March 1, 2001

Mr. S. K. Gambhir
Division Manager - Nuclear Operations
Omaha Public Power District
Fort Calhoun Station FC-2-4 Adm.
Post Office Box 399
Hwy. 75 - North of Fort Calhoun
Fort Calhoun, NE 68023-0399

SUBJECT: FORT CALHOUN STATION, UNIT NO. 1 - ISSUANCE OF AMENDMENT RE: LEAK TIGHT SLEEVES AS AN ALTERNATIVE TUBE REPAIR METHOD TO PLUGGING DEFECTIVE STEAM GENERATOR TUBES (TAC NO. MA9653)

Dear Mr. Gambhir:

The Commission has issued the enclosed Amendment No. 195 to Facility Operating License No. DPR-40 for the Fort Calhoun Station, Unit No. 1. The amendment consists of changes to the Technical Specifications (TS) in response to your application dated July 28, 2000, as supplemented by letter dated December 14, 2000.

The amendment revises TS Sections 2.1.4, 3.1, 3.17, Table 3-13, Table 3-14, and associated Bases, to allow the installation of ABB Combustion Engineering leak tight sleeves as an alternative tube repair method to plugging defective steam generator tubes.

A copy of the related Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's next biweekly *Federal Register* notice.

Sincerely,

/RA/

L. Raynard Wharton, Project Manager, Section 2
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-285

Enclosures: 1. Amendment No. 195 to DPR-40
2. Safety Evaluation

cc w/encls: See next page

* by phone

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 1, 2001

Mr. S. K. Gambhir
Division Manager - Nuclear Operations
Omaha Public Power District
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L. Raynard Wharton

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

OMAHA PUBLIC POWER DISTRICT

DOCKET NO. 50-285

FORT CALHOUN STATION, UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 195
License No. DPR-40

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by the Omaha Public Power District (the licensee) dated July 28, 2000, as supplemented by letter dated December 14, 2000, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this license amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, Facility Operating License No. DPR-40 is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 3.B. of Facility Operating License No. DPR-40 is hereby amended to read as follows:

    B. <u>Technical Specifications</u>

    The Technical Specifications contained in Appendix A, as revised through Amendment No. 195, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. The license amendment is effective as of its date of issuance and shall be implemented within 30 days from the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Stephen Dembek, Chief, Section 2
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: March 1, 2001

ATTACHMENT TO LICENSE AMENDMENT NO. 195

FACILITY OPERATING LICENSE NO. DPR-40

DOCKET NO. 50-285

Replace the following pages of Appendix A Technical Specifications with the attached revised pages. The revised pages are identified by amendment number and contain vertical lines indicating the areas of change.

REMOVE	INSERT
v	v
vii	vii
2-11	2-11
2-12a	2-12a
3-2	3-2
3-86	3-86
---	3-86a
3-87	3-87
3-88	3-88
3-89	3-89
---	3-89a
---	3-89b
3-90	3-90
---	3-90a
3-91	3-91

TECHNICAL SPECIFICATIONS - TABLES

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TABLE OF CONTENTS (ALPHABETICAL ORDER)
Continued

2.0 LIMITING CONDITIONS FOR OPERATION

2.1 Reactor Coolant System (Continued)

2.1.4 Reactor Coolant System Leakage Limits

Applicability

Applies to the leakage rates of the reactor coolant system whenever the reactor coolant temperature (T_{cold}) is greater than 210 °F.

Objective

To specify limiting conditions of the reactor coolant system leakage rates.

Specifications

To assure safe reactor operation, the following limiting conditions of the reactor coolant system leakage rates must be met:

(1) If the reactor coolant system leakage exceeds 1 gpm and the source of leakage is not identified within 12 hours, the reactor shall be placed in the hot shutdown condition. If the source leakage exceeds 1 gpm and is not identified within 24 hours, the reactor shall be placed in the cold shutdown condition.

(2) If leakage exceeds 10 gpm, the reactor shall be placed in the hot shutdown condition within 12 hours. If the leakage exceeds 10 gpm for 24 hours, the reactor shall be placed in the cold shutdown condition.

(3) Primary-to-secondary leakage through the steam generator tubes shall be limited to 150 gallons per day per steam generator and 300 gallons per day total for both steam generators. When primary-to-secondary leakage has been determined to be in excess of the limit, the leakage rate shall be reduced to within limits in 4 hours or the reactor shall be placed in the cold shutdown condition within the next 36 hours.

