

UNITED STATES NUCLEAR REGULATORY COMMISSION

NORTHERN STATES POWER COMPANY  
PRAIRIE ISLAND NUCLEAR GENERATING PLANT

DOCKET NO. 50-282  
50-306

REQUEST FOR AMENDMENT TO  
OPERATING LICENSES DPR-42 & DPR-60

LICENSE AMENDMENT REQUEST DATED MAY 15, 1997

Northern States Power Company, a Minnesota corporation, requests authorization for changes to Appendix A of the Prairie Island Operating License as shown on the attachments labeled Exhibits A, B, C, D and E. Exhibit A describes the proposed changes, reasons for the changes, safety evaluation and a significant hazards evaluation. Exhibits B and C are copies of the Prairie Island Technical Specifications incorporating the proposed changes. Exhibit D contains the plan for implementation of the voltage-based steam generator repair criteria and Exhibit E contains the Westinghouse main steam line break allowable leak rate analysis.

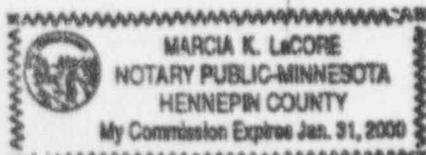
This letter contains no restricted or other defense information.

NORTHERN STATES POWER COMPANY

By Joel P. Sorensen  
Joel P Sorensen  
Plant Manager  
Prairie Island Nuclear Generating Plant

On this 15<sup>th</sup> day of May 1997 before me a notary public in and for said County, personally appeared Joel P Sorensen, Plant Manager, Prairie Island Nuclear Generating Plant, and being first duly sworn acknowledged that he is authorized to execute this document on behalf of Northern States Power Company, that he knows the contents thereof, and that to the best of his knowledge, information, and belief the statements made in it are true and that it is not interposed for delay.

Marcia K. LaCore



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## Exhibit A

### Prairie Island Nuclear Generating Plant License Amendment Request May 15, 1997

#### Evaluation of Proposed Changes to the Technical Specifications Appendix A of Operating License DPR-42 and DPR-60

Pursuant to 10 CFR Part 50, Sections 50.59 and 50.90, the holders of Operating Licenses DPR-42 and DPR-60 hereby propose the following changes to Appendix A, Technical Specifications:

#### Introduction

This license amendment request proposes changes to Technical Specifications (TS) 3.1.C, "Reactor Coolant System Leakage" and 4.12, "Steam Generator Tube Surveillance". The proposed changes for Prairie Island would implement a voltage-based repair criteria per the requirements of NRC Generic Letter (GL) 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking." The date requested for approval is September 18, 1997 to support preparation for the Unit 1 refueling outage scheduled to begin on October 18, 1997. The earliest that implementation may occur, if needed, on Unit 2 would be during the refueling outage scheduled for November 7, 1998.

The steam generators at Prairie Island are Westinghouse Model 51 steam generators with 7/8 inch diameter mill-annealed Alloy 600 tubing and carbon steel drilled hole tube support plates.

#### Proposed Changes

In order to utilize the Voltage Based Repair Criteria, Technical Specifications related to reactor coolant system leakage limitations and steam generator tube surveillance as well as the related Technical Specification Bases must be revised. A brief description of the proposed revisions is provided below. The specific wording changes to the Technical Specifications are shown in Exhibits B and C. These proposed changes closely follow the model technical specifications contained in Attachment 2 of Generic Letter 95-05.

##### 1. Proposed Changes to Technical Specification 3.1.C.2.e.

The limit for total reactor coolant system to secondary coolant system leakage through both steam generators of 1.0 gallon per minute will be changed to a limit of 150 gallons per day of primary-to-secondary leakage through any one steam generator.

2. Proposed new Technical Specification 4.12.B.5.

"Indications left in service as a result of application of tube support plate voltage-based repair criteria shall be inspected by bobbin coil probe during all future refueling outages."

3. Proposed new Technical Specification 4.12.B.6.

"Implementation of the steam generator tube/tube support plate repair criteria requires a 100 percent bobbin coil inspection for hot leg and cold leg tube support plate intersections down to the lowest cold leg tube support plate with known outside diameter stress corrosion cracking (ODSCC) indications. The determination of the lowest cold leg tube support plate intersections having ODSCC indications shall be based on the performance of at least a 20 percent random sampling of tubes inspected over their full length."

4. Proposed Changes to Technical Specification 4.12.D.1.(f).

An exemption is added for the voltage based repair criteria. "This definition does not apply to tube support plate intersections for which the voltage-based repair criteria are being applied. Refer to Specification 4.12.D.3 for the repair limit applicable to these intersections."

