Commonwealth Edison Company
1400 Opus Place
Downers Grove, IL 60515

ComEd

September 1, 1995

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Document Control Desk

Subject: Supplement to Application for Amendment to Facility Operating Licenses:

Byron Nuclear Power Station, Units 1 and 2
NPF-37/66; NRC Docket Nos. 50-454/455

Braidwood Nuclear Power Station, Units 1 and 2
NPF-72/77; NRC Docket Nos. 50-456/457

"Steam Generators"

Reference: 1. D. Saccomando letter to the Nuclear Regulatory Commission dated February 13, 1995, transmitting Proposed Technical Specification Amendment Regarding Increase in Interim Plugging Criteria.

2. H. Pontious letter to Nuclear Regulatory Commission dated July 7, 1995, transmitting Proposed Technical Specification Amendment Regarding Increase in Interim Plugging Criteria.

Reference 1 transmitted Commonwealth Edison Company's (ComEd's) proposal to amend Appendix A, Technical Specifications of Facility Operating Licenses: NPF-37, NPF-66, NPF-72 and NPF-77. The proposed amendment request addresses Technical Specification changes necessary to increase the Interim Plugging Criteria (IPC) value for Byron and Braidwood Stations Unit 1 Steam Generators (SGs). Information contained in that amendment request justifies an increase in the IPC for the hot-leg tube intersections with outside diameter stress corrosion cracking (ODSCC) from 1.0 volt to 3.0 volts. This amendment request was subsequently superceeded via Reference 2.

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As a result of discussions with the Staff and some recent industry events, ComEd is providing this supplement, which will superceeded in its entirety, those transmitted via References 1 & 2.

The following text details the differences between the attached proposed Technical Specification and those previously submitted:

- The attached proposal replaces previous references a to Frank Miraglia memorandum to Edward Jordan requesting CRGR review of Generic Letter 95-XX, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes affected by Outside Diameter Stress Corrosion Cracking," dated May 30, 1995, with a reference to the recently issued GL 95-05 which addressed the same topic.

- Unlike the Generic Letter, which allows implementation of a voltage criteria for more than one cycle, the attached Technical Specification amendment request specifies that the 3 volt criteria would be applicable for Braidwood Unit 1 Cycle 6 & Byron Unit 1 through Cycle 8.

- The attached supplement refers to recent utility experiences which has resulted in inspections of some steam generator internals.

- Also, due to recent utility experiences, ComEd a Steam Generator Internal Inspection plan to identify indications detrimental to the integrity of the load path necessary to support the 3.0 volt IPC. The attached proposed Technical Specification includes verbiage that requires ComEd to notify the staff prior to returning the steam generator to service and to submit a Safety Assessment if such indications are found.

This package consists of the following:

Attachment A:	Description and Safety Analysis of Proposed Changes to Appendix A
Attachment B:	Byron/Braidwood Unit 1 Steam Generator Alternate Plugging Criteria Methodology
Attachment C-1:	Proposed Changes to the Technical Specification Pages for Braidwood Station
Attachment C-2:	Proposed Changes to the Technical Specification Pages for Byron Station
Attachment D:	Evaluation of Significant Hazards Consideration

Attachment E: Environmental Assessment
Attachment F: Leak Rate Methodology

In this proposed package ComEd has committed to follow the probe wear standard as described in GL 95-05. Please be aware that ComEd is currently evaluating use of the probe wear standard for the bobbin coil probe as described in the Generic Letter and may be contacting the Staff to request relief in this area. We understand that recently Farley Units 1 & 2 was granted permission to perform the probe wear assessment using the same inspection techniques as employed during their previous refueling cycle. If ComEd decides to ask for similar relief, the Staff will be contacted as soon as possible to disposition this issue.

This amendment request is considered a cost beneficial licensing action. Application of a 3.0 volt interim plugging criteria for ODSCC indications at the hot-leg tube support plates (TSPs) would reduce the projected maximum number of tubes needing plugging or repair due to ODSCC to 80 for Byron, 62 for Braidwood. This represents a "savings" of 920 tubes at Byron and 913 tubes at Braidwood that would have had to be plugged or repaired using the previous 1.0 volt IPC. This represents a dollar savings of $1.8 Million per station at Byron and Braidwood assuming all these tubes were plugged. However, since plugging levels this high approach currently analyzed maximums, sleeving these tubes could add as much as $6.1 Million a piece at Byron and Braidwood in outage inspection and repair costs. This dollar savings is based only upon repair costs and does not include additional costs associated with plant output derating, extension of outage time and personnel exposure.

ComEd requests that this proposed license amendment be approved to permit application of this 3.0 volt IPC during Braidwood's A1R05 refueling outage which commences September 30, 1995, and Byron's B1P02 mid-cycle outage which commences October 20, 1995. Approval of this license amendment request is required in order to declare the Byron Unit 1 and Braidwood Unit 1 SGs operable, prior to entering Mode 4, Hot Shutdown. Based on the current outage schedule, Braidwood Unit 1 is predicted to enter Mode 4 on November 7, 1995. It is worthy to note that Braidwood's SG manways are scheduled for reinstallation on October 25, 1995. In order to minimize potential rework and scheduling impact, ComEd respectfully requests that this amendment be approved on or before October 25, 1995.

This application of the IPC is applicable to only Byron Unit 1 and Braidwood Unit 1. It is however being submitted for all four operating licenses because the Technical Specification pages are common to both units.

To the best of my knowledge and belief, the statements contained in this document are true and correct. In some respects these statements are not based on my personal knowledge, but on information furnished by other ComEd employees, contractor employees, and/or consultants. Such information has been reviewed in accordance with company practice, and I believe it to be reliable.

Please address any further comments or questions regarding this matter to this office.

Sincerely,

OFFICIAL SEAL
MARY JO YACK
NOTARY PUBLIC STATE OF ILLINOIS
MY COMMISSION EXPIRES 11/29/97

Denise M. Saccomando
Nuclear Licensing Administrator

Mary Jo Yack 9-1-95

Attachments

cc: D. Lynch, Senior Project Manager - NRR
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S. Ray, Acting Senior Resident Inspector-Braidwood
H. Peterson, Senior Resident Inspector - Byron
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ATTACHMENT A

DESCRIPTION AND SAFETY ANALYSIS OF
PROPOSED CHANGES TO APPENDIX A
TECHNICAL SPECIFICATIONS OF
FACILITY OPERATING LICENSES
NPF-37, NPF-66, NPF-72, AND NPF-77

A. DESCRIPTION OF THE PROPOSED CHANGE

Commonwealth Edison (ComEd) proposes to amend the Byron and Braidwood Technical Specification (TS) 3.4.5, "Steam Generators," the bases for TS 3.4.5, and TS 3.4.8, "Specific Activity". This proposal supersedes the previous ComEd requests of February 13, 1995 and July 7, 1995.

The changes proposed to TS 3.4.5 will implement a 3.0 volt bobbin coil probe, Steam Generator (SG) Tube Support Plate (TSP) Interim Plugging Criteria (IPC) limit for Outside Diameter Stress Corrosion Cracking (ODSCC)indications at the hot-leg TSP intersections for Braidwood Unit 1 Cycle 6, and for Byron Unit 1 for the remainder of Cycle 7 and through Cycle 8. A 1.0 volt IPC will be applied to ODSCC indications at the cold-leg TSP intersections.

The changes proposed to TS 3.4.8.a involve reducing Reactor Coolant System (RCS) dose equivalent Iodine-131 (I-131) for Byron Unit 1 and Braidwood Unit 1.

Additional changes are proposed to make the Byron Unit 1 and Braidwood Unit 1 TS consistent with the Model TS contained in Generic Letter 95-05, "Voltage-Based Repair Criteria For Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking," August 3, 1995 (Generic Letter 95-05).

Specific changes are discussed in detail in Section E of this attachment. Affected TS pages showing the actual changes are included in Attachments C-1 and C-2.

B. DESCRIPTION OF THE CURRENT REQUIREMENT

For Byron Unit 1 and Braidwood Unit 1, the Technical Specification Surveillance Requirements (TSSRs) for TS 3.4.5 require, in part, that axial flaws indicative of ODSCC confined within the thickness of the TSP may remain in service provided that the following requirements are met:

- If the flaw-like bobbin coil signal amplitude is less than or equal to 1.0 volt, or

- If the flaw-like bobbin coil signal amplitude is greater than 1.0 volt but less than or equal to 2.7 volts and the signal is not confirmed with Rotating Pancake Coil (RPC) examination, and

- The flaw-like bobbin coil signal is not in a location that is susceptible to collapse or deformation during a postulated Loss Of Coolant Accident (LOCA) + Safe Shutdown Earthquake (SSE) event.

- Tubes containing flaw-like bobbin coil signal amplitudes greater than 2.7 volts must be plugged or repaired, regardless of RPC confirmation.

For Byron only, if as a result of leakage due to a mechanism other than ODSCC at the TSP intersection, or some other cause, an unscheduled inspection is performed, bobbin coil voltage limits are determined in accordance with an equation that takes into account the time remaining in the cycle, the structural limit voltage, and the bobbin voltage at the beginning-of-cycle (BOC).

For Braidwood only, the TSSRs discuss eddy current inspection guidelines and contain a requirement that the projected End of Cycle (EOC) distribution of crack indications must result in a total primary to secondary leakage of less than 9.1 gallons per minute (gpm).