(4) To determine leakage to the containment, a containment atmosphere radiation monitor (gaseous or particulate) or dew point instrument, and a containment sump level instrument must be operable.

   a. With no containment sump level instrument operable, verify that a containment atmosphere radiation monitor is operable, and restore the containment sump level instrument to operable status within 30 days.

   b. With no containment atmosphere radiation monitor and no dewpoint instrument operable, restore either a radiation monitor or dewpoint instrument to operable status within 30 days.

   c. With only the dewpoint instrument operable, or with no operable instruments, enter Specification 2.0.1 immediately.

Limiting primary to secondary leakage is important to ensure steam generator tube integrity. The plant is expected to be operated in a manner such that the secondary coolant will be maintained within those chemistry limits found to result in negligible corrosion of the steam generator tubes. If the secondary coolant chemistry is not maintained within these limits, localized corrosion may likely result in stress corrosion cracking. The extent of cracking during plant operation would be limited by the limitation of steam generator tube leakage between the primary coolant system and the secondary coolant system (primary-to-secondary leakage = 150 gallons per day through any one steam generator or 300 gallons per day total). The safety analysis assumes a 1 gpm primary to secondary leak as the initial condition. The Technical Specification requirement to limit primary to secondary leakage through any one steam generator to less than 150 gallons per day is significantly less than the initial condition for the safety analysis. This limit is based on industry operating experience as an indication of one or more propagating tube leak mechanisms. This leakage rate provides reasonable assurance against tube burst at normal and faulted conditions and provides reasonable assurance that flaws will not propagate to burst prior to detection by leakage monitoring and commencement of plant shutdown. Operating plants have demonstrated that primary-to-secondary leakage of 150 gallons per day can readily be detected by radiation monitors. Leakage from any one steam generator in excess of this limit will require plant shutdown and an unscheduled inspection, during which the leaking tubes will be located and plugged or repaired.

References

(1) USAR, Section 11.2.3

(2) USAR, Page G.16-1

3.0 SURVEILLANCE REQUIREMENTS

3.1 Instrumentation and Control (Continued)

Substantial calibration shifts within a channel (essentially a channel failure) will be revealed during routine checking and testing procedures.

The minimum calibration frequencies of once-per-day (heat balance adjustment only) for the power range safety channels, and once each refueling shutdown for the process system channels, are considered adequate.

The minimum testing frequency for those instrument channels connected to the Reactor Protective System and Engineered Safety Features is based on ABB/CE probabilistic risk analyses and the accumulation of specific operating history. The quarterly frequency for the channel functional tests for these systems is based on the analyses presented in the NRC approved topical report CEN-327-A, "RPS/ESFAS Extended Test Interval Evaluation," as supplemented, and OPPD's Engineering Analysis EA-FC-93-064, "RPS/ESF Functional Test Drift Analysis."

The low temperature setpoint power operated relief valve (PORV) CHANNEL FUNCTIONAL TEST verifies operability of the actuation circuitry using the installed test switches. PORV actuation could depressurize the reactor coolant system and is not required.

Calibration of instrument channels with resistance temperature detector (RTD) or thermocouple sensors may consist of an inplace qualitative assessment of sensor behavior and normal calibration of the remaining adjustable devices in the channel. Whenever a sensing element is replaced, the next required CHANNEL CALIBRATION shall include an inplace cross calibration that compares the other sensing elements with the recently installed sensing element. The CHANNEL CALIBRATION may be performed by means of any series of sequential, overlapping, or total channel steps so that the entire channel is calibrated.

Calculation of the Reactor Coolant System (RCS) total flow rate by performance of a precision calorimetric heat balance once every 18 months verifies that the actual RCS flow rate is greater than or equal to the minimum required RCS flow rate (Table 3-3, Item 15, Reactor Coolant Flow).

The Frequency of 18 months reflects the importance of verifying flow after a refueling outage when the core has been altered, Steam Generator tubes plugged or repaired, or other activities, which may have caused an alteration of flow resistance.

This requirement is modified by a footnote that requires the surveillance to be performed within 24 hours after ≥95% reactor thermal power (RTP) following power escalation from a refueling outage. The footnote is necessary to allow measurement of the flow rate at normal operating conditions at power in MODE 1.

3.0 SURVEILLANCE REQUIREMENTS

3.17 Steam Generator Tubes

Applicability

Applies to in-service surveillance of steam generator tubes.

Objective

To ensure the integrity of the steam generator tubes.

Specifications

Each steam generator shall be demonstrated OPERABLE by performance of the following in-service inspection program.

(1) Steam Generator Sample Selection and Inspection Methods

The in-service inspection shall be performed on each steam generator on a rotating schedule. Under some circumstances, the operating conditions in one steam generator may be found to be more severe than those in the second steam generator. Under such circumstances, the sample sequence shall be modified to inspect the steam generator with the most severe conditions.

