NSP

Northern States Power Company

Prairie Island Nuclear Generating Plant

1717 Wakonade Drive East
Welch, Minnesota 55089

March 15, 1995

U S Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

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

Response to NRC Request For Additional Information Related to
F* and L* Steam Generator Repair License Amendment Request

The attached information is being provided in response to your letter dated March 8, 1995 which transmitted NRC Staff questions related to our License Amendment Request dated January 9, 1995 which proposed the incorporation of F* and L* Steam Generator Tube Repair Criteria into the Prairie Island Technical Specifications. The attached information does not fully respond to all of the NRC Staff questions in the March 8, 1995 request. In order to focus our resources on supporting the review of the F* repair criteria, responses to the NRC Staff questions specific to the L* repair criteria are not being provided at this time, but will be provided following submittal of the responses to questions related to the F* repair criteria. Responses to the remaining F* related questions, not included in this submittal, are still being formulated, and will be provided as soon as possible.

In this letter we have made new Nuclear Regulatory Commission commitments which are identified as such in the attachment as the statements which are in italics. Please contact Gene Eckholt (612-388-1121, Ext. 4663) if you have any questions related to the attached responses.

Michael D Wadley for.

Roger O Anderson
Director
Licensing and Management Issues

c: Regional Administrator - Region III, NRC
Senior Resident Inspector, NRC
NRR Project Manager, NRC
J E Silberg

Attachments: 1. Response to March 8, 1995 NRC Request For Additional Information.

2. Westinghouse Letter NSP-95-207, dated March 1, 1995

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ATTACHMENT 1

Response to March 8, 1995 NRC Request For Additional Information

The following information is provided in response to requests for additional information received from the NRC Staff related to the Prairie Island License Amendment Request for the F*/L* steam generator repair criteria:

Question A-1:

The calculation of the proposed F* distance utilizes a coefficient of friction of 0.2 (Section 2.2.2). This value was determined from results of pullout tests. What level of confidence was employed in determining this final value of 0.2?

Answer:

We are unable to respond to this question at this time, our response to this question will be provided with the submittal transmitting the Combustion Engineering Report discussed below.

Question A-2:

The proposed changes to the technical specifications define the F* and L* distances as the value calculated in WCAP-14225 plus an additional length to account for eddy current test (ECT) uncertainty. The NRC cannot approve such definitions as they are currently written because of the inherent flexibility within these definitions. Please quantify ECT uncertainty lengths for F* and incorporate these values into the definition for the F* distance.

Answer:

Our intent in asking for this flexibility is that eddy current probe technology is changing and the uncertainty number is expected to change depending on both the inspection technology and the additional roll expansion process. It is NSP's opinion that this parameter, which is a variable depending on equipment used, should be controlled by the licensee's procedures and modification process. However, we submit the following information to support our License Amendment Request for the F* Alternate Plugging Criteria.

At Prairie Island 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 0.2 inches as described below. Therefore, the F* distance measured by eddy current (sum of 1.07 and 0.18) will be conservatively set at 1.3 inches.

The 95% confidence level uncertainty in location is based on testing done by ZETEC with a new type of eddy current probe to be used at Prairie Island. This new probe is a combination probe containing both rotating coils and bobbin coils in one probe body fabricated with close tolerances on the distances between the coils. The probe is then calibrated against known EDM and expansion transition landmarks to provide a very accurate determination of the distance between tube expansion zone landmarks and/or indications of degradation.

The results of qualification of this probe on 3/4 inch tubing follow (testing on 7/8 inch tube is in progress). Using a set of measurements at 600 kHz containing 23 data points over distances varying from 1.7 to 5.7 inches from the tube end to bottom of the roll transition, the deviation of the eddy current measurement from the actual distance was 0.026 plus or minus 0.159 inches at 95% confidence level. Based on this data taken at 600 kHz, the eddy current distance error would be 0.2 inches. For Prairie Island tubing that measurement will be taken at 800 kHz.

