APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION REGION IV

NRC Inspection Report: 50-285/85-26

Operating License: DRP-40

Docket: 50-285

Licensee:

Omaha Public Power District

1623 Harney Street Omaha, Nebraska 68102

Facility Name: Fort Calhoun Station, Unit 1

Inspection At: Omaha and Fort Calhoun, Nebraska

Inspection Conducted: November 18-22, 1985

Inspectors: R. E. Chiland
A. R. Johnson, Reactor Inspector, Engineering

Section, Reactor Safety Branch

2/19/86 Date

D. Norman, Reactor Inspector, Operations

Section, Reactor Safety Branch

2/19/86 Date

Approved:

Ireland, Chief, Engineering Section

Reactor Safety Branch

2/19/86

Inspection Summary

Inspection Conducted November 18-22, 1985 (Report 50-285/85-26)

Areas Inspected: Announced, followup inspection of previously identified apparent violations, unresolved items, an open items (50-285/8509-01 through 08), and actions taken by Omaha Public Power District (OPPD) with regard to meeting the requirements of 10 CFR 50.49. Commitments made by OPPD during a December 13, 1985, meeting at Region IV, Arlington, Texas, are summarized in the inspection report. The inspection involved 81 inspector-hours onsite by two NRC inspectors. Results: The inspection determined that the licensee had completed all but four corrective actions to meet the requirements of 10 CFR 50.49, with deficiencies still open regarding apparent violations/unresolved issues identified during the NRC EQ team inspection of April 29 to May 3, 1985, (50-285/85-09) as follows:

Apparent Violation/Unresolved Item		IE Report Item	Status
1.	Allis-Chalmers Pump Motors	285/8509-01	0pen
2.	PAM Instrument Accuracy	285/8509-02	Open
3.	Conax Electric Penetration Assemblies	285/8509-03	Closed
4.	States Company Terminal Blocks	285/8509-04	Open
5.	Rockbestos Pyrotrol III Cable	285/8509-05	0pen
6.	Definition of Harsh Radiation Environment	285/8509-06	Closed
Оре	en Items		
1.	Completion of Procedures	285/8509-07	Closed
2.	Containment Ambient Temperature	285/8509-08	Closed

One unresolved item (285/8526-01 - Refer to paragraph 2.b), originally described as part of item 1 above, but not considered within the scope of the 10 CFR 50.49 program, has been identified.

DETAILS

1. Persons Contacted

Principal Licensee Employees

xW.G. Gates, Manager, Fort Calhoun Station

xMerl Core, Supervisor, Maintenance

xR. L. Andrews, Division Manager, Nuclear Production

*F. A. Thurtell, Division Manager, QARA *+A. W. Richard, Supervisor, Corporate QA

*+xR. L. Jaworski, Section Manager, Technical Services

*+xJ. K. Gasper, Manager, Administrative Services
*+S. K. Gambhir, Manager, GSE Electrical and Nuclear

+P. Surber, Section Manager, Generating Station Engineering

*+xR. F. Mehaffey, Supervisor, I&C and Electrical, Technical Services

*+D. J. Munderloh, Engineer, Nuclear Regulatory & Industry Affairs

xJ. Foley, Supervisor, I&C and Electrical

xJ. Fisicaro, Supervisor, Nuclear Regulatory and Industry Affairs

NRC

xD. Hunter, RIV, Chief, Reactor Safety Branch

xJ. Gagliardo, RIV, Chief, Reactor Projects Branch,

x+P. H. Harrell, Senior Resident Inspector

- +D. M. Hunnicutt, RIV, Chief, Reactor Projects Section B, +AR. E. Ireland, RIV, Chief, Engineering/Operations Section
- *+xA. R. Johnson, RIV, Reactor Inspector *+xD. E. Norman, RIV, Reactor Inspector
 - M. Murphy, RIV, Reactor Project Inspector

*Denotes those present during entrance interview.

+Denotes those present during exit interview

xDenotes those in attendance at the December 13, 1985, meeting at Region IV, Arlington, Texas.

In addition to the above personnel, the NRC inspectors held discussions with various operations, engineering, technical support, and administrative members of the licensees' staff.