For Byron and Braidwood, TS 3.4.8.a requires that the specific activity of the RCS be limited to 1.0 microCurie per gram (μCi/gm) dose equivalent I-131. For Braidwood only, TS 3.4.8.a references a footnote which requires that for Unit 1 Cycle 5, RCS dose equivalent I-131 will be limited to 0.35 μCi/gm.

C. BASES FOR THE CURRENT REQUIREMENT

The surveillance requirements for inspection of SG tubes ensure that the structural integrity of this portion of the RCS will be maintained. For tubes left in service due to application of IPC, analyses are performed to demonstrate acceptable probability of tube burst, and that Main Steam Line Break (MSLB) leakage is within site specific limits.

Inservice inspection of SG tubing is essential in order to maintain surveillance of the conditions of the tubes in the event that there is evidence of mechanical damage or progressive degradation due to design, manufacturing errors, or inservice conditions that lead to corrosion. Inservice inspection of SG tubing also provides a means of characterizing the nature and cause of any tube degradation so that corrective measures can be taken.

For Byron only, the unscheduled inspection voltage equation takes into account indication growth that occurs during the cycle. It conservatively establishes a voltage limit for each previously identified indication above which the tube must be plugged.

The inspection guidelines identified in the Braidwood Specifications ensure that the maximum number of indications are detected and ensure reliable, consistent acquisition and analysis of data.

With respect to TS 3.4.8, the limitations on the specific activity of the reactor coolant ensure that the resulting 2-hour doses at the Site Boundary will not exceed an appropriately small fraction of Title 10 Code of Federal Regulations Part 100 (10 CFR 100) dose guideline values following a SG tube rupture accident in conjunction with an assumed steady state reactor-to-secondary SG leakage rate of 1 gpm.

The current Braidwood Unit 1 Cycle 5 limit of 0.35 µCi/gm referenced in the footnote to TS 3.4.8.a is based on ensuring the resulting 2-hour doses at the Site Boundary will not exceed an appropriately small fraction of 10 CFR 100 dose guideline values in conjunction with the predicted MSLB leakage calculated as part of Braidwood Station's April 30, 1994, D. Saccomando to W. Russell letter.

For Braidwood, the leakage limits specified in the TS ensure that current offsite dose limits are maintained.

D. NEED FOR REVISION OF THE REQUIREMENT

At Byron and Braidwood, Unit 1 has four Westinghouse Model D-4 SGs and Unit 2 has four Westinghouse Model D-5 SGs. These models differ significantly in tube and TSP materials and design. The D-4 SGs have 0.75 inch thick carbon steel TSPs with drilled hole tube supports. The D-5 SGs have 1.125 inch thick stainless steel TSPs with Quatrefoil tube supports. The D-4 SG tubes are mill annealed Inconel 600 which were hard rolled into the tubesheet during initial assembly. Subsequently, the D-4 tubes were shot peened in the tubesheet area and thermally stress relieved in the U-bend area.

The D-5 tubes are heat treated Inconel 600 which were hydraulically expanded into the tube sheet during initial assembly. Over the past several refueling outages, the number of Unit 1 SG tubes plugged per outage has been increasing at Braidwood and Byron. Unit 1 has had more defective tubes than Unit 2 primarily due to the design differences between the D-4 and D-5 SGs as described above.

Current repair projections for the Braidwood Unit 1 Cycle 5 Refueling Outage indicate that, using the current 1.0 volt IPC, as many as 975 SG tubes may need to be plugged or repaired by sleeving due to ODSCC. If all these tubes were plugged, this would result in a total of 2653 plugged tubes in the Braidwood Unit 1 SGs. Projections for Byron Station's Unit 1 Mid-Cycle outage indicate that, using the current 1.0 volt IPC, as many as 1000 SG tubes may need to be plugged or repaired by sleeving due to ODSCC. If all these tubes were plugged, this would result in a total of 2752 plugged tubes in the Byron Unit 1 SGs. Plugging levels this high approach currently analyzed maximum levels and could result in significantly reduced RCS flow rates, plant output deratings, excessive outage repair costs and severely restricted SG life. Sleeving a sufficient number of tubes to reduce plugging to acceptable levels would result in a significant increase in outage cost, outage length, and radiation exposure.

Application of a 3.0 volt IPC for ODSCC indications at the hot-leg TSPs would reduce the projected maximum number of tubes needing plugging or repair due to ODSCC to 80 for Byron, 62 for Braidwood. This represents a "savings" of 920 tubes at Byron and 913 tubes at Braidwood that would have had to be plugged or repaired using the previous 1.0 volt IPC. This represents a dollar savings of $1.8 Million apiece at Byron and Braidwood assuming all these tubes were plugged. However, since plugging levels this high approach currently analyzed maximums, sleeving these tubes could add as much as $6.1 Million apiece at Byron and Braidwood in outage inspection and repair costs.

Calculations conducted for Braidwood and Byron have shown that the resulting 2-hour doses at the Byron and Braidwood site boundaries will not currently exceed an appropriately small fraction of 10 CFR 100 dose guideline values in conjunction with the predicted MSLB leakage calculated in accordance with this submittal and a dose equivalent I-131 level of 1.0 μCi/gm. The site allowable leakage calculated using a dose equivalent I-131 level of 1.0 μCi/gm is 9.4 gallons per minute (gpm) for Braidwood, and 12.8 gpm for Byron. This leakage includes accident leakage and the allowed 0.1 gpm primary-to-secondary leakage for each of the 3 unfaulted SGs per TS 3.4.6.2.c.

However, in order to provide a defense in depth approach to application of this requested IPC and to envelope any future increases in MSLB leakage due to tube degradation, Byron and Braidwood are lowering their RCS dose equivalent I-131 levels to 0.35 μCi/gm for all future cycles until SG replacement. Site allowable leak rates calculated using 0.35 μCi/gm dose equivalent I-131 are 26.8 gpm for Braidwood and 36.5 gpm for Byron. This leakage also includes accident leakage and the allowed 0.1 gpm primary-to-secondary leakage for each of the 3 unfaulted SGs per TS 3.4.6.2.c. Although not anticipated, the operating period may be adjusted to less than the full operating cycle to meet the specified leakage limit or RCS dose equivalent I-131 may be reduced further to allow more leakage and a longer operating period. Reducing the RCS dose equivalent I-131 below 0.35 μCi/gm will require a justification supporting the request that evaluates the release rate data described in Reference 6 of Generic Letter 95-05.

Bases changes are being made to Braidwood and Byron TS in order to accurately reflect the changes made to the individual specifications.

Finally, additional changes are being made to make Byron and Braidwood TS consistent with the model TS contained in Generic Letter 95-05.

E. DESCRIPTION OF THE REVISED REQUIREMENT

For Byron Unit 1 and Braidwood Unit 1, ComEd is requesting an IPC of 3.0 volts for ODSCC indications at hot-leg TSP intersections and an IPC of 1.0 volt for ODSCC indications at cold-leg TSP intersections.

For Byron, the equation for determining cold-leg voltage acceptance criteria for an unscheduled mid-cycle outage is revised for conformance to Generic Letter 95-05. For Braidwood, the equation for an unscheduled mid-cycle outage cold-leg voltage acceptance criteria is added to the specification for conformance with Generic Letter 95-05. The hot-leg plugging or repair limit for unscheduled outages is 3.0 volts for Byron Unit 1 and Braidwood Unit 1.

Braidwood's probability of tube burst limit is decreased from $2.5x10^{-2}$ to $1.0x10^{-2}$ consistent with Generic Letter 95-05. TS 3.4.8 is being revised for Byron and Braidwood to reduce the Unit 1 RCS dose equivalent I-131 limit from 1.0 μCi/gm to 0.35 μCi/gm. Other changes are being made to Byron and Braidwood TS to make them more consistent with the requirements of Generic Letter 95-05.

The specific TS modifications necessary to accomplish the changes discussed above are described below.

<u>TSSR 4.4.5.2,Steam Generator Tube Sample Selection and Inspection</u>

These changes to the surveillance requirements will specify that all tubes remaining in service due to application of IPC be included among the tubes to be inspected as part of, or in addition to, the sample selection made in accordance with the criteria of Table 4.4-2 of TSSR 4.4.5.2. The surveillance requirements will specify the minimum tube length inspection scope necessary to implement IPC. These changes are consistent with the direction given in Generic Letter 95-05.

For consistency, Item 5 of TSSR 4.4.5.2.b for Braidwood will be renumbered as Item 6. A new Item 5 will be added to TSSR 4.4.5.2.b for Braidwood, and revised for Byron. This item reads as follows:

"5) For Unit 1, indications left in service as a result of application of the tube support plate voltage-based repair criteria shall be inspected by bobbin coil probe during all future refueling outages."

For Byron, this item was previously incorporated. However, it will be revised by adding the word refueling to the existing specification and making other minor changes for consistency with Generic Letter 95-05.

For Braidwood Unit 1, TSSR 4.4.5.2.d will be revised to read as follows:

"d. For Unit 1 Cycle 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."

The wording is the same for Byron Unit 1 except that it is applicable "through Cycle 8" instead of for "Cycle 6."

TSSR 4.4.5.4, Acceptance Criteria

TSSR 4.4.5.4.a.6 will be changed to be consistent with the guidance provided in Generic Letter 95-05. For Braidwood Unit 1, the modified section of TSSR 4.4.5.4.a.6 will read:

"...For Unit 1 Cycle 6, this definition does not apply to tube support plate intersections for which the voltage-based repair criteria are being applied. Refer to 4.4.5.4.a.11 for the repair limit applicable to these intersections;"

The wording is the same for Byron Unit 1 except that the definition is applicable "through Cycle 8" instead of for "Cycle 6."

