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December 6, 2011

ULNRC-05825

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 CO.
FACILITY OPERATING LICENSE NPF-30
LICENSEE EVENT REPORT 2010-009-02
HIGH ENERGY LINE BREAK (HELB) PROGRAM DEFICIENCIES

The enclosed licensee event report (LER) is submitted in accordance with 10 CFR 50.73 to report the identification of programmatic deficiencies in the implementation of the Callaway Plant High Energy Line Break (HELB) Program. These deficiencies resulted in previous events in which the operability of potentially affected plant equipment cannot be demonstrated.

LER 2010-009-01, submitted via Ameren Missouri letter ULNRC-05819, contained incorrect time periods for some of the cases described in the report. This error has been entered into the Callaway Plant Corrective Action Program. LER 2010-009-02 is hereby submitted to correct the erroneous time periods and to indicate that time periods in one case exceeded the completion times permitted by the Callaway Plant Technical Specifications.

This letter does not contain new commitments.

Sincerely,

Fadi M. Diya
Vice President Nuclear Operations

ACS/nls

Enclosure: LER 2010-009-02

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Index and send hardcopy to QA File A160.0761

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LICENSEE EVENT REPORT (LER)

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

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Callaway Plant Unit 1	05000483	1 OF 7

4. TITLE
High Energy Line Break (HELB) Program Deficiencies

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
12	1	2010	2010	- 009 -	02	12	06	2011	FACILITY NAME	DOCKET NUMBER

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

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	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 12/01/2010, evaluation of a Nuclear Oversight audit of Engineering Programs identified cases in which Callaway Plant did not properly implement High Energy Line Break (HELB) defenses. These cases of improper HELB barrier and boundary control challenged equipment Operability. In some cases, components may not have been able to perform their HELB mitigation functions if the associated HELB event had occurred. These components include a Component Cooling Water heat exchanger bypass valve, a control room air conditioning unit, and level transmitters for the Reactor Vessel Level Indication System.

The failure to properly implement HELB defenses was determined to be a programmatic deficiency of the HELB Program at Callaway Plant. Technical guidance in the Hazard Barrier Program procedure and management oversight of the HELB program were both determined to be insufficient to prevent challenges to equipment Operability. Corrective actions include the development of appropriate compensatory measures, calculation of HELB hazard information and barrier capabilities, increased management oversight, and verification that HELB analysis of record reflects current plant configuration.

1. OVERVIEW OF HIGH ENERGY LINE BREAK DEFENSES AND RIS 2001-09

A high energy line break (HELB) is a postulated event that can introduce harsh environmental conditions (e.g., temperature, pressure, humidity, and flooding) to plant equipment and challenge the operability of equipment needed to mitigate the HELB. Defenses against HELB events include: 1) ensuring equipment located in rooms susceptible to a postulated HELB are qualified to operate in harsh conditions, 2) implementing barriers to shield unqualified equipment from the HELB hazard, and 3) removal of the hazard by isolation of the high-energy line (or reduction of the energy in the line).

Implementation of a HELB boundary by means of high energy line isolation can prevent areas downstream of the isolation point from being subject to the high-energy hazard upstream of the isolation point. In areas where isolation of high-energy lines can not occur, hazard barriers are credited with protecting plant equipment from the harsh conditions of a postulated HELB event. At Callaway Plant, the implementation of hazard barriers is performed under Hazard Barrier Program procedure APA-ZZ-00750.

Hazard barriers for HELB events are typically doors or hatches that can be opened, removed, or otherwise impaired. When hazard barriers are impaired in such a way that they would not be reasonably expected to protect against hazards as required, Regulatory Issue Summary (RIS) 2001-09 provides the following guidance (edited slightly, as shown, for the context of this LER):

> [Limitations may exist for] continued reactor operation with a hazard barrier removed. For example, an auxiliary feedwater (AFW) pump that is credited with mitigating a HELB event would be rendered inoperable if a barrier that is credited with protecting the AFW pump from the effects of the postulated HELB event is removed to allow maintenance to be performed in the AFW pump room. The pump would not be able to mitigate the HELB event with the barrier removed, and consistent with the guidance provided in [RIS 2005-20], the [Technical Specification (TS)] limiting condition for operation of the AFW pump would apply. It may be possible to take compensatory measures to maintain pump Operability and avoid entering the TS action statement for shutting down the reactor (e.g., installing a temporary barrier that provides equivalent protection). Also, if the hazard does not exist at the time (e.g., if the high energy line is isolated and depressurized), the pump would remain operable.

2. INITIAL PLANT CONDITIONS

The overall programmatic deficiencies described in this report were discovered when the plant was in Mode 1 at 100% power. Plant conditions specific to each resulting case are described in Section 3 of this LER.

