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OPPD
Omaha Public Power District
1946 - 2006
Fort Calhoun Station
P.O. Box 550
Fort Calhoun, NE 68023

December 11, 2006
LIC-06-0129

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, DC 20555

Reference: Docket No. 50-285

Subject: Licensee Event Report 2006-005 Revision 0 for the Fort Calhoun Station

Please find attached Licensee Event Report 2006-005, Revision 0, dated December 11, 2006. This report is being submitted pursuant to 10 CFR 50.73(a)(2)(i)(B), 50.73(a)(2)(ii)(B) and 50.73(a)(2)(v)(D). If you should have any questions, please contact me.

Sincerely,

J. A. Reinhart
Site Director – Fort Calhoun Station

JAR/EPM/epm

Attachment

c:
INPO Records Center

IE22

NRC FORM 366 (6-2004)

U.S. NUCLEAR REGULATORY COMM

LICENSEE EVENT REPORT (LER)

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

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Fort Calhoun Station	05000285	1 OF 6

4. TITLE
Faulty Maintenance Renders One Train of Containment Spray System Inoperable

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
10	10	2006	2006	005	00	12	11	2006		05000
									FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE: 5

10. POWER LEVEL: 0

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)
Erick Matzke, Compliance Engineer	402-533-6855

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
A	BE	ISV	Fisher	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)*

At 1500 CDT, on October 10, 2006, while performing maintenance on one of two installed containment spray header valves (HCV-345), personnel determined that the HCV-345 valve disk had been installed incorrectly during the previous refueling outage. HCV-345 is a vee-ball valve. Actual valve position was found to be nearly the opposite of the remote indication. The resulting effect would be that an accident signal to open HCV-345 would have the valve 20 percent open instead of 100 percent open (or 80 percent open instead of closed during normal operations). A single failure of the other containment spray header valve would have resulted in substantially reduced containment spray flow.

The maintenance procedure allowed for the flexibility of performing selected portions of the procedure without providing adequate annotations to identify risk-important steps that could impact final valve alignment. A test to verify flow and isolation capabilities after the valve was installed in the system is impractical to perform. The procedure used to conduct the maintenance was relied upon to ensure proper valve operation without detailed acceptance criteria or verifications. This resulted in the post maintenance test process failing to identify the problem.

The valve was repaired and verified to be in its correct operating position. Maintenance procedures are being rewritten to preclude this from occurring again.

NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

BACKGROUND

The function of the containment spray system is to limit containment pressure rise and reduce leakage of airborne radioactivity from containment by providing a means for cooling the containment following a loss-of-coolant accident (LOCA). This system reduces the leakage of airborne radioactivity by effectively removing radioactive particulates from the containment atmosphere. Removal of radioactive particulates is accomplished by spraying water into the containment atmosphere. The particulates become attached to the water droplets which fall to the floor and are washed into the containment sump. Either containment spray train is capable of fulfilling the system design function.

Pressure reduction is accomplished by spraying cool, borated water into the containment atmosphere which provides a means for cooling the containment atmosphere. Heat removal is accomplished by recirculating and cooling the water through the shutdown heat exchangers. The system is independent of and redundant to the containment air cooling and filtering system. Either system can prevent exceeding containment design pressure (60 psig) during a design basis accident. The containment spray system is a two header system. Each containment spray header is normally isolated by a header isolation valve, HCV-344 or HCV-345. Either containment spray header is fully capable of mitigating the consequences of the analyzed design basis accidents (DBAs).

EVENT DESCRIPTION

At 1500 CDT, on October 10, 2006, while performing maintenance on one of two installed containment spray header valves (HCV-345), personnel determined that the HCV-345 valve disk had been installed incorrectly during the previous refueling outage. HCV-345 is a vee-ball valve. Actual valve position was found to be nearly the opposite of the remote indication. The resulting effect would be that an accident signal to open HCV-345 would have the valve 20 percent open instead of 100 percent open (or 80 percent open instead of closed during normal operations). A single failure of the other containment spray header valve would have resulted in substantially reduced containment spray flow.

At 2257 CDT on October 10, 2006, an eight (8) hour notification was made to the NRC Headquarters Operation Office (HOO) per 10 CFR 50.72 (b)(3)(ii)(B). This report is being made per 10 CFR 50.73(a)(2)(i)(B), 50.73(a)(2)(ii)(B) and 50.73(a)(2)(v)(D).