(2) Steam Generator Tube Sample Selection and Inspection

The steam generator tube minimum sample size, inspection result classification, and the corresponding action required shall be as specified in Table 3-13. The in-service inspection of steam generator tubes shall be performed according to Specification 3.17(4)(i), "Tube Inspection," and at the frequencies specified in Specification 3.17(3). The inspected tubes shall be verified acceptable per the acceptance criteria of Specification 3.17(4). When applying the exceptions of (i), (ii) and (iii) below, previous degradation, imperfections, or defects in the area of the tube repaired by sleeving are not considered an area requiring reinspection or inspection of adjacent tubes. The tubes selected for each in-service inspection shall include at least 3% of the total tubes in the steam generators and the tubes selected for these inspections shall be selected on a random basis, except:

(i) If the tube is recorded as a degraded tube, then an adjacent tube shall be inspected.

(ii) The first sample inspection during each in-service inspection of each steam generator shall include all non-plugged tubes that previously had detectable wall penetrations (>20%) and shall also include tubes in those areas where experience has indicated potential problems.

(iii) The second and third sample inspections, if required, may be less than an entire tube length inspection provided the inspection concentrates on those

areas of the tube sheet array and on those portions of the tubes where defects were previously detected.

(iv) To the extent practical, where experience in similar plants with similar water chemistry indicates critical areas to be inspected, then at least 50% of the tubes inspected shall be from these critical areas.

The results of each sample inspection shall be classified into one of the following three categories (this classification shall apply to the inspection of tubes and is exclusive of the sleeve inspection requirements in Specification 3.17(2a)).

Category	Inspection Results
C-1	No more than 5% of the tubes inspected are degraded and none of the inspected tubes are defective.
C-2	No more than 1% of the tubes inspected are defective, or between 5% and 10% of the tubes inspected are degraded.
C-3	More than 1% of the tubes inspected are defective, or more than 10% of the tubes inspected are degraded.

NOTE: In all inspections, previously degraded tubes must exhibit growth of greater than 10% through wall or growth of greater than 25% of the repair limit to be included in the above calculations.

(2a) Steam Generator Tube Sleeve Sample Selection and Inspection

The steam generator tube sleeve minimum sample size, inspection result classification, and the corresponding action required shall be as specified in Table 3-14. The in-service inspection of steam generator tube sleeves shall be performed according to Specification 3.17(4)(i), "Tube Sleeve Inspection," and at the frequencies specified in Specification 3.17(3). The inspected tube sleeves shall be verified acceptable per the acceptance criteria of Specification 3.17(4). The tube sleeves selected for each in-service inspection shall include at least 20% of the total number of tube sleeves in the steam generators and the tube sleeves selected for these inspections shall be selected on a random basis, except:

(i) If the tube seleeve is recorded as a degraded tube sleeve and an adjacent tube sleeve exists, then an adjacent tube sleeve shall be inspected.

(ii) The first sample inspection during each in-service inspection of each steam generator shall include all tube sleeves in non-plugged tubes that previously had detectable wall penetrations (> 20%) and shall also include tube sleeves in those areas where experience has indicated potential problems.

(iii) To the extent practical, where experience in similar plants with similar water chemistry indicates critical areas to be inspected, then at least 50% of the tube sleeves inspected shall be from these critical areas. Where the number of sleeves in the critical areas represent less than 50% of the initial sample, all sleeves in the critical areas shall be inspected.

The results of each sample inspection shall be classified into one of the following three categories (this classification shall apply to the inspection of sleeves and is exclusive of the tube inspection requirements in Specification 3.17(2)).

Category	Inspection Results
C-1	No more than 5% of the tube sleeves inspected are degraded and none of the inspected tube sleeves are defective.
C-2	No more than 1% of the tube sleeves inspected are defective, or between 5% and 10% of the tube sleeves inspected are degraded.
C-3	More than 1% of the tube sleeves inspected are defective, or more than 10% of the tube sleeves inspected are degraded.

NOTE: In all inspections, previously degraded tube sleeves must exhibit growth of greater than 10% through wall or growth of greater than 25% of the repair limit to be included in the above calculations.

(3) Inspection Frequencies

The above required in-service inspections of steam generator tubes and tube sleeves shall be performed at the following frequencies (inspections shall be performed, unless otherwise specified, coincident with refueling outages or any scheduled cold shutdown for plant repair and maintenance):

(i) In-service inspections shall be performed at intervals of not less than 12 nor more than 24 calendar months after the previous inspection, subject to the following clarifications and exceptions.

1. If a plant operating cycle is less than 12 months, inspections may be performed at the end of that cycle.

2. If two consecutive tube inspections following service under all volatile treatment conditions result in all inspection results falling into the C-1 category or if two consecutive tube inspections demonstrate that previously observed degradation has not continued and no additional degradation has occurred, the tube inspection interval may be extended to a maximum of once per 40 months.

