November 4, 1997

Mr. Roger O. Anderson, Director
Nuclear Energy Engineering
Northern States Power Company
414 Nicollet Mall
Minneapolis, Minnesota 55401

SUBJECT: PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT NOS. 1 AND 2 - ISSUANCE OF AMENDMENTS RE: INCORPORATION OF COMBUSTION ENGINEERING STEAM GENERATOR WELDED TUBE SLEEVE DESIGNS (TAC NOS. M97367 AND M97368)

Dear Mr. Anderson:

The Commission has issued the enclosed Amendment No. 132 to Facility Operating License No. DPR-42 and Amendment No. 124 to Facility Operating License No. DPR-60 for the Prairie Island Nuclear Generating Plant, Unit Nos. 1 and 2, respectively. The amendments consist of changes to the Technical Specifications (TS) in response to your application dated November 27, 1996, as supplemented August 15, September 2, and October 3, 1997.

The amendments incorporate Combustion Engineering (CE) steam generator tube sleeve designs and installation and examination techniques. Specifically, the amendments make changes to TS 4.12, "Steam Generator Tube Surveillance," and its associated Bases Section B.4.12, "Steam Generator Tube Surveillance."

A copy of our related Safety Evaluation is also enclosed. The notice of issuance will be included in the Commission's biweekly Federal Register notice.

Sincerely,

ORIGINAL SIGNED BY

Beth A. Wetzel, Senior Project Manager
Project Directorate III-1
Division of Reactor Projects - III/IV
Office of Nuclear Reactor Regulation

Docket Nos. 50-282 and 50-306

Enclosures:
1. Amendment No. 132 to DPR-42
2. Amendment No. 124 to DPR-60
3. Safety Evaluation

cc w/encl: See next page
DISTRIBUTION: See attached page
*No major changes to SE.

DOCUMENT NAME: G:\WPDOCS\PRAIRIE\PI97367.AMD

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DATE	10/ 16 /97		10/ 16 /97		SE 10/ 09 /97		10/ 3 /97		10/ 3 /97	

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Mr. Roger O. Anderson, Director
Northern States Power Company

Prairie Island Nuclear Generating Plant

cc:

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Tribal Council
Prairie Island Indian Community
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DATED: November 4, 1997

AMENDMENT NO. 132 TO FACILITY OPERATING LICENSE NO. DPR-42-PRAIRIE ISLAND UNIT 1
AMENDMENT NO. 124 TO FACILITY OPERATING LICENSE NO. DPR-60-PRAIRIE ISLAND UNIT 2

Docket File
PUBLIC
PDIII-1 Reading
E. Adensam (EGA1)
B. Wetzel (2)
C. Jamerson
OGC
G. Hill (4)
W. Beckner
P. Rush
ACRS
J. McCormick-Barger, RIII
S. Ray, RIII
SEDB (TLH3)

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

NORTHERN STATES POWER COMPANY

DOCKET NO. 50-282

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 132
License No. DPR-42

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

   A. The application for amendment by Northern States Power Company (the licensee) dated November 27, 1996, as supplemented August 15, September 2, and October 3, 1997, 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 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, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. DPR-42 is hereby amended to read as follows:

Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 132, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of issuance, with full implementation within 30 days.

FOR THE NUCLEAR REGULATORY COMMISSION

Beth A. Wetzel

Beth A. Wetzel, Senior Project Manager
Project Directorate III-1
Division of Reactor Projects - III/IV
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: November 4, 1997

ATTACHMENT TO LICENSE AMENDMENT NO. 132

FACILITY OPERATING LICENSE NO. DPR-42

DOCKET NO. 50-282

Revise Appendix A Technical Specifications by removing the pages identified below and inserting the attached pages. The revised pages are identified by amendment number and contain vertical lines indicating the area of change.

REMOVE	INSERT
TS 4.12-1	TS 4.12-1
TS 4.12-2	TS 4.12-2
TS 4.12-4	TS 4.12-4
TS 4.12-5	TS 4.12-5
--	Table TS 4.12-2
B 4.12-1	B 4.12-1
B 4.12-2	B 4.12-2

4.12 STEAM GENERATOR TUBE SURVEILLANCE

Applicability

Applies to inservice surveillance of the steam generator tubes.

Objective

To assure the continued integrity of the steam generator tubes that are a part of the primary coolant pressure boundary.

Specification

Steam generator tubes in each unit shall be determined operable by the following:

A. Steam Generator Sample Selection and Inspection-Each steam generator shall be determined operable in accordance with the in-service inspection schedule in Specification 4.12.C. The in-service inspection may be limited to one steam generator on a rotating schedule encompassing 6% of the tubes in the single steam generator, provided the previous inspections indicated that the two steam generators are performing in a like manner.

B. 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 Tables TS.4.12-1 and TS.4.12-2. The in-service inspection of steam generator tubes shall be performed at the frequencies specified in Specification 4.12.C and the inspected tubes shall be verified acceptable per the acceptance criteria of Specification 4.12.D. The tubes selected for each in-service inspection shall include at least 3% of the total number of tubes in all steam generators and at least 20% of the total number of sleeves in service in both steam generators; the tubes selected for these inspections shall be selected on a random basis except:

   1. 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.

2. The first sample of tubes selected for each in-service inspection (subsequent to the preservice inspection) of each steam generator shall include:

   (a) All tubes that previously had detectable wall penetrations (>20%) that have not been plugged or sleeve repaired in the affected area.

   (b) Tubes in those areas where experience has indicated potential problems.

   (c) A tube inspection (pursuant to Specification 4.12.D.1.(h)) shall be performed on each selected tube. If any selected tube does not permit the passage of the eddy current probe for a tube inspection, this shall be recorded and an adjacent tube shall be selected and subjected to a tube inspection.

3. In addition to the sample required in Specification 4.12.B.2.a through c, all tubes which have had the F* criteria applied will be inspected in the F* regions of the roll expanded region. The roll expanded region of these tubes may be excluded from the requirements of 4.12.B.2.a.

4. The tubes selected as the second and third samples (if required by Tables TS.4.12-1 or TS.4.12-2) during each inservice inspection may be subjected to a partial tube or sleeve inspection provided:

   (a) The tubes selected for these samples include the tubes from those areas of the tube sheet array where tubes with imperfections were previously found.

   (b) The inspections include those portions of the tubes or sleeves where imperfections were previously found.

