

ENCLOSURE

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket No: 50-285
License No: DPR-40
Report No: 50-285/97-17
Licensee: Omaha Public Power District
Facility: Fort Calhoun Station
Location: Fort Calhoun Station FC-2-4 Adm.
P.O. Box 399, Hwy. 75 - North of Fort Calhoun
Fort Calhoun, Nebraska
Dates: August 25-29, 1997
Inspectors: Harry A. Freeman, Resident Inspector, Comanche Peak Steam
Electric Station
Vincent G. Gaddy, Resident Inspector, Fort Calhoun Station
Approved By: William D. Johnson, Chief, Projects Branch B
Division of Reactor Projects

ATTACHMENTS:

Attachment 1: Supplemental Information
Attachment 2: Sequence of Events
Attachment 3: Corrective Actions

EXECUTIVE SUMMARY

Fort Calhoun Station
NRC Inspection Report 50-285/97-17

Operations

- During the initial setup portion of a surveillance test, the test lead placed the control switches for the containment spray header isolation valves in the OVERRIDE position contrary to the surveillance test procedure (Section O1.1).
- With all three containment spray pumps inoperable, Technical Specification 2.4 was not satisfied, and the unit was not placed in hot shutdown or in a subcritical condition with temperature $< 300^{\circ}\text{F}$ within the required time intervals of Technical Specification 2.0.1 (Section O1.1).
- The operating crew had numerous opportunities to identify that the containment spray system was inoperable (Section O1.2).
- Failure to document the changes in the operational status of safety equipment in the official control room logs, as required, was indicative of a lack of attention-to-detail in the conduct of control room operations (Section O1.3).
- Surveillance procedure weaknesses included: multiple actions required by one step; equipment nomenclature which differed from component labels; and failure to address expected annunciators (Section O3.1).
- The annunciator response procedure was weak in that it did not require operators to announce which annunciators were in alarm or to explain why they were in alarm when annunciators were expected during a test (Section O3.2).
- Each of the control room operators involved with the event failed to demonstrate a questioning attitude concerning the lit annunciators. Crew supervision failed to provide adequate oversight during the performance of the surveillance test (Section O4.1).
- The shift turnover was inadequate. Operators did not question the cause of the spray valve off normal alarms and they did not verify the status of the containment spray system (Section O4.2).
- Having the containment spray system inoperable for 12.5 hours on August 21, 1997, resulted in a negligible increase in core damage frequency. The containment design basis pressure limit for loss of coolant or main steamline break accidents would not have been exceeded assuming actual conditions (Section O8.1).
- Several of the deficiencies identified in this containment spray system disabling event are similar to the identified causes for the March 18, 1996, event involving disabling the low temperature overpressure protection function (Section O).

Engineering

- The evaluation to determine the time that the containment spray pumps could run without flow was based on realistic engineering principles and used conservative assumptions (Section E8.1).

Report Details

Summary of Event

On August 21, 1997, Fort Calhoun Station was operating at 100 percent power. The major activity for the day shift was a routine inservice pump test and valve exercise test on the safety injection and containment spray systems. At approximately 8 a.m. (CDT), the licensed operator running the test (test lead) placed the control switches for both containment spray header isolation valves in override. This action would prevent an engineered safeguards feature signal from opening the header isolation valves and would prevent containment spray from reaching either spray header. The test lead announced the subsequent off-normal alarms as "my alarm," and continued with the surveillance test.

Due to various delays, the day shift did not complete the surveillance test and completion of the test was left for the oncoming night shift. At approximately 6 p.m., the day shift conducted a watch relief with the night shift. The cause of the lit annunciators was not discussed and the abnormal positions of the containment spray header isolation valve control switches were not discussed during turnover. During system restoration at 8:38 p.m., the test lead and the licensed senior operator recognized that the containment spray header isolation valve control switches were mispositioned. The result of this event was operation outside the parameters allowed by Technical Specifications and outside the design basis of the plant. A one hour report was made to the NRC at 9:35 p.m.

A sequence of events is included as Attachment 2.

I. Operations

O1 Conduct of Operations

O1.1 Mispositioned Switch

a. Inspection Scope

The inspectors reviewed the surveillance test procedures, control room logs, and the licensee's draft root cause analysis report to determine the sequence of events surrounding the operation of the containment spray system outside the Technical Specification and design basis safety requirements.

b. Observations and Findings

Surveillance Test Procedure OP-ST-SI-3008, "Safety Injection and Containment Spray Pump Inservice Test and Valve Exercise Test," Revision 19, was the major activity discussed by the oncoming crew during shift turnover. At 7:30 a.m., the test lead held a prejob briefing with those personnel who were to be directly involved with the surveillance test performance. At approximately 8 a.m., the test lead performed Step 7.10 which stated, "record the as found positions for the Containment Spray control valves and test switches HCV-344 (AI-30A) and HCV-345 (AI-30B), THEN place the valve and test switch in the Required position." The valves were required to be closed and the test switches were required to be in

the TEST position. The containment spray header isolation valves were already in their normally closed position.