(Open) Apparent Violation/Unresolved Item 285/8509-01 Allis-Chalmers Pump Motors

The NRC inspector reviewed the following areas with respect to cited deficiencies regarding the Component Cooling Water (CCW) pump motors:

Replacement Windings Qualifications

(1) Previous Findings:

The original motor windings for the CCW pump motors were qualified for an 18-year life based on a thermal aging analysis of the glass fiber fabric insulating material. The licensee had failed to demonstrate the claimed 40-year life of the replacement windings which had been installed in motor AC-3B, which had failed, and were to be installed in the remaining two motors.

(2) Corrective Action:

During this inspection, the NRC inspectors reviewed a Sargent and Lundy letter dated June 25, 1985, which reported results of their aging analysis of the replacement windings, with Fiberglass Polyester insulation. The analysis, based on material aging properties reported in Wyle Report No. 26333-23, showed a qualified life of 40 years based on the licensee's predicted motor operating environment. Based on this review, the replacement windings appear to be qualified for 40 years.

b. CCW Pump Vibration

In a letter dated October 11, 1985, responding to NRC Inspection Report 50-285/85-09 findings concerning the CCW motors, the licensee stated that motor AC-3A required new bearings and balancing due to high vibration levels in 1979, 1982, and 1983. It was stated that the higher frequency of repair for this motor was a result of high vibration induced by the inlet piping on AC-3A. During the inspection, the NRC inspectors reviewed Engineering Evaluation and Analysis Request (EEAR) No. FC-79-98, dated June 29, 1979, which identified a CCW pump inlet piping vibration problem. Vibration levels of 4.2 mils, without the AC-3A pump running, were identified. Modification Request No. FC 79-98, dated May 14, 1981, approved by the plant manager and section manager, stated that an emergency resolution of the problem was needed as soon as possible. The EEAR had not been closed and there was no evidence that the requested modification was completed. The apparent failure to act promptly on an identified problem is considered an unresolved item pending further review during a subsequent inspection (285/8526-01).

c. Motor Maintenance

(1) Previous Findings:

The licensee had not established nor performed a maintenance program to preserve the Allis-Chalmers CCW pump motors in a qualified state.

(2) Corrective Actions:

The licensee's stated corrective actions, with respect to the CCW pump motors, were reviewed and found to be acceptable. The NRC inspector also reviewed the manufacturer's recommended maintenance procedures and Operation Support Analysis Report (OSAR) 85-73, which was the analysis leading to the establishment of maintenance requirements. The analysis identified the need for installation of zerk fittings for lubricating the bearings with Texaco Marfax multipurpose grease at 18-month intervals. Documentation was reviewed which showed the lubricant to be able to withstand a TID of 2.3 x 10^7 RAD. This TID is well above the dose expected to be experienced by the motors. One motor will be inspected after 3 years of operation to determine the adequacy of the lubrication schedule. The licensee replaced the bearings of motor AC-3C during the current outage because the lubricant type was unknown in that motor.

Documentation for the above maintenance was reviewed and the motors were inspected to determine corrective action implementation, where possible. During the walkdown of the equipment, it was identified that intake grills on two motors were not in place.

During the meeting in Region IV on December 13, 1985, OPPD committed to complete the following additional actions concerning CCW motor maintenance prior to operating the plant at power:

- (a) Review existing procedures for adequacy and implementation.
- (b) Revise procedures to show a frequency of about 3 months for cleaning grills.
- (c) Ensure that all grills are in place prior to startup.
- (d) Assure that maintenance orders for motors (all safetyrelated equipment) require QA review and signoff of work accomplished.

d. Generic Implications of Findings Associated with CCW Motors

The EQ Master List contains a number of electric motors; however, the CCW motors were selected as a sample during the EQ team inspection, and several deficiencies were identified. As a part of the inspection followup, the NRC inspector reviewed the licensee's corrective actions and determined that they were specific to the CCW motors and did not address the maintenance program for all EQ motors. Therefore, the corrective action with respect to motor maintenance was not considered complete. During the meeting in Region IV on December 13, 1985, the licensee committed to the following additional corrective actions prior to operating the plant at power:

- (1) Review maintenance procedures for each motor on the EQ Master List to ensure that maintenance required to maintain qualification status is adequate.
- (2) Perform necessary maintenance when procedures are found to be inadequate or if maintenance had not been performed as required by current procedures.

