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U. S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, DC 20555-0001

Braidwood Station, Unit 2  
Facility Operating License No. NPF-77  
NRC Docket No. STN 50-457

- Subject: Response to Request for Additional Information Regarding the Braidwood Station, Unit 2 Fall 2006 Steam Generator Inspection
- References: (1) Letter from T. Coutu (Exelon Generation Company, LLC) to U. S. NRC, "Braidwood Station, Unit 2, Twelfth Refueling Outage Steam Generator Inservice Inspection Summary Report," dated January 29, 2007 (ADAMS Ascension No. ML070290637)
- (2) Letter from R. F. Kuntz (U. S. NRC) to C. M. Crane (Exelon Generation Company, LLC), "Braidwood Station, Unit 2 – Request for Additional Information Related to the 12<sup>th</sup> Refueling Outage Steam Generator Inservice Inspection Summary Report (TAC No. MD4199)," dated July 12, 2007

In the Reference 1 submittal, Exelon Generation Company, LLC (EGC) provided the Braidwood Station Unit 2 Fall 2006 Steam Generator Inservice Inspection Summary Report. Based on NRC review of the referenced submittal, additional information was requested in Reference 2 to complete their review of the Braidwood Station Unit 2 Fall 2006 Steam Generator Inservice Inspection Summary Report.

The attachment to this letter provides the EGC response to the request for additional information.

Should you have any questions concerning this letter, please contact Mr. David Gullott, Regulatory Assurance Manager, at (815) 417-2800.

Respectfully,



Thomas Coutu  
Site Vice President  
Braidwood Station

## Attachment A

### Braidwood Station Unit 2 Fall 2006 Refueling Outage Steam Generator Inspection Summary Report Response to Request for Additional Information

#### Question 1:

*Please discuss the extent to which indications attributed to wear were inspected with a rotating probe to confirm the absence of cracking at these locations.*

#### Response to Question 1:

The Braidwood Station Unit 2 steam generator eddy current inspection program requires 100% full-length bobbin coil inspection of all four SGs. All bobbin coil indications that are classified as "I-Codes" require additional specialized inspection methods, typically +Point™ (rotating probe), in order to disposition. Additionally, all freespan indications of wear, typically associated with secondary side foreign objects, require additional inspection by +Point™, in order to disposition. Wear at support structures other than at Anti-Vibration Bars (AVB) also requires additional inspection by +Point™ when first identified. This is in order to assure these signals are associated with normal wear at support structures such as those associated with the cold leg preheater region support plates. Wear that occurs at the intersection of the tube and the AVBs typically does not receive additional diagnostic inspection unless it is identified as having a non-quantifiable indication, indicates an unusually large growth rate, or is convenient to an area that is already being inspected by +Point™.

#### **Braidwood Station Unit 2 Twelfth Refueling Outage (A2R12) Results**

Braidwood performed +Point™ of all indications of foreign object wear (seven indications in six tubes) identified during the Braidwood Station Unit 2 A2R12 refueling outage. This included re-inspection of all indications of foreign object wear that had been identified during previous outages and allowed to remain in service since it was confirmed that the object that caused the wear was no longer present. None of the indications showed signs of Stress Corrosion Cracking (SCC).

Braidwood performed +Point™ inspection of seven of the eight indications of preheater support plate wear identified during the Braidwood Station Unit 2 A2R12 refueling outage. The one indication of preheater support plate wear that was not inspected with +Point™ during A2R12 had been inspected with +Point™ during the A2R10 outage in November of 2003. None of the indications showed signs of SCC.

The indications described represent all indications of tube wear other than wear at the Anti-Vibration Bar (AVB) locations identified during A2R12.

As identified in the Braidwood Station Unit 2 A2R12 Steam Generator Summary Report, a total of 847 indications of AVB wear were identified during the Braidwood Station Unit 2 A2R12 refueling outage. The majority of these indications have been present for multiple cycles and are considered to be slow growing. Development of cracking within the areas of AVB wear has not been identified in units containing similar tubing material (i.e., Thermally Treated Alloy-600). As such, a small sample of AVB wear indications received +Point™ inspection during A2R12. Seven indications of AVB wear were inspected with +Point™. None of the indications showed signs of SCC.