3. EVENT DESCRIPTION

A Nuclear Oversight (NOS) audit of Engineering Programs identified deficiencies in the Callaway Plant HELB Barrier Program in late 2010. Upon NOS identification of these deficiencies, a standing order was issued that required an engineering evaluation to be performed prior to impairing any HELB barriers (in place of APA-ZZ-00750 guidance). No HELB barriers were impaired at the time the order was issued.

Beginning on December 1, 2010, subsequent evaluation of these issues began to reveal instances within the last three years in which the improper implementation of HELB defenses may have challenged equipment Operability. These instances appeared to involve inadequate control of HELB barrier impairments and/or inadequate analysis of the HELB hazards in Engineering evaluations.

An analysis of each of these cases was performed with a computer model using assumptions based on the analysis of record. Results of this analysis are summarized below for each case.

NARRATIVE

In the cases below involving HELB barrier impairments performed under Fire Protection Impairment Permits (FPIPs), the necessary compensatory measures (e.g., hourly or continuous fire watches) to maintain fire and pressure boundary functions were met. However, due to programmatic deficiencies in the HELB program, it is assumed for this analysis that compensatory measures were not sufficient to maintain HELB barrier function. (The causes and events that led to the overall programmatic deficiencies are discussed in Section 6 of this LER.)

Case 1: Main Steam Line Break in the Main Steam Tunnel Affecting the Auxiliary Building

Door DSK11273 provides a barrier between the main steam tunnel and the Auxiliary Building stairwell A-2. With DSK11273 open, its HELB barrier function is defeated, exposing the stairwell to the effects of a postulated Main Steam Line Break (MSLB) in the main steam tunnel.

The piping in the main steam tunnel is especially robust and designed not to exceed stress limits that would cause a pipe failure. However, a failure of this piping was assumed for the purposes of this analysis.

With door DSK11273 impaired, the elevated pressure following a postulated MSLB could have caused stairwell doors to three floors of the Auxiliary Building to fail. The resulting environment on these floors could adversely impact the 'A' Train level transmitters for the Reactor Vessel Level Indication System (RVLIS). Operability of these transmitters cannot be demonstrated for this postulated MSLB scenario with DSK11273 impaired.

RVLIS is included in the Post-Accident Monitoring (PAM) instrumentation required by Callaway Plant Technical Specification (TS) 3.3.3. Required Action A.1 of TS 3.3.3 directs restoration of the inoperable channel within 30 days.

This configuration existed four times in the three years preceding discovery of the event. In this period, the longest single impairment of DSK11273 lasted for 4 hours, 26 minutes. DSK11273 was impaired for a cumulative total of 9 hours, 10 minutes over this period, in Mode 1.

Case 2: Main Steam Line Break in the Turbine Building

Doors DSK13291, DSK14032, and DSK33044 are HELB boundary doors that separate the Turbine Building from the Auxiliary Building. At least one of these three doors was blocked open under a number of FPIPs since December 1, 2007. Impairing one of these doors allows a postulated MSLB in the Turbine Building to affect areas in the Auxiliary Building containing equipment not qualified to withstand a MSLB environment. Individual analysis for each door is as follows:

A) Impairment of door DSK13291 provided a flow path from a postulated MSLB in the Turbine Building to the AFW pump vestibule and associated pipe chase rooms. However, analysis has provided reasonable assurance that equipment in this area required to mitigate this postulated MSLB would have performed the required functions in this scenario.

B) Impairment of door DSK14032 provided a flow path from a postulated MSLB in the Turbine Building to the Motor-Generator (MG) Set room. However, this door was only impaired in Modes 5, 6, and No Mode. No MSLB is required to be postulated in these Modes.

C) Impairment of door DSK33044 provided a flow path from a postulated MSLB in the Turbine Building to the 2000' elevation of the Auxiliary Building. The resulting environment in this area could have adversely impacted the 'A' Train level transmitters for RVLIS, similar to the condition described in Case 1. Additionally, relays in control panel RP330 could also be adversely affected in this scenario. The affected

relays control the following equipment in the 'A' Train:

- Component Cooling Water (CCW) heat exchanger bypass valve
- Control Room Air Conditioning System (CRACS) air conditioning unit
- Class 1E electrical equipment air conditioning unit

With DSK33044 impaired, operability for these components cannot be demonstrated in this postulated MSLB scenario.

The Technical Specifications for RVLIS, CCW and CRACS are TS 3.3.3, TS 3.7.7 and TS 3.7.11, respectively. The most limiting Technical Specification associated with inoperability of the equipment supported by the Class 1E air conditioning unit is LCO 3.0.3 until compensatory actions are taken. The actions required by the Technical Specifications for these conditions are as follows:

- TS 3.3.3 Required Action A.1 directs restoration of the inoperable RVLIS channel within 30 days.
- TS 3.7.7 Required Action A.1 directs restoration of the inoperable CCW train within 72 hours.
- TS 3.7.11 Required Action A.1 directs restoration of the inoperable CRACS train within 30 days.
- LCO 3.0.3 directs Mode 3 entry within 7 hours.