The results of each sample inspection shall be classified into one of the following three categories:

Category	Inspection Results
C-1	Less than 5% of the total tubes inspected are degraded tubes and none of the inspected tubes are defective.
C-2	One or more tubes, but not more than 1% of the total tubes inspected are defective, or between 5% and 10% of the total tubes inspected are degraded tubes.
C-3	More than 10% of the total tubes inspected are degraded tubes or more that 1% of the inspected tubes are defective.

Note: In all inspections, previously degraded tubes must exhibit significant (>10%) further wall penetrations to be included in the above percentage calculations.

D. Acceptance Criteria

1. As used in this Specification:

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

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

(c) Degraded Tube means a tube containing imperfections ≥20% of the nominal wall thickness caused by degradation.

(d) % Degradation means the percentage of the tube wall thickness affected or removed by degradation.

(e) Defect means an imperfection of such severity that it exceeds the repair limit. A tube containing a defect is defective.

(f) Repair Limit means the imperfection depth at or beyond which the tube shall be removed from service by plugging or repaired by sleeving because it may become unserviceable prior to the next inspection and is equal to 50% of the nominal tube wall thickness. If significant general tube thinning occurs, this criteria will be reduced to 40% wall penetration. This definition does not apply to the portion of the tube in the tubesheet below the F* distance provided the tube is not degraded (i.e., no indications of cracks) within the F* distance for F* tubes. The repair limit for the pressure boundary region of any sleeve is 31% of the nominal sleeve wall thickness.

(g) Unserviceable describes the condition of a tube if it leaks 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.

(h) 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.

(i) Sleeving is the repair of degraded tube regions using a new Alloy 690 tubing sleeve inserted inside the parent tube and sealed at each end by welding or by replacing the lower weld in a full depth tubesheet sleeve with a hard rolled joint. The new sleeve becomes the pressure boundary spanning the original degraded tube region.

(j) F* Distance is the distance from the bottom of the hardroll transition toward the bottom of the tubesheet that has been conservatively determined to be 1.07 inches (not including eddy current uncertainty).

(k) F* Tube is a tube with degradation, below the F* distance, equal to or greater than 40%, and not degraded (i.e., no indications of cracking) within the F* distance.

2. The steam generator shall be determined OPERABLE after completing the corresponding actions (plug or repair by sleeving all tubes exceeding the repair limit and all tubes containing through-wall cracks or classify as F* tubes) required by Tables TS.4.12-1 and TS.4.12-2.

3. Tube repair, after October 1, 1997, using Combustion Engineering welded sleeves shall be in accordance with the methods described in the following:

CEN-629-P, Revision 2, "Repair of Westinghouse Series 44 and 51 Steam Generator Tubes Using Leak Tight Sleeves";

CEN-629-P, Addendum 1, Revision 1, "Repair of Westinghouse Series 44 and 51 Steam Generator Tubes Using Leak Tight Sleeves"

E. Reports

1. Following each in-service inspection of steam generator tubes, if there are any tubes requiring plugging or sleeving, the number of tubes plugged or sleeved in each steam generator shall be reported to the Commission within 15 days.

2. The results of steam generator tube inservice inspections shall be included with the summary reports of ASME Code Section XI inspections submitted within 90 days of the end of each refueling outage. Results of steam generator tube inservice inspections not associated with a refueling outage shall be submitted within 90 days of the completion of the inspection. These reports shall include: (1) number and extent of tubes inspected, (2) location and percent of wall-thickness penetration for each indication of an imperfection and (3) identification of tubes plugged or sleeved.

3. Results of steam generator tube inspections which fall into Category C-3 require notification to the Commission prior to resumption of plant operation, and reporting as a special report to the Commission within 30 days. This special report shall provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence.

4. The results of inspections performed under Specification 4.12.B for all tubes that have defects below the F* distance, and were not plugged, shall be reported to the Commission within 15 days following the inspection. The report shall include:

a. Identification of F* tubes, and

b. Location and extent of degradation.

Table TS.4.12-2
Steam Generator Tube Sleeve Inspection

1st Sample Inspection			2nd Sample Inspection	
Sample Size	**Result**	**Action Required**	**Result**	**Action Required**
A minimum of 20% of Tube Sleeves (1)	C-1	None	N/A	N/A
	C-2	Inspect all remaining tube sleeves in this S.G. and plug or repair defective sleeved tubes.	C-1	None
			C-2	Plug or repair defective sleeved tubes
			C-3	Perform action for C-3 result of first sample
	C-3	Inspect all tube sleeves in this S.G., inspect 20% of the tube sleeves in the other S.G., and plug or repair defective sleeved tubes	The other S.G. is C-1	None
			The other S.G. is C-2	Perform action for C-2 results of first sample
			The other S.G is C-3	Inspect all tube sleeves in each S.G. and plug or repair defective sleeved tubes

(1) Each type of sleeve is considered a separate population for determination of scope expansion

4.12 STEAM GENERATOR TUBE SURVEILLANCE

Bases

The Surveillance Requirements for inspection of the steam generator tubes ensure that the structural integrity of this portion of the RCS will be maintained. The program for inservice inspection of steam generator tubes is based on a modification of Regulatory Guide 1.83, Revision 1. In-service inspection of steam generator tubing is essential in order to maintain surveillance of the conditions of the tubes 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 also provides a means of characterizing the nature and cause of any tube degradation so that corrective measures can be taken.

At the request of the NRC, a requirement for in-service inspection of at least 20% of the total number of sleeves in service in both steam generators was added to TS 4.12.B. In addition, Table TS•4.12 -2 was added to provide sample expansion requirements based on the results of the initial sample inspection similar to Table 4.12-1 This type of sample size and expansion requirement is consistent with the EPRI PWR Steam Generator Examination Guidelines. The sample selection is applied to each type of sleeve. Types of sleeves are categorized by such characteristics as the installation vendor, the sleeve material, the type of joint such as lower edge weld or lower hard roll joints, the sleeve location such as tube support plate or tubesheet and whether not the welded joints have received post weld heat treatment.

The plant is expected to be operated in a manner such that the secondary coolant will be maintained within those parameters found to result in negligible corrosion of the steam generator tubes. If the secondary coolant chemistry is not maintained within these parameters, localized corrosion would most likely result in stress corrosion cracking. The extent of cracking during plant operation would be limited by the limitation of steam generator leakage between the primary coolant system and the secondary coolant system (primary-to-secondary leakage = 1.0 gpm). Cracks having a primary-to-secondary leakage less than 1.0 gpm during operation will have an adequate margin of safety against failure due to loads imposed by design basis accidents (Reference 1). Operating plants have demonstrated that primary-to-secondary leakage as low as 0.1 gpm will be detected by radiation monitors of steam generator blowdown. Leakage in excess of 1.0 gpm will require plant shutdown and an unscheduled eddy current inspection, during which the leaking tubes will be located and plugged or sleeved.

