

May 15, 1995

Mr. Roger O. Anderson, Director  
Licensing and Management Issues  
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: F\* STEAM GENERATOR TUBE REPAIR CRITERIA  
(TAC NOS. M91122 AND M91123)

Dear Mr. Anderson:

The Commission has issued the enclosed Amendment No. 118 to Facility Operating License No. DPR-42 and Amendment No. 111 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 partial response to your application dated January 9, 1995, as supplemented February 7, March 15, March 22, April 3, and April 20, 1995. These amendments allow the use of an alternate steam generator tube plugging criteria for the part of the tubes within the tubesheet. They incorporate revised acceptance criteria for tubes with degradation in the tubesheet roll expansion (F\* and L\* criteria) and will enable Prairie Island to avoid unnecessary plugging of steam generator tubes.

Insofar as time is of the essence, the staff is reviewing the F\* and L\* parts of your request separately. The staff has completed its review of the proposed TS changes for the F\* criteria and finds them acceptable. The staff will issue a separate Safety Evaluation for the L\* criteria at a later date.

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, Project Manager  
Project Directorate III-1  
Division of Reactor Projects - III/IV  
Office of Nuclear Reactor Regulation

9505220036 950515  
PDR ADOCK 05000282  
P PDR

Docket Nos. 50-282 and 50-306

Enclosures:

1. Amendment No. 118 to DPR-42
2. Amendment No. 111 to DPR-60
3. Safety Evaluation

cc w/enclosures: See next page

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NAME	CJamerson <i>J</i>		BWetzel <i>Baw</i>		<i>M. Wong</i>	CCarpenter <i>CC</i>	
DATE	5/3/95		5/12/95		5/12/95	5/15/95	

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DATED: May 15, 1995

AMENDMENT NO. 118 TO FACILITY OPERATING LICENSE NO. DPR-42-PRAIRIE ISLAND UNIT 1  
AMENDMENT NO. 111 TO FACILITY OPERATING LICENSE NO. DPR-60-PRAIRIE ISLAND UNIT 2

Docket File

PUBLIC

PDIII-1 Reading

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C. Grimes, O-11F23

L. Banic

ACRS (4)

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W. Kropp, RIII

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cc: Plant Service list

180002

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

Prairie Island Nuclear Generating  
Plant

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Regional Administrator, Region III  
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Kris Sanda, Commissioner  
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Site Licensing  
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1717 Wakonade Drive East  
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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. 118  
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 January 9, 1995, as supplemented February 7, March 15, March 22, April 3, and April 20, 1995, 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:

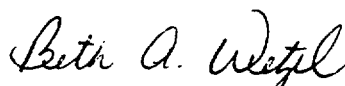
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Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 118, 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, 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: May 15, 1995

ATTACHMENT TO LICENSE AMENDMENT NO. 118

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 4.12-2

TS 4.12-2

TS 4.12-4

TS 4.12-4

TS 4.12-5

TS 4.12-5

B 4.12-2

B 4.12-2

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B 4.12-3

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 Table TS.4.12-1) during each inservice inspection may be subjected to a partial tube 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 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 than 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  $\geq 20\%$  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.
- (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 means that tube sleeving is permitted only in areas where the sleeve spans the tubesheet area and whose lower joint is at the primary fluid tubesheet face.
- (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 Table TS.4.12-1.

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:
  1. Identification of F\* tubes, and
  2. Location and extent of degradation.

#### 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)

4.12 STEAM GENERATOR TUBE SURVEILLANCE

Bases continued

Descriptions of other future sleeve designs shall be submitted to the NRC for review and approval prior to their use in the repair of degraded steam generator tubes. The submittals related to other sleeve designs shall be made at least 90 days prior to use.

