Ameren MISSOURI

Callaway Plant

December 21, 2017

ULNRC-06404

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

10 CFR 50.73(a)(2)(i)(B)

Ladies and Gentlemen:

**DOCKET NUMBER 50-483**
**CALLAWAY PLANT UNIT 1**
**UNION ELECTRIC CO.**
**RENEWED FACILITY OPERATING LICENSE NPF-30**
**LICENSEE EVENT REPORT 2017-003-00**
**VIOLATION OF TECHNICAL SPECIFICATION 3.6.3**
**CONTAINMENT ISOLATION CHECK VALVE FOUND IN OPEN POSITION**

The enclosed Licensee Event Report (LER) is submitted in accordance with 10 CFR 50.73(a)(2)(i)(B) to report a violation of Technical Specification 3.6.3, "Containment Isolation Valves," due to the inoperability of the inside containment isolation valve for containment penetration P-67.

This letter does not contain new commitments.

If you have any questions concerning this LER, please contact Tom Elwood, Supervising Engineer, Regulatory Affairs and Licensing at (314) 225-1905.

Sincerely,

Barry L. Cox
Senior Director, Nuclear Operations

Enclosure: LER 2017-003-00

cc: Mr. Scott A. Morris
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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 | 2. DOCKET NUMBER | 3. PAGE |
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| Callaway Plant Unit 1 | 05000483 | 1 OF 6 |

**4. TITLE**

Violation of Technical Specification 3.6.3, Containment Isolation Check Valve Found in Open Position

| 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 |
| 10 | 31 | 2017 | 2017 | 003 | 000 | 12 | 29 | 2017 | FACILITY NAME | DOCKET NUMBER |
| | | | | | | | | | | 05000 |

| 9. OPERATING MODE | 11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)* | | | |
|---|---|---|---|---|
| Defueled | ☐ 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) |
| **10. POWER LEVEL** | ☐ 20.2203(a)(2)(ii) | ☐ 50.36(c)(1)(ii)(A) | ☐ 50.73(a)(2)(v)(A) | ☐ 73.71(a)(4) |
| 0% | ☐ 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 |
|---|---|---|---|---|---|---|---|---|---|
| B | JM | ISV | Velan | Y | | | | | |

| 14. SUPPLEMENTAL REPORT EXPECTED | 15. EXPECTED SUBMISSION DATE | MONTH | DAY | YEAR |
|---|---|---|---|---|
| ☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO | | | | |

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

Between 4/21/2016 and 11/2/2017, containment isolation valve KCV0478 was inoperable due to an improperly functioning check valve internal assembly (i.e. hanger / disc). This check valve serves as the inside containment isolation valve (CIV) for penetration P-67. The containment isolation integrity function was maintained by KCHV0253, the outer CIV for penetration P-67, during the time KCV0478 was inoperable.

The valve was found in the fully open position on 10/31/2017 (during Refuel 22) after the penetration failed to pressurize for the Local Leak Rate Test (LLRT). The valve appears to have been stuck in the open position from a fire protection system flow test conducted on 4/21/2016 during Refuel 21. Technical Specification (TS) 3.6.3 requires each CIV to be OPERABLE in Modes 1 through 4. In this case, it was not known that the valve was in full open position when the plant entered Mode 4 on 5/5/2016. Therefore, a condition prohibited by TS 3.6.3 subsequently occurred due to failure to comply with the Required Actions specified in the TS for an inoperable CIV.

The root cause of the valve inoperability was dimensional interferences due to inadequate design clearances in the vendor supplied internal assembly (i.e. hanger / disc) on KCV0478. For corrective action, the check valve will be replaced with a new design utilizing corrosion resistant materials.

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NARRATIVE

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

The issue addressed in this LER concerns the failure of a normally closed check valve that serves as a containment isolation valve (CIV) [EIIS System: JM, Component: ISV]. The affected valve is situated in a fire protection line [EIIS System: KP] that penetrates containment at penetration P-67 and runs to hose racks / sprinkler inside containment. The containment isolation provisions for this line consist of CIVs inside and outside containment, consistent with the requirements of General Design Criterion (GDC) 56.

In general, the containment isolation valves form part of the containment pressure boundary and provide a means for fluid penetration flow paths not serving accident consequence limiting systems to be provided with two isolation barriers that are closed on a containment isolation signal. These isolation devices are either passive or active (automatic). Manual valves, de-activated automatic valves secured in their closed position (including check valves with flow through the valve secured), blind flanges, and closed systems are considered passive devices. Check valves, or other automatic valves designed to close without operator action following an accident, are considered active devices.