Wastage-type defects are unlikely with proper chemistry treatment of secondary coolant. However, even if this type of defect occurs it will be found during scheduled in-service steam generator tube inspections. Repair or plugging will be required of all tubes with imperfections that could develop defects having less than the minimum acceptable wall thickness prior to the next inservice inspection which, by the definition of Specification 4.12.D.1.(f), is 50% of the tube or sleeve nominal wall thickness. Wastage type defects having a wall thickness greater than 0.025 inches will have adequate margins of safety against failure due to loads imposed by normal plant operation and design basis accidents (Reference 1). Steam generator tube inspections of operating

4.12 STEAM GENERATOR TUBE SURVEILLANCE

Bases continued

plants have demonstrated the capability to reliably detect wastage type defects that have penetrated 20% of the original 0.050-inch wall thickness (Reference 2).

Plugging or sleeving is not required for tubes meeting the F* criteria.

The F* distance will be controlled by a combination of eddy current inspection and/or process control. For a new additional roll expansion, the requirement will be at least 1.2 inches of new hard roll. This is controlled by the length of the rollers (1.25 inch effective length). The distance from the original roll transition zone is also controlled by the process in that the lower end of the new roll expansion is located one inch above the original roll expansion. In the case of the new roll, eddy current examination will confirm there are no indications in the new roll region and that there is a new roll region with well defined upper and lower expansion transitions.

When eddy current examination, alone, must determine the F* distance, such as in the existing hard roll region, or when multiple lengths of additional hard rolls have been added, the eddy current uncertainty is qualified by testing against known standards. That value is expected to be 0.18 inches. Therefore, the F* distance measured by eddy current (sum of 1.07 and 0.18) will be conservatively set at 1.3 inches.

When more than one Alternate Repair Criteria are used, the summation of leakage from all tubes left in service by all repair criteria must be less than the allowable leakage for the most limiting of those Alternate Repair Criteria.

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 prior to 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.

Degraded steam generator tubes may be repaired by the installation of sleeves which span the section of degraded steam generator tubing. A steam generator tube with a sleeve installed meets the structural requirements of tubes which are not degraded.

The following sleeve designs have been found acceptable by the NRC Staff:
a. Westinghouse Mechanical Sleeves (WCAP 10757)
b. Westinghouse Brazed Sleeves (WCAP-10820)
c. Combustion Engineering Leak Tight Sleeves (CEN-294-P, for sleeves installed prior to October 1, 1997)
d. Combustion Engineering Leak Tight Sleeves (CEN-629-P, for sleeves installed after October 1, 1997)

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

NORTHERN STATES POWER COMPANY

DOCKET NO. 50-306

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT NO. 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 124
License No. DPR-60

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

   A. The application for amendment by Northern States Power Company (the licensee) dated November 27, 1996, as supplemented August 15, September 2, and October 3, 1997, 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 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, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. DPR-60 is hereby amended to read as follows:

Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 124 , are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of issuance, with full implementation within 30 days.

FOR THE NUCLEAR REGULATORY COMMISSION

Beth A. Wetzel

Beth A. Wetzel, Senior Project Manager
Project Directorate III-1
Division of Reactor Projects - III/IV
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: November 4, 1997

ATTACHMENT TO LICENSE AMENDMENT NO. 124

FACILITY OPERATING LICENSE NO. DPR-60

DOCKET NO. 50-306

Revise Appendix A Technical Specifications by removing the pages identified below and inserting the attached pages. The revised pages are identified by amendment number and contain vertical lines indicating the area of change.

REMOVE	INSERT
TS 4.12-1	TS 4.12-1
TS 4.12-2	TS 4.12-2
TS 4.12-4	TS 4.12-4
TS 4.12-5	TS 4.12-5
--	Table TS 4.12-2
B 4.12-1	B 4.12-1
B 4.12-2	B 4.12-2

4.12 STEAM GENERATOR TUBE SURVEILLANCE

Applicability

Applies to inservice surveillance of the steam generator tubes.

Objective

To assure the continued integrity of the steam generator tubes that are a part of the primary coolant pressure boundary.

Specification

Steam generator tubes in each unit shall be determined operable by the following:

A. Steam Generator Sample Selection and Inspection-Each steam generator shall be determined operable in accordance with the in-service inspection schedule in Specification 4.12.C. The in-service inspection may be limited to one steam generator on a rotating schedule encompassing 6% of the tubes in the single steam generator, provided the previous inspections indicated that the two steam generators are performing in a like manner.

B. 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 Tables TS.4.12-1 and TS.4.12-2. The in-service inspection of steam generator tubes shall be performed at the frequencies specified in Specification 4.12.C and the inspected tubes shall be verified acceptable per the acceptance criteria of Specification 4.12.D. The tubes selected for each in-service inspection shall include at least 3% of the total number of tubes in all steam generators and at least 20% of the total number of sleeves in service in both steam generators; the tubes selected for these inspections shall be selected on a random basis except:

1. 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.

2. The first sample of tubes selected for each in-service inspection (subsequent to the preservice inspection) of each steam generator shall include:

   (a) All tubes that previously had detectable wall penetrations (>20%) that have not been plugged or sleeve repaired in the affected area.

   (b) Tubes in those areas where experience has indicated potential problems.

   (c) A tube inspection (pursuant to Specification 4.12.D.1.(h)) shall be performed on each selected tube. If any selected tube does not permit the passage of the eddy current probe for a tube inspection, this shall be recorded and an adjacent tube shall be selected and subjected to a tube inspection.

3. In addition to the sample required in Specification 4.12.B.2.a through c, all tubes which have had the F* criteria applied will be inspected in the F* regions of the roll expanded region. The roll expanded region of these tubes may be excluded from the requirements of 4.12.B.2.a.

4. The tubes selected as the second and third samples (if required by Tables TS.4.12-1 or TS.4.12-2) during each inservice inspection may be subjected to a partial tube or sleeve inspection provided:

   (a) The tubes selected for these samples include the tubes from those areas of the tube sheet array where tubes with imperfections were previously found.

   (b) The inspections include those portions of the tubes or sleeves where imperfections were previously found.

The results of each sample inspection shall be classified into one of the following three categories:

Category	Inspection Results
C-1	Less than 5% of the total tubes inspected are degraded tubes and none of the inspected tubes are defective.
C-2	One or more tubes, but not more than 1% of the total tubes inspected are defective, or between 5% and 10% of the total tubes inspected are degraded tubes.
C-3	More than 10% of the total tubes inspected are degraded tubes or more that 1% of the inspected tubes are defective.

