



UNITED STATES  
NUCLEAR REGULATORY COMMISSION

REGION IV  
612 EAST LAMAR BLVD, SUITE 400  
ARLINGTON, TEXAS 76011-4125

January 8, 2010

EA-09-200

Mr. Adam C. Heflin, Senior Vice  
President and Chief Nuclear Officer  
AmerenUE  
P.O. Box 620  
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Subject: CALLAWAY - FINAL SIGNIFICANCE DETERMINATION  
NRC INSPECTION REPORT 05000483/2009010

Dear Mr. Heflin:

The U.S. Nuclear Regulatory Commission's (NRC) Inspection Report 05000483/2009009 (ADAMS ML0927306560), dated September 30, 2009, described the results of a special inspection conducted to examine the circumstances surrounding the failure of the turbine-driven auxiliary feedwater pump to start on May 25, 2009. In this report, the NRC concluded that a failure to adequately lubricate the turbine-driven auxiliary feedwater pump trip throttle valve during Refueling Outage 16 resulted in the pump failure. The safety significance of this finding was assessed on the basis of the best available information, including influential assumptions, using the applicable Significance Determination Process and was preliminarily determined to be a White (i.e., low to moderate safety significance) finding. The report discussed an apparent violation of the plant's technical specifications that was being evaluated for further NRC action under the NRC's Significance Determination Process and the NRC Enforcement Policy. This letter provides the final significance determination of the preliminary White finding.

In the cover letter of NRC Inspection Report 05000483/2009009, the NRC informed AmerenUE of the NRC's preliminary conclusions. At the request of AmerenUE, a Regulatory Conference was held on November 9, 2009, at the NRC Region IV office in Arlington, Texas (ADAMS ML093210487). During the meeting, your staff described your assessment of the significance of the finding and the corrective actions taken to resolve it, including the root cause evaluation of the finding. You agreed with the violation and the NRC's description of the event; however, your staff presented a revised risk analysis. This analysis concluded that the finding was less safety significant than the NRC's preliminary significance determination. As supporting evidence, your staff presented information regarding the quantification of manual operator recovery of the turbine-driven auxiliary trip throttle valve during postulated design basis accidents. Specifically, your staff provided information relevant in the selection of the performance shaping factors for ergonomics and available time used for quantification of operator recovery. For ergonomics, your staff provided a detailed description of the event that occurred on May 25, 2009, including an account from an operations technician that indicated the turbine-driven auxiliary feedwater

pump trip throttle valve could be operated with near normal force. For available time, your staff provided an analysis of time to steam generator dryout that revealed an additional twenty minutes that could be available for operator recovery based on the reactor core conditions at the time of the pump failure and additional inventories available within the steam generators. Additionally, your staff provided an assessment of the timing required to perform certain recovery actions that suggested the timing data used in the NRC's original significance determination process may have been overly conservative.

After considering the information developed during the inspection and the information provided by AmerenUE at the Regulatory Conference, the NRC determined that the available time performance shaping factor was appropriately characterized in the original analysis, but that small changes were justified in the postulated timeline for recovery. The NRC reached this conclusion after careful consideration of the differences in the postulated timelines and consideration of actual timing data from NRC inspections. The NRC staff also concluded that the extra twenty minutes available until steam generator dryout was not valid for use in the Significance Determination Process since it was not based on average plant conditions. For the ergonomics performance shaping factor, the NRC staff concluded that this aspect of recovery is more appropriately characterized as "poor" as opposed to the original determination that the ergonomics were "misleading." This determination was made after consideration of statements made by the operations technician who operated the turbine-driven auxiliary feedwater pump trip throttle valve on May 25, 2009. The NRC determined that the ability to operate the valve with near normal force meant the subject performance deficiency would not be an impediment to recovery of the valve. Additionally, the NRC found that since the valve could be operated, the complexity performance shaping factor is more appropriately characterized as "nominal."

Given the above changes, the NRC concluded that the failure to adequately lubricate the turbine-driven auxiliary feedwater pump trip throttle valve during Refueling Outage 16 resulted in a change in core damage frequency of  $7.5E-7$  per year. The NRC therefore concluded that the finding is most appropriately characterized as having very low safety significance (Green).