5. Proposed new Technical Specification 4.12.D.3.

This new section provides the detailed requirements for the voltage based repair criteria.

6. Proposed new Technical Specification 4.12.E.5

This new section provides the detailed reporting requirements for the voltage based repair criteria.

7. Correction to Technical Specification 4.12.C.1

A typographical error has been corrected in Section 4.12.C.1.

The Bases for Specification 3.1.C and 4.12 are revised to incorporate the voltage based repair criteria. The changes to the bases are shown in Exhibit B.

### **Justification**

The current Prairie Island Technical Specification 4.12.D.1.(f) requires plugging of tubes based on percent through wall degradation of 50% (40% for significant general tube thinning). Since tube degradation due to stress corrosion cracking is difficult to detect and size, and since the Prairie Island steam generator tubing is expected to be susceptible to outside diameter stress corrosion cracking, Generic Letter 95-05 provides an alternative method to allow some tubes to remain in service with degradation due to predominantly axially oriented outside diameter stress corrosion cracking confined within the tube to tube support plate locations.

The basis for steam generator tube surveillance and repair is to ensure that the structural and leakage integrity of the tubes is maintained during normal operating, transient, and postulated accident conditions. The voltage based repair criteria detailed in the proposed technical specifications reflects a conservative approach for the Prairie Island Nuclear Generating Plant, recognizing that a voltage-based repair criteria has been demonstrated to provide adequate margins in accordance with Generic Letter 95-05. The proposed tube repair criteria is to be implemented in accordance with Generic Letter 95-05 as outlined below and in Exhibit D.

1. Tube specimens will be removed, tested and examined in accordance with Generic Letter 95-05, or an NRC approved industry program, to determine if degradation exists at tube support plates which meets the requirements for the voltage based repair criteria of Generic Letter 95-05.
2. A bobbin coil inspection of 100 percent of the hot leg and cold leg tube support plate intersections down to the lowest cold leg tube support plate with known outside diameter stress corrosion cracking (ODSCC) will be performed. Determination of the lowest cold leg tube support plate intersections having ODSCC indications is based on performing a 20 percent random sampling of tubes inspected over their full length.
3. Eddy current examination data acquisition and analysis procedures consistent with the methodology used to develop the voltage based repair criteria will be implemented. Probe wear will be maintained in accordance with NRC accepted industry procedures.
4. Degradation signals confined within the thickness of the tube support plate with bobbin voltages less than or equal to 2.0 volts will be allowed to remain in service.
5. Degradation signals confined within the thickness of the tube support plate with a bobbin voltage of greater than 2.0 volts will be plugged or repaired except as noted in paragraph 6.
6. Degradation signals confined within the thickness of the tube support plate with a bobbin voltage greater than 2.0 volts, but less than or equal to the upper voltage repair limit, as measured by bobbin coil, may remain in service if a rotating pancake coil (RPC) probe, or acceptable alternative probe, inspection does not confirm degradation. An acceptable alternative means a nondestructive examination technique that is qualified using similar criteria as that used for qualifying rotating pancake coil probes. Degradation indications with a bobbin voltage greater than the upper voltage repair limit will be plugged or repaired.
7. The repair criteria will not be applied to tube support plate intersections 1) with interfering signals from copper, 2) with large mixed residual signals which could

cause a 1.0 volt ODSCC indication to be missed or misread, or 3) with dent signals greater than 5.0 volts as measured by the bobbin probe.