3. The inspections of tube sleeves shall be configured to ensure that each individual tube sleeve is inspected at least once in 60 months, with the following exception: if the 60 month time frame fails during an operating cycle, completion of that cycle is acceptable prior to meeting this requirement.

(ii) Increased Inspection Frequencies

1. If results of the in-service inspection of the steam generator tubes conducted in accordance with Table 3-13 at 40-month intervals fall in Category C-3, the inspection frequency shall be increased to at least once per 20 months. The increase in inspection frequency shall apply until a subsequent inspection meets the conditions specified in Section 3.17(3)(i)2 above, at which time the interval can be extended to a 40-month period.

2. If results of the inservice inspection of tube sleeves conducted in accordance with Table 3-14 fall into Category C-3, the inspection frequency shall be increased such that 100% of the tube sleeves in the affected steam generator are inspected during subsequent inspections. The increase in inspection frequency shall apply until two consecutive tube sleeve inspections meet the conditions for Category C-1 or two consecutive tube sleeve inspections demonstrate that previously observed degradation has not continued and no additional degradation has occurred, at which time the inspection frequency of Specification 3.17(3)(i)3 shall again apply.

(iii) Unscheduled in-service inspections shall be performed on each steam generator in accordance with the first sample inspection specified in Tables 3-13 and 3-14 during the shutdown subsequent to any of the following conditions:

1. Primary-to-secondary tube leaks (not including leaks originating from tube-to-tube sheet welds) in excess of the limits of Section 2.1.4 of the Technical Specifications,

2. A seismic occurrence greater than the Operating Basis Earthquake,

3. A loss-of-coolant accident requiring actuation of the engineered safeguards, or

4. A main steam line or main feedwater line break.

(4) Acceptance Criteria

(i) As used in this specification:

Imperfection means an exception to the dimensions, finish or contour of a tube or sleeve from that required by fabrication drawings or specifications. Eddy-current testing indications below 20% of the nominal tube or sleeve wall thickness, if detectable, may be considered as imperfections.

Degradation means a service-induced cracking, wastage, wear or general corrosion occurring on either inside or outside of a tube or sleeve.

Degraded Tube or Sleeve means a tube or sleeve containing imperfections $\geq$20% of the nominal wall thickness caused by degradation. Any tube which does not permit the passage of the eddy-current inspection probe through its entire length and U-bend shall be deemed a degraded tube. Any tube sleeve which does not permit the passage of the eddy current inspection probe through its entire length shall be deemed a degraded sleeve.

% Degradation means the percentage of the tube or sleeve wall thickness affected or removed by degradation.

Defect means an imperfection of such severity that it exceeds the plugging or repair limit.

Plugging or Repair Limit means the imperfection depth at or beyond which the tube shall be removed from service by plugging or repaired by sleeving in the affected area because it may become unserviceable prior to the next inspection. Plugging or repair limit is equal to 40% of the nominal tube wall thickness for the original tube wall. Sleeved tubes shall be plugged upon detection of unacceptable degradation in the pressure boundary region of the sleeve.

Unserviceable describes the condition of a tube or sleeve if it leaks in excess of analyzed limits or contains a defect large enough to affect its structural integrity in the event of an Operating Basis Earthquake, a loss-of-coolant accident, or a steam line or feedwater line break.

Tube or Tubing means that portion of the tube which forms the primary system to the second system pressure boundary.

Tube Inspection means an inspection of the steam generator tube from the point of entry (hot leg side) completely around the U-bend to the top support of the cold leg, excluding any areas defined under "Tube Sleeve Inspection."

Tube Repair or Sleeve refers to a process that re-establishes tube serviceability. Acceptable tube repairs will be performed using the Combustion Engineering, Inc. Leak Tight Sleeve as described in the proprietary Combustion Engineering, Inc. Report, CEN-630-P, Revision 02, "Repair of 3/4" O.D. Steam Generator Tubes Using Leak Tight Sleeves," June 1997.

Tube repair includes the removal of plugs that were previously installed as a corrective or preventive measure for the purpose of sleeving the tube. A tube inspection as defined herein is required prior to returning previously plugged tubes to service.

Tube Sleeve Inspection refers to inspection of the section of the steam generator tube repaired by sleeving. This includes the pressure retaining portions of the parent tube in contact with the sleeve, the sleeve-to-tube weld, and the pressure retaining portion of the sleeve.

(ii) The steam generator shall be determined OPERABLE after completing the corresponding actions (plug or repair all tubes exceeding the plugging or repair limit and all tubes containing through-wall cracks, plug all tubes with sleeves containing defects) required by Tables 3-13 and 3-14.