Given that the preliminary White finding described in the September 30, 2009, report is more appropriately characterized as a finding of very low safety significance, the following enclosure closes the associated apparent violation documented in NRC Inspection Report 05000483/2009009 as a self-revealing Green violation. Because of the very low safety significance and because the finding has been entered into your corrective action program, the NRC is treating this finding as a noncited violation, consistent with Section VI.A.1 of the NRC Enforcement Policy. If you contest the significance of this noncited violation, you should provide a response within 30 days of the date of this letter, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555-0001, with copies to the Regional Administrator, U.S. Nuclear Regulatory Commission, Region IV, 612 E. Lamar Blvd, Suite 400, Arlington, Texas 76011-4125; the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001; and the NRC Resident Inspector at the Callaway Plant facility. In addition, if you disagree with the characterization this finding, you should provide a response within 30 days of the date of this letter, with the basis for your disagreement, to the Regional

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Administrator, Region IV, and the NRC Resident Inspector at the Callaway Plant. The information you provide will be considered in accordance with Inspection Manual Chapter 0305.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, and its enclosure, will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Please note that the NRC administratively opened Inspection Report 05000483/2009010 to track time spent reviewing the issues described in this letter. This letter will serve as the basis to close this report number.

Sincerely,

**/RA/**

Dwight D. Chamberlain, Director  
Division of Reactor Projects

Docket: 50-483  
License: NPF-30

Enclosure: Summary of Risk Assessment and Final Significance Determination  
w/Attachment: Supplemental Information

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ADAMS: <input type="checkbox"/> No <input checked="" type="checkbox"/> Yes		<input type="checkbox"/> SUNSI Review Complete	Reviewer Initials:	
		<input checked="" type="checkbox"/> Publicly Available	<input checked="" type="checkbox"/> Non-Sensitive	
		<input type="checkbox"/> Non-publicly Available	<input type="checkbox"/> Sensitive	
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JGroom	MChambers	DDumbacher	DLoveless	MHaire
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12/30/09	1/7/10	12/30/09	1/4/10	1/7/10
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GBMiller	RJCaniano	DDChamberlain		
<b>/RA/</b>	<b>/RA/</b>			
1/7/10	1/7/10			

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## SUMMARY OF RISK ASSESSMENT AND FINAL SIGNIFICANCE DETERMINATION

NRC Inspection Report 05000483/2009009, dated September 30, 2009, documented the results of a special inspection conducted to understand the facts and circumstances related to the failure to start of the Callaway turbine-driven auxiliary feedwater pump on May 25, 2009. The inspection found that AmerenUE failed to adequately lubricate the turbine-driven auxiliary feedwater pump trip throttle valve during Refueling Outage 16 which resulted in the pump's failure to start on May 25, 2009. The safety significance of this finding was assessed on the basis of the best available information, including influential assumptions, using the applicable Significance Determination Process and was preliminarily determined to be a White (i.e., low to moderate safety significance) finding.

Following the Regulatory Conference that was held on November 9, 2009, (ADAMS ML093210487) the NRC completed a Phase 3 significance determination evaluation and concluded that the finding was of very low safety significance. The NRC's final significance determination requantified the probability of operator recovery of the turbine-driven auxiliary feedwater pump taking into account information provided by the licensee at the Regulatory Conference. That information revealed that the likelihood of recovery was greater than originally evaluated due to the as found condition of the valve on May 25, 2009. This enclosure documents the NRC's final characterization of the apparent violation documented in NRC Inspection Report 05000483/2009009.

### A. NRC-Identified and Self-Revealing Findings

Cornerstone: Mitigating Systems

- Green. The team identified a self-revealing noncited violation of Technical Specification 3.7.5, "Auxiliary Feedwater System," involving the failure to adequately lubricate turbine-driven auxiliary feedwater pump trip throttle valve FCHV0312. During surveillance testing on May 25, 2009, the turbine-driven auxiliary feedwater pump did not start as expected due to hardened grease on the valve spindle of valve FCHV0312. The previous lubrication preventative maintenance activity had been missed, and lack of lubrication increased friction between the sliding nut and spindle preventing the valve from opening. Following lubrication, the turbine-driven auxiliary feedwater pump tested satisfactorily. The licensee entered this deficiency in their corrective action program as Callaway Action Request 200904216.