8. Tube support plate intersections with 1) indications exceeding 2.0 volts as measured by bobbin coil, 2) interfering signals from copper, 3) large mixed residual signals which could cause a 1.0 volt ODSCC indication to be missed or misread, or 4) dent signals greater than 5.0 volts as measured by the bobbin probe will be inspected with a rotating pancake coil probe or acceptable alternative probe and any indications found will be repaired.
9. A Beginning of Cycle (BOC) voltage distribution will be determined using a probability of detection (POD) of 0.6.
10. An end-of-cycle (EOC) voltage distribution for the next cycle of operation will be established for each cycle based upon the most recent EOC eddy current data. Based upon this distribution, projected main steam line break (MSLB) leakage will be determined based on the guidance of Generic Letter 95-05 using the most recent NRC approved EPRI voltage leak correlation. Projected leakage must remain at or below the maximum leak rate which results in postulated offsite doses remaining within the applicable limits of 10 CFR 100 and postulated control room doses remaining within the limits of GDC 19. This value has been determined to be 6.4 gpm in the faulted steam generator and is limited by the pre-accident iodine spike case in the control room. (The off site doses for an assumed MSLB leakage of 6.4 gpm from the faulted steam generator remain within the acceptance criteria for the site boundary and the low population zone.) Should the projected MSLB leakage exceed 6.4 gpm, the steam generator tube(s) with the highest voltage indications will be successively repaired until the leakage estimation drops to less than or equal to 6.4 gpm. Total allowable leakage for both the intact and faulted loop is 6.5 gpm. As an alternative, the actual measured EOC voltage distribution can be used when it is impractical to complete the projected EOC calculation prior to returning the steam generators to service in determining whether reporting criteria apply.
11. The upper voltage repair limit ( $V_{URL}$ ) will be determined prior to each outage using the most recently approved NRC database to determine the tube structural limit ( $V_{SL}$ ).
12. The conditional tube burst probability during a postulated MSLB event will be calculated and if the value exceeds  $1.0 \times 10^{-2}$ , the Commission will be notified. As an alternative, the actual measured EOC voltage distribution can be used when it is impractical to complete the projected EOC calculation prior to returning the steam generators to service in determining whether reporting criteria apply.
13. The operational leakage limit will be reduced to 150 GPD in each steam generator and leakage monitoring guidelines will be implemented to ensure that should a

significant leak occur in service, the leakage will be detected and the plant shut down in a timely manner.

14. Prior to returning the steam generators to service, the Commission will be notified if the projected EOC voltage distribution results in an estimated leakage greater than the leakage limit, if unusual indications are found at the tube support plates, or if the calculated MSLB conditional probability of burst at EOC exceeds  $1.0 \times 10^{-2}$ .

Use of the voltage based alternate repair criteria precludes the unnecessary removal of tubes from service which satisfy structural integrity recommendations consistent with Regulatory Guide 1.121 and maintains the heat transfer area and reactor coolant flow area. This minimizes the loss of margin in the reactor coolant flow through the steam generator in the loss-of-coolant accident (LOCA) analysis and assists in maintaining reactor coolant flow rates in excess of that required for operation at full power. The proposed license amendment may preclude occupational radiation exposure that would otherwise be incurred by plant workers involved in tube plugging or repair operations. Reduction in the amount of tube repair or plugging required can reduce the length of plant outages and reduce the time that the steam generator is open to the containment environment during an outage. NSP has determined that this methodology is applicable to our steam generators, provided the degradation morphology is confirmed by metallurgical examination, and provides a safe and effective alternative to repair or plugging.

## **Safety Evaluation**

### **Introduction**

The voltage-based repair criteria involves a correlation between eddy current bobbin probe signal voltage amplitude with the more specific measurement of tube burst pressure and leak rate. The principal parameter is voltage amplitude which is correlated with tube burst capability and leakage potential. The repair criteria are developed from testing of laboratory induced ODSCC specimens, extensive examination of pulled tubes from operating steam generators, and field experience from leakage due to indications at the tube support plates.

A plan for implementation of the voltage-based repair criteria is provided in Exhibit D. Due to the enhanced and expanded inspection program and methodology required by the voltage-based repair criteria, the overall safety level of the Prairie Island steam generator tubing will be maintained.

The voltage-based repair criteria are commensurate with Regulatory Guide (RG) 1.121 and 1.83 criteria, and, hence, ensure compliance with General Design Criteria 14, 15, 30, 31, and 32. As stated in Generic Letter 95-05, the voltage-based repair criteria ensure structural and leakage integrity for all postulated design basis events. The structural criteria are intended to ensure that indications subjected to the voltage repair

limits will be able to withstand pressure loadings consistent with the criteria of Regulatory Guide 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes." Also, General Design Criteria (GDC) 2 and 4 continue to be met as it is expected that the Prairie Island steam generators can continue to perform their intended safety function.

From a tube leakage perspective, the potential for adverse radiological consequences due to primary-to-secondary leakage during postulated accident condition loadings is addressed. The most limiting accident affected by the implementation of the voltage-based repair criteria evaluated with regard to the potential for radiological consequences is a postulated Main Steamline Break (MSLB) event outside of containment and upstream of the main steam isolation valve. The potential for excessive leakage during a MSLB is minimized by verifying that the expected distribution of crack indications at the end of each cycle would result in a level of leakage for which the radiological consequences remain acceptable. Calculated tube leakage is limited to assure that the assessment of doses resulting from a MSLB (outside of containment and upstream of the main steamline isolation valve) will be less than the requirements of 10 CFR 100 and GDC-19.