TSSR 4.4.5.4.a.11 will be replaced with the plant specific Insert D identified in Attachments C-1 and C-2. Insert D defines the repair limit requirements for IPC implementation and incorporates the 3.0 volt hot-leg IPC limit and the 1.0 volt cold-leg IPC limit.

For Braidwood Unit 1, Insert D reads as follows:

11. For Unit 1 Cycle 6, the Tube Support Plate Plugging Limit is used for the disposition of an alloy 600 steam generator tube for continued service that is experiencing predominantly axially oriented outside diameter stress corrosion cracking confined within the thickness of the tube support plates. At tube support plate intersections, the plugging (repair) limit is based on maintaining steam generator tube serviceability as described below:

    a. Steam generator tubes, with degradation attributed to outside diameter stress corrosion cracking within the bounds of the cold-leg tube support plate with bobbin voltages less than or equal to the lower voltage repair limit [Note 1] will be allowed to remain in service. Steam generator tubes, with degradation attributed to outside diameter stress corrosion cracking within the bounds of the hot-leg tube support plate with bobbin voltages less than or equal to 3.0 volts will be allowed to remain in service.

    b. Steam generator tubes with degradation attributed to outside diameter stress corrosion cracking within the bounds of the cold-leg tube support plate with a bobbin voltage greater than the lower voltage repair limit [Note 1], will be repaired or plugged, except as noted in 4.4.5.4.a.11.d below.

c. Steam generator tubes with degradation attributed to outside diameter stress corrosion cracking within the bounds of the hot-leg tube support plate with a bobbin voltage greater than 3.0 volts will be repaired or plugged.

d. Steam generator tubes, with indications of potential degradation attributed to outside diameter stress corrosion cracking within the bounds of the cold-leg tube support plate with a bobbin voltage greater than the lower voltage repair limit [Note 1] but less than or equal to the upper voltage repair limit [Note 2], may remain in service if a rotating pancake coil inspection does not detect degradation. Steam generator tubes, with indication of outside diameter stress corrosion cracking degradation within the bounds of the cold-leg tube support plate with a bobbin voltage greater than the upper voltage repair limit [Note 2] will be plugged or repaired.

e. Certain intersections as identified in WCAP-14046, Section 4.7, will be excluded from application of the voltage-based repair criteria as it is determined that these intersections may collapse or deform following a postulated LOCA + SSE event.

f. If an unscheduled mid-cycle inspection is performed, the following mid-cycle repair limits apply instead of the limits identified in 4.4.5.4.a.11.a, 4.4.5.4.a.11.b and 4.4.5.4.a.11.d for outside diameter stress corrosion cracking indications occurring in the steam generator cold-legs. For outside diameter stress corrosion cracking indications occurring in the steam generator hot-legs, the limits in 4.4.5.4.a.11.a and 4.4.5.4.a.11.c apply. The mid-cycle repair limits are determined from the following equations:

$$V_{MURL} = \frac{V_{SL}}{1.0 + NDE + Gr\left(\frac{CL - \Delta t}{CL}\right)}$$

$$V_{MLRL} = V_{MURL} - (V_{URL} - V_{LRL})\left(\frac{CL - \Delta t}{CL}\right)$$

Where:

V_{URL}	=	upper voltage repair limit
V_{LRL}	=	lower voltage repair limit
V_{MURL}	=	mid-cycle upper voltage repair limit based on time into cycle
V_{MLRL}	=	mid-cycle lower voltage repair limit based on V_{MURL} and time into cycle
Δt	=	length of time since last scheduled inspection during which V_{URL} and V_{LRL} were implemented.
CL	=	cycle length (the time between two scheduled steam generator inspections)
V_{SL}	=	structural limit voltage
Gr	=	average growth rate per cycle length
NDE	=	95-percent cumulative probability allowance for nondestructive examination uncertainty (i.e., a value of 20 percent has been approved by NRC)

Implementation of these mid-cycle repair limits should follow the same approach as in TS 4.4.5.4.a.11.a, 4.4.5.4.a.11.b, 4.4.5.4.a.11.c and 4.4.5.4.a.11.d.

Note 1: The lower voltage repair limit is 1.0 volt for indications of outside diameter stress corrosion cracking occurring at cold-leg tube support plate intersections.

Note 2: The upper voltage repair limit for indications of outside diameter stress corrosion cracking occurring at cold-leg tube support plate intersections is calculated according to the methodology in Generic Letter 95-05 as supplemented.

For Byron Unit 1, Insert D reads the same except that it is applicable "through Cycle 8" instead of for "Cycle 6."

<u>TSSR 4.4.5.5, Reports</u>

TSSR 4.4.5.5.d will be replaced with Insert E. For Braidwood Unit 1, Insert E reads as follows:

"d. For implementation of the voltage-based repair criteria to tube support plate intersections for Unit 1 Cycle 6, notify the staff prior to returning the steam generators to service should any of the following conditions arise:

1. If estimated leakage based on the projected end-of-cycle (or if not practical, using the actual measured end-of-cycle) voltage distribution exceeds the leak limit (determined from the licensing basis dose calculation for the postulated main steam line break) for the next operating cycle.

2. If circumferential crack-like indications are detected at the tube support plate intersections.

3. If indications are identified that extend beyond the confines of the tube support plate.

4. If indications are identified at the tube support plate elevations that are attributable to primary water stress corrosion cracking.

5. If the calculated conditional burst probability based on the projected end-of-cycle (or if not practical, using the actual measured end-of-cycle) voltage distribution exceeds 1×10^{-2}, notify the NRC and provide an assessment of the safety significance of the occurrence.

6. Following a steam generator internals inspection, if indications detrimental to the integrity of the load path necessary to support the 3.0 volt hot-leg IPC are found, notify the NRC and provide an assessment of the safety significance of the occurrence."

The wording is the same for Byron Unit 1 except that it is applicable "through Cycle 8" instead of for "Cycle 6."

This change removes from TS the requirement to report SG inspection results to the Nuclear Regulatory Commission within 90 days of completion of the inspection. This requirement is currently incorporated in Byron TS and was part of the proposed changes to Braidwood TS in the February 13, 1995 submittal. Byron and Braidwood will continue to report SG inspection results in accordance with Generic Letter 95-05.

TS 3.4.8

For Braidwood, the reference to Cycle 5 in the footnote to TS 3.4.8.a will be deleted. This footnote now reads:

"**For Unit 1, reactor coolant DOSE EQUIVALENT I-131 will be limited to 0.35 μCi/gm."

For Braidwood, a footnote with wording identical to that described above has also been added to the applicable TS ACTION statements and the notations for Table 4.4-4.

For Byron, a footnote to TS 3.4.8.a, to the applicable TS ACTION statements, and Table 4.4-4 will be added. This footnote will read:

"**For Unit 1, reactor coolant DOSE EQUIVALENT I-131 will be limited to 0.35 μCi/gm."

For Byron and Braidwood, Figure 3.4-1 of TS 3.4.8 is being revised to include a new transient Iodine limit curve for Unit 1 based on the new Unit 1 dose equivalent Iodine-131 level of 0.35 μCi/gm. A footnote is added to identify Unit 1 curve applicability when RCS Specific Activity is greater than 0.35 μCi/gm Dose Equivalent I-131.

BASES 3/4.4.5, Steam Generators

The discussion in the Bases section of TS dealing with the dispositioning of SG tubes experiencing ODSCC cracking within the thickness of the TSPs will be revised.

The revised discussion reads as follows for Byron[Braidwood]:

"The voltage-based repair limits for Unit 1 in Surveillance Requirement (SR) 4.4.5 implement the guidance in Generic Letter 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking" (Generic Letter 95-05) for Westinghouse-designed steam generators (SGs) with the exception of the specific voltage limit. Generic Letter 95-05 discusses a 1.0 volt Alternate Plugging Criteria (APC) that can be applied to more than one cycle of operation. Byron[Braidwood] SR 4.4.5 implements a 3.0 volt hot-leg Interim Plugging Criteria (IPC) and a 1.0 volt cold-leg IPC for the Unit 1 SGs per WCAP-14273, "Technical Support for Alternative Plugging Criteria with Tube Expansion at Tube Support Plate Intersections for Braidwood-1 and Byron-1 Model D-4 Steam Generators" for a specified operating cycle.

The voltage-based repair limits of SR 4.4.5 are applicable only to Westinghouse-designed SGs with outside diameter stress corrosion cracking (ODSCC) located at the tube-to-tube support plate intersections. The voltage-based repair limits are not applicable to other forms of SG tube degradation nor are they applicable to ODSCC that occurs at other locations within the SG. Additionally, the repair criteria apply only to indications where the degradation mechanism is dominantly axial ODSCC with no significant cracks extending outside the thickness of the support plate. Refer to Generic Letter 95-05 for additional description of the degradation morphology.

Application of the 3.0 volt hot-leg IPC requires verification of the integrity of the SG internals load path necessary to support this IPC in accordance with the Byron/Braidwood Steam Generator Internals Inspection Plan.

Implementation of SR 4.4.5 requires a derivation of the voltage structural limit from the burst versus voltage empirical correlation and then the subsequent derivation of the voltage repair limit from the structural limit (which is then implemented by this surveillance).