Although not directed by the procedure, the test lead then placed the containment spray header isolation valve control switches for Valves HCV-344 and HCV-345 in the OVERRIDE position. Placing the control switches in the OVERRIDE position would prevent the valves from automatically opening on a valid containment spray actuation signal. The test lead indicated that he placed the switches in the OVERRIDE position to ensure that the valves would not open and spray down containment while running the containment spray pumps. Although he felt uncomfortable placing the switches in OVERRIDE he did not seek assistance from other operators and convinced himself that placing the switches in OVERRIDE was the right thing to do. The failure to comply with the requirements of Surveillance Test Procedure OP-ST-SI-3008 is an apparent violation of Technical Specification 5.8.1 (50-285/9717-01).

Performing the above actions caused annunciators to alarm. The test lead acknowledged the alarms and announced, "my alarm." The licensed senior operator (LSO) acknowledged that the alarms were expected. The licensee proceeded with the surveillance test.

By late afternoon, maintenance problems had delayed the completion of the surveillance test. Crew management determined that the oncoming shift would complete the final portions of the test. From approximately 6 p.m. until 6:30 p.m., the two crews conducted shift turnover. An oncoming licensed senior reactor operator received a turnover from the test lead and then relieved the balance-of-plant operator.

By 8:38 p.m., the surveillance test was complete and the test lead was performing restoration in accordance with Step 7.20 which stated, "place Containment Spray Control Valves AND Test Switches in the as-found position recorded in Step 7.10." The test lead placed the test switches in the OFF position and expected the remaining annunciators to clear. However, two annunciators remained lit. At that time, both the test lead and the LSO recognized that the containment spray header isolation valve control switches had been mispositioned. Having both of these switches in OVERRIDE would prevent a safety signal from opening the containment spray header isolation valves, rendering the containment spray system, including all three containment spray pumps, inoperable. The test lead placed the control switches back to AUTO.

Technical Specification 2.4, "Containment Cooling," limiting condition for operation requires in part that Containment Spray Pumps SI-3A, SI-3B, and SI-3C and their associated valves, piping and interlocks be operable during power operation. The modification of minimum requirements for the specification allows for two of these pumps to be inoperable at any one time during power operation. Technical Specification 2.0.1 requires in part that, in the event that the limiting condition for

operation cannot be satisfied because of circumstances in excess of those addressed in the specification, the unit shall be placed in at least hot shutdown within 6 hours, and in at least subcritical and $< 300^{\circ}\text{F}$ within the next 6 hours. With all three containment spray pumps inoperable, Technical Specification 2.4 was not satisfied for approximately 12.5 hours, and the unit was not placed in hot shutdown nor in a subcritical condition with temperature $< 300^{\circ}\text{F}$ within the required time intervals. The failure to comply with Technical Specification 2.0.1 is an apparent violation (285/9717-02).

c. Conclusions

During the initial setup of a surveillance test, the test lead placed the control switches for the containment spray header isolation valves in the OVERRIDE position contrary to the surveillance test procedure. This is an apparent violation of Technical Specification 5.8.1.

With all three containment spray pumps inoperable, Technical Specification 2.4 was not satisfied, and the unit was not placed in hot shutdown nor in a subcritical condition with temperature $< 300^{\circ}\text{F}$ within the required time intervals. The failure to shutdown the unit is an apparent violation of Technical Specification 2.0.1.

O1.2 Identification Opportunities

a. Inspection Scope

The inspectors interviewed the operators involved, and reviewed the sequence of events and control room logs to determine what opportunities were available to identify that the containment spray system was inoperable on August 21, 1997. In addition, the inspectors reviewed the licensee's corrective actions in response to EA 96-204.

b. Observations and Findings

The first opportunity that the licensee had to identify that the containment spray system was inoperable occurred when the spray valve off normal annunciators alarmed. Neither the operator at the controls nor the LSO referenced the annunciator response procedure or questioned the cause of the alarms. Since the test lead announced the alarms as "that's mine" or "expected" and since the LSO did not remember whether he looked at the annunciator, the licensee missed this opportunity to identify that the containment spray system was inoperable. In addition to the test lead and the LSO, the control room staff consisted of the shift supervisor, the reactor operator, and balance-of-plant operator.