In accordance with the guidance provided in Generic Letter 95-05, radiological dose calculations (Exhibit E) were performed at the Exclusion Area Boundary (EAB), for the Low Population Zone (LPZ) and the control room for the MSLB (outside of containment and upstream of the main steamline isolation valve). The limiting acceptance criteria were for the MSLB with an pre-accident iodine spike and are General Design Criteria 19 guideline values. Based on these analyses, the control room dose is limiting and the leak rate associated with the 30 Rem thyroid limit is 6.4 gpm. This evaluation was performed in accordance with Generic Letter 95-05 guidance and uses ICRP 30 dose conversion factors, consistent with recent license amendment requests for similar plants which have implemented the voltage-based repair criteria. In addition, the dose to technical support center personnel for the MSLB outside of containment under voltage based repair criteria was determined to be less than the control room dose.

Application of the voltage-based repair criteria requires that the normal operating primary-to-secondary leak rate be limited to 150 GPD in any one steam generator. Axial cracks having leakage less than this limit have a demonstrated capability to maintain an adequate margin of safety to withstand normal operating and accident loadings.

The above criteria represent the conservative limits which support structural integrity of the potentially degraded tube bundle, commensurate with the applicable NRC Regulatory Guides, during normal operation and postulated accident conditions.

In establishing the voltage-based repair criteria, the general approach is to establish the existence of acceptable margins to tube burst and excessive steam generator tube leakage during all plant conditions.

## Evaluation

NRC Generic Letter 95-05 (Reference 1) has established the framework for utilities to follow who desire to implement the voltage-based criteria. A voltage-based steam generator tube repair criteria which includes the following items has been developed for Prairie Island:

1. Determination of the degradation morphology by examination of pulled tube specimens,
2. Standardized inspection requirements and data analysis guidelines,
3. Determination of an end-of-cycle voltage distribution using an approved methodology,
4. Prediction of primary-to-secondary steam generator tube leakage for a postulated MSLB event. The recommended MSLB leakage calculation will be performed using the most recent NRC approved EPRI voltage-leak rate correlation,
5. Calculation of a MSLB primary-to-secondary allowable leakage limit using NUREG-0800 guidance for comparison,
6. The use of a reduced normal operating primary-to secondary leakage limit, and
7. Calculation of an overall end-of-cycle tube burst probability during a postulated MSLB.

## Tube Pulls and Degradation Morphology

In general, the degradation morphology occurring at the tube support plate (TSP) intersections at plants in the U.S. can be described as axially oriented ODSCC. Axially oriented macrocracks can occur at one or more azimuthal locations around the circumference of the tube. The macrocracks are comprised of short, nearly collinear microcracks separated by ligaments of non-degraded material. Typical microcrack length is less than 0.2 inch. The corresponding macrocrack can be as long as the support plate thickness. Minor to moderate intergranular attack (IGA) can occur in addition to the axial ODSCC. Eddy current history at Prairie Island and recent tube pulls from the tube sheet crevice region do not suggest tube degradation morphology different from that described by Generic Letter 95-05. In accordance with Generic Letter 95-05, tube pulls for the verification of degradation morphology as dominantly axial ODSCC will be performed during the outage when the voltage-based criteria is first applied for each Prairie Island unit. The number and frequency of subsequent tube pulls will be consistent with Generic Letter 95-05 requirements, or Prairie Island will participate in an NRC endorsed industry program per Section 4.a of Generic Letter 95-05.

### Inspection and Analysis Requirements

Implementation of the voltage-based plugging criteria requires a 100% inspection of all hot leg tube support plate intersections and cold leg intersections down to the lowest cold leg tube support plate intersection with identified ODSCC in order to provide a conservative inspection philosophy and to monitor the progression of ODSCC.

Probe wear will be monitored to ensure compliance with the NRC approved industry procedure (NRC letters from Brian Sheron (NRR) to Alex Marion (NEI) dated February 9, 1996 and March 18, 1996 and NEI letters from Alex Marion to Brian Sheron dated January 23, 1996 and February 23, 1996). The NEI letter identifies the following exception to the referenced NRC letter regarding probe wear. Reinspections of all intersections in low row tubes (rows 1-9) where entry from both the cold leg as well as the hot leg would be required will not be performed. All tubes with indications above 75% of the repair limit will be reinspected with an acceptable probe when the probe fails the wear check. Non-affected intersections in those subject tubes will be reinspected as permitted by access from the hot leg side unless cold leg entry is required to reinspect indications on the cold leg side that are above 75% of the repair limit. This exception will be applicable to Prairie Island.