This item will remain open pending further NRC review of the corrective actions committed to by the licensee.

Open) Apparent Violation/Unresolved Item 285/8509-02 Post Accident Monitoring Instrumentation (PAM)

(a) Previous Findings:

The required accuracies of most PAM transmitters were not established nor compared with transmitter errors reported from qualification type testing.

(b) Corrective Action:

The licensee's corrective action consisted of reviewing the questionable instrumentation requirements as outlined in Emergency Procedures (EP) 5, 5A, 5B, 29, and 36 and comparing the required accuracies to the accuracies of the instrumentation. The licensee concluded that the existing instrumentation was capable of fulfilling its PAM requirements and stated that accuracy requirements would be included in the next revision to the EEQ manual.

The NRC inspectors reviewed OSAR 85-70 which showed the analysis performed to determine if accuracies of the installed instrumentation would be adequate for the intended functions. These functions include: (1) Engineered Safety Feature Actuation, (2) Reactor Trip Initiation, and (3) Operator Information. In addition, Wyle Test Report No. 45700-1 and Victoreen Report No. 95031, which established PAM instrumentation accuracies, were reviewed. Revised Table 1 of the EEQ manual was reviewed; it presented the acceptable signal error and the Device (transmitter) error for PAM and other EEQ devices. In most cases the two errors were identical, indicating that all available tolerance was consumed by the transmitters, and no tolerance was available for the remaining instrumentation circuitry. When the total circuit tolerance is considered, it would be possible that the error of the signal being transmitted would exceed the acceptable signal error.

Additionally, the NRC inspectors reviewed calibration procedures in Operating Manual XI, Part 8, for containment pressure channels PT-783, PT-784, PT-785, and PT-786, and it appeared that after calibration errors were permitted to be in excess of the acceptable signal errors.

During the meeting in Region IV on December 13, 1985, OPPD committed to take the following additional actions regarding PAM instrumentation prior to operating the plant at power:

- (1) Determine the loop error (uncertainty) associated with each PAM instrumentation loop.
- (2) Compare errors (uncertainties) with those permitted by the new Emergency Operating Procedures (EOP), and if EOP errors (uncertainties) are exceeded, replace existing instrumentation with more accurate instrumentation.
- (3) Revise and expand EEQ Manual, Table 1 to show errors (uncertainties) of instrumentation loops compared to those permitted by the new EOPs.
- (4) Document results and conclusions of above reviews in EQ records for PAM transmitters.
- (5) Analyze required operating range of each PAM transmitter to consider the effect of higher errors (uncertainties) of transmitters when operating in the lower part of the operating range.

This item will remain open pending further NRC review of the corrective actions committed to by the licensee.

4. (Closed) Apparent Violation/Unresolved Item 285/8509-03 Conax Electrical Penetration Assemblies

(a) Previous Findings:

Electrical penetration assemblies (EPA) had been modified with Dow Corning silicone rubber RTV. Qualification after the modification had not been adequately demonstrated and/or documented.

The NRC inspectors reviewed documentation which identified 90 questionable EPAs. Teflon seals and conductor insulation in the units failed qualification tests and had been modified by applying RTV silicone rubber to the effected areas, but had not been qualified after the modification.

EEAR FC-85-009, dated January 12, 1985, identified the subject EPAs as being unqualified and recommended their replacement; however, there was no evidence at the time of the EQ team inspection that the licensee had made a decision to replace them, and it was not clear if the modification was to be substituted for replacing the EPAs.

The questionable EPAs contain 480 VAC cables which provide intermittent service to MOVs and to PORV solenoids and continuous 125 VDC, in the milliamp (ma) range, to instrumentation.

(b) Corrective Action:

The licensee elected to replace the EPAs with new qualified units. The EPA qualification packages were reviewed by the NRC inspectors. The System Component Worksheet (SCEW) showed qualification of the

replacement units to a 40-year life based on type tests. Qualification was substantiated by reviewing a Sargent and Lundy report dated November 15, 1985, in which the Arrhenius methodology supported a qualified life greater than 40 years. Test data for the model were based on Conax Report No. IPS-1319, dated October 30, 1985, in which items similar to Conax replacement EPAs had been tested in an environment more harsh than that expected at Fort Calhoun. The tested conductor sealant material (Polysulfone, 0.84ev activation energy) and conductor material (Kapton Polyimide Filen, 0.915ev activation energy) were identical to the material in the replacement EPAs. Testing of these properties had been reported in Conax Report IPS-325, dated August 16, 1985. Based on data reviewed, the NRC inspectors concluded that EPAs had been qualified for a 40-year life, not by type tests as stated on the SCEW sheet, but by provision of f(2) of Rule 50.49 which states. "Testing a similar item of equipment with a supporting analysis to show that the equipment to be qualified is acceptable.