Within the three years preceding discovery of the event, the longest single impairment of DSK33044 lasted for 4 hours, 50 minutes. DSK33044 was impaired eight times in Mode 1 for a cumulative total of 14 hours, 56 minutes in this period.

Case 3: Auxiliary Steam HELB Affecting the Essential Service Water Pipe Room

The initial disposition of this case was concerned with the exposure of equipment in the Essential Service Water (ESW) pipe chase room to a harsh environment following a postulated auxiliary steam line break in the Auxiliary Building 1974' elevation hallway via door DSK11011. Based on the results of a seismic analysis performed on the auxiliary steam lines in this hallway, however, an auxiliary steam line break is not required to be postulated in this location.

Case 4: Auxiliary Steam HELB in the Boric Acid Batching Tank Room

Boric acid batching tank auxiliary steam isolation valve FBV0147 serves as a HELB boundary for the associated auxiliary steam line. When FBV0147 is open, the auxiliary steam line downstream of the valve must be considered a high energy line. In this case, a harsh environment following an auxiliary steam line HELB affecting the Auxiliary Building 2026' level corridor must be postulated.

HELB analysis assumes FBV0147 is maintained closed. However, FBV0147 was maintained open for the majority of the previous three years. This configuration discrepancy had been previously identified at Callaway Plant, but the analysis performed at the time erroneously determined that the integrity of the barrier into the 2026' level corridor would be maintained in a HELB event. This barrier, boric acid batching tank room door DSK14071, is now expected to fail in this scenario. Thus, analysis of this scenario now considers a harsh environment to have existed in the adjoining corridor whenever FBV0147 was open, regardless of the status of DSK14071.

Analysis of this scenario provides reasonable assurance that equipment in the 2026' elevation corridor would have performed the functions required to mitigate this postulated HELB. However, during the period FBV0147 was maintained open, one or both of the doors to the 'A' Train electrical penetration room (room 1410) were opened to the 2026' elevation corridor on multiple occasions. When these doors and FBV0147 were open concurrently, the 'A' Train electrical penetration room could have been exposed to a harsh

environment following a postulated HELB in the boric acid batching tank room. In this scenario, operability of 'A' Train motor control center NG01B, located in room 1410, cannot be demonstrated following the postulated line break. The pathway configuration for this scenario existed eleven times in Mode 1 in the three years prior to discovery.

The Technical Specification associated with NG01B in Modes 1-4 is TS 3.8.9, *Distribution Systems – Operating*. Required Action A.1 of TS 3.8.9 directs restoration of the inoperable distribution subsystem within 8 hours and also within 16 hours from discovery of failure to meet the LCO. If the distribution subsystem is not restored within 8 hours, TS 3.8.9 Condition D is then entered. TS 3.8.9 Required Action D.1 requires Mode 3 entry within 6 hours. Thus, an impairment period greater than 14 hours represents a condition prohibited by TS 3.8.9 in this scenario.

Of the eleven instances in the preceding three years that this configuration existed, three exceeded the 14 hours allowed by TS 3.8.9. These three instances lasted for 29 hours, 23 minutes; 40 hours; and 70 hours, 28 minutes. The cumulative duration of the eleven instances was 199 hours, 24 minutes.

Case 5: Auxiliary Building Equipment Hatches and Stairwell Doors

In addition to the other cases described in this section, multiple configurations of Auxiliary Building equipment hatches and stairwell doors were known to have been impaired since December 2007. These hatches and doors are credited as HELB barriers in the analysis of record. Without adequate compensatory measures, the impairment of one or more of these hatches and doors could have allowed the harsh environment from a postulated Auxiliary Building HELB to spread to other levels in the Auxiliary Building containing equipment not qualified for the pressure, temperature and steam conditions associated with a HELB.

Analysis has shown, however, that the impairment of Auxiliary Building equipment hatches and stairwells would not have caused inoperability of equipment required to mitigate a postulated Auxiliary Building HELB beyond what is described in the other cases in this section.

4. ASSESSMENT OF SAFETY CONSEQUENCES

In order to have significant safety consequences following a postulated MSLB or HELB, structures, systems, or components required to mitigate the initiating accident or hazard would have to be rendered non-functional. This LER documents numerous scenarios which had the potential to affect both trains of multiple systems which would be required to function following a MSLB or HELB event. However, for all situations in which the functionality of one train of a required system could have been adversely impacted, it was shown that the opposite train was available and capable of performing the credited safety function in the resultant environmental conditions. Detailed equipment qualification analysis at the individual component level, inherently robust mechanical and electrical equipment, and/or the physical separation of redundant trains provided assurance that at no time were there any substantial safety consequences.