Additionally, methodology for new probe variability will utilize guidance from NEI to NRC letters dated January 23 and February 23, 1996 and letters from NRC to NEI dated February 9 and March 18, 1996.

An RPC inspection will be conducted for all degradation indications exceeding a signal amplitude of 2.0 volts but less than or equal to a floating upper voltage repair limit ( $V_{URL} = V_{SL} - V_{NDE} - V_{GR}$ ). (In accordance with Generic Letter 95-05, rotating pancake coil inspection also includes the use of comparable or improved nondestructive examination techniques.) The RPC results are to be evaluated to establish that the principal indications can be characterized as ODSCC and to confirm the absence of detectable crack-like circumferential indications and detectable ODSCC indications extending outside the thickness of the tube support plate. If indications other than ODSCC are identified, these indications will be evaluated against a (bobbin coil) 40% depth requirement for tube plugging as applicable. The RPC inspection recommendation is consistent with a threshold value below which MSLB leakage is expected to be negligible and other types of degradation (wear, cold leg thinning, etc.) are not expected to have a significant effect on steam generator tube integrity. The standardized inspection plan provided by the voltage-based repair criteria uses an ASME calibration standard cross-calibrated to the laboratory standard and the use of a probe wear standard. If circumferential cracking or primary water stress corrosion cracking indications are detected in dented intersections, it may be necessary to expand the RPC sampling plan to include dents less than 5.0 volts.

### Tube Integrity Evaluations

The methodology of WCAP-14277 Revision 1, which has been reviewed for previous Westinghouse Model 51 voltage based repair criteria license amendment requests, or later revisions, will be used to calculate the EOC voltage distribution, the postulated MSLB leak rate and conditional probability of tube burst.

### End of Cycle MSLB Leakage Prediction

The recommended calculation to predict the primary-to-secondary tube leakage during a postulated MSLB event will be performed using the most recent NRC approved EPRI voltage-leak rate correlation. MSLB leakage as a function of EOC voltage distribution will be determined in accordance with Generic Letter 95-05, Section 2.b, "Total Leak Rate During MSLB." A probability of detection (POD) of 0.6 will be used until an alternate NRC approved POD function becomes available.

### Allowable MSLB Leakage

The maximum allowable MSLB leakage from steam generator tubing has been determined to be 6.4 gpm in the faulted loop. This value was established based on NUREG-0800 guidelines as suggested by Generic Letter 95-05 and assessed both offsite dose and control room dose. The technical specification reactor coolant and secondary coolant dose equivalent Iodine-131 activity limits of 1.0 microcuries per gram and 0.1 microcuries per gram, respectively, are used in the analysis for establishing the initial radioactivity conditions.

### EOC Conditional Probability of Tube Burst during an MSLB

Upon implementation of the voltage-based repair criteria, projected voltage distributions for the following cycle will be established using current EOC eddy current data. The overall tube burst probability for the next cycle will be established at that time and compared to the acceptance criteria of  $1 \times 10^{-2}$ .

### Reduced Primary-to-Secondary Operational Leakage Limit

The normal operating primary-to-secondary leak rate limit defined in the technical specifications will be revised to 150 gpd per steam generator as part of the voltage-based license amendment. Postulated leakage at 150 gpd from a free span single crack would imply a throughwall crack length corresponding to a bobbin voltage representative of an indication far in excess of any end-of-cycle predicted voltage and would also be expected to provide burst integrity at MSLB conditions. If primary-to-secondary leakage occurs during operation, it is reasonable to assume that more than one crack would contribute to the leakage value.

### Repair Criteria

The criterion of Regulatory Guide 1.121 to maintain a factor of 3 times normal operating pressure differential on tube burst is inherently satisfied during normal operating conditions due to proximity of the tube support plates to the degradation area. Steam generator tube denting (due to TSP corrosion) and cracking potentially initiate and progress at high temperature within the TSP. Since the tubes and support plates are in an equilibrium situation during normal operation, and since the causes of the cracking occur at the tube-to-tube support plate intersections, it is clear that the cracking would be situated within the plates during normal operating conditions and that tube burst cannot occur due to degradation within the TSP. Therefore, the most appropriate manner to assess degraded tube operability and burst potential with regard to Regulatory Guide 1.121 is to examine the tube integrity at faulted (MSLB) conditions, since the tube support plates have the potential to deflect during the rapid blowdown phase of a postulated double-ended guillotine break of the main steamline, thereby uncovering the degradation area.