The voltage structural limit is the voltage from the burst pressure/bobbin voltage correlation, at the 95-percent prediction interval curve reduced to account for the lower 95/95-percent tolerance bound for tubing material properties at 650^{0}F (i.e., the 95-percent LTL curve). The voltage structural limit must be adjusted downward to account for potential flaw growth during an operating interval and to account for NDE uncertainty. The upper
voltage repair limit for cold-leg indications at the tube support plate; V_{URL}, is determined from the structural voltage limit by applying the following equation:

$$V_{URL}=V_{SL}-V_{Gr}-V_{NDE}$$

where V_{Gr} represents the allowance for flaw growth between inspections and V_{NDE} represents the allowance for potential sources of error in the measurement of the bobbin coil voltage. Further discussion of the assumptions necessary to determine the voltage repair limit is contained in Generic Letter 95-05.

The mid-cycle equation in SR 4.4.5.4.a.11.f should only be used during unplanned inspections in which eddy current data is acquired for indications at the cold-leg tube support plates. The voltage repair limit for indications at the hot-leg tube support plates remains at 3.0 volts during unplanned inspections.

SR 4.4.5.5 implements several reporting requirements recommended by Generic Letter 95-05 for situations which the NRC wants to be notified prior to returning the SGs to service. For the purposes of this reporting requirement, leakage and conditional burst probability can be calculated based on the as-found voltage distribution rather than the projected end-of-cycle voltage distribution (refer to Generic Letter 95-05 for more information) when it is not practical to complete these calculations using the projected end-of-cycle voltage distributions prior to returning the SGs to service. Note that if leakage and conditional burst probability were calculated using the measured end-of-cycle voltage distribution for the purposes of addressing Generic Letter 95-05 sections 6.a.1 and 6.a.3 reporting criteria, then the results of the projected end-of-cycle voltage distribution should be provided per Generic Letter 95-05 section 6.b(c) criteria."

The specific value for the maximum site allowable primary-to-secondary leakage for EOC MSLB conditions is removed.

F. BASES FOR THE REVISED REQUIREMENT

The technical bases for the changes proposed in this amendment request are contained in the following documents:

- WCAP 14273, "Technical Support for Alternate Plugging Criteria with Tube Expansion at Tube Support Plate Intersections for Braidwood 1 and Byron 1 Model D-4 Steam Generators," January 1995.

- WCAP 14046, "Braidwood Unit 1 Technical Support for Cycle 5 Steam Generator Interim Plugging Criteria," Revision 3, March 1995.

- Electric Power Research Institute (EPRI)Report NP-7480-L, "Steam Generator Tubing Outside Diameter Stress Corrosion Cracking at Tube Support Plates - Database for Alternate Repair Criteria, 3/4 Inch Tubing," Volume 2, October 1993.

- Westinghouse Document SG-95-01-003, "Byron Unit 1 End-of-Cycle 6 Interim Plugging Criteria Report," January 17, 1995.

- WCAP 14277, "SLB Leak Rate and Tube Burst Probability Analysis Methods for ODSCC at TSP Intersections," January 1995.

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

- Indications Restricted from Burst (IRBs) Summary Leak Test Report.

A comparison of Generic Letter 95-05 with currently approved IPCs at Byron and Braidwood identified a number of TS differences. These specification differences are identified in Section E of this document. These changes are primarily editorial in nature and provide clarification and conformance to Generic Letter 95-05.

In addition to updating Byron and Braidwood Station's TS for conformance with Generic Letter 95-05, this amendment request proposes to implement a 3.0 volt IPC repair limit for hot-leg tube intersections with ODSCC for Byron Unit 1 and Braidwood Unit 1. While the current 1.0 volt IPC criteria is based on a structural limit derived from freespan tube burst conditions, the 3.0 volt IPC criteria is based on the constraining effects of the TSP to reduce burst probability to negligible levels.

Selected hot-leg tubes will be hydraulically expanded to serve as anchors to limit tube support plate motion during a postulated steam line break event. With TSP motion limited, the length of a crack confined within the TSP that would be subjected to freespan conditions due to TSP movement would be greatly reduced, thus reducing tube burst probabilities during accident conditions. Degradation of SG internals has been identified in other plants. Due to this, ComEd has developed a Byron/Braidwood SG internals inspection plan. This plan will be used to verify the integrity of the SG internal components necessary to support implementation of this amendment request.

Approach

The approach applied to developing the 3.0 volt IPC methodology for hot-leg tube support plate intersections is based on developing the minimum requirements, establishing design objectives more limiting than the minimum requirements, and evaluating the overall performance based on supporting analyses for the tube expansion process. The general approach can be described as follows:

- Define acceptable TSP displacements to reduce the tube burst probability to negligible levels based on the conservative assumption that all hot-leg TSP intersections have throughwall indications equal to the limited TSP displacement resulting from tube expansion.

- Identify the tubes and locations that require expansion to limit TSP movement during a MSLB event to displacements that result in negligible tube burst probabilities.

- Identify additional tubes and locations for expansion to provide sufficient redundancy in the unlikely event that one or two expansions fail due to degradation.

- Define tube expansion functional requirements and process qualifications to ensure that design requirements are met.

- Verify, by inspection in accordance with the Byron/Braidwood SG internals inspection plan, the integrity of the SG internal components necessary to support implementation of the 3.0 volt hot-leg IPC.

- Calculate a tube structural voltage limit based on limited TSP displacement due to tube expansion.

- Demonstrate that MSLB leakage with limited TSP displacement due to tube expansion can be adequately determined by the proposed leakage predictions as described in Attachment F.

- Maintain current leakage limits and operational measures to monitor, trend, and respond to SG tube leakage as specified in the original IPC submittal.

- Maintain existing eddy current inspection guidelines to increase detectability and reduce voltage variability.

Attachment B provides a detailed description of the methodology used for evaluation of the increased IPC limit for hot-leg intersections and a discussion of the operational measures in place at Byron and Braidwood relative to IPC implementation.

Braidwood will be deleting the reference to Cycle 5 in the footnote referenced in Braidwood TS 3.4.8.a, adding footnotes limiting Unit 1 dose equivalent I-131 to the applicable TS ACTION statements of TS 3.4.8 and Table 4.4-4, and revising Figure 3.4-1 to accommodate the Unit 1 Iodine limit. Byron will be adding a footnote to TS 3.4.8.a, to the applicable TS ACTION statements of TS 3.4.8 and Table 4.4-4 to require that Unit 1 RCS dose equivalent I-131 be limited to 0.35 μCi/gm. Byron Figure 3.4-1 will also be revised to accommodate the new Unit 1 Iodine limit.

Calculations conducted for Braidwood and Byron have shown that the resulting 2-hour doses at the Byron and Braidwood site boundaries will not currently exceed an appropriately small fraction of 10 CFR 100 dose guideline values in conjunction with the predicted MSLB leakage calculated in accordance with this submittal and a dose equivalent I-131 level of 1.0 μCi/gm. The site allowable leakage calculated using a dose equivalent I-131 level of 1.0 μCi/gm is 9.4 gpm for Braidwood, and 12.8 gpm for Byron. This leakage includes accident leakage and the allowed 0.1 gpm primary-to-secondary leakage for each of the 3 unfaulted SGs per TS 3.4.6.2.c. However, in order to provide a defense in depth approach to application of this requested IPC and to envelope any future increases in MSLB leakage due to tube degradation, Byron and Braidwood are lowering their RCS dose equivalent I-131 levels to 0.35 μCi/gm for all future cycles until SG replacement. Site allowable leak rates calculated using 0.35 μCi/gm dose equivalent I-131 are 26.8 gpm for Braidwood and 36.5 gpm for Byron. This leakage also includes accident leakage and the allowed 0.1 gpm primary-to-secondary leakage for each of the 3 unfaulted SGs per TS 3.4.6.2.c. Although not anticipated, the operating period may be adjusted to less than the full operating cycle to meet the specified leakage limit or RCS dose equivalent I-131 may be reduced further to allow more leakage and a longer operating period. Reducing the RCS dose equivalent I-131 below 0.35 μCi/gm will require an evaluation to be performed of the release rate data.

G. IMPACT OF THE PROPOSED CHANGE

With the implementation of this license amendment request, the Braidwood and Byron Unit 1 SGs will continue to satisfy the requirements of Regulatory Guide (RG) 1.121. For the hot-leg TSP intersections, the use of tube expansion and stabilization limits the tube/TSP relative displacements that occur during a postulated MSLB such that the tube burst margins for Braidwood Unit 1, and Byron Unit 1 are reduced to negligible levels.

Lowering the Unit 1 RCS dose equivalent I-131 limit from 1.0 μCi/gm to 0.35 μCi/gm is conservative and provides a defense in depth approach to implementation of this IPC. Based on current predictions of MSLB leakage at the time of SG replacement, the lower RCS dose equivalent I-131 limit also ensures that the resulting 2-hour dose rates at the Braidwood and Byron site boundaries will not exceed an appropriately small fraction of 10 CFR 100 dose guideline values.

Implementation of this amendment request could "save" as many as 920 tubes at Byron and 913 tubes at Braidwood that would have had to be plugged or repaired using the previous 1.0 volt IPC. This represents a dollar savings of $1.8 Million apiece at Byron and Braidwood assuming all these tubes were plugged. However, since plugging levels this high approach currently analyzed maximums, sleeving these tubes could add as much as $6.1 Million apiece at Byron and Braidwood in outage inspection and repair costs. This will also minimize the RCS loop flow asymmetries and thermal power derates.