(5) Reporting Requirements

(i) Following each in-service inspection of steam generator tubes, the number of tubes plugged or repaired in each steam generator shall be reported to the Commission within 30 days.

(ii) The complete results of the steam generator tube in-service inspection shall be reported to the Commission within 6 months following completion of the inspection. This report shall include:

1. Number and extent of tubes and tube sleeves inspected.

2. Location and percent of wall thickness penetration for each imperfection.

3. Identification of tubes plugged.

4. Identification of tubes repaired by sleeving.

(iii) Results of steam generator tube inspections which fall into Category C-3 and require prompt notification of the Commission shall be reported pursuant to Section 5.6 of the Technical Specifications prior to resumption of plant operation. The written followup of this report shall provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence.

TABLE 3-13

STEAM GENERATOR TUBE INSPECTION

<table>
<tr><th colspan="3">1st Sample Inspection</th><th colspan="2">2nd Sample Inspection</th><th colspan="2">3rd Sample Inspection</th></tr>
<tr><th>Sample Size</th><th>Result</th><th>Action Required</th><th>Result</th><th>Action Required</th><th>Result</th><th>Action Required</th></tr>
<tr><td rowspan="8">A minimum of 300 tubes per S.G.</td><td>C-1</td><td>None</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td rowspan="4">C-2</td><td rowspan="4">Plug or repair defective tubes and inspect additional 600 tubes in this S.G.</td><td>C-1</td><td>None</td><td>N/A</td><td>N/A</td></tr>
<tr><td rowspan="2">C-2</td><td rowspan="2">Plug or repair defective tubes and inspect additional 1200 tubes in this S.G.</td><td>C-1</td><td>None</td></tr>
<tr><td>C-2</td><td>Plug or repair defective tubes</td></tr>
<tr><td>C-3</td><td>Perform action for C-3 result of first sample</td><td>C-3</td><td>Perform action for C-3 result of first sample</td></tr>
<tr><td rowspan="3">C-3</td><td rowspan="3">Inspect all tubes in this S.G., plug or repair defective tubes and inspect 600 tubes in other S.G.

Prompt notification to NRC pursuant to specification 5.6</td><td>The second S.G. is C-1</td><td>None</td><td>N/A</td><td>N/A</td></tr>
<tr><td>The second S.G. is C-2</td><td>Perform action for C-2 result of second sample</td><td>N/A</td><td>N/A</td></tr>
<tr><td>The second S.G. is C-3</td><td>Inspect all tubes in the second S.G. and plug or repair defective tubes. Prompt notification to NRC pursuant to specification 5.6</td><td>N/A</td><td>N/A</td></tr>
</table>

N/A - Not applicable

TABLE 3-14

STEAM GENERATOR TUBE SLEEVE INSPECTION

<table>
<tr><th colspan="3">1st Sample Inspection</th><th colspan="2">2nd Sample Inspection</th></tr>
<tr><th>Sample Size</th><th>Result</th><th>Action Required</th><th>Result</th><th>Action Required</th></tr>
<tr><td rowspan="7">A minimum of 20% of the installed tube sleeves</td><td>C-1</td><td>None</td><td>N/A</td><td>N/A</td></tr>
<tr><td rowspan="3">C-2</td><td rowspan="3">Plug tubes containing defective sleeves and inspect all remaining installed sleeves in this S.G.</td><td>C-1</td><td>None</td></tr>
<tr><td>C-2</td><td>Plug tubes containing defective sleeves</td></tr>
<tr><td>C-3</td><td>Perform action for C-3 result of first sample</td></tr>
<tr><td rowspan="3">C-3</td><td rowspan="3">Inspect all installed sleeves in this S.G., plug tubes containing defective sleeves, and inspect a minimum of 20% of the installed sleeves in other S.G.

Add the tubes with defective sleeves to the number of defective tubes list for NRC notification per Table 3-13</td><td>The second S.G. is C-1</td><td>None</td></tr>
<tr><td>The second S.G. is C-2</td><td>Perform action for C-2 result of first sample</td></tr>
<tr><td>The second S.G. is C-3</td><td>Inspect all sleeves in the second S.G. and plug tubes containing defective sleeves. Add the tubes with defective sleeves to the number of defective tubes list for NRC notification per Table 3-13</td></tr>
</table>

N/A - Not applicable

Basis

The surveillance requirements for inspection of the steam generator tubes and tube sleeves ensure that the structural integrity of this portion of the RCS will be maintained. The program for in-service inspection of the steam generator tubes is based on a modification of Regulatory Guide 1.83, Revision 1, dated July 1975. The program for in-service inspection of steam generator tube sleeves is based on a modification of EPRI PWR Steam Generator Examination Guidelines, Revision 5, Dated September 1997. In-service inspection of steam generator tubing and tube sleeves is essential in order to maintain surveillance of the conditions of the tubes and sleeves in the event that there is evidence of mechanical damage or progressive degradation due to design, manufacturing errors, or in-service conditions that lead to corrosion.