A second opportunity that the licensee had to identify the problem was during the midshift briefing. The test lead did not discuss the causes of annunciators or the

fact that components were out of a normal lineup. He did not discuss his prior concerns with placing the switches in OVERRIDE.

A third opportunity occurred during shift supervisor control room tours. Like the LSO, the shift supervisor mentioned that he recalled seeing the lit annunciators but he did not question the availability of the containment spray function. He assumed that the annunciators were lit because of the surveillance test.

A fourth opportunity occurred during shift turnover when two licensed reactor operators and seven licensed senior reactor operators walked down the control boards and discussed plant conditions. At that time, two abnormal annunciators were lit, two containment spray header isolation valve control switches were out of position, and a white light above each control switch was lit, indicating that the switch was in OVERRIDE. None of the operators identified these conditions.

In addition, throughout the duration of the event, routine control board observations by the operating crews provided a continuous opportunity to observe the abnormal annunciators and other indications.

The final opportunity occurred during system restoration. The test lead had just completed Step 7.20 and expected that the remaining annunciators would clear. When two annunciators remained lit, the test lead recognized that something was out of position and identified that the control valves were in OVERRIDE.

c. Conclusions

The operating crews had numerous opportunities to identify that the containment spray system was inoperable, including at least four specific missed opportunities. However, due to inadequate supervisory oversight and an apparent lack of a questioning attitude, this problem was not identified until system restoration.

In their response to EA 96-204, the licensee described how the operations manager met with the shift supervisors to discuss maintaining the big picture ensuring proper command and control and how operations personnel had been trained on the importance of a questioning attitude and good attention to detail. These corrective actions were not effective on August 21, in that the shift supervisors did not maintain the big picture and the operations did not maintain a questioning attitude by failing to recognize that the containment spray system was inoperable.

O1.3 Control Room Logs

a. Inspection Scope

The inspectors reviewed the control room logs to determine whether the licensee controlled the operability of safety-related equipment appropriately and in accordance with Technical Specifications. The inspectors compared the status of

equipment documented in the surveillance test procedure documentation to entries in the control room logs.

b. Observations and Findings

Standing Order (SO) O-1, "Conduct of Operations," Revision 33, required that entries in the official control room log be made when any safety-related equipment was placed in or out of operation, and to document compliance with the requirements of a Technical Specification Limiting Condition for Operation. Contrary to this requirement, on August 21, 1997, operators failed to log that the containment spray header isolation valves had been rendered inoperable by placing the control switches in override. Operators failed to properly log the operability of High Pressure Safety Injection Pumps SI-2A and SI-2C in that they were declared operable in the control room logs prior to rendering the pumps operable by opening their respective discharge valves. And as of 7 p.m. on August 28, operators failed to log that Containment Spray Pump SI-3C was operable per Technical Specification 2.4(1)b. The pump had been restored to an operable status on August 21. Failure to comply with the requirements of SO-O-1 is an apparent violation of Technical Specification 5.8.1 (50-285/9717-03).

c. Conclusions

Failure to document the changes in the operational status of safety equipment in the official control room logs, as required, was indicative of a lack of attention-to-detail in the conduct of control room operations.

03 Operations Procedures and Documentation

03.1 Adequacy of Surveillance Procedure

a. Inspection Scope

The inspectors reviewed the surveillance procedure to determine if it was adequate and to determine if it could have contributed to the improper isolation of the containment spray system.

b. Observations and Findings

The inspectors reviewed Surveillance Test Procedure OP-ST-SI-3008. The inspectors noted that the precautions and limitations were adequate to ensure the surveillance was satisfactorily performed.

The inspectors reviewed Step 7.10 of the procedure. The test lead indicated that during this step he placed the containment spray header isolation valve control switches in OVERRIDE. The inspectors noted that this step required the test lead to perform multiple functions. The step directed the test lead to record the as found

position of the containment spray header isolation valves (HCV-344 and HCV-345), record the as found position of the containment spray header isolation valve test switches, verify the containment spray header isolation valves were in the required position, and place the containment spray header isolation valve test switch in the TEST position. The inspectors determined that performing all these actions in one step could have been a potential distraction to the test lead. In the root cause analysis, the licensee also recognized that writing a procedure to perform multiple actions in one procedural step was not consistent with their expectations in SO-G-73, "Fort Calhoun Station Writer's Guide." This standing order indicated that a procedural step should deal with only one idea and related actions should be held to one per step.