H. SCHEDULE REQUIREMENTS

ComEd requests that this proposed license amendment be approved to permit application of this 3.0 volt IPC during Braidwood's A1R05 refueling outage which begins September 30, 1995, and Byron's B1P02 mid-cycle outage which commences October 20, 1995. Approval of this license amendment request is required in order to declare the Byron Unit 1 and Braidwood Unit 1 SGs operable prior to entering Mode 4, Hot Shutdown. Based on the current outage schedule, Braidwood Unit 1 is predicted to enter Mode 4 on Tuesday, November 7, 1995. It is worthy to note that Braidwood's SG manways are scheduled for reinstallation on Wednesday, October 25, 1995. In order to minimize potential rework and scheduling impact, ComEd respectfully requests that this amendment be approved on or before October 25, 1995.

- Identify the tubes and locations that require expansion to limit TSP movement during a MSLB event to displacements that result in negligible tube burst probabilities.

- Identify additional tubes and locations for expansion to provide sufficient redundancy in the unlikely event that one or two expansions fail due to degradation.

- Define tube expansion functional requirements and process qualifications to ensure that design requirements are met.

- Verify, by inspection in accordance with the Byron/Braidwood SG internals inspection plan, the integrity of the SG internal components necessary to support implementation of the 3.0 volt hot-leg IPC.

- Calculate a tube structural voltage limit based on limited TSP displacement due to tube expansion.

- Demonstrate that MSLB leakage with limited TSP displacement due to tube expansion can be adequately determined by the proposed leakage predictions as described in Attachment F.

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- Maintain existing eddy current inspection guidelines to increase detectability and reduce voltage variability.

Attachment B provides a detailed description of the methodology used for evaluation of the increased IPC limit for hot-leg intersections and a discussion of the operational measures in place at Byron and Braidwood relative to IPC implementation.

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With the implementation of this license amendment request, the Braidwood and Byron Unit 1 SGs will continue to satisfy the requirements of Regulatory Guide (RG) 1.121. For the hot-leg TSP intersections, the use of tube expansion and stabilization limits the tube/TSP relative displacements that occur during a postulated MSLB such that the tube burst margins for Braidwood Unit 1, and Byron Unit 1 are reduced to negligible levels.

Lowering the Unit 1 RCS dose equivalent I-131 limit from 1.0 µCi/gm to 0.35 µCi/gm is conservative and provides a defense in depth approach to implementation of this IPC. Based on current predictions of MSLB leakage at the time of SG replacement, the lower RCS dose equivalent I-131 limit also ensures that the resulting 2-hour dose rates at the Braidwood and Byron site boundaries will not exceed an appropriately small fraction of 10 CFR 100 dose guideline values.

Several modeling techniques are employed to determine hydraulic loading on the TSPs and to determine displacements. A thermal hydraulic model (TRANFLO) was developed to predict critical SG parameters during a postulated MSLB such as mass flowrate, pressure drop, fluid temperature, steam quality and void fraction.

The model was run for several different plant operating conditions to determine the most conservative loads resulting from a MSLB. The hot standby condition with a MSLB at the SG nozzle yields the more limiting hydraulic loads and was used in evaluation for limiting tube displacements. A safety factor was applied to the hydraulic loads for additional conservatism.

A structural model was developed to determine relative tube to TSP motions under MSLB loads that were determined with the thermal hydraulic model discussed above. The structural model utilizes a general purpose finite element code that accounts for the physical SG structures and materials, as well as MSLB hydraulic loading. Locations of tube expansions that restrict TSP motion can also be evaluated with the model.

The analyses contained in these models also evaluated acoustic pressure waves caused by the steam line break, and found acoustic effects to have negligible impact on TSP hydraulic loads.

ComEd has performed independent confirmatory analyses of the predicted TRANFLO loads using other computer codes such as Multiflex and RELAP 5. The results of these analyses lead to a confirmation of the predicted TRANFLO loads.

To support a 3.0 volt IPC, the TSP motion is limited during a MSLB event to displacements that result in negligible tube burst probabilities. The modeling techniques described above are used to determine relative tube to TSP motions. These techniques determine the length of a crack within a TSP that could be uncovered due to the relative tube to TSP displacement. From this freespan exposed crack length, a tube burst probability is derived from a correlation that relates crack length to tube burst pressure.

The evaluation conservatively assumes that every hot-leg tube intersection (32,046 intersections) contains a through-wall crack with length equal to the TSP displacement and the crack tip is located at the edge of the TSP. Alternatively, it can be assumed that every hot-leg tube intersection contains a through-wall crack length approximately equal to the thickness of a TSP. For all the postulated 32,046 through-wall cracked intersections, a total tube burst probability of $1x10^{-5}$ was selected as the target for negligible burst probability. This is a factor of 1000 lower than the Generic Letter 95-05 limit of $1x10^{-2}$. The $1x10^{-5}$ tube burst probability corresponds to a maximum through-wall crack freespan length of 0.31" for the postulated 32,046 indications. Therefore, a maximum displacement of 0.31" is the tube expansion design criteria used for limiting TSP motion. However, a 0.1" maximum displacement was selected to be the functional design goal for tube expansion. This provides added conservatism and the ability to perform in situ pressure testing of indications for increasing the leak rate database for constrained tubes.

With a 0.1" displacement for all hot-leg intersections, the total burst probability for throughwall indications at all hot-leg intersections is reduced from $1x10^{-5}$ to $1x10^{-10}$.

A number of tubes were selected for tube expansion to limit the displacement to less than 0.1". Additional tubes were selected to be expanded to serve as redundant or back-up tubes in the unlikely event that a tube expansion fails due to degradation. The redundant tubes ensure that a maximum displacement of 0.31" and a burst probability of $1x10^{-5}$ is achieved when one or more expansions fail. An additional two tubes are required to be expanded to limit a bending stress in the top support plate.

Tube Expansion

As previously discussed, tube expansion will be used on selected tubes to limit relative tube to TSP motion during postulated MSLB events to result in negligible tube burst probabilities. The tube expansion process will essentially convert the selected tubes into stayrods to restrict potential TSP displacements. This is accomplished by hydraulically expanding the tube into the TSP and also creating a bulge larger than the TSP drilled hole above and below the TSP to lock the tube into the TSP to limit motion in both directions. The expanded tube to TSP intersection will be stabilized and the tube will be removed from service.

The tube expansion process and stabilization is accomplished with a sleeve stabilizer. A sleeve is hydraulically expanded into the parent tube to create the necessary expansion and bulge for tube to TSP locking. The sleeve serves two purposes, 1) provides stabilization if the tube fails at the expansion, and 2) provides additional stiffness to the expanded joint. The sleeve stabilizer is designed to prevent damage to adjacent tubes in the unlikely event that the parent tube is severed at the expansion joint. The added stiffness of the expanded joint due to the sleeve provides additional resistance to TSP displacement. The expansion process is a qualified process to ensure that the expansion design functional requirements are met for each application. The expanded tubes will be inspected following the expansion process to ensure that the desired expansion parameters have been achieved.

Degradation of the parent tube expansion or sleeve is not an expected phenomenon. Tube degradation is affected by temperature and stresses in the tube. The operating temperature of the expanded tube is greatly reduced since the tube is removed from service. The temperature of the expanded tube will be the temperature of the secondary side of the SG, which typically ranges from about 520° F to 544° F, as compared to an inservice tube that experiences temperatures of about 610° F.

Laboratory tests have indicated that reducing the temperature from an inservice tube to that of a plugged tube results in a reduction in the stress corrosion cracking initiation by a factor of 16 for similarly stressed tubing.

Corrosion tests have been performed for varying expansion diameters up to and above those required for TSP locking. These tests have concluded that for the expansion process described the stress corrosion cracking potential is not expected to exceed that for hydraulic or hardroll tubesheet expansions. An inspection of three expanded tubes will be performed at a frequency of every three fuel cycles to ensure that degradation of the expansions is not occurring. To perform these inspections, each tube selected for inspection must be de-plugged, inspected, and re-plugged. If circumferential degradation is detected at an expansion, then the inspection will be increased to include other expansions in the SG based on the severity of the indications found in the base inspection.

Industry experience has shown that in SGs with severe corrosion induced denting, tube support plates have been observed to be cracked. Evaluations were performed to assess this concern pertaining particularly to the application of tube expansion to support the 3.0 volt IPC.

A finite element analysis was performed and established that the dent size necessary to cause a stress intensity that exceeds the yield strength of the TSP was a 65 mil diametral dent. Therefore, dents of a smaller size are not expected to produce stress levels that would be a cracking concern. Byron Unit 1 and Braidwood Unit 1 SGs have not experienced corrosion assisted denting at the TSP. To establish that denting does not produce a TSP cracking concern in the future at Byron Unit 1 and Braidwood Unit 1, inspections to evaluate service induced denting will continue and the bobbin coil probe will be used as a go/no-go gauge to assess hot-leg dent sizes. The criteria used to ensure that dents are below the size necessary to cause excessive TSP stress levels is the passage of an appropriately sized bobbin probe through the tube. If the tube does not allow passage of an appropriately sized bobbin probe due to a dent at a hot-leg TSP, then the repair criteria applied to cold-leg ODSCC will be applied to that intersection and adjacent intersections, in lieu of a 3.0 volt IPC. IPC will not be applied to hot-leg or cold-leg intersections with dents greater than 5.0 volts. In addition, tube intersections selected for tube expansion and adjacent intersections must not contain dents greater than 5.0 volts to be considered acceptable expansion candidates.