In-service inspection of steam generator tubing and tube sleeves also provides a means of characterizing the nature and cause of any tube or sleeve degradation so that corrective measures can be taken.

Tubes with defects may be repaired by a Combustion Engineering, Inc. Leak Tight Sleeve. The technical bases for sleeving repair are described in the Proprietary Combustion Engineering, Inc. Report CEN-630-P, Revision 02, "Repair of 3/4" O.D. Steam Generator Tubes Using Leak Tight Sleeves," June 1997.

Whenever the results of any steam generator tubing in-service inspection fall into Category C-3, these results will be promptly reported to the Commission pursuant to Section 5.6 of the Technical Specifications prior to the resumption of plant operation. Such cases will be considered by the Commission on a case-by-case basis and may result in a requirement for analysis, laboratory examinations, tests, additional eddy-current inspection, and revision of the Technical Specifications, if necessary.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 195 TO FACILITY OPERATING LICENSE NO. DPR-40

OMAHA PUBLIC POWER DISTRICT

FORT CALHOUN STATION, UNIT NO. 1

DOCKET NO. 50-285

1.0 INTRODUCTION

By application dated July 28, 2000, as supplemented by letter dated December 14, 2000, Omaha Public Power District (OPPD) requested changes to the Technical Specifications (TS) (Appendix A to Facility Operating License No. DPR-40) for the Fort Calhoun Station, Unit No. 1 (FCS). The requested changes would allow the installation of ABB Combustion Engineering (ABB-CE) leak tight sleeves in defective steam generator tubes as a tube repair method.

The ABB-CE sleeves consist of a tubesheet sleeve design and a tube support sleeve design. A tubesheet sleeve is designed to repair the degraded portion of a tube in the vicinity of the top of the tubesheet. A tube support sleeve is designed to repair the degraded freespan or support plate region of a tube. The revised TS would reference the current generic topical report for ABB/CE welded sleeves, CEN-630-P, Revision 02, "Repair of 3/4-inch O. D. Steam Generator Tubes Using Leak Tight Sleeves," dated June 1997.

The December 14, 2000, supplemental letter provided additional clarifying information, did not expand the scope of the application as originally noticed, and did not change the staff's original proposed no significant hazards consideration determination published in the *Federal Register* on October 18, 2000 (65 FR 62388).

The staff has approved the use of similarly designed sleeves in U.S. nuclear plants. The staff's review of OPPD's submittal is therefore focused on those issues warranting revision, amplification, or inclusion based on plant-specific information. Details of prior staff evaluations of ABB-CE leak tight sleeves may be found in the safety evaluations for Waterford Steam Electric Station, Unit 3, Docket No. 50-382, dated December 14, 1995; Byron Nuclear Power Station, Units 1 and 2 and Braidwood Nuclear Power Station, Units 1 and 2, Docket Nos. 50-454, 50-455, 50-456 and 50-457, dated April 12, 1996; Kewaunee Nuclear Power Plant, Docket No. 50-305, dated June 7, 1997; Prairie Island Units 1 and 2, Docket Nos. 50-282 and 50-306, dated November 4, 1997; Beaver Valley Unit 1, Docket No. 50-334, dated November 25, 1997; and San Onofre Units 2 and 3, Docket Nos. 50-361 and 50-362, dated August 26, 1998; Palo Verde Units 1, 2, and 3, Docket Nos. 50-528, 50-529 and 50-530 dated June 16, 1999.

2.0 BACKGROUND

Previous staff evaluation of ABB-CE sleeves addressed the technical adequacy of the design of the sleeves in terms of structural requirements, material of construction, welding, and non-destructive examination. The staff found the analyses and tests that were submitted to address these areas of component design to be acceptable.

The function of sleeves is to restore the structural and leakage integrity of the tube pressure boundary. Consequently, structural analyses were performed for a variety of loadings including design pressure, operating transients, and other parameters selected to envelope loads imposed during normal operating, upset, and accident conditions. Stress analyses of sleeved tube assemblies were performed in accordance with the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III. Detailed in CEN-630-P, Revision 02, the structural integrity of the sleeve design has been investigated analytically and verified by laboratory tests of sleeve mockups. These analyses, along with the results of qualification testing and previous plant operating experience were cited to demonstrate that the sleeved tube assembly is capable of restoring steam generator tube integrity.

