Northern States Power Company

414 Nicollet Mall
Minneapolis, Minnesota 55401
Telephone (612) 330-5500

June 19, 1985

Director
Office of Nuclear Reactor Regulation
U S Nuclear Regulatory Commission
Washington, DC 20555

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
Docket Nos. 50-282 License Nos. DPR-42
50-306 DPR-60

Response to Generic Letter 85-02, NRC Staff
Steam Generator Recommendations

This letter is provided in response to Generic Letter 85-02, Staff Recommended Actions Stemming From NRC Integrated Program For the Resolution of Unresolved Safety Issues Regarding Steam Generator Tube Integrity. Generic Letter 85-02 requested that NSP provide a description of our overall program for assuring steam generator tube integrity and for steam generator tube rupture mitigation and to describe practices employed to ensure adequate inspection samples are taken in the event that Category C-2 results are obtained during initial sampling.

The response to those requests is provided as an attachment. The material provided in the attachment is provided for the information of the NRC staff and reflects our steam generator program as it currently exists. Measures described may be revised or changed as necessary to assure continued steam generator integrity.

Please contact us if you have any questions related to the information we have provided.

David Musolf
Manager - Nuclear Support Services

DMM/EFE

c: Regional Administrator-III, NRC
NRR Project Manager, NRC
Resident Inspector, NRC
MPCA Attn: F W Ferman
G Charnoff

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Attachment

Attachment

Response to Staff Recommended Actions

1.a. Prevention and Detection of Loose Parts (Inspections)

Following the steam generator tube rupture caused by foreign material in 11 steam generator on October 2, 1979, a complete visual examination of the outer peripheral area of the tube bundles and the tube lanes in 11 and 12 steam generators was done using fiberoptics. Two springs (one of which caused the tube rupture) and part of a hose clamp were found and removed from 11 steam generator. Since then, visual examinations of the outer peripheral area and tube lanes have been conducted as follows:

Date	Steam Generators
January 1980	21 and 22
September 1980	11 and 12
June 1982	21 and 22
November 1982	11 and 12

The entire peripheral areas at the tubesheet are accessible for remote visual inspection in our Westinghouse Model 51 steam generators.

Several things are done at Prairie Island to reduce the corrosion potential at cold shutdown. First, significant efforts are made to maintain the secondary side of the steam generators filled with water. Second, the recirculation system is used for filtering, for adding chemicals as necessary, to provide good mixing of chemicals, to ensure representative samples, and to provide rapid drain down and filling. Third, steam generator water chemistry is monitored closely and contaminants are reduced to within specifications prior to opening the secondary side. Fourth, when contaminant levels increase during cold wet layup due to hideout return, the steam generators are drained and refilled. These practices minimize the corrosion which occurs during cold shutdown, both during wet layup and while the secondary side is open.

A loose parts monitoring system has been installed and is operational for each steam generator.

Item (2), "After any secondary side modifications, or repairs, to steam generator internals" may be unnecessarily restrictive. For example, a full peripheral inspection should not be required after a modification to the tube lane blocking device. This guideline implies a full peripheral inspection is required for that case. We will be conducting a full peripheral inspection following the antivibration bar modification. The extent of inspection should be decided as prudent and necessary on a case by case basis.

1.b. Prevention and Detection of Loose Parts (Quality Assurance)

At Prairie Island, procedure D27.14 provides the requirements for material control of all objects and persons entering and leaving the steam generators. A copy of D27.14 is attached. This procedure is periodically audited by Quality Control personnel while being used. The procedure requires a special closeout inspection and review.

For a complex project, such as the antivibration bar modification, additional specific requirements are used to prevent loose parts, to preclude losing dropped objects, and to itemize parts removed.

