within the licensee's ability to foresee and correct and therefore was not reasonably preventable. No performance deficiency nor violation of NRC requirements was identified. This LER is closed.
(4) LER 2020-008-00, Reactor Trip due to Main Generator Electrical Fault (ADAMS Accession No. ML21049A109). The inspection conclusions associated with this LER

are documented in this report under the Inspection Results Section. This LER is closed.

(5) LER05000483/2021-001-00, Manual Actuation of Essential Service Water System (ADAMS Accession No. ML21098A254). The inspection conclusions associated with this LER are documented in this report under the Inspection Results Section. This LER is closed.

OTHER ACTIVITIES – TEMPORARY INSTRUCTIONS, INFREQUENT AND ABNORMAL

60855 - Operation of an Independent Spent Fuel Storage Installation (ISFSI)

The inspectors performed a review of the licensee's ISFSI activities to verify compliance with requirements of the Certificate of Compliance 72-1040, License Amendment 0, the HI-STORM UMAX Final Safety Evaluation Report (FSAR), Revision 2, and HI-STORM FW FSAR, Revision 3. The inspectors reviewed selected procedures, corrective action reports, and records to verify ISFSI operations were compliant with the Certificate's Technical Specifications, requirements in the FSAR, and NRC regulations.

Operation of an ISFSI (1 Sample)

(1) The inspectors evaluated the licensee's dry cask storage operations, from April 26 - 30, 2021, during an on-site inspection. The Callaway ISFSI is located within the Part 50 reactor's protected area. The UMAX ISFSI vault was designed to hold 48 multi-purpose canisters, each with 37 spent fuel assemblies (MPC-37). The UMAX was situated in a 6 by 8 array. At the time of the routine loading inspection, the Callaway UMAX ISFSI contained a total of 24 canisters, and the licensee was in the process of loading and processing the 25th canister in the spent fuel building. At the end of the loading campaign (early June 2021), the licensee had a total of 30 canisters at the ISFSI.

During the on-site inspection, the inspectors evaluated and observed the following activities:

- walkdown of the ISFSI haul path
- fuel assembly selection and placement into the 25th canister
- heavy load lifts using the cask handling crane to remove the transfer cask with the loaded canister from the spent fuel pool to the canister processing area
- welding and non-destructive testing of the lid-to-shell weld
- processing of the spent nuclear fuel for storage, including bulk water removal, forced helium dehydration, and helium backfill operations
- final sealing of the canister, including welding of the vent and port cover plates, non-destructive testing, and helium leak-testing
- transportation of the 25th canister on the vertical cask transporter from the spent fuel building to the ISFSI

The inspectors reviewed and evaluated the following documentation during the inspection:

- fuel selection evaluations for the canisters loaded since the last NRC ISFSI inspection, the inspectors reviewed the contents of canisters 11 to 25 against the license's technical specifications for approved contents

- radiation surveys for dose at the owner-controlled boundary to verify compliance with the requirements of 10 CFR 72.104 for calendar years 2018, 2019, and 2020
- selected ISFSI related condition reports issued since the last NRC ISFSI inspection (August 2018)
- quality assurance (QA) program implementation, including recent QA audits, surveillances, receipt inspection, and quality control activities related to ISFSI operations
- compliance to technical specifications for operational surveillance activities and FSAR-required annual maintenance activities
- documentation of annual maintenance activities for the site's cask handling crane, vertical cask transporter, and special lifting devices
- selected licensee design changes and program changes to the ISFSI performed under the site's 10 CFR 72.48 program
- changes made by the licensee in the site's 10 CFR 72.212 evaluation report from Revision 3-5

INSPECTION RESULTS

Observation: Semi-Annual Trend Review	71152

The inspectors reviewed the licensee's corrective action program, performance indicators, system health reports, and other documentation to identify trends that might indicate the existence of a more significant safety issue related to the containment spray pumps.

Background

The inspectors reviewed condition reports associated with high particulate counts in lubrication oil for the containment spray (CS) pump motors. The inspectors noted that starting in 2006, oil sample reports show high particulates in these oil samples. Among the 20 specific parameters monitored, the licensee monitors the oil for particles of six different size categories ranging from 4 microns (µm) to 40 µm.

The licensee monitors the performance of CS pump motors using oil samples, vibrations, and other performance data. Procedure EDP-ZZ-01126, "Lubrication Predictive Maintenance Program," Revision 21, contains specifications and monitoring requirements for the four oil reservoirs (two motors, each with upper and lower bearings). It states that elevated particulates should be monitored but are not, in and of themselves, an immediate concern for the motor. The inspector noted that this procedure provides target values for particulates to not exceed certain thresholds (e.g., >10,000 particles per ml for 4 µm particles, >5,000 particles per ml for 6 µm particles), but it contains no threshold for initiating corrective action.

