Ameren MISSOURI

Callaway Plant

July 3, 2018

ULNRC-06446

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

50.73(a)(2)(i)(B),
50.73(a)(2)(v)(A),
50.73(a)(2)(v)(B),
50.73(a)(2)(v)(D)

Ladies and Gentlemen:

DOCKET NUMBER 50-483
CALLAWAY PLANT UNIT 1
UNION ELECTRIC CO.
RENEWED FACILITY OPERATING LICENSE NPF-30
LICENSEE EVENT REPORT 2018-002-00
Inadequate EOP Guidance for Asymmetric Natural Circulation Cooldown

The enclosed licensee event report is submitted in accordance with 50.73(a)(2)(i)(B), 50.73(a)(2)(v)(A), 50.73(a)(2)(v)(B), and 50.73(a)(2)(v)(D) to report a deficiency in the Emergency Operating Procedure guidance for an asymmetric natural circulation cooldown that had the potential to have prevented the turbine driven auxiliary feedwater pump and atmospheric steam dumps from performing their specified safety functions.

This letter does not contain new commitments.

Sincerely,

Roger Wink,
Manager, Regulatory Affairs

Enclosure

cc: Mr. Kriss M. Kennedy
Regional Administrator
U. S. Nuclear Regulatory Commission
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Arlington, TX 76011-4511

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Index and send hardcopy to QA File A160.0761

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NRC FORM 366 (04-2017) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 03/31/2020

LICENSEE EVENT REPORT (LER)

(See Page 2 for required number of digits/characters for each block)

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

1. FACILITY NAME
Callaway Plant Unit 1

2. DOCKET NUMBER
05000483

3. PAGE
1 OF 4

4. TITLE
Inadequate EOP Guidance for Asymmetric Natural Circulation Cooldown

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
05	07	2018	2018	- 002	- 000				FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE
1

10. POWER LEVEL
100%

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☒ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☒ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(C)	☐ 73.77(a)(1)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☒ 50.73(a)(2)(v)(D)	☐ 73.77(a)(2)(i)
☐ 20.2203(a)(2)(vi)	☒ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(vii)	☐ 73.77(a)(2)(ii)
	☐ 50.73(a)(2)(i)(C)	☐ OTHER Specify in Abstract below or in NRC Form 366A	

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT	TELEPHONE 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	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

ABSTRACT *(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)*

On May 7, 2018, during an engineering review of mission time requirements for Technical Specification related equipment, a deficiency was discovered regarding the Emergency Operating Procedure (EOP) guidance for natural circulation cooldown with a stagnant loop. This condition could be the result of a postulated Main Steam Line Break with a loss of offsite power.

During a natural circulation cooldown with a faulted steam generator, flow in the stagnant reactor coolant system (RCS) loop associated with the isolated faulted steam generator (SG) could stagnate and result in elevated temperatures in that loop. This could become an issue when RCS depressurization to residual heat removal system (RHR) entry conditions is attempted. The liquid in the stagnant loop would flash to steam and prevent RCS depressurization. In this condition, the time required to complete the cooldown would be sufficiently long such that the nitrogen accumulators associated with Callaway's atmospheric steam dumps and turbine driven auxiliary feedwater pump flow control valves would be exhausted. As a result, the atmospheric steam dumps and turbine driven auxiliary feedwater pump would not be capable of performing their specified safety functions of cooling the plant to entry conditions for RHR operation.

EOPs have been revised and the EOP change process will be revised to address this issue.

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Callaway Plant Unit 1	05000-483	2018	- 002	- 000

NARRATIVE

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

The event reported in this LER involves procedural deficiencies in Callaway's Emergency Operating Procedure (EOP) network that would have prevented the atmospheric steam dump and turbine driven auxiliary feedwater pump flow control valves from performing their specified safety function of cooling the plant to RHR entry conditions following a postulated main steam line break with a coincident loss of offsite power. The atmospheric steam dumps and turbine driven auxiliary feedwater pump flow control valves are supported by nitrogen accumulators that provide the safety-grade means of operating the valves. EOP guidance for an asymmetric natural circulation cooldown would have resulted in a cooldown duration that would have potentially exhausted the nitrogen accumulators, thus rendering the ASDs and TDAFP from performing a specified safety function.

Callaway Plant has four atmospheric steam dump valves (ASDs) (EIIS: RV). There is one ASD in each main steam (EIIS: SB) line outside of containment and upstream of the associated main steam safety valves and main steam isolation valve. Thus, there is one ASD for each steam generator at Callaway. The ASDs, ABPV0001/2/3/4, are used to remove heat from the reactor coolant system (RCS) when the plant is being started up or shut down with the main condenser not available.