Structural Voltage Limit and Leakage Considerations

The purpose of the TS repair limit is to ensure that tubes accepted for continued service will retain adequate structural and leakage integrity during normal, transient, and postulated accident conditions, consistent with General Design Criteria (GDC) 14, 15, 31, and 32 of Title 10 Code of Federal Regulations Part 50 (10 CFR 50), Appendix A.

Structural integrity is defined as maintaining adequate margins against gross failure, rupture, and collapse of the SG tubing. Regulatory Guide (RG) 1.121, "Basis for Plugging Degraded PWR Steam Generator Tubes," requires a structural safety margin of 1.43 against tube failure under postulated accident conditions and a safety margin of 3.0 against burst during normal operation.

The proposed IPC meets the requirements of RG 1.121. It also demonstrates that tube leakage is acceptably low and that tube burst is a highly improbable event during normal operation and a postulated MSLB event. Implementation of this IPC results in offsite doses that are a small fraction of 10 CFR 100 limits.

For axial ODSCC located at cold-leg intersections, the current 1.0 volt IPC criteria are still applicable. These criteria are derived from freespan burst considerations and are consistent with Generic Letter 95-05 requirements. The structural voltage limit is based on the log-linear relationship between tube burst and bobbin coil voltage. The database used for the calculation of the Byron Unit 1 and Braidwood structural limit is consistent with that described in Generic Letter 95-05, with the inclusion of the recent Byron Unit 1 and Braidwood Unit 1 tube pull results. Since tube burst is precluded during normal operating conditions due to the constraining effects of the TSP, a safety margin of 1.43 is used to derive the lower 95% confidence level voltage under MSLB conditions. This structural voltage limit is 4.75 volts. The voltage limit for allowing non-confirmed rotating pancake coil (RPC) indications to remain in service in the cold leg will be calculated by the methodology described in Generic Letter 95-05.

For axial ODSCC located at hot-leg intersections, tube burst probabilities are reduced to negligible levels during normal, transient, and postulated MSLB conditions due to limited TSP displacements from tube expansion. Therefore, MSLB leakage criteria dictates the structural and repair limits. Since axial ODSCC does not significantly impact the axial tensile loading of the tube, the more limiting degradation modes are cellular corrosion and Inter-Granular Attack (IGA).

Significant IGA depths have not been experienced at the Byron or Braidwood units based on eddy current examinations and tube pull results. Thus, cellular corrosion is the expected crack morphology at TSPs to affect tensile load limits.

From available data (refer to Section 9.0 of WCAP-14273), the pressure that would be required to cause axial separation of a tube with cellular corrosion is well above the 3 times normal operating pressure differential at a bobbin voltage of 37 volts, with a lower bound 95% confidence level applied. Due to the limited size of the database, an additional safety factor is applied to conservatively establish a lower bound structural limit of 20 volts.

Accounting for voltage growth and non-destructive examination (NDE) uncertainty, the full IPC limit exceeds 10 volts. However, for added conservatism a single voltage repair limit for hot-leg indications is specified in this request. All hot-leg TSP ODSCC indications with bobbin coil probe voltages greater than 3.0 volts will be plugged or repaired, regardless of RPC inspection results.

Although the probability of burst is greatly reduced at hot-leg tube intersections due to the constraining effects of the TSP, the probability of higher MSLB leak rate values has been evaluated. A finite probability exists that a crack may open to the limits of the tube to TSP gap and cause increased leakage. This probability is equivalent to the probability of free span burst. Leakage from these Indications Restricted from Burst (IRB) will be accounted for by methods described in Attachment F. These analyses are also discussed in the July 21, 1995, D. Saccomando letter to Office of Nuclear Reactor Regulation Subject: Additional Information Pertaining to the Application for Amendment to Facility Operating Licenses: Byron Nuclear Power Station, Units 1 and 2 NPF 37/66; NRC Docket Nos. 50-454/455, Braidwood Nuclear Power Station, Units 1 and 2 NPF-72/77, NRC Docket Nos 50-456/457.

The total primary-to-secondary tube leakage at MSLB conditions due to IPC application and any other approved alternate repair criteria is not to exceed the site allowable leak rate as calculated in accordance with previously approved IPCs. The site allowable leakage calculated using a dose equivalent Iodine-131 (I-131) level of 1.0 microCurie per gram (μCi/gm) is 9.4 gallons per minute (gpm) for Braidwood, and 12.8 gpm for Byron. Site allowable leak rates calculated using 0.35 μCi/gm dose equivalent I-131 are 26.8 gpm for Braidwood and 36.5 gpm for Byron. This leakage limit includes accident leakage and the allowed 0.1 gpm primary-to-secondary leakage (TS 3.4.6.2.c) for each of the 3 unfaulted SGs.

Probability of Detection

Probability of Detection (POD) of eddy current indications is an important consideration in the development and implementation of IPC. The POD is used to adjust the beginning-of-cycle (BOC) voltage distribution to account for indications not detected during the inspection. The voltage distribution of detected indications is scaled up by a factor of 1/POD and tubes repaired are then subtracted to form the assumed population and voltage distribution for the next operating cycle. The adjusted BOC voltage distribution is used in tube leak and burst assessments in support of the IPC.

To expedite review and approval of this proposed amendment, ComEd will use the Generic Letter 95-05 POD value of 0.6 for all voltage amplitude ranges. The February 13, 1995, submittal discussed the use of a voltage dependant POD. This discussion was supported by an Electric Power Research Institute (EPRI) report. This report is being modified to account for the possible initiation of new ODSCC indications between scheduled SG inspections. When complete, this report may be used as the basis for a future request for an alternate POD.

MSLB Leakage and Burst Probability Analysis Methods

The analysis methodologies to support the current 1.0 volt IPC and proposed 3.0 volt IPC are consistent with the requirements of Generic Letter 95-05, the analysis methods described in the October 24, 1994, Byron Unit 1 Safety Evaluation Report (SER) and WCAP 14277. For the proposed 3.0 volt IPC at hot-leg intersections, the effects of limited TSP displacement are incorporated into the analyses, however, the analysis methodologies remain the same.

Consistent with Generic Letter 95-05, MSLB leakage analyses continue to be based on the EPRI Probability of Leakage (POL) model and the conditional leak rate correlation with the addition of a contribution for IRBs. The leakage assessment consists of predicting a freespan leak rate as a function of bobbin coil voltage, assuming that a leak occurs. The POL model uses the Nuclear Regulatory Commission (NRC) accepted single log-logistic function form. The conditional leak rate correlation (leak rate to bobbin voltage correlation) is a linear regression fit of the logarithms with an upper bound 95% confidence level. This correlation is deemed to be valid when a p-value test result of less than 5% is demonstrated.

A Monte Carlo simulation is applied to the POD adjusted BOC voltage distribution to estimate the MSLB leak rate and burst probabilities at the end-of-cycle (EOC) condition. This approach applies considerations for NDE uncertainty and voltage growth. A full Monte Carlo technique is used to account for regression parameter uncertainty.

The database for the leak and burst correlations is consistent with the database used to support the Byron Unit 1 Cycle 7 IPC as described in the October 24, 1994, SER and the Byron Unit 1 90 day IPC report for Cycle 7 dated January 30, 1995, with the inclusion of Byron Cycle 6 tube pull results. The results of the Braidwood Unit 1 and Byron Unit 1 tube pull results were added tc the industry database.

For the cold-leg indications, the MSLB leak rate value is calculated as described above. MSLB tube burst analyses continue to be based on EPRI tube burst correlations that demonstrate a log-linear relationship between tube burst pressure and bobbin coil voltage. The correlation used to define the structural voltage limit uses a lower 95% confidence level reduced to account for the lower 95/95-percent tolerance bound for tubing material properties at 650^{0}F (i.e. the 95% LTL curve) to correlate burst pressure to bobbin voltage. The tube burst analysis calculates the total probability of burst for a given voltage distribution. This total burst probability includes the summation of the probabilities of burst due to 1 tube bursting, 2 tubes bursting, etc.

Those tubes which will be excluded from application of IPC as a result of the possibility of collapse during a Loss Of Coolant Accident (LOCA) with Safe Shutdown Earthquake (SSE) event have been identified in the revision to WCAP 14046 which was submitted to the NRC on June 19, 1995.

<u>Steam Generator Internals Integrity Issues</u>

During the processing of this amendment request, ComEd has evaluated the experience of several domestic and foreign units with steam generator tube support plate degradations, eddy current signal distortions, and component misalignment. The degradations experienced by these other units include missing or damaged tube support plates and tube support plate cracking.

The mechanisms suspected to cause the tube support plate degradations, signal distortions, and component misalignment have been evaluated for significance and impact on application of 3.0 volt hot-leg IPC repair limits at Byron Unit 1 and Braidwood Unit 1 as discussed below.

Specifically, the following issues have been evaluated:

- TSP degradation related to tube denting.
- TSP degradation related to chemical cleaning.
- TSP degradation in the area of anti-rotation devices.
- Distorted TSP signals related to TSP Geometry.
- Tube Bundle Wrapper Dislocation.