References

1. Testimony of J Knight in the Prairie Island Public Hearing on 1/28/75
2. Testimony of L Frank in the Prairie Island Public Hearing on 1/28/75



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. 111  
License No. DPR-60

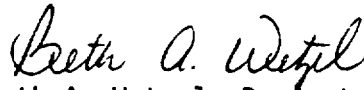
1. The Nuclear Regulatory Commission (the Commission) has found that:
  - A. The application for amendment by Northern States Power Company (the licensee) dated January 9, 1995, as supplemented February 7, March 15, March 22, April 3, and April 20, 1995 complies with the standards and requirements of 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. 111, 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, 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: May 15, 1995

ATTACHMENT TO LICENSE AMENDMENT NO. 111

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 4.12-2

TS 4.12-2

TS 4.12-4

TS 4.12-4

TS 4.12-5

TS 4.12-5

B 4.12-2

B 4.12-2

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B 4.12-3

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 Table TS.4.12-1) during each inservice inspection may be subjected to a partial tube 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 where imperfections were previously found.

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

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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:

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- (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 means that tube sleeving is permitted only in areas where the sleeve spans the tubesheet area and whose lower joint is at the primary fluid tubesheet face.
- (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 Table TS.4.12-1.

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:
  1. Identification of F\* tubes, and
  2. Location and extent of degradation.

#### 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)

4.12 STEAM GENERATOR TUBE SURVEILLANCE

Bases continued

Descriptions of other future sleeve designs shall be submitted to the NRC for review and approval prior to their use in the repair of degraded steam generator tubes. The submittals related to other sleeve designs shall be made at least 90 days prior to use.

References

1. Testimony of J Knight in the Prairie Island Public Hearing on 1/28/75
2. Testimony of L Frank in the Prairie Island Public Hearing on 1/28/75



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATED TO AMENDMENT NOS. 118 AND 111 TO  
FACILITY OPERATING LICENSE NOS. DPR-42 AND DPR-60  
NORTHERN STATES POWER COMPANY (NSP)  
PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT NOS. 1 AND 2  
DOCKET NOS. 50-282 AND 50-306

1.0 INTRODUCTION

By letter dated January 9, 1995, as supplemented February 7, March 15, March 27, April 3, and April 20, 1995, the licensee requested approval of amendments to the Technical Specifications (TSs) for the Prairie Island Nuclear Plant. The amendments would revise TS Section 4.12 to specify an F\* distance within the tubesheet below which indications of degradation would not affect the integrity of a steam generator tube. As a result, tubes with degradation below the F\* distance in the tubesheet would not require sleeving or plugging but could be repaired by installation of additional roll expansion to meet the F\* criterion.

The licensee supported its requests with a Westinghouse report WCAP-14225, "F\* and L\* Plugging Criteria for Tubes with Degradation in the Tubesheet Roll Expansion Region of the Prairie Island Units 1 and 2 Steam Generators," (Proprietary). To support its repair methodology, the licensee also supplied a report by Combustion Engineering, CEN-620-P, Revision 00 "Series 44 & 51 Design Steam Generator Tube Repair Using A Tube Rerolling Technique," (Proprietary).

Although the licensee requested TS changes regarding L\* criteria, the staff's safety evaluation (SE) will address only those changes proposed for the F\* criteria. A separate SE covering the L\* criteria will be issued at a later date.

The March 15, March 22, April 3, and April 20, 1995, letters provided updated TS pages and clarifying information in response to NRC's requests for additional information. This information was within the scope of the original application and did not change the staff's initial proposed no significant hazards consideration determination.

The licensee stated that the proposed changes will provide adequate assurance of steam generator tube integrity because the presence of the tubesheet in conjunction with the hardroll process significantly reduces the potential for

tube failure and/or leakage within the tubesheet when compared to the free span portion of the tube. The presence of the tubesheet constrains the tube and complements the integrity of the tube by minimizing the amount of deformation a tube can undergo beyond its expanded outside diameter. The proximity of the tube and tubesheet, due to the hardroll expansion, limits the amount of primary-to-secondary leakage. The F\* criterion provides a similar level of protection for tube degradation in the tubesheet as that afforded by Regulatory Guide 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes," for degradation located outside the tubesheet region.

## 2.0 DISCUSSION AND EVALUATION

### 2.1 Licensee's Evaluation

#### Engagement Distance Determination

The licensee determined a distance, designated F\* (and identified as the F\* criterion), below the bottom of the roll transition for which tube degradation of any extent does not necessitate remedial action, e.g., sleeving or plugging. This criterion would be used in determining whether or not repairing or plugging of full depth hardroll expanded steam generator tubes is necessary for potential degradation which has been detected in that portion of the tube which is within the tubesheet.