As a specific example of high particulate counts, the inspectors reviewed the oil analysis for the lower bearing oil reservoir on the train A CS pump motor. All eight samples drawn since 2011 were above the increased monitoring thresholds and six samples had off-scale high counts for 4 µm particles with a value of 99,999 particles per milliliter (ml). Similarly, the 6 µm particles exceeded the target threshold and ranged from 5421 particles/ml to 84,965 particles/ml. The inspectors noted that other specific parameters that are monitored for evidence of bearing wear, such as iron, were not at values of concern and there was no water in the oil.

The licensee increased the frequency of sampling and changing the oil in the CS pump motors due to the elevated particulate values in 2013 from every 6 years to every 2 years. Further, the licensee recently assigned an action under Condition Report 202102501 to revisit this and determine if the frequency should remain the same or be increased.

The inspectors requested additional information on the potential source of the elevated particulates. The licensee had a third-party lab perform analytical ferrography to characterize the particulates. The lab determined the 4-6 µm particles included moderate amounts of abrasive, dust, and dirt with a few ferrous wear and black oxide particles. Based on limited wear components, the sample was characterized as indicating good bearing health including rolling wear, cutting wear, and rubbing wear in the lowest category.

Inspector Assessment

The inspectors determined that the licensee has been unsuccessful at removing particulates because they have not been able to completely drain the oil and flush the reservoirs. As documented in Condition Reports 201801839, 201801876, 201805238, and 202003408, the licensee has struggled with removing the recessed drain plugs since at least 2015. Instead, the work instructions for oil changes allowed technicians to drain oil via the sight-glass if the drain plug could not be removed, which does not permit draining the lower portion of the bearing reservoir. In 2018, under Condition Report 201801876, the licensee updated work instructions to require an additional level of supervisor approval prior to using an alternate method such as sight-glass draining. For this reason, there is not significant documentation, such as condition reports, of the drain plug issues prior to 2018.

The licensee assigned an action under Condition Report 202102501 to replace the drain plugs with a new design and started planning the work tasks under Job 21001628. The request for resolution (RFR) used to initiate the design change for the drain plug was previously captured in RFR 180175, created in 2018, but was later cancelled in 2019. This design change was then re-approved in 2020 under RFR 200070. Although the design and condition report action to replace the drain plugs for both CS pump motors are approved, the licensee still has not scheduled the replacement work. At the time of this report, the licensee was looking approximately two refueling outages into the future as the likely target implementation date.

Inspector Conclusions

The inspectors concluded the licensee has been tolerating high particulate in all four CS pump motor bearing reservoirs for 10 years. The licensee's lubrication predictive monitoring program does not contain any required actions for high particulate content to drive resolution of that condition even though the 4 µm particles are off-scale high and they are not able to measure or trend the actual current particle content. This has enabled the licensee to cancel and delay planned modifications to replace the problematic drain plugs rather than resolve the problem and the underlying cause.

The inspectors noted that the licensee did not use a risk assessment to schedule the modification needed to resolve the problem, but if a CS pump motor failed with the plant in Mode 1, the replacement activity would likely exceed the Technical Specification 3.6.6 allowed outage time of 72-hour completion time and result in an unplanned shutdown based on discussions with engineering personnel.

The inspectors noted that immediate operability determinations (IODs) for condition reports associated with elevated particulates in containment spray pump lube oil systems, including Condition Reports 202102501 and 202102454, stated that the pumps are operable but may result in reduced bearing life and premature degradation. However, the licensee has tolerated the condition for over 10 years without assessing the impact of reduced bearing life or examining the condition of the bearings. As a result of NRC questions, the licensee assigned an action under Condition Report 202102501 to evaluate the cumulative run time of the pumps and assess any impact to bearing life.

In summary, although there is not any indication of an imminent risk or failure of either CS pump motor, the licensee has not prioritized addressing a long-standing degraded condition for the CS pump motors.

Reactor Trip Due to Design and Maintenance Failures Associated with the Main Generator			
Cornerstone	Significance	Cross-Cutting Aspect	Report Section
Initiating Events	Green NCV 05000483/2021002-01 Open/Closed	[H.14] - Conservative Bias	71153

The inspectors reviewed a self-revealing, Green finding and associated non-cited violation of Technical Specification 5.4.1.a, "Procedures," for the licensee's failure to properly pre-plan and perform maintenance on the main generator that affected safety-related components. Specifically, the scope of planned work changed significantly as new problems were discovered, errors occurred, and planning inadequacies became apparent. The licensee did not implement appropriate risk mitigating actions such as providing additional vendor oversight or obtaining third party expertise. As a result, the main generator experienced an electrical fault at 90 percent power, the reactor tripped, and safety systems responded to stabilize the plant in Mode 3.