The turbine driven auxiliary feedwater pump (TDAFP) (EIIS system BA, component P) provides flow to all four steam generators. TDAFP flow to each steam generator is controlled by an air-operated flow control valve.

2. INITIAL PLANT CONDITIONS:

Callaway was at 100% Power/Mode 1 at the time of discovery of this event.

3. EVENT DESCRIPTION:

Prior to the initial startup of Callaway, the original Post-TMI "symptom-based" emergency response procedures used at Callaway did not consider the possible impact of the stagnation of an RCS loop when a steam generator is unable to remove heat (asymmetric cooldown) while on natural circulation. The lack of flow would cause the pressure and temperature in the faulted loop to remain elevated during the cooldown process, resulting in it acting as a pressurizer when the operators attempt to depressurize the RCS.

This issue was initially identified by the South Texas Project in 2003, and reported to the NRC by LER 03-006-00. Subsequent to the South Texas Project LER, a generic industry resolution was developed by the Pressurized Water Reactor Owners Group (PWROG). This guidance was provided in 2007 by WCAP-16632-P. This document was intended to allow plants to avoid flow stagnation in the RCS loops by adhering to guidance on cooldown rate verses active loop differential temperature. This guidance was reviewed by Callaway and incorporated into the Callaway EOP network. The cooldown rate limits were incorporated as Figure 1 of procedure ES-0.2, Rev. 9, "Natural Circulation Cooldown." The changes underwent an EOP Review, including a simulator validation of the revised EOP.

The incorporation of the PWROG guidance provided by WCAP-16632-P into Callaway's EOP network was performed in accordance with existing administrative controls for EOP updates. The simulator validation did not cover the entire accident from start to finish, but terminated after the altered portions of the procedure were successfully diagnosed and entered. Neither the EOP Review nor the Simulator Validation detected the fact that the cooldown curve (Figure 1) would require cooldown rates that were sufficiently slow to result in cooldown durations that exceeded the values used in the licensing bases radiological consequence analyses and the mission time capabilities of the nitrogen accumulators associated with the atmospheric steam dumps and the turbine driven auxiliary feedwater flow control valves.

In 2018, during a Callaway engineering review of mission time requirements for Technical Specification related Structures Systems and Components (SSC), operating experience at another commercial nuclear facility was identified that led to a review of WCAP-16632-P. It was determined that during low core decay heat situations, the revised ES-0.2 would require a cooldown rate that was sufficiently slow such that the cooldown duration would exceed the capacity of the safety-grade nitrogen supply and be beyond the assumptions used in the licensing bases radiological consequence analysis for main steam line break.

Upon discovery of the deficiencies in the EOP guidance for an asymmetric natural circulation cooldown, the concern was entered into Callaway's corrective action program and reported to the NRC as Event Notification EN # 53388. Compensatory actions were issued to ensure the operability of affected SSCs and to maintain Callaway within its licensing bases.

4. ASSESSMENT OF SAFETY CONSEQUENCES:

The procedural deficiencies described in this LER represent an adverse condition of minor nuclear safety significance. During a natural circulation cooldown with a faulted steam generator, flow in the stagnant RCS loop associated with the isolated faulted SG could stagnate and result in elevated temperatures in that loop. This could become an issue when RCS depressurization to RHR entry conditions is attempted. The liquid in the stagnant loop would flash to steam and prevent RCS depressurization. In this condition, the time required to complete the cooldown would be sufficiently long that the nitrogen accumulators associated with Callaway's atmospheric steam dumps and turbine driven auxiliary feedwater pump flow control valves would be exhausted. The atmospheric steam dumps and turbine driven auxiliary feedwater pump would not be capable of performing their specified safety functions of cooling the plant to entry conditions for RHR operation.

The extended cooldown duration for events involving an asymmetric natural circulation cooldown would result in an adverse impact on the sequence of events provided in the Callaway Final Safety Analysis Report (FSAR) licensing basis MSLB event. The licensing basis MSLB event described in Section 15.1 of the Callaway FSAR does not result in damage to the nuclear fuel cladding. Radiological consequences are driven by pre-existing fuel defects and iodine spiking associated with plant maneuvers. Specifically, the initial conditions used in the licensing basis MSLB analysis assume that pre-existing fuel defects have driven RCS concentrations of radio-iodines to the maximum levels permitted by Technical Specifications prior to initiation of the accident sequence. It should be noted that Callaway has not had any fuel defects during the last three years. Another item of significance to note is that the most limiting Departure from Nucleate Boiling Rates (DNBR) values calculated for the licensing basis MSLB occur early in the accident sequence. Therefore, the long-term implications of the prolonged cooldown duration would not adversely impact the limiting MSLB DNBR values.