CONCLUSION

The containment spray header isolation valve is a Fisher type 657-8-U-1009 diaphragm actuated valve. The vee-ball is a slice off the surface of a sphere covering an arc of 101 degrees. Along the ball axis of rotation is a drive shaft that extends through the valve packing. On the end of the drive shaft is a lever. Perpendicular to the drive shaft is a rod that connects the valve operator to the same lever. This lever converts the linear motion of the valve operator into a rotation of the drive shaft. The drive shaft has 16 splines on each end. Proper operation of the valve depends on two critical orientations; the orientation of the vee-ball to drive shaft, and the orientation of drive shaft to the lever. To assist the assembly process, the manufacturer provided an index mark on each end of the drive shaft, an index mark inside the ball, and four index marks on the lever. The four index marks on the lever support installation of the operator in four different positions.

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NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* (17)

Sometime prior to the 2005 outage, extra index marks were made at the lever end of the drive shaft. There are a series of indentations in a line across the diameter of the drive shaft. Analysis of the indentations concluded they show the relative position of the ball. When the indentations are parallel to the pipe, the valve is open. When the indentations are perpendicular to the pipe, the valve is closed.

On three separate occasions during the 2005 outage, HCV-345 was removed from the system, disassembled, reassembled, and returned to the system. The activities performed during and following the maintenance did not identify the valve internals had been reassembled incorrectly. Due to the incorrect assembly, when the valve actuator and remote position indication indicated CLOSED, the valve was 80 percent open. When the actuator and remote position indication indicated OPEN, the valve was approximately 80 percent closed. The valve is known to have been operating correctly prior to the 2005 outage. In November 1990, an air pressure test of HCV-345 demonstrated that actual valve position matched indicated position. A review of maintenance records concluded HCV-345 was not removed from the system between 1990 and 2005.

A root cause analysis was performed to determine the reason HCV-345 was incorrectly assembled and to determine why post maintenance testing failed to identify the incorrect assembly, which ultimately resulted in the inoperability of the corresponding containment spray header during cycle 23.

In the 2005 outage, the valve was disassembled three times in the process of repair. There are indications that on the first two reassemblies, the valve ball was installed correctly. On the third reassembly, the valve was removed from the system to inspect the split rings and split ring retainer. To access the split ring retainer, the packing box was removed as a unit to avoid disturbing the new packing that was installed. The information recorded in the work package does not completely explain the orientation between the drive shaft and ball.

The packing box and drive shaft were reinstalled as a single unit. The steps between removing and installing the packing box were marked as not applicable. One of these steps directs the installation of the drive shaft as an individual component. The step reads, "Before inserting shaft into ball, align match marks to same orientation noted in Step 7.19.2." The step for drive shaft installation was marked as not applicable. This is considered a contributing cause for the incorrect assembly.

When this work was performed in 2005, it was the first time this valve had been disassembled. The craft does not receive specific training on this unique valve. Lack of specific training or knowledge means the craft must depend on performing the activity primarily in a rule based mode. This requires the procedure to be very well written to ensure success. The last of the three disassemblies had a specific goal to inspect the split ring retainer. It was recognized the packing did not need to be removed. The work was simplified by removing the packing box and drive shaft as a unit. The procedure allowed portions of the disassembly and reassembly process to be performed to support the scope of the work. The packing box drive shaft unit was removed, the problem was identified and corrected, and then the packing box unit was reinstalled. The steps between removing and reinstalling were marked as not applicable including the step to verify proper drive shaft to ball alignment. The maintenance procedure allowed for the flexibility of performing selected portions of the procedure without providing adequate annotations to identify risk-important steps that could impact final valve alignment. This is considered the root cause for the incorrect assembly.

NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

Post maintenance testing is specified by the work task document. The actions directed by the maintenance procedure to verify the component would perform its specified functions included:

- Before the valve is installed in the system, there are steps to verify the valve is open or closed as required.
- A calibration of the valve actuator.
- A category A and B valve exercise test.
- A remote position indication verification test.

These activities are adequate to demonstrate the component would be capable of performing its specified functions. Immediately before the valve was returned to the system, two significant steps were performed. First, after the valve operator was attached, the valve should have been in its fail position and the procedure directed the worker to, "Verify valve is open." Second, temporary air was then connected to the actuator. With 30 psig applied to the operator the valve should have been in its closed position. The procedure states, "Valve should be fully closed {at} 30 psig." With the incorrect alignment between the drive shaft and the ball, the actual valve position did not match the desired position in either of these two steps. Performance of these steps failed to identify the error. This is considered a contributing cause for the incorrect assembly and the post maintenance test process failing to identify the incorrect assembly.