The F\* criterion provides for sufficient engagement of the tube-to-tubesheet hardroll such that forces that could be developed during normal or accident conditions would be successfully resisted by the elastic preload between the tube and the tubesheet.

In order to evaluate the applicability of any developed criterion for indications within the tubesheet, some postulated type of degradation must necessarily be considered. For this evaluation it was postulated that a circumferential severance of a tube could occur. However, implicit in assuming a circumferential severance may occur is the consideration that degradation of any extent could be demonstrated to be tolerable below the location determined acceptable for a postulated condition.

Tubes are installed in the steam generator tubesheet by a hardrolling process which expands the tube to bring the outside surface into intimate contact with the tubesheet hole. The roll process and roll torque are specified to result in a metal-to-metal interference fit between the tube and the tubesheet.

When the tubes have been hardrolled into the tubesheet, any axial loads developed by pressure and/or mechanical forces acting on the tubes are resisted by frictional forces developed by the elastic preload that exists between the tube and the tubesheet. For some specific length of engagement of the hardroll, no significant forces will be transmitted further down the tube, and that length of tubing, the F\* distance, will be sufficient to anchor the tube in the tubesheet. In order to determine the F\* distance for application in Westinghouse Model 51 steam generators, a testing program was conducted to measure the elastic preload of the tubes in the tubesheet.

An axial length of roll expansion equal to the  $F^*$  distance at the top of the roll expansion of the tube into the tubesheet provides sufficient structural integrity to preclude pull out of the tube due to pressure effects, even after assuming that the tube has expanded a complete circumferential separation at or below the bottom of the  $F^*$  distance. This same axial length of roll expansion of the tube into the tubesheet provides a barrier to leakage during all plant conditions for through wall cracking of the tube in the expanded region below  $F^*$ .

The proposed change designates a portion of the tube for which tube degradation of a defined type does not necessitate remedial action. As noted above, the area subject to this change is in the original or additional expanded portion of the tube within the tubesheet of the steam generators. The  $F^*$  length has been determined to be 1.07 inches (not including eddy current uncertainty). Sound roll expansion of 1.07 inches will satisfy all applicable recommendations of Regulatory Guide 1.121 with regard to tube burst capability.

#### Limitation of Primary-To-Secondary Leakage

As described above, the  $F^*$  criterion requires a minimum length of hardroll engagement below the bottom of the roll transition. For Prairie Island, an  $F^*$  distance of 1.07 inches has been proposed. The presence of the elastic preload presents a significant resistance to flow of primary-to-secondary or secondary-to-primary water for degradation which has progressed fully through the thickness of the tube wall. In effect, no leakage would be expected if a sufficient length of hardroll is present. Because of the difficulty in accurately sizing stress corrosion crack indications, the proposed TSs require that no indications of cracking can be present within the  $F^*$  distance in tubes to which the  $F^*$  criterion is applied. This requirement has the effect of preventing the start of a leak path.

The issue of leakage within the  $F^*$  region up to the top of the roll transition includes the consideration of postulated accident conditions. The relationship between the tubesheet region leak rate at most limiting postulated accident (feedline break) conditions relative to that for normal plant operating conditions has been assessed. For the postulated leak source within the roll expansion, increasing the differential pressure on the tube wall increases the driving head for the leak; however, it also increases the tube to tubesheet loading. For an initial location of a leak source a distance greater than  $F^*$  below the bottom of the roll transition, the feedwater line break pressure differential results in an insignificant leak rate relative to that which could be associated with normal plant operation. This is a result of the increased tube to tubesheet loading associated with the increased differential pressure. Thus, for a circumferential indication within the roll expansion that is left in service in accordance with the  $F^*$  pull-out criterion, any leakage under accident conditions would be less than that experienced under normal operating conditions. Therefore, any leakage under accident conditions would be less than the existing TS leakage limit which is consistent with the accident analysis assumption.

### Tube Integrity Postulated Limiting Conditions

The final aspect of the evaluation is to demonstrate tube integrity under the postulated loss-of-coolant accident (LOCA) condition of secondary-to-primary differential pressure. A review of tube collapse strength characteristics indicates that the constraints provided to the tube by the tubesheet give a margin between tube collapse strength and the limiting secondary-to-primary differential pressure condition, even in the presence of circumferential or axial indications.