The inspectors compared the wording of Step 7.10 of the procedure with the actual control board labels. The inspectors noted that the procedure directed the test lead to record the as found position of the "Containment Spray control valves and test switches HCV-344 (AI-30A) and HCV-345 (AI-30B)." The inspectors walked down the control board and noted that no components were explicitly labeled "containment spray control valves." There were components labeled Containment Spray Valves, Containment Spray Valve Controller, and Containment Spray Valve Test Switch. Since the procedure descriptions and the actual label descriptions were different, this could have contributed to confusion.

The application of good self-checking or self-verification techniques would have caused the test lead to compare the component labels on the control boards with the procedure to verify they were identical. Since they were different, the licensee's expectation was for the test lead to stop and seek assistance.

The inspectors also noted the procedure did not list the expected annunciators that would alarm during performance of the surveillance. Some of the licensee's surveillance procedures provide expected annunciator alarms that would occur during testing. Had this procedure had a list of expected alarms, the test lead would have known that neither the "SPRAY VALVE HCV-344 OFF NORMAL" nor the "SPRAY VALVE HCV-345 OFF NORMAL" annunciators were expected during the surveillance and should have alerted the test lead that containment spray header isolation valves should not be overridden.

c. Conclusions

The procedure required the test lead to perform multiple actions in one step. This was not consistent with the procedure writer's guide. The labels on the control boards and the procedure nomenclature were different, which could cause confusion. The difference in terminology was identified as a weakness by the inspectors. The test lead did not meet the licensee's expectation to stop and seek assistance to resolve the differences. Unlike other surveillance procedures, this procedure did not provide a list of expected annunciators during the test.

O3.2 Annunciator Response

a. Inspection Scope

The inspectors reviewed the annunciator response requirements to determine if proper procedures were followed during the time the containment spray system was inoperable and to determine the adequacy of the annunciator response procedure.

b. Observations and Findings

The inspectors reviewed SO-O-1, "Conduct of Operations," and Procedure ARP-1, "Annunciator Response Procedure," and noted the requirement for acknowledging annunciators was for all expected annunciators to be announced as expected by the licensed operator. All unexpected annunciators were to be verified by the annunciator response procedure. The licensed senior operator was expected to verbally acknowledge the licensed operators.

Surveillance Test OP-ST-SI-3008, "Safety Injection and Containment Spray Pump Inservice Test and Valve Exercise Test," Step 7.10 directed the test lead to verify the as-found position of Valves HCV-344 and 345 (containment spray header isolation valves), and record the test switch positions for these valves. This step also directed the test lead to place the valves in the closed positions and place the test switches in the test position. When the test switches were placed in TEST, Annunciator Windows A33-1/H5 and A34-1/H3, "HCV-344/345 SET SPRAY PUMPS TEST PERMIT" were illuminated. The inspectors determined from interviews that the test lead announced the annunciators as expected, silenced the alarm, and the annunciator was acknowledged by the licensed senior operator.

Annunciator Windows A33-1/H6 and A34-1/H2, "SPRAY VALVE HCV-344 OFF NORMAL" and "SPRAY VALVE HCV-345 OFF NORMAL," were illuminated when the containment spray valve control switches were placed in OVERRIDE. The test lead announced the annunciator as "my alarm." The test lead indicated that someone in the control room verbally acknowledged the annunciators as expected, but he was not sure who verbally acknowledged them. The licensed senior operator stated that he had acknowledged the annunciators but could not recall if he looked at the annunciators he acknowledged.

Since the annunciator was announced as expected by the test lead, the licensee's conduct of operations SO-O-1 and the annunciator response procedure (ARP-1) did not require the test lead to reference the annunciator response procedure to determine why the annunciators came in nor did it require operators to explain why the annunciators came in. Had the test lead referenced the annunciator response procedure, the procedure would have indicated that the containment spray control valves were in OVERRIDE and would have directed that they be returned to AUTO. Referencing the annunciator procedure could have provided an early indication that a safety system had been defeated.

The inspectors determined that a contributor to failing to realize that a safety system had been defeated when the containment spray header isolation valve control switches were placed in OVERRIDE was that the guidance in effect did not require the test lead to verbally read out the annunciator tile when it alarmed. If other members of the operating crew had heard a verbal announcement of the annunciator tiles, perhaps this would have triggered them to question why the containment spray header isolation valves were in an off normal condition. Since the licensed senior operator could not recall if he saw the "SPRAY VALVE HCV-344 OFF NORMAL" or "SPRAY VALVE HCV-345 OFF NORMAL" annunciators, a verbal acknowledgment of the annunciators could also have helped him recognize that a safety system had been defeated.