Note: In all inspections, previously degraded tubes must exhibit significant (>10%) further wall penetrations to be included in the above percentage calculations.

D. Acceptance Criteria

1. As used in this Specification:

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

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

(c) Degraded Tube means a tube containing imperfections ≥20% of the nominal wall thickness caused by degradation.

(d) % Degradation means the percentage of the tube wall thickness affected or removed by degradation.

(e) Defect means an imperfection of such severity that it exceeds the repair limit. A tube containing a defect is defective.

(f) Repair Limit means the imperfection depth at or beyond which the tube shall be removed from service by plugging or repaired by sleeving because it may become unserviceable prior to the next inspection and is equal to 50% of the nominal tube wall thickness. If significant general tube thinning occurs, this criteria will be reduced to 40% wall penetration. This definition does not apply to the portion of the tube in the tubesheet below the F* distance provided the tube is not degraded (i.e., no indications of cracks) within the F* distance for F* tubes. The repair limit for the pressure boundary region of any sleeve is 31% of the nominal sleeve wall thickness.

(g) Unserviceable describes the condition of a tube if it leaks 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.

(h) 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.

(i) Sleeving is the repair of degraded tube regions using a new Alloy 690 tubing sleeve inserted inside the parent tube and sealed at each end by welding or by replacing the lower weld in a full depth tubesheet sleeve with a hard rolled joint. The new sleeve becomes the pressure boundary spanning the original degraded tube region.

(j) F* Distance is the distance from the bottom of the hardroll transition toward the bottom of the tubesheet that has been conservatively determined to be 1.07 inches (not including eddy current uncertainty).

(k) F* Tube is a tube with degradation, below the F* distance, equal to or greater than 40%, and not degraded (i.e., no indications of cracking) within the F* distance.

2. The steam generator shall be determined OPERABLE after completing the corresponding actions (plug or repair by sleeving all tubes exceeding the repair limit and all tubes containing through-wall cracks or classify as F* tubes) required by Tables TS.4.12-1 and TS.4.12-2.

3. Tube repair, after October 1, 1997, using Combustion Engineering welded sleeves shall be in accordance with the methods described in the following:

CEN-629-P, Revision 2, "Repair of Westinghouse Series 44 and 51 Steam Generator Tubes Using Leak Tight Sleeves";

CEN-629-P, Addendum 1, Revision 1, "Repair of Westinghouse Series 44 and 51 Steam Generator Tubes Using Leak Tight Sleeves"

E. Reports

1. Following each in-service inspection of steam generator tubes, if there are any tubes requiring plugging or sleeving, the number of tubes plugged or sleeved in each steam generator shall be reported to the Commission within 15 days.

2. The results of steam generator tube inservice inspections shall be included with the summary reports of ASME Code Section XI inspections submitted within 90 days of the end of each refueling outage. Results of steam generator tube inservice inspections not associated with a refueling outage shall be submitted within 90 days of the completion of the inspection. These reports shall include: (1) number and extent of tubes inspected, (2) location and percent of wall-thickness penetration for each indication of an imperfection and (3) identification of tubes plugged or sleeved.

3. Results of steam generator tube inspections which fall into Category C-3 require notification to the Commission prior to resumption of plant operation, and reporting as a special report to the Commission within 30 days. This special report shall provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence.

4. The results of inspections performed under Specification 4.12.B for all tubes that have defects below the F* distance, and were not plugged, shall be reported to the Commission within 15 days following the inspection. The report shall include:

a. Identification of F* tubes, and

b. Location and extent of degradation.

Table TS.4.12-2
Steam Generator Tube Sleeve Inspection

1st Sample Inspection			2nd Sample Inspection	
Sample Size	**Result**	**Action Required**	**Result**	**Action Required**
A minimum of 20% of Tube Sleeves (1)	C-1	None	N/A	N/A
	C-2	Inspect all remaining tube sleeves in this S.G. and plug or repair defective sleeved tubes.	C-1	None
			C-2	Plug or repair defective sleeved tubes
			C-3	Perform action for C-3 result of first sample
	C-3	Inspect all tube sleeves in this S.G., inspect 20% of the tube sleeves in the other S.G., and plug or repair defective sleeved tubes	The other S.G. is C-1	None
			The other S.G. is C-2	Perform action for C-2 results of first sample
			The other S.G is C-3	Inspect all tube sleeves in each S.G. and plug or repair defective sleeved tubes

(1) Each type of sleeve is considered a separate population for determination of scope expansion

4.12 STEAM GENERATOR TUBE SURVEILLANCE

Bases

The Surveillance Requirements for inspection of the steam generator tubes ensure that the structural integrity of this portion of the RCS will be maintained. The program for inservice inspection of steam generator tubes is based on a modification of Regulatory Guide 1.83, Revision 1. In-service inspection of steam generator tubing is essential in order to maintain surveillance of the conditions of the tubes 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 also provides a means of characterizing the nature and cause of any tube degradation so that corrective measures can be taken.

At the request of the NRC, a requirement for in-service inspection of at least 20% of the total number of sleeves in service in both steam generators was added to TS 4.12.B. In addition, Table TS•4.12 -2 was added to provide sample expansion requirements based on the results of the initial sample inspection similar to Table 4.12-1 This type of sample size and expansion requirement is consistent with the EPRI PWR Steam Generator Examination Guidelines. The sample selection is applied to each type of sleeve. Types of sleeves are categorized by such characteristics as the installation vendor, the sleeve material, the type of joint such as lower edge weld or lower hard roll joints, the sleeve location such as tube support plate or tubesheet and whether not the welded joints have received post weld heat treatment.

The plant is expected to be operated in a manner such that the secondary coolant will be maintained within those parameters found to result in negligible corrosion of the steam generator tubes. If the secondary coolant chemistry is not maintained within these parameters, localized corrosion would most likely result in stress corrosion cracking. The extent of cracking during plant operation would be limited by the limitation of steam generator leakage between the primary coolant system and the secondary coolant system (primary-to-secondary leakage = 1.0 gpm). Cracks having a primary-to-secondary leakage less than 1.0 gpm during operation will have an adequate margin of safety against failure due to loads imposed by design basis accidents (Reference 1). Operating plants have demonstrated that primary-to-secondary leakage as low as 0.1 gpm will be detected by radiation monitors of steam generator blowdown. Leakage in excess of 1.0 gpm will require plant shutdown and an unscheduled eddy current inspection, during which the leaking tubes will be located and plugged or sleeved.