2.a. Inservice Inspection Program (Full Length Tube Inspection)

During scheduled unit refueling outages, full length tube inspections are performed for virtually all accessible tubing in each steam generator. The actual full length examination percentage is approximately 92% of all tubing, with the exceptions being the tubes in Rows 1 through 3 (tight radius U-bends). These rows account for the remaining 8% of tubing and are inspected per Technical Specifications and Regulatory Guide 1.83, Part C.2.f requirements for examination extent. (The partial length examinations on Rows 1-3 are due to ALARA considerations, given the absence of specific historical degradation in these areas). To date we have performed three (3) successive tubing inspections on each Unit (PI 1 & 2) in accordance with this standard practice.

In the event of a forced unit shutdown due to steam generator tube leakage exceeding technical specifications limits, ($\geq$1.0 gpm), we initially perform a visual tubesheet-face inspection to identify defective tube(s). After identifying the leaking tube(s) we employ a standard C-1 examination sampling technique biased for well defined areas of prevalent historical degradation unique to each steam generator. Also included are small sets of tubing which surround the identified defective (leaking) tube(s).

2.b. Inservice Inspection Program (Inspection Interval)

We are currently conducting much more than the minimum required inspection so that we can best ascertain the condition of our steam generators. Prairie Island Technical Specification 4.12 gives a maximum inspection interval of 40 months, which may involve only one steam generator. Thus, the maximum interval is 80 months for one steam generator. Otherwise the Prairie Island steam generator inservice inspection frequencies are consistent with the Standard Technical Specification. The maximum interval limit of 72 months is acceptable.

3.a. Secondary Water Chemistry

The Prairie Island Nuclear Generating Plant has always had a strong secondary water chemistry program. This continually improving program utilizing state of the art equipment and techniques is well supported by Corporate Management. It has resulted in a history of steam generator chemistry which has met and exceeded specifications which have continually become more restrictive.

The Steam Generator Owners Group secondary water chemistry guidelines have been implemented and referenced in Prairie Island Radiation Protection Implementing Procedure 3002. Notes and steps in the Control Room operating procedure authorize chemistry holds when necessary during startup and power operation.

The responsibility and authority to initiate appropriate plant action based on accurate water chemistry information such as power reductions or heat up holds rest with the affected unit's Shift Supervisor. The Duty Chemist recommends actions to the Shift Supervisor based on the Prairie Island chemistry guidelines. As an example, if steam generator cation conductivity increases significantly, the Duty Chemist informs the Shift Supervisor. The Duty Chemist will look for the source of contamination by observing other on-line and grab sample secondary plant chemistry parameters. Meanwhile, the Shift Supervisor will consult with the Duty Engineer. The Duty Chemist will also contact one of the senior plant chemistry staff persons or the Superintendent of Radiation Protection. However, if the situation warrants, the Duty Chemist and Shift Supervisor do have the responsibility and the authority to take plant actions necessary for protection of the steam generators.

3.b. Condenser Inservice Inspection Program

The Prairie Island Nuclear Generating Plant has a very agressive condenser inservice inspection and maintenance program. However, it is not currently included in detail in written plant procedures. It exists as a good maintenance practice at Prairie Island.

During initial startup, a number of nightly power reductions took place to plug leaking condenser tubes. These leaks were caused by tube vibration between tube support plates as shown by pulled tubes. In the Spring of 1975, tube stakes were installed in the condensers of both units.

A partial eddy current inspection of condenser tubes which had been staked was performed in 1976. From then on, eddy current inspections have been conducted every refueling outage. In 1980, 100% of the condenser tubes were inspected by eddy current examination. In 1981-1984, 2500-3000 tubes were inspected in each condenser. These inspections included all tubes listed with suspect indications plus a sampling of good tubes.

In February 1985, 100% of one Unit 1 condenser pass, plus 33% of the other 3 passes were inspected to try to locate and plug tubes which contributed to condenser leakage present only at low circulating water temperatures. Also, in January 1985, a Unit 2 tube leak occurred which was caused by velocity induced vibrations. It occurred in the top area of the tube bundle which was not staked in 1975. Because Unit 1 was down for refueling at that time, additional stakes were installed in Unit 1. This procedure will be repeated in Unit 2 during the next refueling outage.