In accordance with Generic Letter 95-05, in establishing the acceptability of the voltage-based repair criteria and in determining the upper voltage repair limit ( $V_{URL}$ ), the supporting data set must contain all applicable data consistent with the latest revision of the industry data base as approved by the Commission. The upper voltage repair limit will be determined prior to each outage, using the most recently NRC approved data base.

Based upon the latest NRC approved industry voltage-burst correlation (currently 8.7 volts), the end-of-cycle indication would satisfy the steamline break tube burst margin requirement of Regulatory Guide 1.121 with a 1.43 safety factor applied to the MSLB pressure differential. MSLB pressure differential will be limited to approximately 2560 psi, which is the approximate pressurizer safety valve setting plus 3 percent for valve accumulation. The upper voltage repair limit ( $V_{URI}$ ) will be determined prior to each outage using the most recently approved database to determine the tube structural limit ( $V_{SL}$ ). The structural limit is reduced by allowances for nondestructive examination (NDE) uncertainty ( $V_{NDE}$ ) and growth ( $V_{GR}$ ) to establish  $V_{URL}$  (currently 5.2 volts for 1.5 EFPY cycle length). The NDE uncertainty is 20% in accordance with Generic Letter 95-05. The average growth rate for the first cycle of application will be 30% per effective full power year. As growth rates are established for Prairie Island in the future, the indicated growth rate will be unit specific growth or 30%, whichever is larger.

The steam generator tube repair criteria for the tube support plate elevation degradation observed in the steam generator is summarized in Table 1. The recommended tube repair criteria is based upon bobbin coil inspection voltage signal amplitude, which is correlated with tube burst capability. The criteria is developed to preclude free span tube burst if it is postulated that TSP displacement would occur under accident condition loadings. The repair or plugging criteria provides Regulatory Guide 1.121 tube burst margin. The repair criteria (which is much more conservative than the structural repair limit) is expected to result in the majority of the EOC voltages

existing below the MSLB leakage threshold. The upper voltage repair limit ( $V_{URL}$ ) for tube support plate intersections will be determined prior to each outage, using the most recently approved NRC data base.

Table 1: Steam Generator Tube Repair Criteria for Tube Support Plate ODSCC

Bobbin Signal Voltage	Action
$\leq 2.0$	Limited*
$> 2.0$ But less than or equal to $V_{URL}$	Rotating Probe Technology**
$> V_{URL}$	Plug Or Repair

\*If it is found that the potential for MSLB leakage at end-of-cycle conditions exceeds 6.4 gpm in any steam generator, then additional tubes will be plugged or repaired to reduce MSLB leakage potential in that steam generator to below 6.4 gpm. If additional tubes are to be plugged in order to show compliance with the 6.4 gpm leak rate limit, the largest bobbin coil voltage degradation indications would be plugged or repaired.

\*\*Plug or repair if indications of ODSCC are detected.

#### Exclusion of Tubes due to LOCA plus SSE

In addressing the combined effects of loss-of-coolant-accident (LOCA) plus safe shutdown earthquake (SSE) on the steam generator component (as required by GDC 2), it has been determined that tube collapse may occur in the steam generators at some plants. This is the case as the tube support plates may become deformed as a result of lateral loads at the wedge supports at the periphery of the plate due to the combined effects of the LOCA rarefaction wave and SSE loadings. Then, the resulting pressure differential on the deformed tubes may cause some of the tubes to collapse. There are two issues associated with steam generator tube collapse. First, the collapse of steam generator tubing reduces the RCS flow area through the tubes. The reduction in flow area increases the resistance to flow of steam from the core during a LOCA which, in turn, may potentially increase peak clad temperature. Second, there is a potential that partial through-wall cracks in tubes could progress to complete through-wall cracks during tube deformation or collapse.

Tubes which are susceptible to collapse during accident conditions will be excluded from application of the voltage based repair criteria. Since the leak-before-break methodology is applicable to the reactor coolant loop piping at Prairie Island, the probability of breaks in the primary loop piping is sufficiently low that they need not be considered in the structural design of the plant. However, review of Westinghouse seismic umbrella spectra for Model 51 steam generators shows that Prairie Island is bounded by these spectra, that no tubes will undergo deformation due to the combined effects of LOCA plus SSE, and, therefore, no tubes will be excluded from application of

the criteria due to loadings from LOCA plus SSE.