Wastage-type defects are unlikely with proper chemistry treatment of secondary coolant. However, even if this type of defect occurs it will be found during scheduled in-service steam generator tube inspections. Repair or plugging will be required of all tubes with imperfections that could develop defects having less than the minimum acceptable wall thickness prior to the next inservice inspection which, by the definition of Specification 4.12.D.1.(f), is 50% of the tube or sleeve nominal wall thickness. Wastage type defects having a wall thickness greater than 0.025 inches will have adequate margins of safety against failure due to loads imposed by normal plant operation and design basis accidents (Reference 1). Steam generator tube inspections of operating

4.12 STEAM GENERATOR TUBE SURVEILLANCE

Bases continued

plants have demonstrated the capability to reliably detect wastage type defects that have penetrated 20% of the original 0.050-inch wall thickness (Reference 2).

Plugging or sleeving is not required for tubes meeting the F* criteria.

The F* distance will be controlled by a combination of eddy current inspection and/or process control. For a new additional roll expansion, the requirement will be at least 1.2 inches of new hard roll. This is controlled by the length of the rollers (1.25 inch effective length). The distance from the original roll transition zone is also controlled by the process in that the lower end of the new roll expansion is located one inch above the original roll expansion. In the case of the new roll, eddy current examination will confirm there are no indications in the new roll region and that there is a new roll region with well defined upper and lower expansion transitions.

When eddy current examination, alone, must determine the F* distance, such as in the existing hard roll region, or when multiple lengths of additional hard rolls have been added, the eddy current uncertainty is qualified by testing against known standards. That value is expected to be 0.18 inches. Therefore, the F* distance measured by eddy current (sum of 1.07 and 0.18) will be conservatively set at 1.3 inches.

When more than one Alternate Repair Criteria are used, the summation of leakage from all tubes left in service by all repair criteria must be less than the allowable leakage for the most limiting of those Alternate Repair Criteria.

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 prior to 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.

Degraded steam generator tubes may be repaired by the installation of sleeves which span the section of degraded steam generator tubing. A steam generator tube with a sleeve installed meets the structural requirements of tubes which are not degraded.

The following sleeve designs have been found acceptable by the NRC Staff:
a. Westinghouse Mechanical Sleeves (WCAP 10757)
b. Westinghouse Brazed Sleeves (WCAP-10820)
c. Combustion Engineering Leak Tight Sleeves (CEN-294-P, for sleeves installed prior to October 1, 1997)
d. Combustion Engineering Leak Tight Sleeves (CEN-629-P, for sleeves installed after October 1, 1997)

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NOS. 132 AND 124 TO

FACILITY OPERATING LICENSE NOS. DPR-42 AND DPR-60

NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT NOS. 1 AND 2

DOCKET NOS. 50-282 AND 50-306

1.0 INTRODUCTION

By letter dated November 27, 1996, as supplemented August 15, September 2, and October 3, 1997, the Northern States Power Company (NSP or the licensee) requested amendments to the Technical Specifications (TS) appended to Facility Operating License Nos. DPR-42 and DPR-60 for the Prairie Island Nuclear Generating Plant, Unit Nos. 1 and 2. The proposed amendments would allow sleeving of steam generator tubes with sleeves designed by the vendor, ABB Combustion Engineering (CE). Additionally, the proposed TS amendments would establish a repair limit of 31 percent for the pressure boundary of any sleeve and require supplemental inspections of sleeved tubes prior to declaring the steam generator tubes operable per TS 4.12, Steam Generator Tube Surveillance.

The August 15, September 2, and October 3, 1997, letters provided clarifying information and updated TS pages. This information was within the scope of the original application and did not change the staff's initial proposed no significant hazards considerations determination.

Three types of ABB/CE leak-tight sleeves are proposed for use at Prairie Island. Two of the three designs are termed Full Depth Tubesheet (FDTS) sleeves. One FDTS sleeve is welded to the tube near both the upper and lower ends of the sleeve. The second type is welded to the tube near the upper end and a hard roll expansion in the lower tubesheet area secures the tube within the steam generator tubesheet. The third sleeve design spans degraded areas of the steam generator tube at tube support plates or in a free span section of the tube. This tube support sleeve is welded at both ends.

The revised TS would reference the current generic topical report for CE welded sleeves, CEN-629-P, Revision 02, "Repair of Westinghouse Series 44 and 51 Steam Generator Tubes Using Leak Tight Sleeves," and CEN-629-P, Addendum 1, Revision 1, of the same title, both dated January 1997 [proprietary information - not publicly available]. Because the bulk of the technical and regulatory issues for the present request are identical to those reviewed in the previous safety evaluations (SEs) for CE sleeves, this SE discusses only those issues warranting revision, amplification, or inclusion based on recent experience.

Details of prior staff evaluations of CE sleeves may also be found in the SEs 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; Zion Nuclear Power Station, Units 1 and 2, Docket Nos. 50-295 and 50-304, dated October 29, 1996; and Kewaunee Nuclear Power Plant, Docket No. 50-305, dated June 7, 1997. The staff's conclusions in these evaluations apply to the proposed Prairie Island license amendments unless superseded by an evaluation discussed herein.

2.0 BACKGROUND

2.1 Summary of Previous Reviews

Previous staff evaluations of CE sleeves addressed the technical adequacy of the sleeves in the four principal areas of pressure-retaining component design: structural requirements, material of construction, welding, and nondestructive 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 envelop 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. 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 material of construction of the sleeves is nickel Alloy 690, a Code-approved material (ASME SB-163), covered by ASME Code Case N-20. The staff has found that the use of Alloy 690 thermally treated (TT) sleeves is an improvement over the Alloy 600 material used in the original steam generator tubing. Corrosion tests conducted under Electric Power Research Institute (EPRI) sponsorship confirm test results regarding the improved corrosion resistance of Alloy 690 TT over that of Alloy 600. The NRC staff has concluded as a result of these laboratory corrosion tests that Alloy 690 meets the guidelines in Regulatory Guide 1.85, "Materials Code Case Acceptability--ASME Section III, Division 1" (Rev. 24, July 1986) and, therefore, is acceptable. The NRC staff has approved use of Alloy 690 TT tubing in replacement steam generators as well as sleeving applications.

The welding process employed to join the sleeve to the parent tube is automatic autogenous GTAW (gas-tungsten arc welding). The application of this process to the CE sleeve design was qualified and demonstrated during laboratory tests employing full-scale sleeve/tube mock-ups. Qualification of the welding procedures and welding equipment operators was performed in accordance with the requirements of the ASME Code, Section IX (Welding).