Two barriers in series are provided for each penetration flow path so that no single credible failure or malfunction of an active component can result in a loss of isolation or inleakage that exceeds limits assumed in the safety analyses. The Limiting Condition for Operation (LCO) of TS 3.6.3, "Containment Isolation Valves," applies to CIVs and was derived from the assumptions related to minimizing the loss of reactor coolant inventory and establishing the containment boundary during a design basis accident (DBA).

TS operability requirements for the CIVs support assumptions in the safety analysis of any event requiring isolation of containment. The DBAs that result in a release of radioactive material within containment are a loss of coolant accident (LOCA) and a rod ejection accident. In the analyses for each of these accidents, it is assumed that CIVs are either closed or function to close within the required isolation time following event initiation. This ensures that potential paths to the environment through CIVs (including containment shutdown purge and mini-purge valves) are minimized.

### KCV0478 AND ASSOCIATED PIPING GENERAL OVERVIEW

The Reactor Building Fire Protection (FP) water supply is provided by a single 4-inch line that passes through containment penetration P-67. The FP system inside the Reactor Building consists of stand pipes, hose racks and two sprinkler systems (one for each of the Reactor Building cable penetration areas on Elevation 2026').

The configuration of Penetration P-67 consists of a motor-operated, automatic isolation valve outside containment, KCHV0253, and a check valve inside containment, KCV0478, which complies with 10 CFR 50 Appendix A GDC-56, "Primary Containment Isolation," for lines that penetrate containment and connect directly to the containment atmosphere. The P-67 piping is ASME III Class 2, 150 PSI, carbon steel schedule 40 piping. The valves are ASME III Class 2, 150 PSI. Both the piping and valves are seismic Category 1.

Valve KCHV0253 is positioned closed during normal and shutdown plant modes, and is designed to fail in the "as is" position. It is normally operated remotely from a hand switch in the Control Room. The valve can also be manually operated at the valve. The valve is opened only during local leak rate tests (LLRTs), during quarterly stroke testing, and if the FP system is called upon to mitigate a fire inside containment. Valve KCHV0253 also closes automatically on a containment isolation signal to minimize the release of fission products following an accident.

The administrative containment leakage limit for penetration P-67 is 9,000 standard cubic centimeters per minute (sccm) for KCHV0253 and KCV0478. When KCHV0253 is opened for LLRTs or stroke testing, the upstream manual isolation valves are closed to maintain the Reactor Building FP piping in a dry condition.

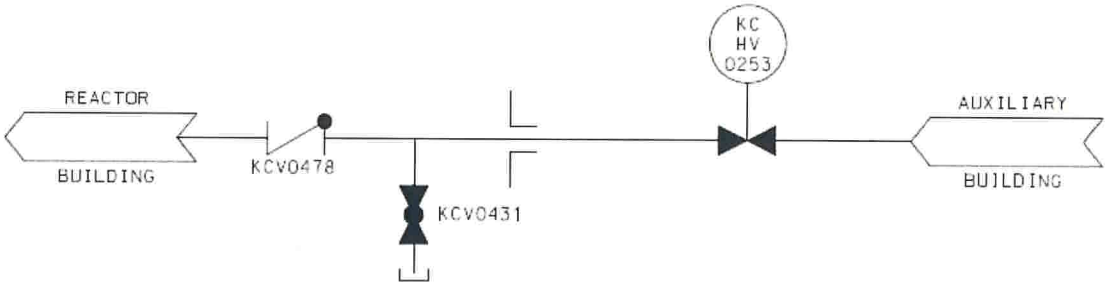


Figure 1 - Containment Penetration P-67 Diagram

**KCV0478 Valve Design:**

KCV0478 is an ASME III Class 2, safety related, swing style check valve. The valve was supplied by Velan Engineering Companies.