Description: On October 7, 2017, the licensee began a planned refueling outage where contractors performed a major main generator modification. This modification replaced the stator (the non-rotation part of the generator) with new components of a different design. After the work was complete the final electrical resistance values of the new stator were identified to be lower than design but acceptable. After attempting some improvements, the licensee decided to defer work on restoring the stator to design resistance values to a future refueling outage. The licensee started up the plant on December 17, 2017.

On September 27, 2020, the licensee started the fall refueling outage early due to an electrical fault in the isophase bus ducts that contain the high-voltage conductors that pass the electrical output of the generator causing a reactor trip. See the Inspection Results section of NRC Integrated Inspection Report 05000483/2020004, ADAMS Accession No. ML21040A410, for additional information on this reactor trip. During this outage, the licensee brought back the main generator contractors to perform rework on the stator with the goal of restoring resistance readings to design values and correct other problems that developed during the previous two operating cycles. As part of this effort, several types of issues associated with the main generator were identified that challenged the licensee: contractor work quality, design error, inadequate work instructions/planning, and licensee oversight of contractors.

Condition Reports	Subject	Issue Types
202005251	Foreign material found in main generator hydrogen seals with damage identified on initial as-found inspection	Contractor work quality, licensee oversight of contractors
202005520, 202006195, 202006243	Stator cooling water in-line strainer flow rate exceeded design specifications resulting in the strainer coming apart. Stator cooling water strainer screen found degraded and missing portions were located inside the main generator as foreign material on initial as--found inspection.	Design error, licensee oversight of contractors
202005410	During removal, the main generator's rotor was oriented incorrectly when placed on its stand and was resting on wedges. This required unplanned inspection to ensure the rotor was not damaged.	Contractor work quality, licensee oversight of contractors, inadequate work instructions
202005657, 202005701	During stator rework, reductions in planned stator insulation thickness were required due to inadequate clearances between phase connections and stator windings.	Contractor work quality, design error, licensee oversight of contractors, inadequate work planning
202005885, 202006034	During stator rework, stator copper conductor material removal was required to allow sufficient clearance for insulation installation. The scope of stator copper conductor removal was later increased when additional locations were identified. During the work, copper removal from one location exceeded allowable specifications.	Contractor work quality, design error, licensee oversight of contractors, inadequate work planning
202006019	During stator rework, insulation installation processes were changed by the contractor, during mock-up testing without informing the licensee	Licensee oversight of contractors
202006271, 20206640, 20206645	During stator rework, a circumferential crack and localized overheating was identified on an internal distribution header requiring replacement of the damaged portion.	Contractor work quality, design error, licensee oversight of contractors
202005446, 202006636, 202006638	Throughout stator rework, contractor personnel were impacted by the pandemic, requiring new, less proficient teams to take over in-progress work.	Contractor work quality, licensee oversight of contractors
202006552, 202006673	During stator rework, stator cooling water hose ferrule collars were over-tightened, damaging stator hose connector locations and requiring repair.	Contractor work quality, licensee oversight of contractors, inadequate work planning
202006899, 202006901	A water leak was identified from a hose connection during stator cooling water flushing. The hose was determined to have been nicked during recent insulation work and the hose required replacement. Further,	Contractor work quality, licensee oversight of contractors, inadequate work planning

	water leaks during stator cooling water flushing introduced water into isophase bus ducts.	

After resolving the above issues and completing the other planned outage activities, the licensee started up the reactor on December 19, 2020. During power ascension on December 24, 2020, the licensee received several abnormal indications and annunciator alarms associated with the main generator instrumentation and auxiliary systems. These indications included increasing stator cooling water conductivity and increasing hydrogen leakage from the main generator cooling system around 12:08 pm. The control room staff stopped the planned power ascension at 90 percent reactor power and dispatched non-licensed operators to the field investigate the alarms. At 12:35 pm, the reactor tripped due to a main generator fault and main turbine trip. The plant was stabilized in Mode 3, using auxiliary feedwater, and the licensee began an investigation into the cause of the trip. This event is documented in Licensee Event Report (LER) 2020-008-00, "Reactor Trip due to Main Generator Fault," ADAMS Accession No. ML21049A109.

The post-fault initial inspections of the main generator internals identified significant damage to hoses and piping used to route cooling water to the stator components. Further, the licensee observed the remnants of melted metal and hose material, black soot, and oily residue in several portions of the main generator enclosure. This information was captured in Condition Report 202007437. The licensee formed a root cause team to investigate the cause of the generator fault and reactor trip under Condition Report 202007410.

