ENCLOSURE

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 50-285/94-04

License: DPR-40

Licensee: Omaha Public Power District
Fort Calhoun Station FC-2-4 Adm.
P.O. Box 399, Hwy. 75 - North of Fort Calhoun
Fort Calhoun, Nebraska

Facility Name: Fort Calhoun Station

Inspection At: Blair, Nebraska

Inspection Conducted: October 31 through December 16, 1994

Inspectors: Elmo E. Collins, Region IV Team Leader
Greg Werner, Region IV Reactor Engineer
Michael Shlyamberg, Contractor

Approved: Thomas Westerman, Chief, Engineering Branch — 3-30-95 Date


Inspection Summary

Areas Inspected: Routine, announced inspection of the licensee's service water systems self-assessment.

Results:

- The licensee's self-assessment team had the necessary experience to conduct an effective assessment.
- The licensee performed, overall, a thorough and comprehensive self-assessment, addressing the required areas of Temporary Instruction 2515/118. The licensee concluded that the service water systems at Fort Calhoun Station were in good condition, and that the design requirements were met operationally.
- One safety significant item was identified by the licensee, which was reviewed in NRC Inspection Report 94-24.
- NRC inspectors concluded that the service water systems at Fort Calhoun Station were operable at the time of the inspection.


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- At the time of the inspection, corrective actions to address most items identified were not formulated or implemented; consequently, the inspectors could not assess the effectiveness of the corrective actions.

Attachments:

- Attachment - Persons Contacted and Exit Meeting

## DETAILS

### 1 INTRODUCTION

NRC Inspection Manual, Inspection Procedure 40501, "Licensee Self-Assessments Related to Safety Issues Inspections," provides guidance on the NRC pilot program to evaluate a licensee's self-assessment effort as an alternative to an extensive NRC safety-issues team inspection. Under this program, the NRC inspection will be conducted in two phases: 1) an in-process inspection in which the NRC will evaluate the capability of the licensee's team and the depth of review by monitoring the conduct of the licensee's in-process assessment, and 2) a final inspection in which the NRC will perform a technical inspection of the licensee's completed self-assessment when the licensee issues its final report.

At Fort Calhoun Station (FCS), the licensee performed their self-assessment of the service water systems from October 24, 1994 through November 11, 1994. The NRC performed the in-process inspection from October 31, 1994, through November 4, 1994, and the final inspection from December 12-16, 1994. The licensee issued their Service Water System Operational Performance Self-Assessment Report on December 7, 1994. Section 2 of this report discusses the in-process inspection, and Sections 4-7 discuss the final inspection.

### 2 IN-PROCESS REVIEW (Temporary Instruction 2515/118)

From October 31 through November 4, 1994, the inspectors monitored the implementation of the self-assessment, evaluated the capability of the licensee's self-assessment team, and evaluated the scope of the licensee's planned effort. The inspectors found that the licensee's Service Water System Operational Performance Inspection Assessment Plan adequately covered the scope of Temporary Instruction 2515/118, "Service Water System Operational Performance Inspection." The inspectors concluded, on the basis of the experience and background of the self-assessment team, that the team had the necessary capability to perform the self-assessment.

The inspectors observed, to the extent possible, the implementation of the self-assessment, including the self-assessment team de-briefings, management de-briefings and interviews, and reviewed the list of questions that were being pursued by the self-assessment team. The inspectors found that the progress and depth of review were good. The licensee's self-assessment team exhibited a questioning attitude.

Initially, because of the way the licensee classified issues identified by their self-assessment team, all questions that were being pursued by the Omaha Public Power District (OPPD) response team were classified as Priority 3, the lowest level. Licensee management found that this method of classifying issues did not establish significance. During the conduct of the self-

assessment, the licensee began classifying issues as significant, potentially significant, and not significant. The inspectors found that the later method of classification of issues better communicated the potential significance of items that were being pursued.

## 3 SYSTEM DESCRIPTIONS (Temporary Instruction 2515/118)

At Fort Calhoun Station (FCS), the following systems were used to cool the safety-related loads: (1) raw water (RW) and (2) closed cooling water (CCW) systems.