The staff considers sleeves to be a long-term repair but not a repair with unlimited service life. The installation of CE leak-tight sleeves involves welding the sleeve to the tube which

potentially creates new locations susceptible to stress-corrosion cracking. The time for the initiation of service-induced degradation in sleeve/tube assemblies is not quantified. Operating experience with tubes fabricated from Alloy 600 indicates that initiation times can vary significantly depending on residual stresses, variability in material properties, and the chemical environment adjacent to the tube material. Consequently, although vendors traditionally conduct accelerated corrosion tests of sleeve/tube assemblies for the purpose of making service life predictions, the staff finds this method too unreliable for deterministic predictions. However, the staff does consider the corrosion test results a good relative indicator of potential performance.

Considering the unreliability of sleeve life predictions, the staff has typically required licensees to inspect a sample of sleeves at each outage. Periodic inservice inspections will provide assurance that any service-induced degradation in sleeves is detected and addressed appropriately. Inservice inspection requirements applicable to the licensee's proposed amendment request are discussed further in Section 2.2.3 of this SE.

2.2 Discussion

Recent experience with the installation and inspection of steam generator tube sleeves has highlighted several areas that were either not relevant to previous sleeving amendments or addressed in detail in the staff evaluations of the sleeving amendments previously referenced. These issues include (1) the preparation of tube surfaces prior to sleeve welding, (2) the adequacy of inspection techniques used to accept sleeve welds, (3) inservice inspection requirements for sleeved tubes, (4) the omission of post-weld heat treatment (PWHT) for sleeve welds, and (5) changes in the eddy current data acquisition rate from the original qualification. In addition to each of these topics, the licensee's proposal to establish a plugging limit for sleeve degradation is discussed in the following sections.

2.2.1 Weld Preparation

In order to form an adequate sleeve to tube weld, prior to performing any weld, the surface of the metal(s) to be welded must be cleaned. For sleeve installation, the inner diameter of the parent tube at the desired weld location must be cleaned of service-induced oxides. The presence of impurities during the welding process can lead to the unacceptable weld indications. For the CE sleeving process, the tube inner surface is cleaned using motorized wire brushes.

Based on recent findings during the inspection of sleeves at other plants, the industry has identified the cleaning process as an essential step in the sleeve installation process. This conclusion is based on an ABB/CE root cause assessment that concluded that changes in the cleaning process, implemented in prior sleeve installations, resulted in the formation of weld zone indications. In order to minimize the potential for these indications, the vendor enhanced the tube cleaning process to ensure the optimum removal of service-induced oxides prior to welding. In order to verify the removal of oxides, a 100-percent visual examination of the cleaned area is performed. CE recommends the visual examination as an interim step until enough field experience is gained to consider adoption of a statistical sampling plan in the future. The licensee for Prairie Island will confirm the effectiveness of the cleaning step in the

sleeve installation by a visual examination of the tube inside diameter surface, as recommended by CE. The licensee will initially inspect 100 percent of the tubes to be sleeved prior to sleeve installation. However, if the visual inspections reveal that the cleaning process is effectively removing all tube oxide deposits, the licensee may relax the requirement to visually inspect tubes after cleaning.

2.2.2 Weld Acceptance Inspections

To verify the acceptability of sleeve welds, the licensee will complete an initial examination of sleeved steam generator tubes prior to returning a repaired tube to service. The acceptance examination includes an inspection using visual, ultrasonic, and eddy current techniques. The analysis of inspection data from three diverse methods of inspection improves the ability to detect fabrication-induced defects. In addition, eddy current data are also used as a baseline for comparison with data obtained in future required periodic inspections.

Past field experience has demonstrated that previous initial acceptance examinations based on visual and ultrasonic inspection techniques may not be sufficient to identify all fabrication-induced defects. As a result, the weld acceptance nondestructive evaluation (NDE) was modified. The modifications include inspection using an ultrasonic tester with an enhanced digitized amplitude system. The enhanced ultrasonic inspection technique provides a greater number of signal properties to more fully characterize a weld. The modified procedure was extensively tested on laboratory produced welds containing a variety of inclusion and lack of fusion defects. Samples were destructively examined and the metallurgical sections compared with the inspection results. Comparison of results demonstrated the revised procedure was highly reliable and that no significant defects should remain undetected when using the enhanced procedure.

In addition to ultrasonic testing, the sleeve weld acceptance criteria require a 100-percent eddy current inspection using a plus point probe. Field experience led CE to discover that weld suckback and circumferentially oriented oxide inclusions would not be detected by ultrasonic inspection techniques. CE has shown the plus point probe reliably detects the various fabrication-induced weld defects, including blowholes, weld suckback, and circumferentially oriented oxide inclusions. The vendor has also shown that eddy current methods can locate the position of a fabrication defect with respect to the weld centerline which is considered the pressure boundary. Thus, for an FDTS sleeve upper weld, indications located above the weld centerline that are acceptable with other inspection techniques may be left in service. However, any indication found below the weld centerline requires the tube to be plugged. For the lower welds on tube support sleeves, this criterion is appropriately modified so that indications below the weld centerline may be left in service.

During a recent installation of welded sleeves at Kewaunee Nuclear Power Plant, the Kewaunee licensee visually identified weld zone indications that were not identified with either eddy current or ultrasonic inspection techniques. Therefore, this finding may indicate that all three inspection methods are needed to ensure acceptable sleeve welding. The licensee for Prairie Island will perform a 100-percent visual examination of all sleeve welds in the fall 1997 Prairie Island Unit 1 refueling outage. The licensee has indicated that visual inspections of

sleeve welds in other future outages may become optional if a high degree of weld acceptability can be demonstrated.

2.2.3 Inservice Inspection Requirements

Included in the licensee's proposed amendment request are changes that would require the licensee to perform an inspection of a number of sleeves at each refueling outage. The minimum sample requirements for tube inspections, which are specified in "Steam Generator Sample Selection and Inspection" within TS 4.12, are established to assess the overall condition of the steam generator. Because sleeved tubes are of a slightly different configuration and may be more susceptible to stress-corrosion cracking than unrepaired tubing, the inservice inspection requirements currently specified in the TS may not be sufficient to address the condition of these tubes.

The licensee has proposed to include additional inservice inspection requirements in the TS to address sleeves. The changes would require the inspection of at least 20 percent of all installed sleeves. This proposal is consistent with current industry guidance for steam generator sleeve examinations. EPRI recommends a 20-percent sample inspection for sleeves. In addition to this licensee proposal, the results from inspections would be classified and, depending on the classification, may require the performance of additional inspections of sleeves.