The licensee's root cause evaluation concluded that on December 24, 2020, the main generator fault was caused by the failure of the portion of a distribution header that was replaced in the fall 2020 refueling outage. This component cracked from a combination of residual stresses from the repair work and resonant vibrations from inadequate bolting during maintenance. As a result, hydrogen used to cool the main generator entered the stator cooling water system, displaced cooling water, disrupted cooling water flow, and led to localized overheating failure of internal conductors to the main generator stator. This original failure then cascaded to other locations in the main generator. In their cause report, the licensee noted that the contractor was not proficient in the repair work performed. The licensee identified that Callaway's engineering and project management programs did not adequately challenge and verify the contractor's plan prior to installation, such as using third-party reviewers, for a unique main generator design. Further, the licensee identified that Callaway did not establish an adequate post-startup monitoring plan to assess the performance of the main generator under load.

The inspectors independently reviewed the issues, associated condition reports, and root cause evaluation for the main generator fault. The inspectors noted that there were examples of as-found damage when the main generator was initially opened at the start of the fall 2020 refueling outage that originated from poor contractor work practices and design errors in the 2017 refueling outage. Specifically, the licensee found examples of damaged or degraded main generator components after only a few years of service, such as foreign material in the hydrogen coolers and the failure of stator cooling water strainers under their design flow conditions. Next, the inspectors noted that there were several additional precursor issues identified during the fall 2020 refueling outage that demonstrated a lack of adequate oversight of the main generator design and contractor work practices. These issues resulted in damaged components such as cut stator water cooling hoses, and design issues such as difficulties performing tasks between adjacent conductors with low clearances.

Ultimately, the inspectors concluded that the licensee failed to properly pre-plan the work on the main generator which contributed to a reactor trip. Despite significantly changing the main generator work scope from problems being identified, including unusual conditions with incomplete information, the licensee did not implement appropriate risk mitigating actions to increase contractor oversight. The inspectors noted that Callaway Plant is the NRC licensee and is responsible for activities taking place on-site including contractor work. The combination of various main generator issues, in aggregate, did not result in an appropriate level of oversight of the contractors and main generator design. The inspectors concluded that the lack of an adequate post-startup monitoring plan after all of the issues encountered during the outage and the technical complexity of the work indicated that the licensee did not have an adequate conservative bias to identify and mitigate problems that might occur while placing the main generator into service following significant generator project.

Corrective Actions: In response to the trip, operators stabilized the plant in Mode 3. The licensee performed a root cause evaluation, implemented a major modification to the main generator to replace the stator with a different design, inspected the main generator rotor, and modified main generator auxiliary systems. Further, the licensee revised standards for contractor oversight and project management to include additional verifications of design changes such as through a third-party with technical capabilities in the subject.

Corrective Action References: Condition Report 202007410

Performance Assessment:

Performance Deficiency: The failure to properly preplan main generator work and provide adequate oversight of contractor design, maintenance work, and testing on the main generator project was a performance deficiency. Specifically, the scope of work changed significantly as new problems were discovered, errors occurred, and planning inadequacies became apparent. The licensee did not implement appropriate risk mitigating actions such as additional vendor oversight, obtaining third party expertise or increased monitoring and testing.

Screening: The inspectors determined the performance deficiency was more than minor because it was associated with the Design Control attribute of the Initiating Events Cornerstone and adversely affected the cornerstone objective to limit the likelihood of events that upset plant stability and challenge critical safety functions during shutdown as well as power operations. Specifically, the performance deficiency resulted in challenging safety systems which were required to initiate an automatic reactor trip, isolate main feedwater, and initiate auxiliary feedwater to reach safe-shutdown conditions.

Significance: The inspectors assessed the significance of the finding using Appendix A, "The Significance Determination Process (SDP) for Findings At-Power." The finding was determined to be of very low safety significance (Green) under Exhibit 1, "Initiating Events Screening Questions," because while the finding did cause a reactor trip, it did not also result in the loss of mitigation equipment relied upon to transition the plant from the onset of the trip to a stable shutdown condition. Specifically, safety systems remained available and the plant responded per design without any complications.