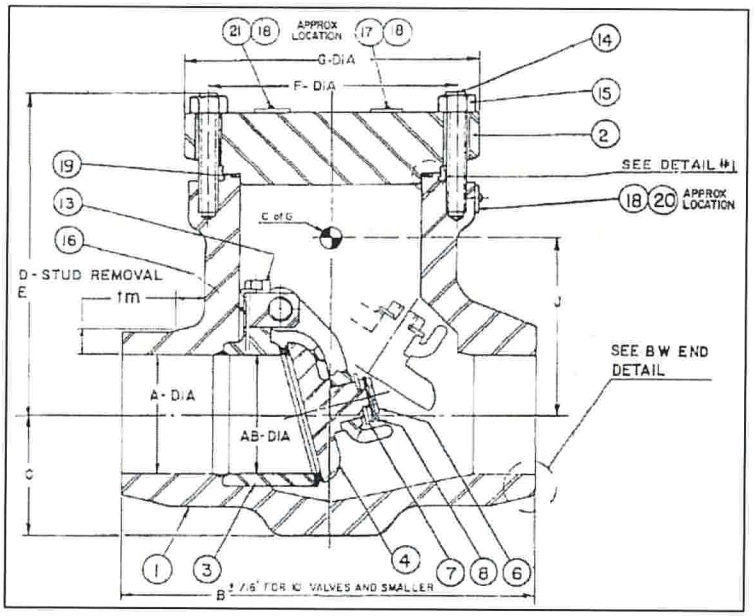


**Figure 2 - KCV0478 Design Drawing Side View (M-223C-00021)**

The major internal components of valve KCV0478 consist of a disc and hanger which are attached to the valve body. The valve is designed to open with fire water flow from the fire header to the associated containment building hose racks / sprinkler and to close or be closed in the event of increased containment pressure that may occur in an accident in containment. The valve body is carbon steel, and the hanger and disc assembly are stainless steel. The original valve disc was carbon steel. Due to susceptibility to corrosion and challenges with seat leakage during LLRT testing, the disc was replaced with a stainless steel disc in 1999 (Refuel 10).

Per discussion with the vendor representative during the root cause investigation for the identified valve failure, it was identified that the dimensions of the disc were too large for the application and had the potential to cause the valve to stick in the open position. In addition, operating experience was documented in which it was identified/inferred or suggested that the tolerances of the hanger assembly could result in the hanger assembly sticking in the open position.

## 2. INITIAL PLANT CONDITIONS:

When the LLRT was performed for KCV0478 on October 28, 2017, Callaway Plant was in its Refuel 22 outage. The reactor fuel had been removed from the reactor vessel and placed in the spent fuel pool in the fuel building where cooling was provided by the spent fuel pool cooling system. The plant had shut down for the refueling outage on 10/7/2017. The LLRT on KCV0478 was performed as part of the normally scheduled surveillance for containment isolation valves.

## 3. EVENT DESCRIPTION:

On October 28, 2017, during Refuel Outage 22, test pressure could not be obtained during the KCV0478 as-found LLRT for containment penetration P-67. Subsequently, on October 31, 2017, during internal inspection of KCV0478, the internal valve disc / hanger assembly was found to be stuck in the fully open position. Upon removal, the valve hanger / disc assembly was inspected for damage and any possible sign of cause. No issues were reported with the hanger / disc assembly, as it was verified to move freely with no discernable damage.

The internal surface of the valve body was cleaned to remove corrosion products. Upon reinstallation of the hanger / disc assembly into KCV0478, the valve internal assembly was stroked / actuated several times manually (with a hanger connected to the valve hanger). After verification of freedom of movement, and hanger / disc measurements, the valve was reassembled. All post maintenance testing (external leak test and LLRT) was completed successfully with satisfactory results.

Prior to finding KCV0478 stuck open on October 31, 2017, the last time KCV0478 was verified to be in the closed position was in RF21 during performance of a LLRT on April 18, 2016. Soon after this LLRT, records show that a flow test of the fire water header to containment was performed on April 22, 2016 via containment penetration P-67 and KCV0478. This test provided sufficient flow to take the valve to its fully open position. Based upon the identification of no other testing, operational line-ups or system transients associated with P-67 or KCV0478 that could have fully opened the valve, prior to Refuel Outage 22, it is likely that KCV0478 was fully open for the entirety of Cycle 22.

As a result of KCV0478 potentially being in the fully open position since the fire protection system flow test on April 22, 2016, it was identified that KCV0478 should have been declared inoperable (incapable of supporting its containment isolation safety function) and that the applicable Conditions and Required Actions under TS 3.6.3 should have been entered. Without knowledge of the condition of the valve, entry into the applicable Conditions and Required Actions under TS 3.6.3 was missed, resulting in a reportable condition.

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## 4. ASSESSMENT OF SAFETY CONSEQUENCES:

With KCV0478 in a fully open position, the containment isolation function is adversely impacted. As discussed previously, KCV0478 is one of three valves associated with P-67 (i.e., in addition to KCHV0253 and KCV0431). In this case, it was not known that KCV0478 was in fully open position when the plant entered Mode 4 on 5/5/2016. In addition to the mode change with an inoperable CIV, the TS Required Action to isolate the affected penetration flow path by use of at least one closed and de-activated automatic valve (within 1 hour), was not met (as explained further below). Therefore, the event is reportable under 10 CFR 50.73(a)(2)(i)(B), i.e., for an operation or condition prohibited by the plant's Technical Specifications. An LER is consequently required.

Despite the inoperability of KCV0478 for an extended period of time, the event is not considered to be a degraded or unanalyzed condition that significantly affected plant safety per 10 CFR 50.73(a)(2)(ii) since the containment isolation/integrity function was maintained by KCHV0253, the outer containment isolation valve for penetration P-67. The total containment "as-found" minimum pathway leak rate remained within the limits of TS 3.6.1 during the timeframe when KCV0478 was inoperable, and for this reason, the event/condition was of low safety significance.