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#### **Basis**

The Braidwood Station Unit 2 steam generators contain Thermally Treated Alloy-600 tubing which has been shown to be much less susceptible to SCC as compared to Mill Annealed Alloy-600 tubing. There have been no confirmed cases of SCC reported by plants with Thermally Treated Alloy-600 tubing in regions of volumetric tube wear.

The EPRI SG Guidelines Section 3.4.3, "Selection of Volumetric Indications in the Presence of Cracking for Follow-Up Characterization," states: "Bobbin coil is capable of sizing volumetric wear, thinning, pitting and impingement indications. However, it is not capable of differentiating between these indications and cracking. Therefore, when bobbin coil indications occur in the same region of the SG that cracking has been identified, then the bobbin coil volumetric indications in the overlapping regions shall be examined using techniques that provide for signal characterization such that the appropriate repair criteria can be applied." Throughout the industry units containing Thermally Treated Alloy-600 tubing have not identified SCC at volumetric indications. Therefore diagnostic inspection of this region is not required per the EPRI SG Guidelines at this time. The additional diagnostic testing that Braidwood Unit 2 currently performs of volumetric indications in the straight portions of the tubing coupled with the scheduled +Point™ inspection of the hot leg tubesheet region and dent / ding population provide an indicator if additional inspection of volumetric indications in the AVB regions is warranted.

#### Question 2:

*Please discuss the inspection results for the one previously plugged tube that was inspected at the location where the plug expansion zone existed. Please discuss the location of the plug expansion zone (e.g., is it greater than 17-inches below the top of the tubesheet).*

#### Response to Question 2:

In April of 2004 Industry Operating Experience (OE) 18236, "PWSCC in De-plugged Tube Expansion Zone (PEZ)," was issued. The OE alerted licensees that Primary Water Stress Corrosion Cracking (PWSCC) had been identified in the hot leg tube Plug Expansion Zone (PEZ) where a tube plug had been removed and the tube was returned to service.

Although the unit identified in the OE contained Mill Annealed Alloy-600 tubing, the potential exists that similar cracking could develop in Thermally Treated Alloy-600 units due to residual stresses from removed plugs in the PEZ. Exelon procedures have requirements for inspection of the hot leg PEZ for any tubes that have been de-plugged. Braidwood Unit 2 contains one tube that has the potential for PWSCC within the PEZ. In the 2B SG Row 1 Column 1, the tube was plugged prior to initial startup due to a blockage within the tube. The tube was plugged with a Mill Annealed Alloy-600 mechanical tube plug. During the Braidwood Unit 2 A2R02 refueling outage in November of 1991, the Alloy-600 tube plug was removed with plans to replace it with a

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Thermally Treated Alloy-690 plug during the same outage. During A2R02 the tube was re-inspected full length and showed no signs of blockage or defects. Therefore the tube was placed back in service.

Although the hot leg PEZ for 2B SG Row 1 Column 1 tube is greater than 17-inches below the top of tubesheet region, Braidwood believes inspection of this region was prudent since it is an off normal condition. Inspection of the PEZ using +Point™ during the Braidwood Unit 2 A2R11 and A2R12 outages showed no signs of PWSCC. Had PWSCC been identified, Braidwood would have conservatively removed the tube from service by mechanical tube plugging.

#### Question 3:

*Several tubes were identified with wear indications attributed to foreign objects/loose parts. Regarding the inspections performed for loose parts, please address the following:*

- (a) Discuss the extent to which a foreign object search and retrieval (FOSAR) was performed. If a FOSAR was performed, discuss the scope and results. If any foreign objects/loose parts were identified, discuss the source and nature of the part and the corrective action taken. If any foreign objects/loose parts were left in the steam generator, please discuss whether an analysis was performed to assess the effect the object/part may have on tube integrity.*
- (b) Two tubes were plugged for wear attributed to foreign objects. These two tubes were located in the interior of the bundle and the indications were located slightly below tube support plates. Given that the foreign object/loose part would have had to migrate through the tube bundle (presumably without causing any discernable damage to the other tubes) and interacted with the subject tubes for some period of time to cause a wear scar, please discuss the extent to which you evaluated the potential that some other degradation mechanism may have caused the indications (i.e., provide the basis for concluding the indications were attributable to wear).*