Cross-Cutting Aspect: H.14 - Conservative Bias: Individuals use decision-making practices that emphasize prudent choices over those that are simply allowable. A proposed action is determined to be safe in order to proceed, rather than unsafe in order to stop. The inspectors determined that the finding had a Human Performance cross-cutting aspect associated with

Conservative Bias in that plant leadership did not ensure that conservative assumptions were used when determining whether changing work scope could be conducted safely. Further, station leadership did not take a conservative approach to decision-making when information was incomplete or conditions were unusual. Specifically, the licensee did not demonstrate a conservative bias to the combination of unexpected conditions encountered with the main generator and vendor errors by increasing their oversight by obtaining additional technical expertise, or conducting a thorough readiness review in order to ensure the condition of the main generator was suitable for reliable operation prior to placing it in service.

Enforcement:

Violation: Technical Specification 5.4.1.a, "Procedures," requires that written procedures shall be established, implemented, and maintained covering the applicable procedures recommended in Regulatory Guide 1.33, Revision 2, Appendix A, February 1978. Regulatory Guide 1.33, Revision 2, Appendix A, Section 9.a, requires, in part, that maintenance that can affect the performance of safety-related equipment should be properly pre-planned and performed in accordance with written procedures and documented instructions appropriate to the circumstances.

Contrary to the above, from September 27, 2020, through December 24, 2020, the licensee failed to properly pre-plan and perform maintenance that could affect the performance of safety-related equipment. Specifically, defects caused by repair work and design changes to the main generator caused the failure of stator water cooling piping and a main generator fault that affected the performance of safety-related equipment by causing a reactor trip and safety system actuations. Throughout the project, the scope of work changed significantly as new problems were discovered, errors required rework occurred, and planning inadequacies became apparent.

Enforcement Action: This violation is being treated as a non-cited violation, consistent with Section 2.3.2 of the Enforcement Policy.

Minor Violation	71153

Minor Violation: While reviewing LER 05000483/2021-001-00, "Manual Actuation of Essential Service Water System," (ADAMS Accession No. ML21098A254), the inspectors identified a minor violation. Technical Specification 5.4.1.a, Procedures, states in part, that written procedures shall be established, implemented, and maintained covering the applicable procedures listed in Regulatory Guide 1.33, "Quality Assurance Program Requirements," Revision 2, Appendix A, February 1978. Regulatory Guide 1.33, Revision 2, Appendix A, Section 9, "Procedures for Performing Maintenance," requires, in part, that maintenance that can affect the performance of safety-related equipment should be properly pre-planned and performed in accordance with written procedures, documented instructions, or drawings appropriate to the circumstances.

Contrary to the above, from January 26 through February 9, 2021, the licensee failed to properly pre-plan and perform a pipe repair on the common lube water supply header to the non-safety service water (SW) pumps in accordance with written procedures, documented instructions, or drawings appropriate to the circumstances.

Specifically, the licensee installed a temporary alteration in support of maintenance (TASM) to provide lube water to the SW pumps while repairing the pipe leak in the permanent lube water system. The configuration of the TASM prevented the licensee from back flushing the

SW Y-strainer and guidance was provided to clean the SW Y-strainer if lube water pressure and flow could not be maintained; however, the licensee failed to generate a contingency task or establish plant conditions to clean the Y-strainer. With the TASM installed, lube water pressure and flow degraded until both running SW pumps tripped and locked out on low lube water pressure.

The loss of the non-safety SW pumps resulted in the licensee manually starting both trains of the safety-related essential service water system to restore cooling flow until the SW system could be restored. The SW pump trip and lockout did not result in the loss of any safety-related function since the essential service water system is the credited system for achieving and maintaining safe shutdown.

Screening: The inspectors determined the performance deficiency was minor. This performance deficiency was screened in accordance with Inspection Manual Chapter 0612, Appendix B, "Issue Screening," dated December 10, 2020, and was determined to be of minor significance because the performance deficiency could not be reasonably viewed as a precursor to a significant event, would not have the potential to lead to a more significant safety concern if left uncorrected and did not adversely affect a cornerstone objective.

Enforcement: This failure to comply with Technical Specification 5.4.1.a, Procedures, constitutes a minor violation that is not subject to enforcement action in accordance with the NRC's enforcement Policy.

The licensee entered this into their corrective action program as Condition Report 202100780 to restore compliance. This minor violation closes LER 05000483/2021-001-00.

EXIT MEETINGS AND DEBRIEFS

The inspectors confirmed that proprietary information was controlled to protect from public disclosure.

- On May 3, 2021, the inspectors presented the Callaway ISFSI routine inspection results to Mr. B. Cox, Site Vice President, and other members of the licensee staff.

- On June 24, 2021, the inspectors presented the Evaluations of Changes, Tests, and Experiments (IP 71111.17T) Inspection results to Mr. F. Bianco, Senior Director of Nuclear Operations, and other members of the licensee staff.

- On July 7, 2021, the inspectors presented the Integrated Resident Inspection results to Mr. B. Cox, Site Vice President, and other members of the licensee staff.