### 2.2 Staff Evaluation

The staff has reviewed similar proposals from other licensees. For consistency in our reviews, the staff compared the information in WCAP-14225 to that in WCAP-13970, "F\* Tube Plugging Criterion for tubes with Degradation in the Tubesheet Roll Expansion Region of the D.C. Cook Unit 1 Steam Generators." The report was almost identical insofar as the F\* criterion. The staff had reviewed Westinghouse WCAP-13970 in its review of a proposal by the licensee for D.C. Cook. Our SE for D.C. Cook found the proposed revision acceptable based on WCAP-13970. Similarly, we find the supporting report acceptable for the licensee for Prairie Island.

However, certain concerns have risen since we completed our evaluation for D.C. Cook, and the staff requested additional information from the licensee in a telephone call on January 27, 1995, and a letter on March 8, 1995. The licensee addressed our requests for information as follows:

#### Qualification of additional roll expansion

In its letters dated January 9, and February 7, 1995, the licensee stated that it will implement rerolled tubesheet joint expansions to obtain new leak tight rerolled joints for tube repair. The technology was qualified by CE. The details were set forth in the above-mentioned CE report.

One factor that can affect the integrity of the repair is the presence of sludge. In its qualification testing the licensee addressed the adverse effects that sludge could have. Sludge from Zion was used to simulate possible sludge conditions between the tube and tubesheet hole.

In its March 15, 1995, letter, the licensee also addressed why the original qualification tests should remain valid despite moving the F\* distance to a new location by rerolling, a location containing sludge which could affect test results, stating:

During qualification testing...tubes were rerolled both with and without sludge between the tube and tubesheet collar...both with wet and dry baked sludge. All tests provided sufficient tube pull out restraint, however, the baked on sludge resulted in minor leakage. Because of this minor leakage, tubes with reroll torque traces representative of hard sludge will not be left in service. Evaluation of the torque trace provides the basis for acceptance or rejection of the new roll region.

The staff finds the licensee's approach is consistent with ensuring repair integrity in full conformance with the above-mentioned testing and analyses. The staff finds the licensee adequately addressed leakage in rerolled tubes based on testing and analysis.

After installing the rerolled joints, the licensee will examine them with eddy current. It will install plugs or sleeves if the reroll process is not successful or if steam generator tubes are unacceptably degraded from the process. The staff finds these solutions acceptable to ensure tube integrity and in accordance with industry practice.

#### Leakage Concerns

The staff asked the licensee to address the ramifications of having more than one alternate repair criterion that allows leakage. The total leakage should continue to be within the allowed limits under accident conditions. In its March 15, 1995, letter, the licensee addressed the maximum postulated accident leakage from cracks allowed to remain in service under the F\*, L\*, and other criteria, such as the interim repair criteria. The licensee has revised the bases for TS 4.12 to incorporate the following statement:

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.

The staff finds the licensee will ensure leakage limits are not exceeded with its proposed statement.

#### Tube Lockup Issue

In its letter dated March 15, 1995, the licensee addressed the effects of tube support plate lockup on F\* with a letter from Westinghouse. Westinghouse found the forces acceptable, stating the following:

The locking, considered as postulated at this plant, occurs during operation. Therefore, the axial force on locked tubes is essentially zero during operation.

For a single tube, locking at the lowest tube support plate, the axial force on the tube is approximately 220 lbs., tensile, during shutdown. For the case which is most likely to be encountered, when locking occurs, i.e., locking of more than one tube, the tensile, per-tube force reduces significantly from the single-tube value. For instance, for ten locked, adjacent tubes, the force reduces to approximately 24 lbs. at the shutdown condition.

Therefore, because the maximum locked-tube forces occur only during shutdown, there is no need to add them to the "3 Delta P" normal operation load of 2973 lbs. which was used to calculate the F\* length in Ref. 2 [of Westinghouse's March 1, 1995 ltr (WCAP-14225)]. The 220 lbs. locked tube

force will be easily accommodated by the F\* length of the tube joint during the shutdown condition. At this condition, i.e., without the beneficial, pressure-tightening and thermal growth mismatch contributions to joint strength, the joint can accommodate approximately 1987 lbs. of axial force. This is approximately nine times the force that can be exerted on the joint by a single, locked tube.