The inspectors questioned whether the wording of the spray valve off normal annunciator tiles was adequate to provide appropriate warning to ensure supervisory oversight. The licensee also recognized this weakness in the annunciator tiles and stated that the wording would be changed to indicate "SPRAY VALVE HCV-344 [or 345] DISABLED."

In addition, the licensee recognized other weaknesses in their annunciator response procedures and indicated that the procedure would be changed to require all alarms be verbalized and the reason for the alarm be announced.

c. Conclusions

The licensed senior operator who acknowledged the operator's announcement of the annunciator and the other members of the operating crew did not exhibit questioning attitudes when the "SPRAY VALVE HCV-344 OFF NORMAL" and "SPRAY VALVE HCV-345 OFF NORMAL" annunciators alarmed. The annunciator response procedure was weak in that it did not require operators to verbally announce what annunciators were in alarm. The procedure required expected alarms to be announced as expected. The procedure did not require operators to explain why annunciators were in alarm. The licensed senior operator could not recall if he looked at the annunciator prior to acknowledgment. The wording on the annunciator tiles did not provide appropriate warning to ensure supervisory oversight.

O3.3 Emergency Response Procedures

a. Inspection Scope

The inspectors reviewed the licensee's emergency response procedure to determine whether adequate guidance existed to ensure that the containment spray system was returned to an operable status prior to damaging the pumps.

b. Observations and Findings

The licensee performed engineering calculations and concluded that following a containment spray actuation signal, the containment spray pumps could run for approximately 30 minutes with their minimum recirculation valves closed prior to being damaged (Section E8.1). The inspectors reviewed the licensee's emergency operating procedures and noted that the procedures provided adequate guidance to direct the operators to ensure the containment spray header isolation valves (HCV-344 and HCV-345) were opened prior to the containment spray pumps being damaged. Numerous scenarios were reviewed by the inspectors, and each would have ensured that containment spray header isolation valves were opened within 30 minutes.

c. Conclusions

The licensee's emergency operating procedure provided adequate guidance to ensure the containment spray header isolation valves were opened prior to damaging the containment spray pumps.

O4 Operator Knowledge and Performance

O4.1 Operator Knowledge and Performance

a. Inspection Scope

The inspectors interviewed the two test leads, the two licensed senior operators, and the off-going shift supervisor involved with the surveillance test. The operators were questioned about their prior experiences with that particular surveillance test, and their knowledge of the causes of the spray valve off normal alarms.

b. Observations and Findings

Each of the five operators interviewed had performed or supervised the surveillance test more than once prior to the event. All those interviewed knew that placing the containment spray header isolation valve control switch in OVERRIDE would cause the alarm and would defeat the engineered safety features signal for that valve. At the time of the test, no one recognized that having both valve off-normal annunciators in alarm at the same time meant that the containment spray system was inoperable. This was similar to a prior event documented in NRC Inspection Report 50-285/96-05 in which the LSO stated that, in retrospect, he felt that he had the knowledge that the action taken would make the power operated relief valves (PORVs) inoperable, but that at the time he did not make the cognitive connection between taking the PORV hand switches to CLOSE and making the PORVs inoperable.

Each licensed operator interviewed was aware of the off-normal alarms during the surveillance test, however, each one assumed that the alarms were lit because they were performing a surveillance test on the containment spray system. Even the shift supervisor stated that during control room tours, he had observed the lit annunciators.

c. Conclusions

Each of the control room operators involved with the event failed to demonstrate a questioning attitude concerning the lit annunciators. While each operator knew the cause of the alarm, none recognized that having both valve off-normal annunciators in alarm simultaneously meant that the containment spray system was inoperable. Additionally, crew supervision failed to provide adequate oversight during the performance of the surveillance test.

O4.2 Shift Turnover

a. Inspection Scope

The inspectors reviewed the sequence of events; reviewed Standing Order SO-O-1, "Conduct of Operations;" interviewed operators; reviewed the shift turnover sheet; and reviewed corrective actions to Escalated Enforcement Action 96-204 to determine the adequacy of the shift turnover.

b. Observation and Findings

The test lead that began performing Surveillance Test OP-ST-SI-3008, "Safety Injection and Containment Spray Pump Inservice Test and Valve Exercise Test," did not complete the test prior to shift turnover. The test lead did not complete Attachment 3 (High Pressure Safety Injection Pump SI-2A), Attachment 6 (Containment Spray Pump SI-3A), or Attachment 9 (Safety Injection Tank Outlet Valves). The test lead turned over the surveillance test to the oncoming senior licensed operator.