DOCUMENTS REVIEWED

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
60855	Engineering Changes	EMPRV job 19005219.115	Temporary shield platform on ISFSI pad for low dose wait area	0
		MP 19-0119	RFR 190016 – Design Change Package for 2021 ISFSI Loading Campaign	0
		MP 20-0004	RFR 180177 - Fuel Building 100A, 480V, 3 Phase Weld Receptacle	0
		PM1008270	Perform HI-TRAC inspection per HI-STORM FW and UMAX FSAR	0
	Engineering Evaluations	CA 3415	10 CFR 72.212 Evaluation Report Callaway Plant	5
71111.01	Corrective Action Documents	Condition Reports	200810481, 201005432, 201105051, 201109098, 201903514, 202003794, 202005792, 202103367	
	Miscellaneous	MP 10-0053	SSPS Printed Circuit Board Power Supply & Master Test Relay Requirements	3
		Westinghouse TB 13-07	Solid State Protection System New Design Universal Logic Board & Safeguards Driver Board 48VDC Input	12/10/2013
	Procedures	ISP-SA-2320A	Unblocked Actuation Slave Relay K626 – Train A	0
		ITM-SB-0001	SSPS Power Supply Predictive Maintenance	11
		OSP-SA-2413A	Train A Diesel Generator & Sequencer Testing	29
		OTN-EF-00001	Essential Service Water System	79
		OTS-SB-0002A	Placing SSPS Train A in Test in Modes 5, 6 & No Mode	7
71111.04	Corrective Action Documents	Condition Reports	202000316, 202003345, 202004338, 202004392, 202005891, 202005909, 202007304, 2020007421, 202101189, 202100129, 202101521, 2021001537, 202101588, 202101812, 202101972, 2021002484, 202102764, 202103032	
	Miscellaneous	Job 18506700	Replace Starting Batteries	
		MP 12-021	TSC/EOF D/G Digital Upgrade Control Kit	0.1
	Procedures	EPGUB51	Technical Support Center Emergency Generator	15
		MSE-ZZ-QS006	NLI/Square D Masterpact Circuit Breaker Preventative Maintenance and Inspections	12

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		OSP-SB-P0002	Train A and Train B Safety Injection Comprehensive Pump Test	0
		OTN-GK-00001	Control Building HVAC System	64
		OTS-ZZ-00002	Technical Support Center Diesel Generator Functional Test	29
71111.05	Corrective Action Documents	Condition Reports	200804182, 202005622, 201010734, 202101097, 202101125, 202101127, 202102437	
	Miscellaneous		Fire Pre-Plan	Various
	Procedures	APA-ZZ-00701	Control of Fire Protection Impairments	26
		APA-ZZ-00741	Control of Combustible Materials	38
		FPP-ZZ-00100	Site Wide Fire Protection Inspection Procedure	14
71111.06	Corrective Action Documents	Condition Reports	200901922, 200903925, 201805151, 201806566, 202003241, 202102234, 202102964	
	Miscellaneous	Job 18004225	Open cable trenches to perform initial inspection for license renewal	
		M-FL-02	Determine Floor Levels in Auxiliary Building Rooms	1
		M-FL-10	Maximum Flood Level for Rooms in the Diesel Generator Building	3
		M-FL-11	Auxiliary Building Flooding	2
		M-FL-17	Summary of Flood Levels	0
		RFR 20102	Cables in Switchyard Trenches Submerged/Wetted	0
	Procedure	APA-ZZ-00750	Hazzard Barrier Program	48
		APA-ZZ-00750	Hazard Barrier Program	48
71111.11Q	Corrective Action Documents	Condition Reports	202103287, 201504294, 201605725	
	Procedures	OSP-AL-P0002	Turbine Driven Auxiliary Feedwater Pump Inservice Test – Group B	82
		OSP-BB-VL005	BBV00001, 22, 40, 59, and EM8815 Inservice Test – IPTE	23
		OTG-ZZ-00001	Plant Heat-up: Cold Shutdown to Hot Standby	95
		OTG-ZZ-00003	Plant Startup: Hot Zero Power to 30% Power – IPTE	64
		OTG-ZZ-00004	Power Operations	100
		OTN-EJ-00001	Residual Heat Removal System	28
		OTN-EM-00001	Safety Injection System	38
		OTO-BB-00002	RCP Off-Normal	35