The use of multi-frequency eddy current examination for condenser inspections was started in 1984.

There are 42,168 stainless steel tubes in each unit's condenser. Unit 1 has 300 tubes plugged and Unit 2 has 352 tubes plugged.

The following are responses to each of the items recommended for inclusion in plant procedures.

1. Prairie Island does have a condenser inservice inspection program. There have been only 2 power reductions due to condenser leaks since 1976.

2. The following methods are currently used at Prairie Island to identify leakage:

   a. Magnesium condenser leak checks
   b. Helium mass spectrometry (both air and water leaks)
   c. Ultrasonics
   d. Hydrostatic test of condenser at end of each refueling outage
   e. Increased cation conductivity
   f. Increased sodium concentrations

3. Either metal or rubber tube plugs are utilized to plug leaking tubes.

4. Cause of leakage has been investigated by tube pulls and eddy current examination.

5. Current preventive maintenance program involves:

   a. Eddy current examination each refueling outage.
   b. Amertap tube cleaning system.
   c. Manual cleaning of inside of condenser tubes each refueling outage, each spring, and as needed when shown by condenser performance.
   d. Visual inspections of condenser prior to closeouts.

e. Special precautions/protection during turbine maintenance or maintenance work inside condenser.
f. Periodic condenser/turbine boot replacement.
g. Valve repacking.
h. Air in-leakage testing prior to refueling outages to identify air leaks and at other times if air in-leakage increases.

4. Primary to Secondary Leakage Limit

The Prairie Island Technical Specification 3.1.c.b limit for primary-to-secondary leakage is 1.0 gallon per minute total which can all be in one steam generator. According to testimony by J. Knight in the Prairie Island public hearing on January 28, 1975, a leak of 1 gpm corresponds to a through wall crack less than 0.6 inches long based on test data. Steam generator tubes having a 0.6 inch long through-wall crack have been shown to resist failure at pressures resulting from normal operation, LOCA, or steam line break accidents. The 500 gallons per day limit per steam generator is overly restrictive and unnecessary for Prairie Island.

5. Coolant Iodine Activity Limit

The Prairie Island Technical Specification limits and surveillance requirements for primary coolant iodine activity are identical to the Standard Technical Specification limits and surveillance requirements.

The Prairie Island high pressure SI pumps have a shutoff head of 2170 psig. For purposes of compliance with Section 2.9 of NUREG-0844, we believe these pumps are not "low head" pumps. The proposed reduction in iodine limits does not apply.

6. Safety Injection Signal Reset

No components change status when the safety injection signal is reset. At Prairie Island, the switchover from the boric acid storage tanks to the refueling water storage tanks occurs only on low level in the boric acid storage tank.

Response to Request for Information Concerning Category C-2 Steam Generator Tube Inspection

1.a. Prairie Island's Refueling Steam Generator Inspection, as described in 2a & b, does not fall into the C-1 inspection category. Prairie Island's initial inspection is 100% full length inspection of all tubes which can be inspected from one leg of the steam generator (approximately 92% of the tubes) and a NUREG-0844 defined inspection of the remaining hot leg tubes (approx 8%).

This inspection exceeds the NUREG-0844 definition of a category C-3 inspection and makes the question of inspection group sizing and the inclusion of other steam generators in the C-2 program not applicable at Prairie Island. It is our belief, that to better plan the overall refueling outages, each individual task should be well defined. The overall outage time is less if a 100% inspection is initially planned then if an additional C-2 inspection is added to an original C-1 inspection.

However, if the need to do a partial examination arises (such as during an outage caused by a steam generator tube leak), the following items would be considered.

(a) Additional inspection beyond Technical Specifications.