The sleeve material, thermally treated (TT) Alloy 690, is a nickel-iron-chromium alloy. It is an ASME Code approved material, specified in ASME SB-163, and is incorporated in ASME Code Case N-20. The staff has determined that the use of Alloy 690 TT material is an improvement over the Alloy 600 material used in the parent tube. Corrosion tests conducted under Electric Power Research Institute (EPRI) sponsorship confirm that Alloy 690 TT resists corrosion better than that of Alloy 600. As a result of these laboratory corrosion tests, the staff has concluded that Alloy 690 TT satisfies the guidelines in Regulatory Guide 1.85, "Materials Code Case Acceptability ASME Section III, Division 1," Revision 24, dated July 1986. The staff has approved use of Alloy 690 TT tubing in previous sleeving applications.

For the tubesheet sleeve, the upper end of the sleeve is welded to the parent tube in the freespan region above the tubesheet and the lower end is hard-rolled into the tubesheet below the expansion zone. For the tube support sleeve, both ends of the sleeve are welded to the parent tube. The welding process uses automatic autogenous gas tungsten arc welding which was qualified and demonstrated during laboratory tests by full scale mock-ups. Qualification of the welding procedures and welding equipment operator was performed in accordance with the specifications of the ASME Code, Section IX.

The staff considers sleeves to be a long-term repair but not a repair with unlimited service life. The welding of the sleeve to the tube may create new locations susceptible to stress corrosion cracking. The time for the initiation of service induced degradation in sleeve-tube assemblies is difficult to quantify. Operating experience with tubes fabricated from Alloy 690 shows that initiation times can vary significantly depending on residual stresses, variability in materials properties, and the operating environment adjacent to the tube materials. Although vendors traditionally conduct accelerated corrosion tests of sleeve-tube assemblies to predict service life, the staff finds this method unreliable for deterministic predictions. However, the staff does consider that the corrosion tests give a viable indicator of potential performance.

Considering the challenges in predicting sleeve life, licensees inspect a sample of sleeves at each outage to provide assurance that if any sleeve degradation is occurring, it is detected and addressed early. Inservice inspection requirements applicable to OPPD's proposed amendment are discussed further in this safety evaluation.

3.0 EVALUATION

Experience with steam generator tube sleeves has revealed certain issues that need to be evaluated in addition to sleeve design and qualification as discussed in previous NRC safety evaluations. These issues involve weld preparation, weld acceptance inspections, inservice inspection expansion criteria, sleeve plugging limits, post weld heat treatment, and primary-to-secondary leakage limits, which are discussed below.

3.1 Section III Design, Weld Preparation and Acceptance Inspections

The ABB/CE topical report, CEN-630-P, Revision 02, provides a description of the Section III requirements and acceptance criteria as applied to steam generator tube sleeves and the results of the design analysis and tests. For example, load cycling tests were performed to satisfy Section III, Class 1 fatigue requirements. This topical report demonstrates that this type of sleeve repair meets code design requirements.

Previous NRC safety evaluations of this topical report are referenced in Section 1.0, which contains additional discussion of weld preparation and acceptance inspections. OPPD stated that they will perform visual inspection after tube cleaning in accordance with CEN-630-P, Revision 02. They will also conduct UT and ET examinations after the completion of the sleeve-to-tube weld for all installed sleeves in accordance with CEN-630-P, Revision 02. In addition, OPPD will perform a VT-1 inspection of each sleeve-to-tube weld until sufficient data has been obtained with UT and ET techniques to show that these techniques are capable of detecting and resolving uncertainties in the weld joint. The staff finds that the proposed weld preparation and inspection methods are acceptable.

3.2 Inservice Inspection Requirements

For inservice inspection of sleeved tubes, OPPD has proposed in TS 3.17 (2a) to perform an initial inspection of 20 percent of sleeves at each refueling outage. The minimum sample requirements for tube inspections are established to assess the overall condition of steam generator tubing. OPPD's proposed inspection sampling for sleeved tubes is consistent with sleeve inspection sampling plans previously approved by the staff and consistent with the current industry guidance for steam generator sleeve examinations as specified in EPRI report, TR-107569, Revision 5, "Steam Generator Examination Guidelines." In addition to the 20 percent initial sample, the results from inspections would be classified and, depending on the classification of sleeve degradation, additional sleeves may be inspected.

3.3 Sleeve Plugging Limit

The sleeve plugging limit is defined in the FCS plant TS as the imperfection depth in the sleeve at or beyond which the sleeved tube shall be removed from service. The sleeve plugging limit is calculated from the minimum acceptable sleeve wall thickness to maintain structural integrity.