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
71111.12	Corrective Action Documents	Condition Reports	201902387, 202000567, 202007130, 202100385, 202101533, 202102237, 202102453, 202102540	
	Miscellaneous	CA0176	Temporary Configuration Change Tracking	2
		OQAM	Operating Quality Assurance Manual	35
	Procedures	APA-ZZ-00103	EOP Program Procedure	
		APA-ZZ-00315	Configuration Risk management Program	15
		APA-ZZ-00322, Appendix C	Job Planning	60
		APA-ZZ-00605	Temporary System Modifications	41
		EDP-ZZ-04024	Configuration Control	35
		EOP Addendum 19	Aligning ESW to AFW Suction	4
71111.13	Miscellaneous		Forced Outage 73 Shutdown Safety Management Plan	6
		NUMARC 93-01	Industry Guidelines for Monitoring the Effectiveness of maintenance at Nuclear Power Plants	4
	Procedures	APA-ZZ-00322, Appendix F	Online Work Integrated Risk Management	18
		APA-ZZ-01250	Operational Decision Making	18
		EDP-ZZ-01128, Appendix 1	SSCs in the Scope of the Maintenance Rule at Callaway	11
		ODP-ZZ-0002, Appendix 2	Risk management Actions for Planned Risk Significant Activities	17
71111.15	Corrective Action Documents	Condition Reports	201701448, 202102131, 202102237, 202102548, 202102868	
71111.17T	Corrective Action Documents	Condition Report	201706241, 201804069, 201804473, 201805523, 201901379, 202004939, 202001155, 201903261, 201801822, 201801943, 201800700, 201801263, 201905733, 201902075, 202000441, 202101851, 201901943, 201608055, 201801260, 201803313	
	Corrective Action Documents Resulting from Inspection	Condition Reports	202103507, 202103550	

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
	Engineering Changes	Design Change Package - MP 17-0006	ESW Water Hammer Mitigation Modification	2
		Design Change Package - MP 17-0006	ESW Water Hammer Mitigation Modification	2
		Design Change Package - MP 18-0040	Contingency Modification for RPV Stuck Stud Removal	3
		Design Equivalent Change Package - MP 18-0042	ESW Water Hammer Modification - CRAC Tie Ins	2
		Design Equivalent Change Package - MP 19-0113	ESW Water Hammer Mitigation Phase 2	1
		Engineering Disposition - MP 03-1002	Main Feedwater Pump Turbine Control System Replacement	11
		Field Change Request - MP 18-0042	ESW Water Hammer Modification - CRAC Tie Ins	0
		Field Change Request - MP 18-0042 FCR02	ESW Water Hammer Mitigation - CRAC Tie Ins	1
		MP 16-0032	Replace ESFAS and SB069 Status Panels	0
		MP 21-0006	Replace Isophase Bus Welded Flexible Links	0
	Engineering Evaluations	RFR 200113	Document Acceptance of TMRE to Resolve Tornado Missile Protection Non-Conformances	0
	Miscellaneous	50.59 Evaluation - MP 03-1002	Main Feedwater Pump Turbine Control System Replacement	2
		50.59 Evaluation - MP 17-0006	ESW Water Hammer Mitigation Modification	0
		50.59 Evaluation - MP 19-0103	Hot leg Recirculation Valve Position Change and Mission Time Basis Documentation.	0

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		50.59 Evaluation for Operator Actions - MP 19-0103	Hot Leg Recirculation Valve Position Change and Mission Time Basis Documentation	0
		50.59 Evaluation: Operator Actions - MP 03-1002	10CFR50.59 Evaluation; Revision/Sequence 1, Questions for New or Modified Operator Action(s).	0
		50.59 Screen - EOP ADD 19	Aligning ESW To AFW Suction	4
		50.59 Screen - MP 17-0006	ESW Water Hammer Mitigation Modification	0
		50.59 Screen - MP 18-0040	Contingency Modification for RPV Stuck Stud Removal	0
		50.59 Screen - MP 19-0113	ESW Water Hammer Mitigation Phase 2	0
		50.59 Screen - OSP-EF-P001A	ESW Train A Inservice Test	81
		50.59 Screen - OSP-JE-PO0IA	Train A Emergency Diesel Generator Fuel Oil System Inservice Tests	30
		Applicability Determination - MSM-ZZ-QV006	Generic Inspection of Swing Check Valves	0
		Applicability Determination - OSP-BB-LL022	Containment Isolation Valve Leak Rate Test	12
		Applicability Determination - OSP-EF-V001A	ESW Train A Valve Operability	51
		E-009-00242	ABB Power Distribution, Inc. - Instructions for Phase Unbalance Relay	47
		E-009-00338	Class 1E Electrical Equipment Qualification 60Q Phase Unbalance Relay	0