### 3.1 Raw Water System

The RW system is a once-through system that supplied cooling water to the safety-related CCW heat exchangers and provided backup water supply (also referred to as direct cooling) to the following safety-related loads: shutdown cooling heat exchangers, containment cooling coils, the seal and lubrication cooling for the engineered safeguards pumps, and the control room air conditioning units. These loads were normally cooled by the CCW system. The backup water supply was isolated by locked closed air operated valves (interface valves). The system consisted of common piping network with redundant components (e.g. all RW pumps were connected to a common header) instead of the "two independent trains". There were four RW pumps and four CCW heat exchangers. The minimum required number of pumps and heat exchangers was dependent on the RW temperature and other limiting conditions.

The ultimate heat sink for the RW system is the Missouri River. The intake structure consisted of three bays and was designed to minimize the occurrence and the consequences of a barge impact.

### 3.2 Closed Cooling Water

The CCW system is a closed loop system that provided cooling water to the safety-related heat exchangers described in the RW system description and to nonsafety-related loads. The majority of the nonsafety-related loads were not automatically isolated during accident conditions due to the loss of the nonsafety-related instrument air supply. However, these loads were connected to the CCW system by seismically qualified piping. Similarly to the RW system, the CCW system was also comprised of the common piping network instead of the "two independent trains". The CCW system relied on the RW system to provide a backup cooling to safety-related loads. The CCW system was equipped with a surge tank, which was located on the same level as the CCW pumps and was pressurized by nitrogen to 25 psig. In addition to providing the expansion and contraction capability, this tank also provided the static head on the CCW pumps to assure adequate $NPSH_A$. Two out of three CCW pumps were required to provide the safety-related flow in the event of an accident.

## 4 DESIGN REVIEW (Temporary Instruction 2515/118)

The inspectors reviewed the RW and CCW system design bases, design assumptions, calculations, analyses, boundary conditions, and models against licensing commitments and regulatory requirements. The inspectors also assessed the single failure impact on the ability of the CCW system to perform its required safety function and the capability of the systems to meet the thermal and hydraulic performance specifications. The inspectors' review of the above items was comprised of the examination of the licensee's self-assessment findings and independent inspection.

### 4.1 Impact of the Maximum Safeguards on CCW system

The licensee identified a condition which had the potential for rendering both control room air conditioning units inoperable. This condition was documented in Licensee Event Report 94-010. The NRC review of this item is documented in Inspection Report 285/94-24.

### 4.2 RW/CCW Interface Valves

The inspectors found that the licensee performed an in-depth and critical evaluation of the issues related to the RW/CCW interface valves. Specifically, the licensee identified that not all interface valves had been tested (stroked open and closed). The inspectors considered that this evaluation showed a questioning attitude and was a strength.

For design basis accident mitigation, FCS was licensed, considering that alternative cooling must be provided in the event of failure of the CCW system (including pipe rupture) during long-term cooling. This function was questionable because the CCW isolation valves for the shutdown heat exchangers (Valves HCV-480, -484, -481 and -485) were not designed to provide an isolation function, introducing the possibility that RW would leak through the isolation valves into the CCW system, and then out the break. Omaha Public Power District Memorandum PED-FC-94-1173, dated September 28, 1994, addressed the potential flooding concern if direct RW cooling was required due to the CCW pressure boundary failure. The inspectors reviewed this memorandum and found that the memorandum did not consider the break location. The proposed actions relied on the installation of a patch in the auxiliary building.

Engineering Evaluation EA-FC-91-014

The original design requirements for all of the interface valves was to provide the capability for the remote manual opening and to assure that they will fail in the open position in the event of the loss of instrument air. These requirements were modified when these valves were locked closed (Licensee Event Report 90-025). This design change led to a loss of the ability to provide the backup cooling for the engineered safeguards

pumps' seals and coolers since the valves would not be accessible during accident conditions. An Engineering Evaluation EA-FC-91-014 was performed to justify that one-time operation of the emergency core cooling systems pumps without cooling under the design basis accident conditions was acceptable.

The engineering evaluation assumed that pump critical components were in a new or nearly new condition. While the inspectors found that the components appeared to be new or nearly new, the licensee had not implemented additional testing or controls to assure the basis of the engineering evaluation was maintained.