Purchase Order No. 97233, dated May 16, 1985, issued to Conax for procuring replacement EPAs was reviewed. Specification No. 1451, dated March 12, 1985, included in the PO, stated a service environment which was more severe than stated on the SCEW sheet. The licensee explained that the environment in the procurement specification was a generic value and that the predicted environment experienced by items in the harsh environment were as stated in the EQ manual. The NRC inspectors reviewed OSAR 85-14, dated September 30, 1985, which will update the USAR to state that details of the EQ program were to be included in the EEQ Manual. Values in the SCEW sheet will, therefore, be in accordance with the USAR.

This item is considered closed.

5. (Open) Apparent Violation/Unresolved Item 285/8509-04: States Company Terminal Blocks

(a) Previous Findings:

Contrary to paragraph (f) and (k) of 10 CFR 50.49, OPPD did not test specimens of States Company terminal blocks identical to the modified configuration installed in the plant; qualification was not based solely on testing, and the evaluation of design differences between the plant equipment and specimens actually tested did not adequately establish qualification.

(b) Corrective Actions:

The NRC inspectors reviewed OPPD's analysis of the States Company Terminal blocks (TB) type NI (OSAR No. 85-74, 7/16/85) which addresses NRC Information Notices (INs) 84-47 and 83-03. The OPPD position is that the OSAR 85-74 analysis demonstrates qualification of the type NI TBs without credit taken for the RTV application. The NRC inspector also reviewed OSAR 85-23 EQ qualification file, which had been reviewed previously by the NRC inspector during the EQ team

team inspection, 50-285/85-09, of April and May 1985. This qualification file included the General Electric (GE) EQ testing and supporting analysis by Sargent & Lundy (S&L), including a thermal aging analysis by Wyle Laboratories.

The inspection revealed sufficient documentation in OPPD's EQ files to demonstrate that the concern about insulation resistance drop (from 10^{10} to 10^4 ohms) during LOCA tests (as outlined in IN 85-47 during Sandia testing), did not jeopardize any safety function as demonstrated by the above mentioned analysis. However, there is uncertainty about the condition of the RTV barrier, which may have been damaged during repairs or modifications; such damage could create unknown current leakage conditions in the presence of a harsh environment, where the moisture intrusion barrier of the RTV had been broken, and moisture could buildup in holes and cups, etc.

This matter remains open.

Further, the inspection revealed that OPPD did not reapply RTV nor did procedures exist for reapplication of the RTV, when terminations were removed/added to TBs during routine station modifications, maintenance, and surveillance activities. RTV was applied apparently to provide a moisture intrusion barrier to all terminations in junction boxes within the harsh environment. Additionally it was also noted that the RTV was applied during the construction of the Fort Calhoun Station as a wide spread practice by Gibbs & Hill, the architect engineer (AE). The RTV was applied to terminations after the QC inspection was completed.

In OPPD's response letter to the NRC dated October 11, 1985, and at a subsequent meeting in Region IV on December 13, 1985, a commitment was made to change out the TBs to Raychem qualified nuclear splices for: two pressurizer pressure control circuits, four HPSI loop flow circuits to Foxboro transmitters, and two RPS/ESF pressurizer pressure Foxboro transmitter circuits. The remaining equipment identified in the EQ team inspection, was qualified by the above mentioned OSAR 85-74 analysis. This involved only ASCO pilot solenoids for air operated valves, with their associated NAMCO limit switches.

OPPD committed to the following actions of providing qualified terminal blocks: (1) to implement an inspection program identifying those areas where the RTV had broken barriers on TBs (estimate 80 to 100); (2) to repair damaged RTV in those areas, controlled by new procedure, (special process) and (3) to reinspect the subject TBs in accordance with their QA/QC program. Reinspection under OPPD's maintenance order would constitute a visual inspection of completed work, verification of RTV adherence, proper junction box drainage, and an appropriate QC/QA signoff.