TSP Degradation Related to Tube Denting:

ComEd is aware of TSP cracking at a number of units associated with tube denting due to TSP corrosion at the tube to TSP crevice.

Byron Unit 1 and Braidwood Unit 1 have not experienced corrosion induced tube denting. It is shown in WCAP 14273 Section 12.4 that a diametral reduction of 65 mils is required to develop stress levels above yield in the TSP ligaments at dented intersections. For this reason, a requirement that a tube must be capable of passing an appropriately sized bobbin probe through a dented TSP intersection for 3.0 volt IPC to be applied is incorporated. If an appropriately sized bobbin probe can not pass through a dented intersection, all surrounding tube locations must be repaired to the repair criteria applied to the cold-leg TSPs.

TSP Degradation Related to Chemical Cleaning:

During a 1995 steam generator eddy current inspection at a foreign plant, distortions were observed in one area at the top TSP in two of the three steam generators. Visual inspections discovered a small section of the TSP in an area next to the wrapper was missing. The missing parts were found resting on the TSP below the top TSP. The support plate also showed indications of metal loss estimated as high as 0.25 inches of the 0.75 inch thick TSP. The edge of the TSP near the outer wrapper also appeared to have some metal loss. A review of the 1994 eddy current inspection data indicated that support plate distortions had been present, but not identified during the data review process. A root cause investigation was performed by the utility which concluded that the damaged TSPs were a result of a chemical cleaning that occurred in 1992. The chemical cleaning process was developed by the utility and was significantly different than the modified EPRI/SGOG chemical cleaning process performed at Byron Unit 1. The foreign process used a Gluconic Acid/Citric Acid solution at a pH of 3.2 recirculated at a high velocity for 150 hours.

The solution was recirculated from the blowdown pipe through a pump which discharged through three hoses placed above the tube bundle. The flowrate through each hose was required to be less than 1 meter/second, but actual flowrates were up to 2 meters/second in the two affected steam generators. The solvent recirculation rate was 200 cubic meters/hour in the two steam generators and 50 cubic meters/hour in the unaffected generator. In addition, one of the hoses in the affected generators was mispositioned and was too close to the top support plate, thus creating a higher solution velocity at the top TSP.

The higher recirculation velocities is thought to have stripped the cleaning solution inhibitor from the base metal allowing excessive corrosion rates to occur at the top support plate and the blowdown line. This phenonemon was confirmed through testing and also demonstrated by EPRI during the qualification testing of chemical cleaning processes. The metal loss due to corrosion at the top TSP was estimated to be at least 250 mils.

The Byron Unit 1 chemical cleaning that was performed in 1994 used a modified EPRI/SGOG qualified process conducted at high temperature and was significantly different from that performed in the foreign unit. At Byron, the solvent contained a 30% EDTA solution with hydrazine and an inhibitor. The pH of the solution at Byron was 8.0, as contrasted by a 3.2 pH for the foreign unit. The total contact time at Byron was approximately 30 hours, compared to 150 hours for the foreign unit. The Byron chemical cleaning used a fill and drain technique, instead of the recirculation technique. The Byron process involved passivation with an ammonia/hydrazine solution. The overall corrosion measured by actual material coupons was 2.16 mils, well within the allowable limit of 11 mils. Eddy current inspection of the steam generator tubing was performed after the Byron chemical cleaning with no TSP distortions reported.

Due to the differences in the chemical cleaning processes and the root cause analysis that was performed by the foreign utility, ComEd has determined that the TSP damage mechanism at the foreign unit does not apply to Byron Unit 1. No chemical cleanings have been performed at Braidwood Unit 1.

The specific details of the damage experienced at the foreign unit were discussed in proprietary meetings between ComEd and the NRC held on July 20, 1995 and August 17, 1995.

TSP Degradation in the Area of Anti-rotation Devices:

Cracked tube support plates have recently been reported by one foreign utility. Cracked TSPs were discovered when distorted eddy current indications were visually inspected.

The degradation seen has been limited to the top TSP, in the area of the anti-rotation device. This area is unique to the steam generators in that it is where the wrapper anti-rotation device connects to the ID of the shell.

Preliminary review of baseline eddy current data indicates that the degradation may have been present prior to plant operation, indicating that it may be the result of a manufacturing problem. The degradation has been seen in at least one of the three steam generators in each plant inspect thus far.

The steam generator internals of the affected foreign units are similar to the design of the Westinghouse Model 51 steam generator, in particular there is one anti-rotation device of similar design at the top TSP. The single anti-rotational device carries the full load associated with the shell to wrapper motion. The rotational load is believed to be transferred to the TSP, which may increase susceptibility to TSP cracking. However, due to the design differences of the wrapper internals, the Westinghouse design is less susceptible to cracking at this location.

The steam generator internals of a Westinghouse Model D-4 design have three similar anti-rotation devices at the top support plate. The three anti-rotation devices distribute the rotational loads at the three locations which result in lower loads at each individual device, as compared to the foreign units design. Again, there are design differences internal to the wrapper that make the Westinghouse design less susceptible to cracking at this location.

ComEd believes the TSP cracking seen in the foreign steam generators is unique to their design and the fabrication of their internals. Eddy Current inspections at Byron and Braidwood have been performed with no missing support plate signals being reported. ComEd is working closely with the foreign utility in understanding the root cause of the TSP degradation. ComEd is also working closely with the industry to develop improved TSP inspection techniques.

The specific details of the damage experienced at the foreign unit were discussed in proprietary meetings between ComEd and the NRC held on July 20, 1995 and August 17, 1995.

Although ComEd considers the TSP cracking experienced by the foreign steam generators to be unique to their design, an inspection of this TSP along with other SG internals which would be in the MSLB load carrying path as a result of application of the provisions of this amendment will be conducted in accordance with the Byron/Braidwood SG internals inspection plan. Results of this inspection will be reported to the NRC in accordance with the provisions of the reporting requirements section of this amendment request.

Distorted TSP Signals Related to TSP Geometry:

Recently, a domestic utility reported potential TSP degradation unrelated to denting. The utility had reported a small number of distorted TSP signals over the past three refueling outages. Upon further review of the data, and mapping the signals on a tubesheet diagram, it was shown that these signals were associated with TSP geometries. Specifically, the area where the access cover is welded into the TSP produced distorted signals due to permeability variations. In another location, a distorted signal is believed to be associated with the weld between the wedge and the TSP.

These signals have been reviewed by both the utility and Westinghouse and are not believed to be the result of TSP cracking.

Tube Bundle Wrapper Dislocation:

One foreign unit has observed a dislocation of the tube bundle wrapper. Apparently, this was the result of the wrapper not being appropriately attached to its support structure. This was discovered when they were unable to pass sludge lancing equipment through a handhole in the wrapper due to misalignment of the wrapper and handhole of the shell.

Byron Unit 1 and Braidwood Unit 1 have performed steam generator sludge lance operations each refueling outage and have not observed misalignment of the wrapper and the shell. The foreign unit was of a different design and manufacturer than the Byron Unit 1 and Braidwood Unit 1 Westinghouse Model D-4. The wrapper support design is significantly different from that used on the Model D-4 steam generator.

Inspection Requirements

ComEd will develop a SG internals inspection plan to assure the integrity of those SG internal components that are subjected to loads during a MSLB and are necessary to support implementation of this amendment request. This SG internals inspection plan will be provided to the NRC in a separate document.

Technical Specification Surveillance Requirement (TSSR) 4.4.5.2 requires bobbin coil inspections to be performed on 100% of the hot-leg and cold-leg intersections down to the lowest cold-leg TSP elevation having ODSCC. A minimum of a 20% random sample is also to be inspected over the full length of the tube. RPC inspections are to be performed on the following indications:

- All hot-leg TSP indications greater than 3.0 volts.

- All cold-leg TSP indications greater than 1.0 volt.

- All TSP intersections that contain dents greater than 5.0 volts and a 20% sample of dents between 2.5 volts and 5.0 volts. If Primary Water Stress Corrosion Cracking (PWSCC) or circumferential cracking is detected, 100% of the dents between 2.5 volts and 5.0 volts will be inspected.

- All intersections with large mixed residuals that could cause a 1.0 volt signal to be missed or misread.

- All intersections with interfering signals from copper deposits. Neither Braidwood nor Byron has significant copper deposits in the SGs. Guidance on conducting RPC inspections for interference signals due to copper has been included in each station's inspection guidelines.

Any flaw-like indication confirmed by RPC at intersections with dent signals greater than 2.5 volts, large mixed residuals, or copper deposits will result in the tube being repaired by sleeving or plugging. In addition, IPC will not be applied to any crack-like indication in a wedge area or the Flow Distribution Baffle.

Also, the following data acquisition and analysis requirements will be met:

- The bobbin coil will be calibrated against a reference standard in the laboratory by direct testing or by use of a transfer standard.

- The voltage response of new bobbin coil probes for the 40% to 100% American Society of Mechanical Engineers (ASME) throughwall holes will not differ from the nominal voltage by more than ± 10%.

- Probe wear will be controlled by either an in-line measurement device or through the use of a periodic wear measurement. When utilizing the periodic wear measurement approach, if a probe is found to be out of specification (15%), all tubes inspected since the last successful calibration will be reinspected with a new calibrated probe.

- Data analysts will be trained in the use of the ComEd Byron and Braidwood Stations Units 1 and 2 Eddy current Analysis Guidelines and qualified through site specific testing. Data analyst performance will be consistent with the assumptions for analyst measurement variability utilized in the tube integrity evaluations.