### Conclusion

In conclusion, Northern States Power believes there is reasonable assurance that the health and safety of the public will not be adversely affected by the proposed Technical Specification changes.

### Determination of Significant Hazards Considerations

The proposed changes to the Operating License have been evaluated to determine whether they constitute a significant hazards consideration as required by 10 CFR Part 50, Section 50.91 using the standards provided in Section 50.92. This analysis is provided below:

1. The proposed amendment will not involve a significant increase in the probability or consequences of an accident previously evaluated.

The supporting technical evaluation and safety evaluation for the voltage based repair criteria demonstrate that steam generator tube structural and leakage integrity under normal operating and accident conditions will be maintained. Tube burst criteria are inherently satisfied during normal operating conditions due to the proximity of the tube support plate (TSP). Test data referenced in Generic Letter 95-05 indicates that tube burst cannot occur within the TSP, even for tubes which have 100% throughwall electric discharge machining notches, 0.75 inch long, provided that the TSP is adjacent to the notched area. Since tube-to-TSP proximity precludes tube burst during normal operating conditions, use of the criteria must retain tube integrity characteristics which maintain a margin of safety of 1.43 times the bounding faulted condition, main steamline break (MSLB) pressure differential. The Regulatory Guide (RG) 1.121 criterion requiring maintenance of a safety factor of 1.43 times the MSLB pressure differential on tube burst is satisfied by 7/8" diameter tubing with bobbin coil indications with signal amplitudes less than the current 8.7 volts structural limit, regardless of the indicated depth measurement.

The upper voltage repair limit ( $V_{URL}$ ) will be determined prior to each outage using the most recently NRC approved database to determine the tube structural limit ( $V_{SL}$ ). The structural limit is reduced by allowances for nondestructive examination (NDE) uncertainty ( $V_{NDE}$ ) and growth ( $V_{GR}$ ) to establish  $V_{URL}$ . Using the Generic Letter (GL) 95-05 NDE and growth allowances for an example, the NDE uncertainty component of 20% and a voltage growth allowance of 30% per full power year can be utilized to establish a  $V_{URL}$  of 5.2 volts.

Relative to the expected leakage during accident condition loadings, it has been previously established that a postulated MSLB outside of containment but upstream of the main steam isolation valve (MSIV) represents the most limiting

radiological conditions relative to the plugging criteria. In support of implementation of the revised plugging limit, analyses will be performed to determine whether the distribution of cracking indications at the tube support plate intersections during future cycles are projected to be such that primary-to-secondary leakage would result in postulated off site and control room doses exceeding the limits established for application of the voltage-based repair criteria at Prairie Island. A separate calculation has determined the maximum allowable MSLB leakage limit in a faulted loop. This limit was calculated using the technical specification reactor coolant system (RCS) Iodine-131 activity level of 1.0 microcuries per gram dose equivalent Iodine-131 and the recommended Iodine-131 transient spiking values consistent with NUREG-0800. The projected MSLB leak rate calculation methodology prescribed in Section 2.b of Generic Letter 95-C 5 will be used to calculate the end-of-cycle (EOC) leakage. Projected EOC voltage distribution will be developed using the most recent EOC eddy current results and considering an appropriate voltage measurement uncertainty and indication growth allowance. The log-logistic probability of leakage correlation will be used to establish the MSLB leak rate used for comparison with the faulted loop allowable limit. Therefore, as implementation of the voltage-based repair criteria does not adversely affect steam generator tube integrity and implementation will be shown to result in acceptable dose consequences, the proposed amendment does not result in any increase in the probability or consequences of an accident previously evaluated in the Updated Safety Analysis Report (USAR).

2. The proposed amendment will not create the possibility of a new or different kind of accident from any accident previously analyzed.

Implementation of the proposed steam generator tube voltage-based repair criteria does not introduce any significant changes to the plant design basis. Use of the voltage-based repair criteria does not provide a mechanism which could result in an accident outside of the region of the tube support plate elevations since tubes with outside diameter stress corrosion cracking (ODSCC) not occurring inside the thickness of the tube support plates will be plugged or repaired. Neither a single or multiple tube rupture event would be expected during all plant conditions in a steam generator in which the voltage based repair limit has been applied.

Northern States Power will implement a maximum primary-to-secondary leak rate limit of 150 gpd per steam generator to help preclude the potential for excessive leakage during all plant conditions. The Regulatory Guide 1.121 criterion for establishing operational leak rate limits that require plant shutdown are based upon leak-before-break considerations to detect a free span crack before potential tube rupture during faulted plant conditions. The 150 gpd limit provides for leakage detection and plant shutdown in the event of the occurrence of an unexpected single crack resulting in leakage that is associated with the longest permissible crack length.