The credited safety functions necessary to achieve and maintain a safe shutdown, remove residual decay heat, control the release of radioactive material, and mitigate the consequences of the initiating accident or hazard were maintained at all times.

5. REPORTING REQUIREMENTS

Cases 1, 2, and 4 describe situations in which components may not have been able to perform their HELB mitigation function if the associated HELB event occurred. As such, this LER is submitted pursuant to 10 CFR 50.73(a)(2)(ii)(B) as an unanalyzed condition that significantly degraded plant safety because plant equipment that would have required to respond to a postulated HELB event may not have been able to respond to the

event as assumed. Cases 3 and 5 do not describe situations in which components may not be able to perform required HELB mitigation functions.

Case 4 describes three instances in which 'A' Train motor control center NG01B could have been adversely affected by a postulated HELB for a period greater than allowed by TS 3.8.9. Thus, this LER is also submitted pursuant to 10 CFR 50.73(a)(2)(i)(B) as a condition prohibited by Technical Specification 3.8.9, *Distribution Systems – Operating.*

The impairments described in Section 3 would not have prevented fulfillment of the associated safety function. One train of equipment remained available to perform the required HELB mitigation functions in each of the cases presented in Section 3.

6. CAUSE OF THE EVENT

Section 3 of this LER documents a series of cases in which Operability criteria for plant equipment required to mitigate a HELB were not met. These cases are symptomatic of a greater programmatic deficiency in which HELB calculations and guidance were not sufficient to prevent challenges to equipment operability.

Two root causes were determined for this deficiency. The first root cause is that the technical guidance in Hazard Barrier Program procedure APA-ZZ-00750 was insufficient to successfully implement the guidance of RIS 2001-09. Without sufficient guidance, HELB evaluations permitted barrier impairments that did not consistently maintain equipment operability. The second root cause is that management oversight of Engineering programs – specifically, the HELB Program – was not sufficient to prevent challenges to protected equipment. This root cause enabled insufficient technical guidance to persist and also allowed for the inappropriate evaluation of HELB boundaries and barriers. Taken together, these root causes allowed deficiencies to exist within the Callaway Plant HELB defenses.

7. CORRECTIVE ACTIONS

A number of corrective actions have been determined to address the root causes (listed above) and contributing causes of these programmatic deficiencies. These corrective actions include, but are not limited to, the following:

- The pressure capacities of the Auxiliary Building HELB doors and the pressure produced by each type of high energy hazard will be calculated and documented. This will identify the door capabilities and available margin so that proper impairment evaluations can be made in the future. This evaluation has been completed and is pending formal acceptance by Callaway Plant.
- Appropriate compensatory actions for HELB barriers continue to be developed. This will allow equipment Operability requirements to be met when HELB barriers are impaired.
- A list of hazard barriers that are not permitted to be opened in conjunction with other barriers is being developed. This will identify which HELB barriers would be required to provide hazard protection when another HELB barrier is impaired.
- The HELB Program has been designated as an official Engineering Program. This designation requires additional program ownership and oversight.
- A review and verification of the assumptions made in the calculation of record has been performed. This ensures that the analysis reflects current plant configuration.

As stated in Section 3 of this LER, a standing order was established to obtain an engineering evaluation prior to impairing HELB barriers. This order will be lifted once the appropriate corrective actions are implemented.

8. PREVIOUS SIMILAR EVENTS

In December 2009, Callaway Plant personnel identified that auxiliary steam isolation valve FBV0146 was maintained open, contrary to HELB analysis calculations. This event was initially reported to the NRC under Event Notification 45571 as an unanalyzed condition that significantly degrades plant safety. This notification was subsequently retracted when subsequent analysis concluded that the condition did not render safety-related components inoperable.

9. OTHER INFORMATION

The Energy Industry Identification System (EIIS) identifiers for the components and systems mentioned in this report are as follows:

System: SB, Main Steam System

System: CC, Component Cooling Water System
Component: HCV, Hand Control Valve

System: BA, Auxiliary Feedwater System

System: BI, Essential Service Water System

System: SA, Auxiliary Steam System
Component: ISV, Isolation Valve

System: ED, Low Voltage Power System, Class 1E
Component: MCC, Motor Control Center

System: AB, Reactor Coolant System
Component: LT, Level Transmitter

System: IP, Post Accident Monitoring System

System: CB, Chemical Volume and Control System
Component: TK, Tank

System: VI, Control Building Environmental Control System
Component: ACU, Air Conditioning Unit

System: JL, Panels
Components: PL, Panel; RLY, Relay