To summarize, when eddy current is used to measure location, an uncertainty value of 0.20 inches will be used. This value will be confirmed by testing with Prairie Island specific values prior to the May 1995 outage.

Question A-3:

Please show that the maximum postulated accident leakage from cracks that are allowed to remain in service by use of the F* and L* criterion and by the use of other criteria, for example, the interim repair criteria for ODSCC [outside diameter stress cracking and corrosion] at tube support plates, will continue to be within the allowed leakage limits under accident conditions. Such considerations should be discussed in the Bases section of the plant technical specifications.

Answer:

The Bases for Technical Specification 4.12 will be revised and resubmitted 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."

Question A-4:

As currently written, the proposed Technical Specification change would allow the partially rolled tube to tubesheet joint to be re-rolled in order to create a new undegraded region for application of the F* criteria. For the staff to complete its review of the option of re-rolling, please address the following items:

(a) discuss why the original qualification tests should remain valid despite moving the F* distance to a new location by rerolling, a location containing corrosion products which could affect test results,

Answer:

During qualification testing at Combustion Engineering for the reroll process, tubes were rerolled both with and without sludge between the tube and tubesheet collar. In the case of sludge, rolling was conducted 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. Note that this acceptance by torque trace has been successfully implemented at Prairie Island for Combustion Engineering mechanical rolled plugs since September 1990.

The crevice regions at Prairie Island are believed to be relatively clean. Tube samples were removed from 12 Steam Generator tubesheet crevice region in 1985. During visual examination of the removed tubes it was noted that the lower tubesheet crevice region was relatively free of deposits as evidenced by the observation of as-manufactured circumferential polishing marks. (EPRI Report NP-4745-LD, "Examination of Steam Generator Tubes from Prairie Island Unit 1")

(b) provide the test data on leakage testing on roll expanded tubes and justify its applicability to the case of re-rolling tubes in tubesheets containing corrosion products; and

Answer:

The test data from Combustion Engineering is contained in Combustion Engineering report CENO-620P which will be submitted to the NRC as soon as possible following receipt of the final report by NSP. Westinghouse leakage test data for F* will be included with that submittal also.

c) discuss the effects of corrosion products, such as magnetic magnetite at the tube-to-tubesheet interface on eddy current testing capability.

Answer:

Magnetic magnetite, if present, will be present both before and after the rerolling. If the magnetite is wet, it may be pushed out of the reroll region by the expansion processes. During normal eddy current inspections of the tubesheet region, a tube support plate mix is used for analysis. The tube support plate 400/100 kHz mix minimizes both the effect of the tubesheet and the magnetic magnetite. In addition, at Prairie Island there are no copper bearing components in the secondary system and therefore, copper does not complicate the eddy current analysis.

Questions A-5, A-6 and L-1 through 4:

In order to focus our resources on supporting the review of the F* repair criteria, responses to the NRC Staff questions specific to the L* repair criteria (A-5, A-6 and L-1 through 4) will be submitted following the submittal of responses to all the questions related to F*.

Question F-1:

Please address the tube lockup issue.

Answer:

The effects of tube support plate lockup on F* were discussed in response to Question 1 in our February 7, 1995 response to an NRC request for additional information. In that response we committed to provide the NRC a letter from Westinghouse providing additional information on support plate lockup. That letter is attached.

Question F-2:

Please address questions on Indian Point Docket as applicable. A copy of these questions were faxed earlier.

Answer:

Answers to the Indian Point questions are provided below following the Section F questions.

Question F-3:

Please address the surface variations in the bore in tube sheet testing, describing the tubesheet hole finish and the tube OD [outside diameter] finish used for qualification.

Answer:

Tube sheet bore finish was discussed in response to Question 4 in our February 7, 1995 response to an NRC request for additional information. We are also provided the following additional information. The tube OD finish is 18 RMS (microinches). The tubesheet hole bore finish used in qualification was 113 RMS. The tube is brushed on the inside to a bright metal finish to eliminate the variable for additional roll expansion due to oxide on the inside of the tube.