OPPD stated that the foregoing actions would be completed before the plant was returned to power operation.

This item remains open.

6. (Open) Apparent Violation/Unresolved Item 285/8509-05: Rockbestos (Cerro) Pyrotrol III Cable

(a) Previous Findings:

Contrary to paragraph (f) and (k) of 10 CFR 50.49, OPPD did not test specimens of Rockbestos Pyrotrol III cable identical in composition to the cable installed in the plant; qualification was not based solely on testing, and the evaluation of differences between the plant cable and the specimens actually tested did not adequately establish qualification.

(b) Corrective Actions:

OPPD's attempt to qualify Pyrotrol III cable by similarity to Firewall III, as reviewed during the EQ team inspection during April and May 1985, had been replaced with OPPD's qualification file No. OSAR 85-72. The NRC inspectors reviewed the OPPD analysis and the Franklin Report (F-C3348, April 1972) which were contained in their qualification file OSAR No. 85-72. The F-C3348 Franklin tests involved cable splices with Pyrotrol III cable, for the original Fort Calhour Station containment penetration splices (no longer installed). OPPD has elected to take credit for the cable qualification aspects of the F-C3348 testing.

The NRC followup inspection revealed that the F-C3348 Franklin Report contained sufficient documentation to demonstrate Rockbestos (Cerro) Pyrotrol III qualification during LOCA testing under the DOR guideline requirements. The cable specimens were unaged, as permitted under DOR guidelines. The test report contained documented test data sheets, strip chart and multipoint recordings, and a list of instrumentation used during the test. The test report indicated that tests were closely monitored and controlled by a test plan. No test anomalies were identified related to cable qualification. The NRC inspector compared the five 3-hour DBA steam-temperature (included chemical spray) profiles of this test to the MSLB/LOCA environments of the Fort Calhoun EEQ Manual. The five test p ofiles enveloped the Fort Calhoun LOCA environments adequately. The Fort Calhoun MSLB environment was above the test profiles for 35 seconds with a 355°F However, the MSLB qualification inside the containment is not required for Fort Calhoun, as permitted by the DOR guidelines for plants with fully-automatic redundant containment spray systems.

The NRC inspection revealed that the OPPD analysis of the OSAR 85-72 qualification file was adequate to address the radiation and aging aspects of Pyrotrol III cable qualification under DOR guideline requirements.

The analysis indicated the Pyrotrol III cross linked polymer (XLPE) to be suitable for 1 x 10^8 rads TID in accordance with EPRI Report NP 2129. This was well above the expected exposure for gamma and beta, including

worst case background radiation. Wyle Laboratories, Report No. 26333, October 1980, was included in support of the expected beta radiation effects. The analysis using the Arrhenius methodology also indicated a 40-year qualified life (QL) for Pyrotrol III cable, for the worst case conditions inside the containment, considering heat rise due to motor loads, ampacity, and duty cycle. The HPSI pump motors and containment vent fan motors were selected to represent the worst case. The NRC inspectors concluded that sufficient documentation existed in OPPD's EQ files to demonstrate that Rockbestos (Cerro) Pyrotrol III cable is qualified in containment.

During the inspection, however, it was revealed that the ambient temperature of room 81 (Aux bldg) was not considered during the thermal aging calculation of the Pyrotrol III cable used outside the containment. The cable in question was the Pyrotrol III cable which was routed through room 81 to the containment for the containment vent fan cooling motors. Rough calculations indicated a QL of less than 40 years. At the time of the inspections, OPPD was in the process of evaluating conservatisms to this methodology. OPPD proposed to take credit for redundant cables to the vent fan motors, and to reevaluate the duty cycle calculations, to reduce the heat rise factors in the Arrhenius equation. OPPD committed to formalize these analyses and place them in their EQ qualification file. OPPD also committed to recheck a sample of EQ equipment outside the containment, where therma' aging calculations were used in their analyses applied to Pyrotrol III cable qualification. If these analyses do not demonstrate a qualified life of at least 40 years, they will establish a time at which the cables must be replaced.

This item remains open.

(Closed) Apparent Violation/Unresolved Item 50-285/8509-06: Definition of Harsh Radiation Environment

(a) Previous Findings:

The licensee had not established that no EQ equipment could be degraded by a total radiation dose of 1.0×10^5 rads.