Regulatory Guide (RG) 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes" and ASME Code Section III provide guidance on the calculations. However, OPPD has proposed to remove sleeves from service upon detection of unacceptable degradation in the pressure boundary region of the sleeve. OPPD has proposed this requirement in TS 3.17(4)(i).

The proposed change is consistent with industry and staff acceptance criteria, and provides reasonable assurance that tube structural integrity is maintained with adequate margins throughout each operating cycle and is, therefore, acceptable.

3.4 Post Weld Heat Treatment

Residual stress is a contributor to stress corrosion cracking in steam generator tubing. The welding of the sleeve to the parent tube will introduce residual stresses in both the sleeve and the tube. These stresses may increase the susceptibility of the welded joints to stress corrosion cracking. A post weld heat treatment (PWHT) can reduce these stresses and thus may reduce the likelihood of cracking within a welded joint. ABB-CE recommends that a PWHT be a part of the sleeve installation process. OPPD will follow the recommendation in CEN-630-P, Revision 02, in regard to PWHT of the welded joints as required by TS 3.17(4)(i).

3.5 Primary-to-Secondary Leakage Limit

Leak resistance of the sleeve has been demonstrated through laboratory tests. Bounding calculations and laboratory tests have verified that should leakage develop in the welded or rolled joints of sleeved tubes, it would not exceed 1 gallon per minute (gpm) or 1440 gallons per day (gpd) for both steam generators and, thus, the 10 CFR Part 100 guidelines for radiological release would not be affected, even under the most severe postulated conditions. In addition, OPPD has proposed to modify the current primary-to-secondary leakage limit of 720 gallons per day through any one steam generator to the more stringent 150 gallons per day through any one steam generator. This modification is stated in TS 2.1.4 and is consistent with the operational leakage limit accepted by the staff in other sleeving reviews.

3.6 Proposed Technical Specification Changes

In order to implement sleeving of the degraded tubes in the FCS steam generators, OPPD has proposed the following changes to the plant technical specifications.

TS 2.1.4 The primary-to-secondary leakage is limited to 150 gallons per day through any one steam generator or 300 gallons per day for both steam generators.

TS 3.0 The surveillance requirements are revised to include sleeves and repairs.

TS 3.17(2) The steam generator sample selection and inspection section is revised to include the inspection of sleeves.

TS 3.17(2a) Steam generator tube sleeve sample selection and inspection section and Table 3-14 are added to include sleeve sample and inspection criteria. Table 3-14 specifies sleeve sample inspection and associated expansion criteria and is referenced in this section.

TS 3.17(3) The inspection frequency section is revised to include the inspection frequency for sleeves. A requirement is also added to perform a preservice inspection of tubes that have been repaired by sleeving.

TS 3.17(4) The acceptance criteria section is revised to include sleeves in the definitions of defect, degradation, percent degradation, degraded tube or sleeve, imperfection, plugging or repair limit, tube inspection, and unserviceable. This section is also revised to add new definitions for tube or tubing, tube repair or sleeve, and tube sleeve inspection.

TS 3.17(5) The reporting requirement section is revised to include the identification of tubes repaired by sleeving. It requires that specific reports be submitted to NRC when a tube is repaired by sleeving.

TS 3.17(4)(i) CEN-630-P, "Repair of 3/4" O.D. Steam Generator Tubes Using and TS 3.17 Leaktight Sleeves," Revision 02, is referenced.

TS 2.14, TS 3.1, TS 3.17(5), and Table 3-13 These sections and table are revised to add "or repair" defective tubes as an alternative action to plugging defective tubes.

TS 3.17(4) TS 3.17(5), These sections are revised to add "sleeve" or "tube sleeves" to definitions and reporting requirements.

The staff finds that the proposed TS changes contain the necessary requirements to implement the proposed alternate repair method and will provide assurance that SG tube structural integrity will be maintained with adequate margins throughout the operating cycle. Therefore, the proposed TS are acceptable. The staff also notes that TS 3.17 Basis is revised to include tube sleeves, the tube sleeve inspection program, and a reference to CEN-630-P for sleeving repairs.

3.7 Conclusion

The staff finds that the proposed sleeving repairs, as described in the July 28, 2000, submittal and December 14, 2000, supplemental submittal, can be accomplished to produce sleeved tubes of acceptable structural and leakage integrity. The staff finds that the proposed sleeve preservice and inservice inspection, sleeve plugging limit, and primary-to-secondary leakage limit and definitions are acceptable for use to restore degraded tubes to maintain reactor pressure boundary integrity consistent with General Design Criteria (GDC) 14 of Appendix A to 10 CFR 50.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Nebraska State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration and there has been no public comment on such finding (65 FR 62388). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). This amendment also involves changes in recordkeeping, reporting or administrative procedures or requirements. Accordingly, with respect to these items, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(10). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

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