Question F-4:

Provide a commitment to reexamine F* tubes for the first two cycles and describe the examination method in detail.

Answer:

The Technical Specification change proposed as TS 4.12.3 provides the commitment to inspect all F* and L* tubes in the roll expanded region. In addition, NSP committed to doing this inspection with rotating pancake coil or equivalent for the first two cycles of implementation of F* of L* in response to Question 6 in our February 7, 1995 response to an NRC request for additional information.

Question F-5:

Provide the analysis for additional roll expansion.

Answer:

The analysis for additional roll expansion will be included in Combustion Engineering Report CEN-620P which will be submitted to the NRC as soon as possible following receipt of the final report by NSP.

Question F-6:

Concerning your qualification of the inspection method for examining samples of rerolled tubes with entrapped sludge, please send your plan for ensuring that samples are representative of those at Prairie Island.

Answer:

The sludge which has already been used for the qualification testing was magnetite. A recent analysis of the sludge from Prairie Island shows that iron (70%) is the primary constituent of Prairie Island sludge.

Question F-7:

The value of the F* distance (1.07 inch) is less conservative than the value the staff approved for the Summer nuclear plant (1.6 inch). Please explain the difference in the degree of conservatism.

Answer:

We are unable to respond to this question at this time, our response to this question will be provided with the submittal transmitting the Combustion Engineering Report discussed above.

Indian Point Question 1:

Question 1 was not provided to NSP because it contained proprietary information.

Indian Point Question 2:

Several tests subjected tubes to both an internal pressure and an axial load. For the RG 1.121 load tests the licensee should describe the order in which these two loads were applied. If both the pressure and axial loads were increased simultaneously provide details describing the internal pressure vs. time and load vs. time loading sequence.

Answer:

We are unable to respond to this question at this time, our response to this question will be provided with the submittal transmitting the Combustion Engineering Report discussed above.

Indian Point Question 3:

An evaluation of the effects of boric acid corrosion is detailed in "Boric Acid Corrosion of Oconee 1 Upper Tubesheet" (BWNT Document 5I-1206178-00). Please supply this document to clarify the conclusions of BAW-10195 P.

Answer:

Discussion of the effect of boric acid is located on pages 2-11 through 2-13 of WCAP-14225.

Indian Point Question 4:

The tests described in BAW-10195 P attempted to determine whether several variables, not directly included in the equation to determine F* (Question 1) would have an impact on the results. These variables included effects from surface roughness of the tubesheet bore, the yield strength of the tubing, and a larger tubesheet bore. The report concluded that these variables had no effect on the calculated F* length. However, the test matrix does not appear to support the possibility that these variables may interact during testing. If the test matrix did not adequately separate each of the variables then the conclusion in the report may be erroneous. Describe how the test matrix isolated the effects of yield strength and tubesheet bore surface roughness during the testing.

Answer:

We are unable to respond to this question at this time, our response to this question will be provided with the submittal transmitting the Combustion Engineering Report discussed above.

Indian Point Question 5:

Based on staff calculations the tubesheet surface roughness may affect the proposed F* length. The pullout shear stress between the tube and tubesheet varies around a mean value as the surface roughness increases. However, the scatter around this mean appears to increase as the roughness increases( ). Since all data (high and low roughness) were used to develop a 99% confidence level, the resultant F* length may be non-conservative if the actual tubesheet roughness is relatively high compared to the test conditions. In light of the apparent increase in data scatter as surface roughness is relatively high compared to the test conditions. In light of the apparent increase in data scatter as surface roughness increases please provide a response justifying the F* length at a 99% confidence level.