This finding is greater than minor because it was associated with the equipment performance attribute of the Mitigating Systems Cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Using Manual Chapter 0609.04, "Phase 1 – Initial Screening and Characterization of Findings," the issue screened as potentially risk significant since the finding represented a loss of system safety function of a single train for greater than the technical specification allowed outage time. The finding required a Phase 2 analysis. When evaluated per Manual Chapter 0609, Appendix A, "Determining the Significance of Reactor Inspection Findings for At-Power Situations," and the Callaway Plant Phase 2 pre-solved table item "Turbine Driven Auxiliary Feedwater Pump Fails to Start," the inspectors determined this

finding to be potentially risk significant. The finding was forwarded to a senior reactor analyst for review. The final outcome of the Phase 3 Significance Determination Evaluation determined the finding was of very low safety significance (Green).

The inspectors determined that this finding had a crosscutting aspect in the area of human performance associated with the work practices component because the licensee failed to follow the procedural guidance provided when changing the scope of a preventive maintenance task [H.4(b)](Section 1R2).

**B. Licensee-Identified Violations**

None

## REPORT DETAILS

### 1. REACTOR SAFETY

Cornerstone: Mitigating Systems

#### a. Inspection Scope

The special inspection team evaluated the events leading to and the licensee response to the failure to start of the Callaway turbine-driven auxiliary feedwater pump. The results of the team's inspection are documented in NRC Inspection Report 05000483/2009009 (ADAMS ML0927306560). On November 9, 2009, a Regulatory Conference was held between the NRC and AmerenUE staff. At the Regulatory Conference, the NRC was provided additional information that the licensee believed would impact the selection of performance shaping factors used to assess the probability of operator recovery of the failed valve.

Following receipt of this information, the NRC independently verified the licensee's assumptions were technically accurate and represented actual plant conditions. As part of their review, the inspectors reviewed procedures, corrective action documents, and design and maintenance records for the equipment of concern. The team interviewed key station personnel regarding the events that transpired on May 25, 2009, and compared those accounts to station logs and computer records. The team walked down and inspected the equipment in the field including a timing verification and a walkdown of the room during simulated blackout conditions. A list of specific documents reviewed is provided as an attachment to this enclosure.

#### b. Findings

Introduction. The team identified a self-revealing noncited violation of Technical Specification 3.7.5, "Auxiliary Feedwater System," involving the failure to adequately lubricate turbine-driven auxiliary feedwater pump trip throttle valve FCHV0312.

Description. On May 25, 2009, Callaway Plant operators performed surveillance testing Procedure OSP-SA-0007A, "Train A AFAS Slave Relay Test," to test the slave relays used to start the turbine-driven auxiliary feedwater pump. During the performance of Step 6.2.8 of Procedure OSP-SA-0007A, the turbine-driven auxiliary feedwater pump did not start as expected. During troubleshooting, the licensee discovered that the turbine-driven auxiliary feedwater pump trip throttle valve FCHV0312 had traveled in the closed direction in an attempt to latch the valve operator but had stopped prior to completing its stroke. Electrical continuity checks revealed that the motor-operated valve closed torque switch had opened. Callaway operators declutched and manually operated the trip throttle valve actuator. An audible squeak was observed during manual operation indicating mechanical binding within the sliding nut and valve spindle. Following troubleshooting, the licensee performed Job 09003598 to lubricate the trip throttle valve. Once the valve was adequately lubricated, the licensee successfully performed postmaintenance testing.

Callaway replaces the trip throttle valve every third refueling outage with a refurbished valve that was previously removed from the system. The turbine-driven auxiliary

feedwater pump trip throttle valve that failed to open on May 25, 2009, was replaced during Refueling Outage 16 in October 2008. The valve was replaced with a similar valve that was removed from service during Refueling Outage 13 in April 2004 and refurbished in September 2007. The replacement procedure did not have specific lubrication instructions. Lubrication of the valve was scheduled to be performed a few days after replacement as Job 07506359. The maintenance supervisor assigned to coordinate the lubrication incorrectly assumed that the valve was adequately lubricated since it had been recently replaced. Callaway Procedure APA-ZZ-00320, "Work Execution," Section 4.12, allows for a job to be canceled if it is determined that the work is not necessary or has been completed by another job. The maintenance supervisor initiated a job routing request to engineering inquiring if additional inspection was required on valve FCHV0312 since the valve had recently been replaced. Although not specifically referenced, the portion of the job requested to be closed was Section 6.3, "Trip Throttle Valve Lubrication and Inspection."