The operational leakage limit will be reduced to 150 gpd limit consistent with

Generic Letter 95-05. This limit is expected to provide for plant shutdown prior to reaching critical crack lengths for MSLB conditions using the lower 95% leak rate data. Additionally, this leak-before-break evaluation assumes that the entire crevice area is uncovered during blowdown. Partial uncover will provide benefit to the burst capacity of the intersection and only a small percentage of the TSPs are deflected greater than the TSP thickness during a postulated MSLB.

As steam generator tube integrity upon implementation of the voltage-based repair criteria continues to be maintained through inservice inspection and primary-to-secondary leakage monitoring, the possibility of a new or different kind of accident from any accident previously evaluated is not created.

Therefore, the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. The proposed amendment will not involve a significant reduction in the margin of safety.

The use of the voltage-based repair criteria at Prairie Island maintains steam generator tube integrity commensurate with the criteria of the ASME Code and Regulatory Guide 1.121. Regulatory Guide 1.121 describes a method acceptable to the Commission for meeting GDCs 14, 15, 30, 31, and 32 by reducing the probability or the consequences of steam generator tube rupture. This is accomplished by determining the limiting conditions of degradation of steam generator tubing, as established by inservice inspection, for which tubes with unacceptable cracking should be repaired or removed from service. Upon implementation of the proposed criteria, even under the worst case conditions, the occurrence of ODSCC at the tube support plate elevations is not expected to lead to the steam generator tube rupture event during normal or faulted plant conditions. The EOC distribution of crack indications at the tube support plate elevations will be confirmed to result in acceptable primary-to-secondary leakage during all plant conditions in order to assure that radiological consequences meet the requirements of Generic Letter 95-05.

Previous evaluations have indicated a potential for tube deformation and collapse during a postulated loss-of-coolant-accident (LOCA) plus safe-shutdown-earthquake (SSE) event. The tube collapse potential arises from TSP deformation at the support plate wedges. Evaluation of the Westinghouse umbrella seismic spectra provided in Westinghouse letter NSP-92-152 for Model 51 steam generators shows that Prairie Island is bounded by those spectra and that no tubes will undergo deformation due to the combined effects of LOCA plus SSE. Therefore, no tubes need to be excluded from application of the voltage based criteria due to deformation resulting from combined LOCA plus SSE loadings. Addressing Regulatory Guide 1.83 considerations, implementation of the voltage-based repair criteria is supplemented by enhanced eddy current inspection guidelines to provide consistency in voltage normalization, by an extensive bobbin

coil inspection which will include 100% of the hot leg TSP intersections and cold leg intersections down to the lowest cold leg TSP with known ODSCC, by the determination of the TSPs having ODSCC using at least a 20% random sampling of tubes inspected over their full length, and by rotating pancake coil inspection (or equivalent) requirements for the larger indications left in service to characterize the principal degradation as ODSCC.

As noted previously, implementation of the tube support plate intersection voltage-based repair criteria will decrease the number of tubes which must be repaired. The installation of steam generator tube plugs or sleeves reduces the RCS flow margin. Thus, implementation of the voltage-based repair criteria will maintain the margin of flow that would otherwise be reduced in the event of increased tube plugging.

Based on the above, it is concluded that the proposed license amendment request does not result in a significant reduction in margin with respect to plant safety as defined in the USAR or any Bases of the plant Technical Specifications.

Based on the evaluation described above, and pursuant to 10 CFR Part 50, Section 50.91, Northern States Power Company has determined that operation of the Prairie Island Nuclear Generating Plant in accordance with the proposed license amendment request does not involve any significant hazards considerations as defined by NRC regulations in 10 CFR Part 50, Section 50.92.

### **Environmental Assessment**

Northern States Power has evaluated the proposed changes and determined that:

1. The changes do not involve a significant hazards consideration,
2. The changes do not involve a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or
3. The changes do not involve a significant increase in individual or cumulative occupational radiation exposure.

Therefore, the proposed Technical Specification changes would not result in a significant radiological environmental impact.

### **References**

1. NRC Generic Letter 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking," August 3, 1995.

2. EPRI NP-7480-L Addendum 1 with tube database updated as of November 1996.
3. Westinghouse Letter NSD-E-TAP-0032, MSLB Allowable Leak Rate Analysis for Prairie Island, May 13, 1997