HCV-345 is exempt from 10 CFR 50 Appendix J testing because the system is open to containment atmosphere post accident. Therefore the station has not developed a seat leakage test procedure specific for this valve. Performing a flow test through the containment spray valve is not a viable option as the containment would be sprayed with borated water. As a result, the station takes credit for steps performed during maintenance to verify proper operation of the valve. These steps to verify proper operation of the valve are risk important. Following the final maintenance during the 2005 refueling outage, no test was conducted after the valve was installed in the system to verify flow and isolation capabilities. Reliance on the procedure used to conduct the maintenance without detailed acceptance criteria or verifications to ensure proper valve operation resulted in a failure of the post maintenance testing process to identify the error in assembly of the valve. This is considered the root cause of the post maintenance test process failing to identify the incorrect assembly.

The maintenance and post maintenance test performed on HCV-345 was reviewed for applicability to other valves. The misalignment of the splined shaft in HCV-345 could exist in HCV-344 (the other containment spray header isolation) and HCV-341 (a shutdown cooling (SDC) valve). Maintenance on all three valves is performed using the same procedure. The containment spray header isolation valves, HCV-344 and HCV-345, have been verified to be correctly installed. A review of maintenance history concluded the third valve, HCV-341, in the SDC system has never been removed from the system. SDC flow passes through HCV-341. The flow through the SDC system is consistent with system design. As a result of this review it was concluded the issue is limited to the assembly and testing of HCV-341, HCV-344, and HCV-345 and that the valves are now operating correctly.

SAFETY SIGNIFICANCE

Containment spray is only one of two systems that are used to keep the containment cool. The containment cooling and filtering system is also capable of maintaining containment temperature. The containment air cooling and filtering system is redundant to the containment spray system in several of its functions. The containment air cooling and filtering system is comprised of two containment air cooling units (VA-7C and VA-7D) and two containment air cooling and filtering units (VA-3A and VA-3B). The cooling coils for these units are cooled by the component cooling water (CCW) system during normal and accident conditions.

In addition, containment spray is credited with mitigation of the effects of radiological release during a DBA loss of cooling accident (LOCA). The containment cooling and filtering units include high efficiency particulate air filters. Although these units are not credited in the current analysis, they are part of the safety related equipment that is licensed in technical specifications and will perform as designed during DBAs. The filters will limit the radiological consequences of a DBA LOCA to maintain the station within the 10 CFR 50.67 (accident source term) limits. This event has very little potential impact to the public.

SDC is initiated in accordance with the emergency operating procedures for most events that cause emergency safeguards actuation. HCV-344 and HCV-345 provide the isolation boundary between the SDC system and the containment spray system for the cases in which recirculation actuation signal has not occurred – small break LOCAs for example. When SDC entry conditions are reached the plant is relatively stable, and transition to SDC is not necessary for continued core cooling. Establishment of SDC with HCV-345 partially open (indicating closed) would have caused a diversion of coolant from the reactor coolant system to the containment spray system. Numerous indications would have been available to alert the operators, and it is probable that they would have terminated SDC initiation without a loss of core cooling.

CORRECTIVE ACTIONS

HCV-345 was repaired and verified to be in its correct operating configuration. HCV-344 was verified to be in its correct operating configuration. The shutdown cooling system, in which HCV-341 is installed, was also verified to be operating correctly.

Fort Calhoun Station (FCS) will revise the appropriate procedure to address four elements; 1) Refer to the manufacturer's index marks and remove direction to add additional match marks during disassembly. 2) Provide specific acceptance criteria for verifying the valve open or closed as part of final reassembly and annotate these steps as post maintenance test steps. 3) Change the format of the procedure to allow partial performance of the procedure. 4) Annotate any risk-important steps including a second verifier for those steps. These changes will be completed by February 28, 2007

FCS will identify all safety related air operated ball and butterfly valves that are not containment isolation valves. FCS will determine if any risk-important steps require annotation and second verification; and/or ensure that adequate post maintenance testing exists with appropriate acceptance criteria. (Non-safety related equipment reviews are not required because the rework process and maintenance rule will adequately address this population of equipment). Following this, FCS will revise identified procedures. These changes will be completed by February 28, 2007

NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

SAFETY SYSTEM FUNCTIONAL FAILURE

This event does result in a safety system functional failure in accordance with Nuclear Energy Institute (NEI) 99-02, "Regulatory Assessment Performance Indicator Guideline".

PREVIOUS SIMILAR EVENTS

There have not been any other instances of incorrect maintenance on ball valves causing the inoperability of safety systems.