Callaway engineering replied to the job routing request that the valve had been diagnostically tested satisfactorily and that no additional inspection was needed. The engineer's response only answered the specific question asked by the job routing request and did not examine the procedural requirements that were the subject of the request. The engineer did not consult with the technician requesting closure and did not verify that the lubrication job task being closed was completed by the installation procedure. Based on the input received from engineering, the mechanical maintenance supervisor closed the lubrication portion of Procedure MPM-FC-QK001, "Auxiliary Feedwater Pump Turbine Annual Inspection." The mechanical maintenance supervisor failed to verify that the entire work scope of the superseded work document was included in the superseding work document which did not meet the requirements of licensee Procedure APA-ZZ-00320. Since the valve was not lubricated when installed during Refueling Outage 16, the last lubrication of the valve occurred during the refurbishment of the valve in September 2007. The lack of lubrication on valve FCHV0312 resulted in increasing friction between the sliding nut and spindle which caused the valve to fail on demand on May 25, 2009.

The licensee initiated Significant Condition Adverse to Quality Callaway Action Request 200904216 to investigate the failure of the turbine-driven auxiliary feedwater pump to start due to an inadequately lubricated trip throttle valve. The licensee's root cause analysis determined that the failure to lubricate valve FCHV0312 was due to the failure to fully review the closure of the lubrication portion of Procedure MPM-FC-QK001 during Refueling Outage 16. The licensee also concluded that though the actual timing of when the valve would have failed after the last successful surveillance test was unknown, it was reasonable to conclude that the turbine-driven auxiliary feedwater pump was inoperable for a time frame greater than the 72-hour technical specification allowed completion time.

Long term corrective actions were implemented to revise the replacement preventive maintenance procedure to include a lubrication section and a change to the lubricants used for the trip throttle valve. The licensee also identified several corrective actions to address contributing causes including changes to lubrication procedures and corrective actions to address programmatic issues in work control.

Analysis. The performance deficiency associated with this finding involved the licensee's failure to ensure valve FCHV0312 was adequately lubricated such that it remained operable. Specifically, Section 6.3 "Trip Throttle Valve Lubrication and Inspection," of Procedure MPM-FC-QK001, "Auxiliary Feedwater Pump Turbine Annual Inspection," was closed without adequate review. The lack of lubrication resulted in increased friction within the valve which caused the valve not to open on May 25, 2009. This finding is greater than minor because it was associated with the equipment performance attribute of the Mitigating Systems Cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Using Manual Chapter 0609.04, "Phase 1 – Initial Screening and Characterization of Findings," the issue screened as potentially risk significant since the finding represented a loss of system safety function of a single train for greater than the technical specification allowed outage time. The finding required a Phase 2 analysis. When evaluated per Manual Chapter 0609, Appendix A, "Determining the Significance of Reactor Inspection Findings for At-Power Situations," and the Callaway Plant Phase 2 pre-solved table item "Turbine Driven Auxiliary Feedwater Pump Fails to Start," the inspectors determined this finding to be potentially risk significant. The finding was forwarded to a senior reactor analyst for review.

The senior reactor analyst's preliminary analysis as documented in Attachment 4 of NRC Inspection Report 05000483/2009009 determined that this finding appeared to have low to moderate safety significance. The following documents the changes to that preliminary determination and should not be considered a stand alone evaluation.

During the regulatory conference, conducted on November 9, 2009, the licensee provided arguments indicating that the manual operation of valve FCHV0312 on May 25, 2009, was "near normal," and that valve conditions would not have greatly impacted the manual operation of the valve. Therefore, the analyst determined that the SPAR-H human reliability analysis method was the best approach to quantifying the probability that operators would fail to manually realign the valve.

Given the "near normal" operation of valve FCHV0312, the analyst determined that the best characterization of the ergonomics performance shaping factor for diagnosis was "poor," and that the best characterization for the complexity of the action was "nominal." These changes in the performance shaping factors led to a final nonrecovery value of 5.8 percent.

Applying a 5.8 percent nonrecovery probability to the Method 1 analysis provided in Attachment 4, the analyst calculated an incremental conditional core damage probability of 7.50E-7. Therefore, the subject performance deficiency represented a finding of very low safety significance (Green).

The inspectors determined that this finding had a crosscutting aspect in the area of human performance associated with the work practices component because the licensee failed to follow the procedural guidance provided when changing the scope of a preventive maintenance task [H.4(b)].