2.2.4 Post-Weld Heat Treatment

One primary element in the development of service-induced stress-corrosion cracking in steam generator tubing is the residual stresses in the material. In unrepaired tubing, these stresses could originate from the original fabrication of the tubing or from deformation of the tube material at low temperatures (e.g., tubesheet expansion). The installation of sleeve welds will also introduce residual stresses from the welding process in both the sleeve and the tube. These stresses have the potential for increasing the susceptibility of the welded materials to stress-corrosion cracking. A PWHT can reduce these stresses thus potentially increasing the time for the initiation of cracking within a welded joint.

The licensee for Prairie Island has indicated that the PWHT of sleeve welds is optional to reduce stresses in the welds above the tubesheet. At this time, the licensee has indicated it intends to implement a PWHT for sleeve welds. However, this position will be evaluated at each outage that sleeves are installed. Although the omission of a PWHT step may reduce the potential service life of a repaired tube, operational experience with sleeve welds that have not received a PWHT has been good to-date. In addition, the relatively low hot leg operating temperature (590°F) of Prairie Island Units 1 and 2 minimize the potential for the initiation of stress-corrosion cracking.

2.2.5 Sleeve Plugging Limits

The sleeve minimum acceptable wall thickness is determined using the criteria of Regulatory Guide (RG) 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes," and ASME Code Section III allowable stress values and pressure stress equations. According to RG 1.121

criteria, an allowance for NDE uncertainty and postulated operational growth of tube wall degradation within the sleeve must be accounted for when using NDE to determine sleeve plugging limits. Therefore, a conservative tube wall combined allowance for postulated degradation growth and eddy current uncertainty of 20-percent through-wall per cycle was assumed for the purpose of determining the sleeve plugging limit. The sleeve structural limit, which was calculated based on the most limiting of normal, upset, or faulted conditions for 7/8-inch outside diameter steam generator tubes in Westinghouse Model 44 and 51 steam generators, was determined to be 51 percent of the sleeve nominal wall thickness based on ASME Code minimum material properties in accordance with staff positions. Removal of sleeved tubes from service when degradation in the sleeve pressure boundary reaches a depth of 31 percent provides assurance that the minimum acceptable wall thickness will not be violated during the next cycle of operation.

2.2.6 Qualification of Eddy Current Inspection Techniques

In the submittal dated October 3, 1997, the licensee requested that the NRC incorporate CE Engineering Report 97-TR-FSW-001, Revision 0, "Sleeve Data Comparison for Motorized Rotating Plus-Point Coil at Various Rotational and Axial Sample Speeds in 0.875[-inch] Tubing," into the review of the license amendment request to install CE welded sleeves. The referenced topical report provides qualification test results that demonstrate the ability to acquire eddy current inspection data at a higher rate than originally qualified in ABB/CE report 96-OSW-003-P, Revision 0. The original qualification report is referenced in CE topical report CEN-629-P, Revision 1, and qualified a rotating probe pull speed of 0.1 inch per second. The licensee has proposed to inspect CE-welded sleeves for detection of sleeve indications at pull speeds greater than 0.1 inch per second, specifically 0.45 inch per second. In order to characterize the nature of any detected indications using eddy current methods, the licensee would acquire data using probe pull speeds consistent with the original qualification documented in 96-OSW-003-P, Revision 0 (0.1 inch per second).

3.0 EVALUATION

The staff concludes the proposed sleeving repairs as described in the topical report, "Combustion Engineering Leak Tight Sleeves" (CEN-629-P), can be accomplished to produce sleeved tubes of acceptable metallurgical properties, corrosion resistance, and structural and leakage integrity. As indicated previously, recent experience has indicated the need to evaluate additional areas that were either not relevant to previous CE sleeving amendments or addressed in detail in previously approved CE sleeving amendments. The staff evaluation of these issues is discussed below.

Visual surface examinations of the tube inside diameter surface will be used to confirm the adequacy of the cleaning process. The licensee indicated in its amendment that this requirement may be relaxed if the cleaning process appears to be effective. The use of the visual examination will enable the vendor to detect inadequately cleaned surfaces prior to sleeve installation and welding. Welding the sleeve to a poorly cleaned tube surface may result in weld zone indications and possible rejection of the sleeve weld. Experience has demonstrated that the indications that arise from inadequate cleaning are detectable using eddy current and ultrasonic inspection methods. Should the licensee elect to eliminate the visual

inspections, this may increase the sleeve weld rejection rate; however, the adequacy (i.e., structural and leakage integrity) of the sleeve weld will eventually be assessed through post-weld examinations. Because the visual inspection of cleaned tube surfaces does not affect the final disposition of sleeve welds, the staff concludes that the licensee's proposal to make these inspections optional is acceptable.

The licensee's proposal to delete the optional visual inspection of sleeve welds depends on its ability to demonstrate that the visual examination does not detect fabrication indications that are detrimental to the structural and leakage integrity of sleeved tubes. The decision to implement visual examination requirements stems from one instance at another plant where indications were identified only by visual inspection methods. At this time, experience with these indications is limited. Consequently, the licensee will assess the need to continue visual examinations based on experience gained in the upcoming refueling outage. The NRC staff agrees that, given the limited experience with visual sleeve weld acceptance examinations, the performance of visual inspections may not be necessary once additional data from this method of inspection become available. Therefore, the staff concludes that the licensee's proposal to optionally inspect sleeve welds with visual examination techniques is acceptable.

The Prairie Island steam generator tube surveillance requirements currently require an examination of at least 3 percent of the inservice steam generator tubes. The proposed requirement to inspect a 20-percent sample of sleeves at each refueling outage mandates additional inspection sampling that specifically addresses the potential for degradation in repaired steam generator tubing. Because the proposed scope for the inservice inspection of sleeves increases the probability that sleeve/tube degradation is identified during the course of inspections, the staff finds the licensee's proposal for the sleeve inservice inspection requirements acceptable.

A PWHT of sleeve welds may reduce the residual stresses in the vicinity of the sleeve/tube weld and thus decrease the susceptibility of the assembly to stress-corrosion cracking. However, the staff recognizes that, based on previous operating experience, sleeve welds installed without the benefit of a PWHT have demonstrated considerable resistance to stress-corrosion cracking. In addition, the staff notes that sleeve welds should have adequate resistance to the development of service-induced degradation so as to prevent the initiation and growth of flaws that could challenge the structural and leakage integrity of repaired tubes during an operating cycle. If cracking develops within sleeve welds in the future, the requirement to inspect a 20-percent sample of sleeved tubes will improve the likelihood that degraded sleeves are identified and dispositioned according to the TS Repair Limit.