Answer:

According to Mark's Handbook, 8th Edition, page 3-27, the coefficient of friction for hard steel over hard steel increases as the surface roughness increases. The Combustion Engineering testing was conducted at a roughness of about 100 whereas the Westinghouse testing was done at a surface roughness of 250. Since the coefficient of friction is lower for the Combustion Engineering tests the process to be used in the field is bounded by the higher roughness used by Westinghouse. Results were acceptable in both cases. Also, Combustion Engineering conducted leakage and pull out tests with baked on hard scale. Pull out tests were satisfactory, but there was a small amount of leakage. The torque trace for hard scale has characteristics which provide indication that hard scale is present. Under this submittal, such traces would be unacceptable and would result in the tube being plugged or sleeved.

Indian Point Question 6:

The licensee should show that the maximum postulated accident leakage from cracks that are allowed to remain in service by use of the F* criterion and by the use of other criteria, for example, the interim repair criteria for ODSCC at tube support plates, will continue to be within the allowed leakage limits under accident conditions. Such considerations should be discussed in the Basis section of the plant technical specifications.

Answer:

The response to this question is provided in the response to question A-3 above.

Indian Point Question 7:

As currently written the proposed Technical Specification change would allow the partially rolled tube-to-tubesheet joint to be rerolled in order to create a new undegraded region for application of the F* criteria. For the staff to complete its review of the option of re-rolling, the licensee should address the following items: (a) provide the test data on leakage testing on roll expanded tube and justify its applicability to the case of rerolled tubesheets

containing corrosion products (b) discuss the effects of corrosion products, such as magnetic magnetite, at the tube-to-tubesheet interface on eddy current testing capability.

Answer:

The response to this question is provided in the response to question A-4 above.

Indian Point Question 8:

BAW-10195 P states that the F* criteria will establish an undegraded expanded region within the tubesheet which satisfies all of the necessary structural and leakage requirements of Regulatory Guide 1.121 and the plant Technical Specifications. The licensee's proposed Technical Specification states that a F* tube is one, "which has no indication of imperfections within the F* distance." However, an "imperfection " is defined by the Technical Specification as "a deviation from the dimension , finish, or contour required by drawing or specification." The licensee should state that the F* region has "no indications of degradation" or that it is "free from indications of cracking."

Answer:

The description of an F* tube in the Technical Specification changes proposed in our January 9, 1995 License Amendment Request adequately addresses this comment.

ATTACHMENT 2

Westinghouse Letter NSP-95-207 (3 pages)

Dated March 1, 1995

Westinghouse
Electric Corporation

Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

March 1, 1995

NSP-95-207

Mr. R. Pearson
Northern States Power Company
Prairie Island Nuclear Generating Plant
1717 Wakonade Drive East
Welch, MN 55089-9642

Dear Mr. Pearson:

NORTHERN STATES POWER COMPANY
PRAIRIE ISLAND UNITS 1 AND 2
RESPONSE TO NSP VERBAL REQUEST FOR ADDITIONAL
INFORMATION FOR F* AND L*

During the referenced telephone conversation, the NRC had two questions. The questions were provided verbally to Westinghouse. It is believed that these are the questions:

1. How have the forces caused by postulated tube locking at the support plates (TSPs) been included in the ("F-Star") analysis?

2. How will the angle of the possible linear cracks in the roll transition region of the Prairie Island SGs be measured for application of L*?

RESPONSE:

Inquiry Number 1

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, locked 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. 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.

Inquiry Number 2

It is recommended in Reference 2, Page 3-13, that a rotating pancake coil ECT probe or other advanced inspection system be used to inspect, evaluate and define the tube degradation for the application of L*. This includes determination of the crack inclination from the vertical axis.

If you have any questions about these responses, please contact Larry Nelson at (412) 722-5689.

Very truly yours,

WESTINGHOUSE ELECTRIC CORPORATION

T. W. Wallace
Account Manager

cc: J. Usem/W PSFS Minnesota

References:

1) Telecon, Tube Axial Force due to Locking at Tube Support Plate Number 1, R. Pearson, et.al., Northern States Power (NSP), H. Conrad, et.al., NRC, W. Cullen and L. Nelson, Westinghouse, 1/27/95

2) 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