Enforcement. Technical Specification 3.7.5, "Auxiliary Feedwater System," requires, in part, that three trains of auxiliary feedwater shall be operable in Modes 1, 2 or 3. The

technical specifications required that if one train of auxiliary feedwater is inoperable for greater than 72 hours, actions be taken to be in Mode 3 within 6 hours and Mode 4 within 12 hours. Contrary to the required action statements, on May 25, 2009, the turbine-driven auxiliary feedwater pump train was found to be inoperable due to a lack of lubrication of trip throttle valve FCHV0312. Subsequent review determined that the lack of lubrication resulted in the turbine-driven auxiliary feedwater pump being inoperable for greater than 72 hours and action was not taken to be in Mode 3 within 6 hours and Mode 4 within 12 hours. Because of the very low safety significance of this finding and because the licensee has entered this issue into their corrective action program as Callaway Action Request 200904216, this violation is being treated as a noncited violation in accordance with Section VI.A.1 of the Enforcement Policy: NCV 05000483/2009009-01, "Turbine-Driven Auxiliary Feedwater Pump Inoperable Due to Inadequately Lubricated Trip Throttle Valve."

This noncited violation closes Apparent Violation 05000483/2009009-01.

#### 4OA6 Meetings, Including Exit

On December 10, 2009, Mr. G. Miller, Chief, Reactor Project Branch B, presented the final significance determination results to Mr. F. Diya, Vice President, Nuclear Operations, who acknowledged the finding. The NRC verified that no proprietary information was retained.

## SUPPLEMENTAL INFORMATION

### KEY POINTS OF CONTACT

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### LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

#### Opened and Closed

050000483/2009009-01    NCV    Turbine-Driven Auxiliary Feedwater Pump Inoperable Due to Inadequately Lubricated Trip Throttle Valve

#### Closed

050000483/2009009-01    AV    Turbine-Driven Auxiliary Feedwater Pump Inoperable Due to Inadequately Lubricated Trip Throttle Valve

### DOCUMENTS REVIEWED

#### CALLAWAY ACTION REQUESTS

200904216                      200906825

#### CALCULATIONS

<u>NUMBER</u>	<u>TITLE</u>	<u>REVISION</u>
EC-33	Fuel Cycle 17 Decay Heat Load Calculation	1

FC-20	Manual Operation of FCHV0312	0
ZZ-539	Time Until Steam Generator Dry Out After Reactor Trip Assuming a Complete Loss of Feedwater	0

DRAWINGS

<u>NUMBER</u>	<u>TITLE</u>	<u>REVISION</u>
M-22AL01(Q)	Piping and Instrumentation Diagram Auxiliary Feedwater System	33

PROCEDURES

<u>NUMBER</u>	<u>TITLE</u>	<u>REVISION</u>
APA-ZZ-00100	Written Instructions Use and Adherence	21
APA-ZZ-00395	Significant Operator Response Timing	11
EC Supp Guide	Emergency Coordinator Supplemental Guideline	7
ECA-0.0	Loss of All AC Power	10
ETP-FC-00001	Calibration of Terry Turbine Governor Valve Actuator	4
MPM-FC-QK001	Auxiliary Feedwater Pump Turbine Annual Inspection	14
MPM-FC-QK002	Auxiliary Feedwater Pump Turbine Five-Year Internal Inspection	19
ODP-ZZ-00025	EOP/OTO User's Guide	13
ODP-ZZ-0016E	Operations Technicians Watchstation Practices and Rounds	21
OOA-SA-C066Z	Engineered Safety Feature Status Panel SA066Z Alarm Information	1
OSP-SA-0007A	Train A AFAS Slave Relay Test	21
OSP-AL-P0002	Turbine Driven Auxiliary Feedwater Pump Inservice Test – Group B	60
OSP-FC-V0001	Auxiliary Feedwater Pump Turbine Valve Inservice Test	27
OTN-AL-00001 Appendix A	Turbine Driven Auxiliary Feedwater Pump Trip/Throttle Valve Trip Check and Reset	1

JOBS

W219154	05515178	06523136	07506359
08510069	09003598	09006057	09502426

MISCELLANEOUS

Callaway Nuclear Plant Operations Qualifications Card and Standard for Equipment Operator and Secondary Watchstation

Cycle 06-2 Training, Terry Turbine Trip/Throttle and Governor Valves

Non-licensed Operator Continuing Training 07-3, Auxiliary Feedwater

PRAER 09-333, ROP Significance Determination of TDAFP Fail to Start, Revision 0

T61.01110.6/T61.016.6, Auxiliary Feedwater System