The sump temperature profile used in the evaluation was derived from the containment pressure/temperature analysis. The assumptions were to maximize the energy retained in containment volume and minimize the energy transferred to the sump. The assumptions, therefore, did not maximize sump temperature. The inspectors questioned the licensee regarding the amount of cooling necessary for the pumps and the licensee estimated that sump temperature could be about 20°F higher. The licensee considered that the short duration increase of the peak value would not impact pump performance.

4.3 Review of Calculations

The self-assessment review consisted of an in-depth and critical evaluation of the design calculations. Several weaknesses were identified by the licensee with Calculation FC06273, Revision 0, "RW Flows to CCW Heat Exchangers On Raw Water Chosen Pump Performance." The inspectors considered this evaluation to be very good.

The inspectors performed additional independent review and observed similar issues. The Technical Specification requirement that only one RW pump was required when river temperature was less that 60°F was based on the ability to deliver 6,000 gpm of river water to the CCW heat exchangers. This was based on the ability of one pump to deliver up to 6,660 gpm and closure of the air-operated pump discharge valves to prevent the backflow through the other pump discharge check valves. Factors that could negatively affect this were that the current design calculation predicted flows below 6,000 gpm and that the strainer backwash and check valve back flow were not taken into account. The inspectors considered that the calculation issues discussed above did not require prompt resolution due to the RW temperature being significantly below the design basis value of 90°F. However, addressing of these weaknesses would be necessary to provide assurance of the satisfactory operation of the system at limiting conditions. At the time of the inspection, the licensee was formulating corrective actions to address calculational weaknesses.

5 GENERIC LETTER 89-13 (Temporary Instruction 2515/118)

The inspectors reviewed how the recommended actions of Generic Letter 89-13 were implemented at FCS. The basis for this review were the results of the self-assessment documented in the self-assessment report and a limited independent inspection. The results of this review are provided below.

5.1 Recommended Action I

The major emphasis of this action item was on the biological fouling. The recommendations of Generic Letter 89-13 related to the biofouling appear to be implemented at FCS.

5.2 Recommended Action II

Action II of Generic Letter 89-13 requested that licensees implement a program to periodically verify the heat transfer capability of safety-related heat exchangers cooled by the RW system. The test program should consist of an initial test program and a periodic retest program.

Inspectors found that the FCS test program consisted of both inspecting/cleaning and performance testing of safety-related heat exchangers. The performance testing of the CCW heat exchangers was done as required by the Generic Letter 89-13.

Since all of the heat exchangers were included in the inspection program, the inspectors concluded that the licensee's response to Action II was adequate, and the Generic Letter 89-13 intent was met. However, as documented by the licensee's self-assessment, the performance portion of this program exhibited inconclusive trending results. Also, as documented by the licensee's self-assessment, neither test results nor acceptance criteria fully accounted for the instrument and modeling uncertainties. At the time of the in-process inspection, the licensee was formulating corrective actions to address these weaknesses.

5.3 Recommended Action III

Action III recommended the establishment of routine inspection and maintenance programs in order to ensure that silting will not degrade the safety-related functions of the RW system. Section 6.2.3 of this report discusses the licensee's identification of silt.

5.4 Recommended Action IV

Action IV of Generic Letter 89-13 requested that licensees confirm that the RW and CCW systems will perform their intended function in accordance with the licensing basis for the plant. This confirmation should include a review of the ability to perform required safety functions in the event of a single active component failure.

The inspectors found that the licensee identified weaknesses associated with the consideration of single failures of the RW and CCW systems. The limiting single failures were not identified for the maximum CCW return temperature (see Section 4.1). Also, the existing design calculation did not necessarily provide conservative minimum and maximum operating ranges for the RW and CCW systems.

While the inspectors concluded that the RW and CCW system were operable at the time of the inspection, resolution of these weaknesses would be necessary to assure the ability of the RW and CCW to fulfill their safety-related functions during limiting conditions. At the time of the inspection, the licensee was formulating corrective actions to address these issues.

## 6 MAINTENANCE AND SURVEILLANCE (Temporary Instruction 2515/118)

### 6.1 Overview

The inspectors reviewed the licensee's self-assessment report and identified areas of potential weaknesses in the review for microbiological-induced corrosion (MIC); resolution of sanding issues; and operation of plant components by maintenance personnel.