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		Surveillance Test Risk-Informed Documented Evaluation (STRIDE) 19-05	Callaway 18 Month NK Battery and Battery Charger Surveillances	0
		Westinghouse Letter -SCP-18-27, Rev 1	Ameren Missouri, Callaway Plant, Transmittal of Trains A and B Base Case Models for Callaway Water Hammer	04/16/2018
	Procedures		Callaway 10 CFR 50.59 Resource Manual	5
		APA-ZZ-00143	10 CFR 50.59 AND 10 CFR 72.48 REVIEWS	19
		APA-ZZ-00500 Appendix 1	Operability Determinations	36
		APA-ZZ-01023	Primary-to-Secondary Leakage Program	28
		CTP-ZZ-02590	Primary to Secondary Leak Rate Determination	54
		E-0	Reactor Trip or Safety Injection	21
		EOP ADD 19	Aligning ESW to AFW Suction	4
		ESP-ZZ-01016	ASME Section XI IWE Containment Pressure Boundary Inspection	11
		MSM-ZZ-QV006	Generic Inspection of Swing Check Valves	0
		OSP-BB-LL022	Containment Isolation Valve Leak Rate Test	12
		OSP-EF-P001A	ESW Train A Inservice Test	81
		OSP-EF-V001A	ESW Train A Valve Operability	51
		OSP-JE-PO0IA	Train A Emergency Diesel Generator Fuel Oil System Inservice Tests	30
		OTN-AL-00001	Auxiliary Feedwater System	35
		OTN-GK-00001	Control Building HVAC System	54
		OTO-SA-00001	ESFAS Verification and Restoration	44
	Self-Assessments	CR 202003269-005	2021 10 CFR 50.59 Callaway Self-Assessment	06/07/2021
71111.19	Corrective Action Documents	Condition Reports	202102672, 202102683, 202103140, 202103222, 202103245, 202103286	
	Procedures	APA-ZZ-00322, Appendix E	Post-Maintenance Test Program	16
		APA-ZZ-00340,	Surveillance Frequency Control Program STI List	15

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
		Appendix 4		
		ISF-AB-OP534	S/G Press Op Test Loop 3 Protection 1	23
		ISL-AB-OP534	S/G Press Channel Cal Loop 3 Protection 1	28
	Work Orders		10502135, 20513698, 21002135	
71111.20	Procedures		Forced Outage 73 Shutdown Safety Management Plan	6
71111.22	Corrective Action Documents	Condition Reports	202101548, 202102119, 202102418	
	Miscellaneous	PM1008315	Train A RHR System Venting	
		PM1008316	Train B RHR System Venting	
	Procedures	ODP-ZZ-00016	Reactor Operator Watchstation Practices and Logs	83
		OSP-EJ-PV04A	Train A RHR and RCS Check Valve Inservice Test	18
		OSP-EJ-PV04B	Train B RHR and RCS Check Valve Inservice Test	21
		OSP-SA-00003	Emergency Core Cooling System Flow Path Verification and Venting - Modes 1-4	53
	Work Orders		21501180	
		Job Order	19507229	10/10/2020
		Job Order	195072555	10/10/2020
71151	Corrective Action Documents	Condition Reports	200403784, 200900713, 201007829, 201103304	
	Miscellaneous		Control Room Logs	
			NRC Performance Indicator Transmittal Reports, Barrier Integrity Cornerstone	
			NRC Performance Indicator Transmittal Reports, Mitigating Systems Cornerstone	
			MSPI Basis Document	
	Procedures	RRA-ZZ-00001	NRC Performance Indicator Program	22
		APA-ZZ-01111	Mitigating Systems Performance Index (MSPI) Program Administration	6
		KDP-ZZ-02000	NRC Performance Indicator Data Collection	20
71152	Corrective Action Documents	Condition Reports	201801839, 201801876, 201805238, 202003408, 202004782, 202006922, 202100289, 202100235, 202100423, 202101831, 202102501, 202102516, 202103439	

Inspection Procedure	Type	Designation	Description or Title	Revision or Date
	Miscellaneous	NEI 99-02	Regulatory Assessment Performance Indicator Guidelines	7
		Job 200002801	Job Adjust MSK06 Alignment and Sensitivity as Needed to Support Pass Testing	0
		MP 20-0080	Protected Area Intrusion Detection System Configuration Change	0
		RFR 200171	Protected Area Intrusion Detections System Configuration Enhancement	0
	Procedures	APA-ZZ-00604	Requests for Resolution	39
		IP-ENG-001	Standard Design Process	1
		SDP-ZZ-00030	Security Plan Revision Process	16
		EDP-ZZ-01126	Lubrication Predictive Maintenance Program	21
		OTN-EM-00001	Safety Injection System	38
71153	Corrective Action Documents	Condition Reports	202001783, 202007410	