- Quantitative noise criteria (resulting from electrical noise, tube noise, calibration standard noise) will be included in the data analysis procedures. Data failing to meet these criteria will be rejected, and the tube will be reinspected.

- Data analysts will review the mixed residuals on the standard itself and take action as necessary to minimize the residuals.

- A 0.610 inch diameter bobbin coil probe will be utilized for the inspection. If a 0.610 inch diameter probe will not pass through a portion of a tube, IPC will not be applied to the portion of the tube that is inspected by a smaller probe.

- An appropriately sized bobbin probe will be used as a go/no-go gauge to determine acceptability of dented intersections and adjacent intersections for 3.0 volt IPC.

- The presence of hot-leg TSPs will be verified by eddy current.

- Data analysts will be trained on the potential for PWSCC cracking to occur at TSP intersections. The data analysts will be sensitized to identify indications attributed to PWSCC.

The bobbin and RPC examinations will be performed using enhanced inspection guidelines that are intended to increase detectability and reduce voltage variability in support of IPC implementation. The IPC guidelines that will be used in the Braidwood Unit 1 and Byron Unit 1 Fall 1995 inspections are the same guidelines used to support the Byron Unit 1 Fall 1994 IPC inspection.

Operational Measures

Braidwood Station's April 25, 1994, and Byron Station's August 1, 1994, request for a 1.0 volt IPC contained a description of enhanced operational and procedural measures that Braidwood and Byron Stations have taken to ensure a defense-in-depth approach against SG tube failures and detection of flaws that would exceed steam line break leakage limits. The measures remain in place at Braidwood and Byron and are summarized below.

- Actions have been taken to mitigate the corrosive environment in the TSP crevices and to increase the likelihood that future growth rates and crack morphologies will be within expected bounds.

- The alert and alarm setpoints on the main steam line and steam jet air ejector radiation monitors have been lowered to ensure early positive indication of primary to secondary leakage.

- Chemistry procedures have been revised to facilitate "quick counts" of chemistry samples to give rapid confirmation of SG leakage.

- SG chemistry sampling frequencies have been increased to hourly when primary-to-secondary leakage is detected, and then reduced to not less frequently than once per day once leakage stabilizes.

- In order to quickly determine if SG leakage is increasing during a tube leak event, Braidwood Operating Abnormal Procedure (BwOA SEC-8)and Byron Operating Abnormal Procedure (BOA SEC-8), have been revised to require that radiation monitors be checked at an increased frequency when SG leakage is detected.

- Tube rupture, tube leakage, and main steam line break scenarios are conducted frequently in the simulator. These scenarios include varying radiation monitor responses as appropriate.

- Byron and Braidwood Emergency Procedures require continuous monitoring for SG tube leakage. BwOA SEC-8, and BOA SEC-8 require continued monitoring of leakage during a shutdown to ensure detection of increasing leakage.

- Control Room daily surveillances have been revised to require that hourly trend readings of steam jet air ejector radiation monitor activity levels be reviewed on a daily basis.

- Braidwood and Byron TS 3.4.6.2.c has been changed to limit primary-to-secondary leakage to 600 gallons per day total reactor-to-secondary leakage through all SGs not isolated from the Reactor Coolant System, and 150 gallons per day through any one SG.

<u>Generic Letter 95-05 Review</u>

ComEd will implement all the requirements contained in Generic Letter 95-05. Below is a list which summarizes some of the key requirements contained in this memorandum and modifications due to application of the 3.0 volt IPC.

<u>Exclusion of Intersections</u>

IPC will not be applied to the following intersections:

- LOCA + SSE tubes (Wedge area).

- Dents greater than 5.0 volts.

- Dents 2.5 volts to 5.0 volts with crack-like indications.

- Large mixed residuals that could cause a 1.0 volt indication to be missed or misread.

- Intersections with interfering copper signals.

- Flow distribution baffles.

- PWSCC or Circumferential crack-like indications at TSP

Repair Criteria

The following indications/tubes will be repaired:

- All hot-leg ODSCC TSP indications greater than 3.0 volts, regardless of RPC confirmation.

- All cold-leg ODSCC indications greater than the upper voltage limit.

- All cold-leg ODSCC indications between the lower voltage limit and the upper voltage limit that are confirmed by RPC.

- Tubes with known leakage.

- RPC confirmed flaws indicative of ODSCC/PWSCC at locations that are excluded from IPC as described above.

The cold-leg repair criteria will be applied to the following hot-leg intersections, in lieu of 3.0 volt IPC:

- Intersections that contain corrosion induced dents such that an appropriately sized bobbin probe cannot pass through the dented intersection. Intersections adjacent to these tubes will also have the cold-leg repair criteria applied.

IPC Voltage Limit Determination

- A single voltage limit of 3.0 volts for hot-leg TSPs.

- A lower voltage limit of 1.0 volt for cold-leg TSPs.

- For cold-leg TSPs, an upper voltage limit is determined by reducing the structural voltage limit by voltage growth and NDE uncertainty.

  - Determined prior to each outage.

  - Use the larger of the site specific growth rate or 30%/EFPY.

  - NDE uncertainty of 20% of the BOC voltage.

Voltage Growth Distribution

- Growth rates determined by indications identified at two successive inspections, except that indications that grow from (non-detectable degradation) NDD to a relatively large voltage (e.g. 2.0 volts) will be included.

- Current cycle growth rates will be used if the current inspection or the current and previous inspections used IPC guidelines.

- The most limiting growth rates will be used from the last two inspection cycles.

- Negative growth rates will be included as zero growth.

- Re-evaluation of previous cycle data will be compensated for changes made in data acquisition guidelines.

- Effects of chemical cleaning will be evaluated, if performed.

Tube Pulls

- A minimum of two tubes and 4 TSP intersections have been removed at Byron Unit 1 and Braidwood Unit 1. A minimum of one additional tube (minimum 2 TSP intersections) will be removed following an additional 34 effective full power months or 3 refueling cycles, whichever is shorter.

- Alternatively, ComEd will participate in a NRC approved industry sponsored tube pull program.

- Leak/burst tests will be performed under MSLB conditions to confirm failure mode is axial and to add to the industry correlation database.

- Destructive testing will also be performed to confirm degradation morphology.

- Tube selection will be consistent with Generic Letter 95-05 requirements.

Operational Leakage

- Implemented 150 gpd leakage limit.

- Implemented a primary-to-secondary leakage monitoring program.

- Effectiveness of leakage monitoring procedures and operator actions have been assessed and appropriate procedure changes made.

- Leakage instrumentation alarm setpoints have been reviewed and revised as appropriate.

MSLB Leakage and Burst Probability Assessments

- BOC voltage distribution determined by scaling upwards the as-found voltage distribution by 1/(POD=0.6) and then subtracting the indications repaired.

- EOC voltage distributions determined by Monte Carlo simulations that account for voltage growth, eddy current variability, and parameter uncertainty.

- MSLB leakage based on EPRI Probability of leakage model and conditional leak rate model and reflects an upper 95/95% confidence level.

- The database used for leak and burst correlations will be the industry database as approved by the NRC.

- Calculated MSLB leakage will not exceed offsite or control room dose limits.

- For hot-leg intersections, the MSLB leakage will include a bounding IRB leakage contribution determined through testing.

- Probability of Burst limit under postulated MSLB conditions will not exceed $1x10^{-2}$.

Reporting Requirements

- NRC notification prior to returning the SG to service (Mode 4) should any of the following arise:
    - Projected EOC or as-found MSLB leakage exceeds site allowable limit.
    - Projected EOC or as-found probability of burst exceeds $1x10^{-2}$.
    - If circumferential crack-like indications are found at TSP intersections.
    - If indications are identified that extend beyond the confines of the TSP.
    - If PWSCC indications are found at TSPs.
- A safety assessment is to be provided to the Staff prior to returning the SG to service should the MSLB leakage or probability of burst values exceed their respective limits, or if a SG internals inspection identifies indications detrimental to the integrity of the load path necessary to support the 3.0 volt IPC.
- The complete results of the inspection, structural assessments, the Upper Voltage Repair limit used, and tube pull results, if applicable, are to be submitted to the Staff within 90 days of plant restart (Mode 2).
- Prompt notification will be made to the Staff should corrosion induced denting greater than 5 volts be found.

Inspection Requirements

- 100% bobbin coil probe of hot-leg tubes down to the lowest cold-leg indication.
- Minimum 20% bobbin coil probe of cold-leg tubes.

RPC Inspection Requirements

- All hot-leg TSP indications greater than 3.0 volts.
- All cold-leg TSP indications greater than 1.0 volts.

- All TSP intersections that contain dents greater than 5.0 volts and a 20% sample of dents between 2.5 volts and 5.0 volts. If PWSCC or Circumferential Cracking is detected, 100% of the dents between 2.5 volts and 5.0 volts will be inspected.

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- All intersections with interfering signals from copper deposits. Neither Braidwood nor Byron has significant copper deposits in the SGs. Guidance on conducting RPC inspections for interference signals due to copper has been included in both stations inspection guidelines.

Data Acquisition and Analysis

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- The presence of hot-leg TSPs will be verified by eddy current.

- Data analysts will be trained on the potential for primary water stress corrosion cracking to occur at TSP intersections. The data analysts will be sensitized to identify indications attributed to primary water stress corrosion cracking.