### 6.2 Maintenance

#### 6.2.1 Maintenance Effectiveness Assessment

The inspectors conducted an independent walkdown of the CCW and RW systems to determine the material conditions of these systems and then compared the results with the self-assessment team findings. The inspectors observed some minor deficiencies. Licensee personnel had also identified minor deficiencies; however, no safety significant deficiencies were found. The licensee was tracking these deficiencies.

In order to assess the adequacy of maintenance being performed, the licensee reviewed previous maintenance work packages, observed ongoing maintenance, reviewed maintenance history, interviewed workers and engineers, scrutinized deferred outage maintenance, and evaluated the effectiveness and scope of the preventive maintenance program.

During interviews and reviews of maintenance history, the licensee self-assessment team members identified repetitive maintenance issues on the RW pump impellers, RW pump shaft seal water, and the intake traveling screens. While observing a maintenance activity, a problem was identified with the manipulation of a valve by maintenance technicians inside a clearance boundary. The self-assessment team did not identify any problems with deferred outage maintenance or with the preventive maintenance program. The licensee indicated that a review of historical maintenance activities against preventive maintenance tasks revealed that the preventive maintenance items were effective. The inspectors independently reviewed the maintenance history and deferred outage maintenance and concluded that the licensee's self-assessment was thorough.

The RW system engineer stated that the repetitive maintenance on the pump impellers (pump lift clearance adjustments) was attributed to pump shaft stretch. Evaluations on different types of shaft material were being

conducted. Also, the self-assessment team member stated that an engineering change notice was being processed to change out the pump impeller material. An independent review of the engineering change was not done since it had not been completed.

The licensee planned Modification MR-FC-94-019 to upgrade the RW pump shaft seal water system to safety grade, and this was being credited as the solution for repetitive maintenance associated with the seal system. The system engineer stated that with the changes in system design, current repetitive failures of the seal water system should be eliminated.

Overall, maintenance activities observed by the self-assessment team were determined to be completed in an appropriate manner. However, one exception was noted during the replacement of a protective boot on a piston actuator for CCW Valve HCV-400C (CCW return from containment air cooling and filtering unit coils). The team member identified that the maintenance technicians had worked outside the work scope by manipulating the valve without appropriate work instructions. Incident Report 940381 was written to document this observation. The incident report was still open at the end of this inspection. Portions of two maintenance activities were observed by the inspectors and no deficiencies were identified. For the portion of the work activities observed, the work documents contained the necessary instructions and post-work testing requirements.

6.2.2 Microbiologically Induced Corrosion

The RW system engineer stated that only two through-wall failures (RW Valves RW-130 and RW-169 vent nipples) had occurred in the RW system since 1991. Incident Report 940165, "Root Cause and Generic Implications Analysis Report," described the failure on RW-130 as "localized pitting due to the existence of stagnant, oxygenated conditions." The system engineer also stated that the failed section was sent to three laboratories for analysis. No evidence of MIC was identified. Additionally, the system engineer stated whenever the RW system piping was opened for maintenance, he performed visual inspections of interior piping, and no evidence of MIC had been observed.

The RW interface piping and valves contain ideal conditions for MIC; however, no failures in this configuration of piping have been identified. Recent ultrasonic measurements taken at the request of the system engineer on RW interface piping elbows to the shutdown cooling heat exchanges indicated no abnormal loss of wall thickness.

The inspector also interviewed the circulating water system engineer. He stated that all through-wall pipe failures have been either attributed to erosion or to exterior corrosion attack. In addition, the inspectors requested a list of all through-wall piping failures attributed to MIC. Licensing personnel stated that no failures have been attributed to MIC.

Based upon the information provided, the inspectors concluded that the licensee had adequately evaluated and addressed pipe through-wall failures, and the inspectors did not identify evidence of MIC related failures.

6.2.3 Sanding and Silting Problems

The licensee self-assessment team performed a historical review of RW system problems caused by sand. The licensee identified that, as early as 1972, the RW pumps would "sand in" and trip upon starting. The recommendations provided at that time were not implemented until 1994. The self-assessment team identified that the resolution of this sanding problem was untimely.