## 5. REPORTING REQUIREMENTS:

This LER is submitted pursuant to 10 CFR 50.73(a)(2)(i)(B) to report a condition prohibited by Technical Specifications.

Specifically, with KCV0478 inoperable, Condition A of TS 3.6.3 would have been required to be entered. This Condition is applicable to penetration flow paths having two containment isolation valves (which is the case for P-67 and its associated penetration flow paths, particularly the KCV0478-KCHV0253 penetration flow path). Per Condition A, for one or more penetration flow paths with one containment isolation valve inoperable, Required Actions A.1 and A.2 must be entered. Required Action A.1 requires isolating the affected penetration flow path by use of at least one de-activated automatic valve, closed manual valve, blind flange, or check valve with flow secured through the valve, within a specified Completion Time of 4 hours. Required A.2 requires verifying that the affected penetration flow path is isolated within a specified Completion Time of 31 days (for isolation devices outside containment). With either (or both) of these Completion Times and Required Actions not met, Condition E applies and its Required Actions E.1 and E.3 become applicable. These Required Actions require the plant to be shut down such that per Required Action E.1, the plant must be in Mode 3 within 6 hours, and per Required Action E.2, the plant must be in Mode 5 within 36 hours.

Since KCV0478 was not known to be inoperable when the plant entered the Applicability of LCO 3.6.3 upon restart from Refuel 21 (assuming the condition existed at the time), the above-noted Conditions and Required Actions were not entered and thus not met. Compliance with Required Action A.1, in particular, would have required CIV KCHV0253 to be closed and deactivated within 4 hours. With Required Action A.1 not met within 4 hours, the plant would have been required to be in Mode 3 within the following 6 hours per Required Action E.1, and in Mode 5 within 36 hours.

It may also be noted that a violation of LCO 3.0.4.a occurred in connection with the plant entering the Applicability of LCO 3.6.3, with the assumed valve inoperability. With an LCO not met, LCO 3.0.4.a only permits entry into the Applicability of that LCO when the associated Actions to be entered permit continued operation in the applicable Mode for an unlimited period of time. This provision would only have been met if Required Actions A.1 and A.2 of LCO 3.6.3 had been met.

## 6. CAUSE OF THE EVENT:

The reported condition is the result of dimensional interferences due to inadequate design clearances in the vendor supplied internal assembly (i.e. hanger / disc) for KCV0478. The inadequate design clearances resulted in excessive (i.e. outside of approved design) contact of the KCV0478 internal assembly with the valve body.

## 7. CORRECTIVE ACTIONS:

The immediate corrective action was to clean the valve, disc, and hanger assembly and successfully re-perform the LLRT. The planned corrective action to prevent recurrence (CAPR) is to replace check valve KCV0478 with a new design utilizing corrosion resistant materials (e.g. stainless steel). Critical dimensions are to be requested and obtained from the vendor for the new valve and they will be incorporated into applicable work instructions to be used for verification of proper design clearances during initial inspection/installation and future maintenance on KCV0478.

The following actions are being taken to ensure the issue does not re-occur until the above CAPR is complete.

a) Revise FP full-flow preventive maintenance (PM) test to include a task to perform a post-test LLRT.

b) Generate new PM to clean check valve KCV0478 every outage.

c) Install or verify the stainless steel disc is still within the vendor provided dimensions in KCV0478 in RF23.

d) Inspect the KCV0478 hanger in the installed configuration to ensure no dimensional interference exists between the hanger stop and valve body. If contact is identified that could impact valve closure, adjust / modify hanger or valve body to ensure KCV0478 internal assembly on the hanger stop is not susceptible to binding and/or the valve will freely move in the open/closed direction as designed.

e) Administrative controls are in place to ensure the actions of TS 3.6.3 are taken for penetration P-67 if water is flowed through KCV0478. This will ensure the penetration is isolated and compliance with TS 3.6.3 actions are met.

## 8. PREVIOUS SIMILAR EVENTS:

Based upon a review of available internal OE, Callaway had an opportunity to address the condition identified with KCV0478 in Refuel 10 (1999) when the valve internal assembly stuck after replacing the disc assembly. Actions were taken that verified successful operation of the valve in the closed / open direction. However, the cause of the event was not fully understood, and as a result, the issue was not fully addressed, thus leading to recurrence of this issue.

LER 2010-007-00 documents a violation of TS 3.6.3 where the failure to adequately implement administrative controls for opening a normally closed containment isolation valve was identified. While the LER is associated with the same TS, the cause is completely unrelated and the corrective actions taken would not have prevented the KCV0478 event.