During the shift turnover, the day shift supervisor discussed that Procedure OP-ST-SI-3008 was in progress and needed to be completed. He did not identify that the control switches for the containment spray header isolation valves were in the OVERRIDE position and that the valves could not perform their intended safety function.

In accordance with Standing Order SO-O-1, "Conduct of Operations," the Shift Supervisor's Log, although it was not the official control room log, should be utilized by the shift supervisor to record items which should be passed on to relieving shift supervisors and to plant management. The log did not note the inoperability of the containment spray system.

SO-O-1 also states that the oncoming shift shall review the shift turnover sheet with their respective counterparts and sign the sheet at the end of the turnover. The condition of the containment spray system was not discussed on the shift turnover sheet.

Corrective action following the March 1996 event involving the disabling of the low temperature overpressure protection function included a new requirement for the shift supervisors and licensed senior operators to walk down the control boards prior to assuming the shift. Prior to the low temperature overpressure protection event, these board walkdowns had been optional.

In this event, when the containment spray system had been rendered inoperable, the "SPRAY VALVE HCV-344 OFF NORMAL" and "SPRAY VALVE HCV-345 OFF NORMAL" annunciators were lit, the containment spray header isolation valve control switches were in the OVERRIDE position, and a white indicating light above each containment spray valve switch was lit.

During the board walkdown portion of the shift turnover, seven senior reactor operators, a reactor operator, and the test lead (reactor operator) all walked by these indicators and did not recognize that the containment spray system was inoperable. All operators interviewed indicated they saw the annunciators. Two of the operators indicated they did not look at the switch positions during the board walkdown and, as a result, did not notice the illuminated white light above the containment spray header isolation valve switches and the control switches in OVERRIDE. All operators indicated that they assumed that the annunciators were lit due to the surveillance test.

Following shift turnover, the test lead and oncoming senior licensed operator discussed the remaining surveillance attachments that needed to be performed and also the restoration sequence. They did not discuss the cause of the lit annunciators.

Step 7.2.2 of Revision 33 of SO-O-1, "Conduct of Operations," states a number of shift turnover requirements, including the following:

- The oncoming shift shall familiarize themselves with conditions in areas for which they are responsible;
- Each person will brief his/her relief on the condition and status of that portion of the plant to which he/she is assigned; and
- Each operator shall personally verify the status of important system operating parameters, especially those for safety systems.

The failure of the offgoing operators to properly brief their relief operators and the failure of the relieving operators to verify the operational status of the containment

spray system prior to assuming the shift is an apparent violation of Technical Specification 5.8.1 (50-285/9717-04).

c. Conclusions

During the shift turnover operators did not question the cause of the containment spray valve off normal alarms. Operators accepted that the annunciators were in due to testing. Although operators knew that having the containment spray control header isolation valves in OVERRIDE brought in the annunciators they did not make the cognitive link that this defeated a safety system.

In their response to EA 96-204, the licensee described how the shift turnover process had been improved. These improvements required a thorough shift turnover to include out-of-normal switch positions and illuminated annunciators, and a walkdown of the control room boards by the shift supervisors and licensed senior operators to enhance their knowledge of plant and system status. Although this change was proceduralized in Standing Order SO-0-1, the corrective action was not effective in that during the shift turnover on August 21, the oncoming shift supervisor and licensed senior operator did not recognize the condition of the containment spray system.

O8 Miscellaneous Operations Issues

O8.1 Safety Significance

a. Inspection Scope

The inspectors reviewed the Updated Safety Analysis Report; the licensee's Individual Plant Examination; a "White Paper on Safety Evaluation for CR [condition report] 199701066 for the Containment Spray Valves in Override;" and a document from Asea Brown Boveri, "Transmittal of Results for OPPD [Omaha Public Power District] Containment LOCA [loss of coolant accident] Analysis with Containment Sprays Unavailable," dated August 28, 1997.

b. Observations and Findings

The containment spray system consists of three pumps and two spray headers supplied through Valves HCV-344 and HCV-345. The containment spray system provides the primary means of containment pressure suppression. The containment air cooling system provides backup to the containment spray system and consists of two cooling and filtering units and two smaller cooling units.

The analysis listed in Updated Safety Analysis Report Chapter 14 reviewed the effects of a large loss-of-coolant accident and a main steam line break accident on containment integrity. A vendor for the licensee reanalyzed the effect of having the containment spray system inoperable on peak containment pressure for these two

accidents. The licensee assumed a loss of offsite power coincident with the loss-of-coolant accident and the failure of one diesel generator to run. The licensee used actual river water temperature for the analysis. The analysis concluded that peak containment pressure would not have exceeded the containment design basis pressure limit of 60 pounds per square inch gage under the specified conditions. The inspectors found that the licensee's assumptions were appropriate.