Reviews of documentation by the licensee's self-assessment team led them to the conclusion that sand/silt obstruction of RW/CCW backup lines was not probable. The licensee's conclusion was based on the piping configuration consisting of RW/CCW backup lines tapping off the top of the main header, a rise of over 50 feet before the first component supplied, and no flow in the header. No previous sand/silt obstruction incidents were documented with the exception of finding sand in RW/CCW backup discharge lines for the shutdown cooling heat exchangers (Generic Letter 89-13 inspection). The sand was determined to have accumulated since original plant construction.

On December 2, 1994, while replacing the soft seat liner for RW Backup Valve HCV-401E, "RW/CCW Interface Valve to Containment Air Cooler VA-1B," a soft sand/silt plug was discovered in the supply piping. Incident Report 940413 was initiated to document the condition. On December 20, another soft sand plug was discovered while reworking Valve HCV-403E, "RW/CCW Interface Valve to Containment Air Cooler VA-8B." The inspectors performed a physical walkdown of the RW/CCW backup piping and confirmed the configuration used to support the licensee's previous conclusions that sanding was not probable in the RW backup lines actually existed in the plant.

The RW backup supply to the emergency core cooling systems pumps tapped off the header just downstream of where sand/silt was found in the containment cooler supply. The low pressure safety injection pumps and the shutdown cooling heat exchangers with cooling provided by RW enabled the plant to be cooled to cold shutdown in the event of a fire in the CCW pump room (Appendix R requirement). The inspectors questioned the flow path for RW backup to the components necessary for an Appendix R shutdown. The RW system engineer and his supervisor stated that the RW backup flow path to the low pressure safety injection pumps and shutdown cooling heat exchangers were operable.

The basis for operability of the shutdown cooling heat exchangers was based on an inspection of the RW/CCW interface valves conducted during the 1990 refueling outage as part of Generic Letter 89-13 inspections. Sand was found in the discharge piping when HCV-482B and HCV-483B were removed. No sand was found in the supply RW backup piping. The sand was not hardened and since high flow rates would be encountered, the sand would be washed away.

The operability of the RW backup for the low pressure safety injection pumps was based upon subjective evidence, since no disassembly of any of the RW backup valves to the emergency core cooling systems pumps had been conducted. System engineering personnel indicated that if sand were present at the valves, the valves may not cycle or would fail to seat completely, and this had not been observed. In addition, licensee personnel stated that if a soft sand plug existed, it would be pushed through the system by water pressure. The system engineer had also been involved with flushing the emergency core cooling systems pumps oil cooling heat exchangers and no evidence of sand had been observed in the heat exchangers.

During the exit meeting, licensee senior management personnel reiterated the operability of the RW backup flow path necessary for Appendix R cold shutdown.

## 6.3 Surveillance and Testing

### 6.3.1 Surveillance and Testing Effectiveness Assessment

The licensee self-assessment members performed an extensive review of surveillance testing, inservice testing, and preoperational testing and compared this to the design basis documents and technical specification requirements. Interviews with the personnel responsible for these areas were conducted. The licensee's self-assessment team members also observed surveillance testing activities.

In order to evaluate the licensee self-assessment effort, the inspectors observed interviews conducted by the licensee team members and found them to be probing. The inspectors interviewed the team members responsible for the surveillance and testing area and concluded that the licensee was addressing the areas outlined in their inspection plan and that the scope was appropriate to fulfill the related requirements of Temporary Instruction 2515/118.

During the in-process inspection, the inspectors reviewed Modification MR-FC-88-61, "Air Check Valve for RW Discharge Valves," to determine if changes made to the system had been incorporated into the surveillance or inservice testing program. Surveillance Test IC-ST-IA-3003, "Raw Water Instrument Air Accumulator Check Valve Operability," did test the check valves. The licensee had identified a deficiency in the testing methodology since it did not take into account instrument inaccuracies which could effect the volume of air required to close the valves. The licensee was tracking this item.

The licensee self-assessment team identified that during October 1994, air sparging of the RW/CCW heat exchangers was not being done on an equal basis. Reviews of control room logs for the month of October determined that the daily shift surveillance requirement for RW/CCW heat exchanger air sparging was being completed as required.