If only SSCs and actions available in a licensing basis safety analysis scenario are credited, it is postulated that the nitrogen accumulators would be exhausted prior to reaching RHR entry conditions. Should this occur, the ASDs would close, and the plant would heat back up to the saturation conditions associated with the lift setpoint for the main steam safety valves (MSSVs). Plant operation in this condition would not result in damage to the fuel clad. The plant would remain in this condition until reasonable recovery actions not typically credited in licensing basis safety analysis could be taken. Following a MSLB event, radiological conditions would not restrict movement about the plant site. Reasonable recovery actions that would be taken to resolve the condition would include replenishing the Condensate Storage Tank (CST) and/or Hardened Condensate Storage Tank (HCST) inventories. The plant air compressors are non-Technical Specification, non-safety related components located in the Turbine Building. Therefore, credit is not taken for the air compressors in the licensing basis safety analysis. However, an air compressor is provided with electrical power from a safety-grade supply and cooling from the essential service water system. The Emergency Operating Procedure network includes guidance that directs the operators to start an instrument air compressor following entry into the Emergency Operating Procedures. Therefore, it is probable that a plant compressor would be available following a Design Bases Accident. Availability of the instrument air system would serve to significantly extend the availability of the atmospheric steam dumps. Use of the FLEX air compressors would also represent a reasonable recovery strategy that would significantly extend the service time of the atmospheric steam dumps.

Based on these considerations, it is concluded that the procedural deficiencies described in this LER do not represent a condition that has more than minor safety significance.

5. REPORTING REQUIREMENTS:

This LER is submitted pursuant to 50.73(a)(2)(i)(B), 50.73(a)(2)(v)(A), 50.73(a)(2)(v)(B), and 50.73(a)(2)(v)(D).

The prolonged cooldown duration potentially caused by the inadequate EOP guidance could have resulted in the ASDs and TDAFP being incapable of performing a specified safety function following a postulated asymmetric natural circulation cooldown. Specifically, the ASDs and TDAFP would not have been capable of cooling the plant to RHR entry conditions following a main steam line break with a coincident loss of offsite power. SSCs incapable of performing their specified safety functions are considered to be inoperable. The period of inoperability for the ASDs and TDAFP exceeded the allowances of Technical Specifications 3.7.4, "Atmospheric Steam Dump Valves (ASDs)," and 3.7.5, "Auxiliary Feedwater (AFW) System." Thus, this event is being reported as an operation or condition prohibited by Technical Specifications in accordance with 50.73(a)(2)(i)(B).

As explained above, the prolonged cooldown duration potentially caused by the inadequate EOP guidance would have resulted in the ASDs and TDAFP being incapable of performing a specified safety function following a postulated asymmetric natural circulation cooldown. Specifically, the ASDs and TDAFP would not have been capable of cooling the plant to RHR entry conditions following a main steam line break with a coincident loss of offsite power. Thus, this event is being reported as a condition that could have prevented fulfillment of a safety function in accordance with 50.73(a)(2)(v)(A), 50.73(a)(2)(v)(B), and 50.73(a)(2)(v)(D).

6. CAUSE OF THE EVENT:

The generic accident mitigation strategy provided by WCAP-16632-P was not appropriate for Callaway. The EOP review and validation process in use at the time when WCAP-16632-P was issued was not sufficient to identify the flaws in the WCAP-16632-P accident mitigation strategy prior to that strategy being incorporated into Callaway's EOP network.

7. CORRECTIVE ACTIONS:

A revised accident mitigation strategy has been developed to preclude excessive cooldown durations during an asymmetric natural circulation cooldown. This strategy has been incorporated into Callaway's EOP network. Additionally, Callaway's administrative procedures for the EOP program will be revised to provide an enhanced level of review to increase the likelihood of identifying deficiencies in generic industry guidance prior to the incorporation of the generic guidance into Callaway's EOP network.

8. PREVIOUS SIMILAR EVENTS:

A review of LERs from the past three years found no other events in which the failure to detect deficiencies in generic industry guidance regarding EOP content led to a reportable condition.