1. When was the last examination conducted?

2. When is the next refueling outage scheduled during which a 100% examination will be done?

3. What is the type and extent of degradation? Is it similar to previous history or radically different?

(b) One or both steam generators included in inspection

Since Prairie Island only has two steam generators per unit, the second steam generator is also normally examined, even during an unscheduled outage. Because of the frequent 100% examinations, the condition of the steam generators is well known and the need to examine both steam generators can be readily evaluated based on the degradation encountered.

(c) Reinspection Schedule

Our time frame for reinspection is each refueling outage for all tubes based on the current condition of the Prairie Island steam generators. If new steam generators were installed, this policy may change to reflect new conditions. Reinspection should be based on the number, type, and growth of indication. For example, even though a 100% tube sheet examination was done during the unscheduled Unit 1 outage in November, 1984, a 100% exam was done again in January, 1985.

2. We have always considered the potential for a steam generator tube rupture when evaluating the amount of degradation allowed for each type of defect in the criteria for plugging steam generator tubes. Some examples of this follow:

   (a) The Technical Specification limit is based on maintenance of "adequate margin of safety against failure due to loads imposed by normal plant operation and design basis accidents".[1]

   (b) Results of the Prairie Island cold leg thinning tube pull and analysis were discussed during a meeting with NRC and Westinghouse on Febuary 12, 1980. As this meeting a predicted corrosion growth rate and design bases accident stresses were used to justify the plugging limit.

   (c) Continued operation of Unit 1 after its December 1983 refueling outage with indications exceeding the plugging limit was based on the low potential hazard from a design basis accident. These indications were discovered from data analysis following restart and were located in the tube sheet crevice area.

   (d) Additionally, where a large enough sample population is available, a statistical analysis of indication growth rates is done. These rates and a statistical safety factor are used to project the next cycle maximum indication size. This size is compared with the minimum wall thickness that is required to verify there is a margin of safety to the Technical Specification Limit.

[1] Testimony of J. Knight (NRC) in the Prairie Island Public Hearing on 1/28/75.

Steam Generator Integrity Actions

Chemistry control of steam generators has received emphasis throughout the life of the plant. A continuous decrease in steam generator cation conductivity has occurred since startup, to the present level of about 0.2 umho/cm. An early design decision to use only ferrous materials in the secondary system has contributed to a low level of contaminant ingress. Rapid response and diligent investigation of secondary side chemistry anomalies has resulted in negligible time with steam generator chemistry out of specification.

Several other things have been done in recent years which further demonstrate the commitment Northern States Power has made to ensure steam generator integrity.

1. Northern States Power joined Steam Generator Owners Group II in 1982.

2. The Prairie Island Steam Generator Committee was formed in March, 1982. The purpose of the committee is to monitor and assess the condition of the steam generators and to set policy concerning the Prairie Island steam generators.

3. Upgrading of the makeup water treatment system in 1983 added new cation and anion beds, and a new state-of-the-art control and monitoring system. This change significantly increased the quality and capacity of the makeup water system.

4. A condensate polishing system has been installed. It has been used in accordance with the Steam Generator Owners Group guidelines. Condensate polishing is used for startup operation following outages and for condenser tube leaks.

5. Chemistry records are placed on a computer record system daily to provide rapid data recovery.

6. The condenser air in leakage program utilizes a helium mass spectrometer for detecting air leaks

7. A larger steam generator blowdown system is being installed which will provide heat recovery and 100 GPM blowdown capacity per steam generator.

8. Crevice flushing of the tube sheet crevice has been done on both units and is considered each refueling outage.

9. Operating procedures have been changed to limit the ingress of contaminants to the steam generators. For example, the start of the heater driven pumps is delayed to allow heater drains to be dumped to the condenser and then out through the condensate polishers.

10. Sludge lancing and tube bundle washdowns are performed as necessary. Generally they are done in each steam generator each refueling outage.

11. Another modification to the steam generator blowdown system provided connections for the steam generator recirculation system to improve control of steam generator wet layup.