Selected items identified in the licensee report and Q&A list were reviewed. All of the items identified were to be corrected and were entered into either the corrective action process or administrative tracking system; however, no assessment as to the completeness or effectiveness of the corrective actions was performed since the licensee had not completed the corrective actions.

6.3.2 RW/CCW Interface Valve Testing

The licensee's self-assessment team identified the failure to test the RW/CCW interface valves. Significant CAR 94-220 documented this condition. During the second week of the NRC inspection, the inspectors reviewed the details surrounding the failure to test the RW/CCW interface valves.

During the 1992 outage, the licensee declared all RW/CCW interface valves inoperable and did not test the valves. This decision appeared to have been based on information contained within the USAR which specified no requirements for RW backup to safety-related components during any USAR described accident. In August 1993, additional information indicated the RW backup function was necessary under certain conditions, and all RW backup valves, with the exception of four valves, were tested. Three RW backup valves to the containment air coolers and one RW backup to Shutdown Cooling Heat Exchanger B were not tested. Raw water backup to the containment air coolers was determined not to be necessary for any accident conditions.

The RW backup to the shutdown cooling heat exchangers was a requirement for an Appendix R cold shutdown. This was identified as a concern to the licensee. American Society of Mechanical Engineers, Section XI, "Inservice Testing of Valves in Light-Water Reactor Power Plants," allowed valves not to be tested if inoperable. However, Section 3.2 also stated that inservice testing shall be done on valves required to be operable to fulfill their required function.

Licensee management stated the requirements of Appendix R were satisfied by the testing completed on the RW backup valves to Shutdown Heat Exchanger A and the availability of Heat Exchanger A. This satisfied the questions concerning the operability of components necessary to complete an Appendix R cold shutdown.

6.4 Conclusion

The inspectors concluded the self-assessment of maintenance, surveillance, and testing associated with the service water system operational inspection was thorough. A thorough review of programs, procedures, implementation, and personnel performance allowed licensee personnel to appropriately evaluate the performance of the raw water and component cooling water systems.

## 7 LICENSEE SELF-ASSESSMENT CAPABILITY (Temporary Instruction 2515/118)

Overall, the inspectors concluded that the licensee demonstrated a good self-assessment capability. The licensee identified weaknesses in calculations, the absence of basis for the maximum CCW design temperature, untimely corrective actions for RW/CCW interface valve testing, weaknesses in the previously performed safety system functional reviews, weaknesses in the single failure analysis for the CCW system, and untimely corrective actions on sanding problems in the RW system.

At the time of the NRC final inspection, the licensee was in the process of formulating the corrective actions to address the performance problems identified by their self-assessment, consequently the inspectors were not able to evaluate the scope or effectiveness of the licensee's corrective actions. The inspectors did not identify any immediate operability issues.

ATTACHMENT

## 1 PERSONS CONTACTED

### 1.1 Licensee Personnel

R. Andrews, Division Manager, Nuclear Services
J. Chase, Manager, Fort Calhoun Station
G. Cook, Supervisor, Station Licensing
J. Gasper, Manager, Training
G. Gates, Vice President, Nuclear
R. Jaworski, Manager, Station Engineering
L. Kusek, Manager, Nuclear Safety Review Group
D. Lakin, Nuclear Review Safety Group Specialist
E. Matzke, Station Licensing Engineer
W. Orr, Manager, Quality Assurance and Quality Control
T. Patterson, Division Manager, Nuclear Operations
R. Phelps, Acting Manager, Production Engineering
J. Skiles, Acting Manager, Production Engineering Department
M. Tesar, Manager, Corrective Actions
D. Trausch, Manager, Nuclear Licensing
B. Van Sant, Engineer, Production Engineering Department

The above listed personnel attended the exit meeting. In addition to the personnel listed above, the inspectors contacted other personnel during this inspection period.

## 2 EXIT MEETING

An exit meeting was conducted on December 16, 1994. During this meeting, the inspectors reviewed the scope and findings of the report. The licensee acknowledged the items presented by the inspectors. The licensee did not identify as proprietary any information provided to, or reviewed by, the inspectors.