The NRC concerns were related to Regulatory Position C.4.C, discussed in Regulatory Guide 1.89, Revision 1, with regard to equipment exposed to low-level radiation doses with damage thresholds greater than 10^4 rads; generally data exists to show that components containing organic materials would remain functional for a TID of 1.0 x 10^5 rads; but for electronic components failures in metal oxide semiconductor devices can occur at somewhat lower doses.

(b) Corrective Action:

OPPD addressed the concern about choosing a radiation threshold dose low enough to ensure that radiation damage to master list equipment

was adequately considered. OPPD's screening criteria for radiation dose effects were reviewed during the followup inspection effort.

The NRC inspectors reviewed the OPPD EQ program documents which establish the new screening criteria: (1) EEQ Manual, Enclosure 1, Revision 1, "EEQ Program Users Guide", September 20, 1985; (2) OSAR 85-33, "EEQ Environmental Determination," April 29, 1985, and (3) OSAR 85-69 "EEQ Mild Environment," September 25, 1985.

OPPD revised the above documents to reflect a screening criterion in the range of 10^5 to 10^3 rad for electric equipment requiring equipment evaluation on an individual basis for its applicability, using caution when epoxy resin or nylon is involved. This criterion was supported by the review and tests conducted by EPRI (Report NP-2129) and confirmed by EPRI Report NP-4172 M which cautions about the use of epoxy resin or nylon.

OPPD's screening criteria for <u>electronic</u> components were revised to reflect 10³ rads in the above documents.

OPPD has identified and evaluated each piece of equipment using the new screening criterion, both for <u>electronic</u> and <u>electric</u> equipment. The evaluation considered all EQ equipment on a case by case basis for applicability.

This item is considered closed.

8. (Closed) Open Item 285/8509-07: Completion of Procedures

(a) Previous Finding:

Three isolated deficiencies were identified concerning inadequate EQ Procedures.

(b) Corrective Actions:

The NRC inspectors reviewed SO G-21, Revision 24, dated September 26, 1985, "Station Modification Control" and Administrative Procedure A-6, dated August 1985, "Electrical Equipment Qualification Control File (EEQCF) Control and Updating." Resolution of the concerns expressed during the EQ team inspection was verified.

This item is considered closed.

9. (Closed) Open Item 284/8509-08: Containment Ambient Temperature

(a) Previous Findings:

Containment ambient temperatures of 85° F were used in OPPD's thermal aging calculations in their qualification files for replacement trans-

mitters used in containment. Documentation in support of this value was requested, but the item remained open at the close of NRC team inspection.

(b) Corrective Action:

The NRC inspectors reviewed OPPD's analysis (OSAR-85-67, July 19, 1985), which: (1) demonstrates the correctness of the normal EEQ containment operating temperature environment of 85°F; and (2) establishes actual temperature margins for each type of equipment in the containment and demonstrates the conservatism used by OPPD in their determination of EEQ program QL. These margins demonstrate qualification to 90°F with no required rebuilding or maintenance of the equipment. OSAR-85-67 was reviewed by the NRC as supplemental to OPPD's response letter to the NRC, dated October 11, 1985.

The NRC inspectors reviewed the Arrhenius methodology calculation used to determine equivalent aging for the equipment with the highest degree of sensitivity to temperature excursions over 85°F (Target Rock solenoids). The calculation demonstrated less degradation than would be expected if the material were aged at a constant 85°F without variation throughout its qualified life.

The NRC inspectors reviewed OPPD's calculations for each type of equipment in containment to demonstrate conservatisms used by OPPD in their EEQ program in determining QL. Each type of equipment was considered for required QL plus ten percent; OPPD demonstrated qualification to an equivalent containment ambient temperature of 90°F.

This open item is considered closed.

10. Exit Meeting

The NRC inspectors met with licensee representatives on November 22, 1985, to discuss the scope and findings of the inspection. The NRC inspectors and Regional Staff met with licensee representatives in the Region IV offices on December 13, 1985, to discuss the corrective actions to be taken with regard to EQ Team Inspection Report 50-285/85-09 and the corrective actions which were still needed to resolve issues raised during the November 18-22, 1985, followup inspection.