12. Tube samples have been removed to provide further information about the cold leg tube support plate thinning and about the type of degradation occurring in the tube sheet crevice region.

13. NSP personnel attend industry seminars and actively participate in committies on steam generator problems and chemistry controls.

We believe Northern States Power Company has an effective program dealing with issues related to steam generator integrity.

Generator/Per#_____
Retention Time: 5 Years

SECURITY OF THE STEAM GENERATOR

SECONDARY SIDE/PRESSURIZER (CIRCLE ONE)

HANDHOLE/MANWAY (CIRCLE ONE)

RWP #_____

FIRE HAZARD REVIEW YES/NO _____ DATE:_____

S.S. APPROVAL TO COMMENCE WORK_____ DATE:_____

****

O.C. REVIEW DATE:_____

REVIEWED BY:_____ DATE:_____

APPROVED BY:_____ DATE:_____
SUPT. O.E.

IBM

1.0 PURPOSE

This procedure is to establish the method for Material Control of all tools, equipment, and personal articles entering and leaving the steam generator secondary side/pressurizer. Loose foreign objects left in these steam generator/pressurizer can cause steam generator tube damage. All reviews and inspections required will be documented on other D27 procedures or WRA's.

2.0 INITIAL CONDITIONS (For Steam Generator)

2.1 The Steam Generator is isolated and drained per D27.9, the Manway or Handhole Remove Procedures (D27.1, D27.3, D27.9, or WRA).

2.2 For the Steam Generator Handholes a remote Security Station can be used. Before beginning removal of the handholes ensure that the TV Camera and speakers are operable.

3.0 PRECAUTIONS

3.1 Before entering the steam generator/pressurizer verify adequate O_2 levels.

3.2 Assure necessary radiation surveys have been completed prior to entering the steam generator/pressurizer.

4.0 PROCEDURE

4.1 All materials, tools, equipment, and personal articles entering and leaving the vessel must be logged in/out on the Tools, Equipment, and Materials Log (PINGP Form 58). The individual bringing the equipment in or out must enter his name, the date, and the time.

4.2 All hand tools (screwdrivers, wrenches, etc) and personal effects (eyeglasses, watches, pencils, etc.) entering the steam generator must be secured with a lanyard or suitable attachment to prevent accidental dropping of the article down the steam generator barrel. The anti-C's must be taped closed to prevent chains, dosimeters, etc from falling out.

4.3 The condition of items being removed from the vessel shall be checked to ensure that part of that item does not remain in the vessel.

4.4 The Security Watch may be temporarily secured if; work in the vessel is stopped, all loose small material (weld rod, feedring plugs, etc.) remove, as determined by review of log, and the temporary covers installed.

NOTE: The Security Watch must be re-established before the temporary covers can be removed.

4.5 Before any area of the steam generator or pressurizer is made inaccessible (installation of the tube lane blocking device, steam generator wrapper, access window; deck plate to feedring area, etc.). An inspection of the handhole/manway cover area (if possible) and review of the PINGP 58 log shall be done before closing up the area. This inspection and review can be done by the System Engineer, Maintenance Supervisor, or QC Inspector. The inspection shall verify that no foreign objects or dirt deposit can be seen in the S/G secondary side or pressurizer. This inspection shall be documented on the PINGP 58 log and the Control Room copy of the applicable D27. series procedure or WRA. The inspector should also inform the group responsible for closure that the steam generator or pressurizer has been inspected.

4.6 After the manway/handhole cover is reinstalled, torqued inplace, and the PINGP 58 forms reviewed by QC or Sys. Engineer. The Security watch can be permanently secured and the PINGP 58 forms destroyed. PINGP 58 forms reviewed.

_____
SYS ENG/QC.

4.7 Return the procedure to the Control Room or signoff the Master Copy.

_____

REVIEWED: _____
SHIFT SUPERVISOR/DATE

_____
SYSTEM ENGINEER/DATE

_____
QC/DATE