CE Report 97-TR-FSW-001, Revision 0, documented the qualification of eddy current probe pull speeds up to 0.6 inch per second. The staff previously reviewed a proposal from Wisconsin Public Service Corporation (WPSC) to use higher eddy current probe speeds in the inspection of CE-welded sleeves at Kewaunee referencing this same qualification report. The NRC approved a maximum pull speed of 0.45 inch per second for the inspections at Kewaunee. Based on the results of the performance demonstration documented in 97-TR-FSW-001, Revision 0, the NRC concluded that this pull speed was acceptable for detection only. Data obtained to characterize the nature of indications with eddy current were to be acquired at a pull speed of 0.1 inch per second. Because the proposal by the licensee to inspect sleeves at

Prairie Island is consistent with the inspection parameters previously reviewed for sleeve inspections at Kewaunee, the staff concludes that the use of an elevated data acquisition rate of 0.45 inch per second is acceptable for the detection of sleeve indications with eddy current inspection methods. If the licensee should desire to utilize probe pull speeds in excess of 0.45 and 0.1 inch per second for detection and characterization, respectively, a requalification would be necessary to demonstrate equivalent or improved inspection capabilities at the higher speeds.

The structural analysis of sleeve/tube assemblies in CEN-629-P, Revision 02, assumes a material ultimate tensile strength of 90 ksi for Alloy 690 sleeves. According to the topical report, this value was determined based on actual test data. The sleeve design description in the report specifies that the Alloy 690 tubing "is procured to the requirements of the ASME Boiler and Pressure Vessel Code, Section II SB-163, Code Case N-20." In addition, Section 2 of the topical report states that the sleeve dimensions, materials, and joints were designed to the applicable ASME Boiler and Pressure Vessel Code. The staff notes that ASME Code Case N-20-3 states, "nickel-chromium-iron Alloys 600 and 690...may be used in the construction of Class 1 components in accordance with Section III, Division 1, provided the tensile, yield strength, and design stress intensity values as listed in Tables 1, 2, and 4, respectively are used." Table 1 in Code Case N-20-3 lists the ultimate strength of Alloy 600 and 690 as 80 ksi. Therefore, the staff has concluded that the use of 90 ksi in the calculations to evaluate sleeve margins of safety is inconsistent with the design requirements stated in CEN-629-P, Revision 2. The staff notes that the use of a 90-ksi tensile strength does not affect the conclusion that the sleeve design will provide adequate structural and leakage integrity for repaired steam generator tubes. In addition, the proposed sleeve repair limit is also unaffected by the use of an incorrect value for material tensile strength.

The licensee has proposed to amend the Prairie Island Unit 1 and 2 TS to permit the installation of CE leak tight sleeves per topical report CEN-629-P, Revision 2 and CEN-629-P, Addendum 1, Rev. 1. Other requirements as specified previously are also proposed for the installation and inspection of welded sleeves. The NRC staff has concluded, based on previous evaluations of CE sleeve repairs and the discussion included Section 3.0 of this SE, that the amendments to the Prairie Island TS to allow the installation of CE sleeves are acceptable and will ensure that steam generator tube integrity is maintained. Although some of the calculations in the referenced topical report are in error due to the use of invalid material properties, the staff notes that the overall results obtained from the analysis are correct. Therefore, the conclusion of acceptability of the proposed TS changes remains unchanged.

4.0 Summary

The NRC staff concludes that the proposed sleeving repairs, as described in the CE sleeve topical reports CEN-629-P, Rev. 2 and CEN-629-P, Add. 1, Rev. 1 will produce sleeved tubes with acceptable metallurgical properties, structural and leakage integrity, and corrosion resistance. Therefore, the NRC staff concludes that the repair of SG tubes using sleeves designed by CE and described in the aforementioned topical reports is acceptable.

The licensee proposed the following changes in the TSs to implement the CE sleeving repair methodologies discussed above:

1. Proposed Changes to TS 4.12.B, "Steam Generator Tube Sample Selection and Inspection"

   A new requirement is added to specify that a minimum sample inspection of 20 percent of the total number of sleeves in service in both steam generators is required. In addition, the results of the sleeve inspections are to be classified and additional actions taken, if necessary, per Table TS 4.12-2.

2. Proposed Changes to TS 4.12.B.4, "Steam Generator Tube Sample Selection and Inspection"

   This section is modified to require additional inspections of sleeved tubes based on the results classification of the initial sample inspection.

3. Proposed Changes to TS 4.12.D.1(f), "Repair Limit"

   The definition of Repair Limit is modified to specify that the repair limit for the pressure boundary region of any sleeve is 31 percent of the nominal sleeve wall thickness.

4. Proposed Changes to TS 4.12.D.1(i), "Sleeving"

   The definition of Sleeving is modified to permit tube repair by inserting Alloy 690 sleeves inside the parent tube over degraded tube areas and securing the sleeve in place by welding or mechanically rolling. The new sleeve then becomes the pressure boundary.

5. Proposed New TS 4.4.12.D.3

   Section is added to specify that tube repair using CE-welded sleeves shall be in accordance with the methods described in CE topical reports CEN-629-P, Revision 2, and CEN-629-P, Addendum 1, Revision 1.

6. Proposed New Table TS 4.12-2, "Steam Generator Tube Sleeve Inspection"

   Table TS 4.12-2 is added to the TS to specify that a 20-percent sample inspection is required for tube sleeves. In addition, the table also states the actions (i.e., additional inspections) necessary based on the results classification from the initial sample.

7. Proposed Changes to B 4.12, "Bases"

   The bases for including additional inservice inspection requirements for sleeved tubes is added. In addition, the section is modified to indicate that the NRC has approved the installation of CE leak tight sleeves per CEN-629-P for sleeves installed after January 1, 1997.

The staff has reviewed the TS changes discussed above and finds that they consistently incorporate the CE sleeving repair processes previously discussed in this SE and will provide adequate assurance of SG tube integrity. Therefore, the proposed changes are acceptable.

5.0 STATE CONSULTATION

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

6.0 ENVIRONMENTAL CONSIDERATION

The amendments change a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and change surveillance requirements. The NRC staff has determined that the amendments involve 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 amendments involve no significant hazards consideration and there has been no public comment on such finding (62 FR 43370). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

7.0 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 amendments will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: P. Rush

Date: November 4, 1997