The staff finds these solutions acceptable because they are in accordance with industry procedures. The staff accepts the Westinghouse analysis.

#### Re-examination

In its letters dated February 7 and March 15, 1995, the licensee addressed staff concerns about re-examination of F\* tubes for the first two cycles and described its examination method.

The licensee stated that new TS 4.12.3 provides the criteria to inspect all F\* tubes in the roll expansion region. In addition, the licensee states that it will perform inspections with rotating pancake coil or equivalent for the first two cycles of implementation of F\*. The staff finds these solutions acceptable because they are in accordance with industry procedures.

#### Proposed TS Changes

The licensee proposed the following changes in the TS to implement the F\* criterion.

##### 1. Proposed New TS 4.12.B.3

The proposed new TS 4.12.B.3, would add a requirement to inspect the F\* distance in the roll expanded region of all tubes that have had the F\* criterion applied. New TS 4.12.B.3, would also allow the roll expanded region of these tubes to be excluded from the requirements of TS 4.12.B.2.a. The previous TS 4.12.B.3 is being renumbered to 4.12.B.4.

##### 2. Proposed Changes to TS 4.12.D.1.f

The current definition of "Repair/Plugging Limit" in TS 4.12.D.1.f, is being modified to note that the 40% repair/plugging limit does not apply to the part of the tube in the tubesheet below the F\* distance for F\* tubes, if the tube is not degraded, (i.e., no indications of cracks) within the F\* distance.

##### 3. Proposed New TS 4.12.D.1.j and TS 4.12.D.1.k

New TS 4.12.D.1.j and TS 4.12.D.1.k provide definitions for the F\* distance and an F\* tube.

4. Proposed New TS 4.12.E.4

Proposed new TS 4.12.E.4 adds a requirement to report to the NRC the results of inspections performed under TS 4.12.B for all tubes that have defects below the F\* distance and were not plugged.

5. Proposed Revision to Bases 4.12

The Bases have been revised to incorporate changes in the TS.

The staff has reviewed the TS changes in the licensee's submittal and finds them acceptable. These TSs provide acceptable implementation of the F\* criteria as analyzed in the Westinghouse Report WCAP-14225 and CE Report, CEN-620-P, Revision 00. Based on a review of the licensee's submittal, the staff concludes that tubes can be left in service with eddy current indications of pluggable magnitude that are below the F\* distance provided the tube is not degraded within the F\* distance. The F\* distance is 1.07 inches (not including eddy current uncertainty) from the bottom of the hardroll transition toward the bottom of the tube sheet.

The staff concludes that the proposed TS changes on steam generators surveillance requirements, Section 3/4.4.12, as detailed in the licensee's submittal of January 9, 1995, as supplemented February 7, March 15, March 22, April 3, and April 20, 1995, are acceptable and may be incorporated in amendments to the operating licenses for Prairie Island Generating Plant, Units No. 1 and 2, in accordance with 10 CFR 50.90 and 50.92.

The staff will complete its review of the L\* criteria and issue its SE at a later date.

3.0 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.

4.0 ENVIRONMENTAL CONSIDERATION

The amendments 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 (60 FR 14023). The amendments also change reporting or recordkeeping requirements. Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9) and (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 amendments.

5.0 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: M. Banic

Date: May 15, 1995

## 6.0 REFERENCES

1. Westinghouse Electric Corporation, WCAP-14225, "F\* AND L\* Tube Plugging Criteria for Tubes with Degradation in the Tubesheet Roll Expansion Region of the Prairie Island Units 1 and 2 Steam Generators," December 1994. (Proprietary information. Not publicly available.)
2. Westinghouse Electric Corporation, WCAP-14226, "F\* AND L\* Tube Plugging Criteria for Tubes with Degradation in the Tubesheet Roll Expansion Region of the Prairie Island Units 1 and 2 Steam Generators," December 1994. (Non-proprietary)
3. Combustion Engineering, Inc., CEN-620-P, Rev. 00, "Series 44 & 51 Design Steam Generator Tube Repair Using a Tube Re-Rolling Technique," Final Report, March 1995. (Proprietary Information. Not publicly available.)