The event resulted in a negligible increase in either the Level I core damage frequency or the Level II large early release frequency. The redundancy provided by the containment coolers, actual river water temperatures during the 12.5-hour period, proceduralized operator actions in the Emergency Operating Procedures, and the ability to establish alternate cooling through the low pressure safety injection system contributed to this finding.

c. Conclusions

Having the containment spray system inoperable for 12.5 hours on August 21, 1997, resulted in a negligible increase in core damage frequency. The containment design basis pressure limit for loss of coolant or main steam line break accidents would not have been exceeded assuming actual conditions.

III. Engineering

E8 Miscellaneous Engineering Issues

E8.1 Containment Spray Pump Minimum Recirculation Path Isolation

a. Inspection Scope

During the inspection, the licensee informed the inspectors that the containment spray pump minimum recirculation flow valves were normally shut in order to meet minimum required spray flow with one pump. The inspectors reviewed a licensee consultant evaluation, "Operation of the Ft. Calhoun Station Containment Spray Pumps Short-term at Zero Flow Conditions," dated August 29, 1997, to determine the potential for damage to the containment spray pumps, had they been run without flow for an extended period of time.

b. Observations and Findings

The containment spray pumps are single-stage, double-suction, motor-driven pumps with pump suction and discharge piping located on the pump casing at the 12-o'clock position. The position of the pump suction allows the heated water in the pump suction to rise into the suction piping and cooler water in the suction piping to enter the pump and thus reduce the rate of temperature rise. The evaluation assumed that the water in the 12 inch suction piping up to, but not including the common suction header, would provide cooling to the pump. The evaluation

assumed no similar heat transfer to the discharge header due to the closed pump discharge check valve and assumed no heat transfer occurred across the pump casing to the environment.

The evaluation concluded that a spray pump could run for approximately 40 minutes with no flow before saturation conditions (28 pounds per square inch absolute, 245°F) would be reached. The evaluation concluded that there would be no adverse short-term or long-term effect from operating the pumps with no flow for up to 30 minutes.

The inspectors determined that the evaluation was based on realistic engineering principles and used conservative assumptions.

c. Conclusions

The inspectors concluded that the contractor evaluation was valid and that there was sufficient time for operator actions following an accident to avoid damage to the containment spray pumps.

V. Management Meetings

X1 Exit Meeting Summary

At the exit meeting on August 29, the licensee acknowledged the inspector's findings. The licensee then discussed their planned and in-progress corrective actions which are listed in Attachment 3.

The inspectors asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

ATTACHMENT 1

SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee

W. Gates, Vice President, Nuclear
J. Chase, Plant Manager
R. Short, Manager, Operations
S. Gambhir, Division Manager, Engineering and Operations
R. Conner, Manager, Training
D. Levin, Licensed Test lead
M. Anderson, Licensed Operator
J. Ashcroft, Licensed Senior Operator
S. Pallas, Licensed Senior Operator
J. Cook, Licensed Senior Operator, Shift Supervisor

INSPECTION PROCEDURES USED

93702 Prompt Onsite Response To Events At Operating Power Reactors

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-285/9717-01	APV	Containment spray header isolation valve control switches placed in override - failure to follow procedures (Section O1.1).
50-285/9717-02	APV	Failure to comply with Technical Specification 2.0.1 while containment spray system inoperable (Section O1.1).
50-285/9717-03	APV	Control room logs inaccurate - failure to follow procedures (Section O1.3).
50-285/9717-04	APV	Inadequate shift turnover - failure to follow procedures (Section O4.2).

ATTACHMENT 2

SEQUENCE OF EVENTS

<u>TIME</u>	<u>DESCRIPTION</u>
<u>August 18</u>	
0855	Containment Spray Pump SI-3B inoperable for maintenance.
<u>August 21</u>	
0730	Test lead (licensed operator) conducted prejob briefing and discussed individual responsibilities with persons involved in the surveillance.
0800	Nonlicensed operator reported that testing could begin on pumps in Room 21 (West Safety Injection Pump Room).
0800	Test lead performed Steps 7.5 through 7.10. Following completion of Step 7.10, test lead placed the containment spray valve control switches in OVERRIDE.
0900	Started test on Low Pressure Safety Injection Pump SI-1A.
0919	Completed test on Low Pressure Safety Injection Pump SI-1A.
0930	Started test on High Pressure Safety Injection Pump SI-2C.
0946	Completed test on High Pressure Safety Injection Pump SI-2C.
1000	Surveillance testing delayed in order to complete maintenance on Containment Spray Pump SI-3B.
1130	Mid-shift briefing.
1605	Maintenance complete. Started test on Containment Spray Pump SI-3B.
1644	Started test on High Pressure Safety Injection Pump SI-2B.
1658	Completed test on High Pressure Safety Injection Pump SI-2B.
1707	Completed test on Containment Spray Pump SI-3B.
1716	Started test on Containment Spray Pump SI-3C.
1733	Completed test on Containment Spray Pump SI-3C. Test stopped for shift turnover.

- 1800 Shift turnover initiated.
- 1810 (approx) Nine licensed operators (seven senior reactor operators and two operators) walked down control panels and noticed the "SPRAY VALVE HCV-344 OFF NORMAL" and "SPRAY VALVE HCV-345 OFF NORMAL" annunciators and believed they were lit due to the surveillance test.
- 1820 (approx) Test lead turned over with senior reactor operator to complete the test. They discussed the three remaining test attachments to be performed.
- 1835 (approx) Shift turnover completed.
- 2038 During test restoration, the senior reactor operator recognized the containment spray valve control switches were in OVERRIDE and the containment spray system was inoperable.
- 2039 Restored containment spray valve control switches to AUTO. The total time the containment spray system was inoperable was approximately 12.5 hours.
- 2135 NRC notification made due to being outside design basis and system being unavailable to mitigate the consequences of an accident.

ATTACHMENT 3

LICENSEE PROVIDED LIST OF CORRECTIVE ACTIONS

1. Crew Stand Downs - 5/6 crews completed, last crew 9/4/97.
2. Enhanced Board Walkdowns - 5/6 crews completed, last crew 9/4/97.
3. Verbalization of all Alarms, Reason Why & LSO Acknowledgment - 5/6 crews completed. ARP-1 revised.
4. Management Observations of Shift Turnover - Scheduled observations complete. Compiling results and improvements by 9/4/97.
5. Root Cause Analysis - 95 percent complete. Complete by 9/4/97.
6. Test Monitor Program - Fully implemented via OPD 5-14. Management observations in progress.
7. PRC review of Event/Short-term Corrective Actions - Completed 8/23/97.
8. Site Notification of Event - Issued White Paper on 8/25/97.
9. Operations Unity Council - Met 8/26/97.
 - a. Operator Cognitive and Mental Skills Assessment
 - b. Crew Teamwork and Performance Reviews
 - c. Revised Operator Code of Conduct
 - d. Welcoming New Operator to Crew
10. Standardize Mid-Shift Briefing - Out-of-Normal Alarm/Switches tracked and discussed. OPD and Form to be issued by 9/4/97.
11. Expanded Peer Check Program - HCV-344/345 completed 8/23/97. Approximately 25 other switches marked 8/25/97. Further evaluation and marking by 9/30/97.
12. SRO Concurrence when Disabling Safety-Related Equipment (including overrides) - 5/6 crews complete. Procedure implementation by 9/4/97.
13. Safety Significance - Preliminary evaluation completed 8/28/97. Determined not safety-significant.
14. ARP Review - In progress, complete by 9/15/97.
15. Evaluate use of Normal Position Colored Dots on Control Switches - Decision by 9/15/97.
16. Operator Training - Next Rotation (97-6), complete 11/7/97 -e.g. detailed review of event and causes, review of switch overrides/annunciators and HCV-344 and SI-3B/3C Interlock and Technical Specification implications.
17. Out-of-Normal Label - Label designed, implement by 9/5/97.
18. Individual "Day" Schedule for Operations - Format options being reviewed by SS's, implement by 9/5/97.
19. Human Performance Review by Dr. Stark - In progress, complete by 9/30/97.
20. Expected Annunciator Marking Program - Start implementation by 9/30/97. All procedures done by 1998 RFO plus 2 months.
21. Open Containment Spray Pump Mini-Recirc. Valves - Complete by 10/31/97.
22. Revise Annunciator Tile Wording (Off-Normal to Disabled) - 10/31/97.
23. Operations Department Self-Assessment - Start 9/8/97.
24. NSRG Independent Review of Event. - In progress, complete by 9/5/97.
25. "Warning" Ops Note next to HCV-344/345 Control Switches - Completed 8/23/97.
26. No scheduled activities in Control Room for first 4-hours for crew returning from long break (e.g. 14 days) - Implement 9/4/97. Long Term - Revise work schedule.