#### Response to 3(a):

During the Braidwood Station Unit 2 A2R12 refueling outage the following secondary side visual inspections were performed:

- Top of tubesheet visual inspection / FOSAR in all SGs. (Includes periphery of tube bundle, limited in-bundle and tube free lane)
- Visual inspection / FOSAR in the preheater high flow regions in the 2C SG
- Visual inspection of the Waterbox Rib and Cap Plate region in the 2C SG
- Visual inspection of the 8<sup>th</sup> and 11<sup>th</sup> tube support plate region in the 2C SG (visual inspection primarily to assess deposit loading)
- Visual inspection of the steam drum / moisture separator region in the 2D SG

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The following table lists all newly identified foreign objects during the Braidwood Station Unit 2 A2R12 refueling outage that were not able to be retrieved from the SGs. As determined by visual inspection and eddy current inspection, none of these objects caused wear to the surrounding tubes. Prior to startup from A2R12, an analysis was performed by the Westinghouse Steam Generator Engineering Group that determined operation until the next scheduled SG inspection (A2R13), was acceptable with the foreign objects remaining in the SGs.

Foreign Objects Remaining in the SGs Initially Identified During A2R12

SG	Elevation	Location	Description	Comment
2C	TSP 2-Cold	Row-22 Col-20	Wire 0.375" long x 0.016" dia.	Wire fixed against tube
2C	TSP 2-Cold	Row-26 Col-46	Wire 0.75" long x 0.016" dia.	Fell into tube crevice
2C	TSP 2-Cold	Row-44 Col-44	Wire 0.25" long x 0.016" dia.	Wedge in tube crevice
2C	TSP 2-Cold	Row-22 Col-70	Wire 0.50" long x 0.016" dia.	Fixed in tube crevice
2D	TTS Hot Leg	Row-3 Col-3	Metal Strip 1.0" long x 0.125" tall x 0.010" thick	Object is mobile, unable to retrieve

TSP = Tube Support Plate  
 TTS = Top of Tubesheet

The objects listed above were identified during A2R12, were unable to be retrieved, and were determined to be acceptable for continued operation through engineering evaluation.

Through the extensive visual and eddy current inspections performed during A2R12, additional foreign objects were identified and successfully removed from the secondary side of the SGs. A summary of these objects is listed below. As determined by visual inspection and eddy current inspection, none of these objects caused wear to the surrounding tubes.

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Foreign Objects Identified and Retrieved During A2R12

SG	Elevation	Nearby Tubes	Description Approximate Size	Comment
2A	TTS	Row-49 Col-65	Slag 1.0" x 0.25" x 0.25"	Retrieved
2B	TTS	Row-21 Col-57	Metal Turning 0.312" x 0.062" x 0.015"	Retrieved
2C	TSP 2-Cold	Row-27 Col-44	Wire 0.2" x 0.015"	Retrieved
2C	TSP 2-Cold	Row-34 Col-52	Wire 0.5" x 0.015"	Retrieved
2C	TSP 2-Cold	Row-21 Col-71	Wire 0.5" x 0.015"	Retrieved
2C	TSP 2-Cold	Row-22 Col-87	Metal Turning 0.5" x 0.25" x 0.015"	Retrieved
2C	TSP 2-Cold	Row-32 Col-52	Wire 1.0" x 0.052"	Retrieved
2C	TSP 2-Cold	Row-1 Col-55	Round Metal 0.052"	Retrieved
2C	TSP 2-Cold	Row-1 Col-55	Metal Turning 0.5" x 0.052" x 0.052"	Retrieved
2C	TSP 2-Cold	Row-3 Col-56	Metal Turning 0.25" x 0.125" x 0.125"	Retrieved
2C	TSP 2-Cold	Row-7 Col-56	Wire 0.25" x 0.052"	Retrieved
2C	TSP 2-Cold	Row-15 Col-59	Wire 0.25" x 0.015"	Retrieved
2C	TSP 2-Cold	Row-13 Col-60	Gasket 1.0" x 0.18" x 0.05"	Retrieved
2C	TSP 2-Cold	Row-1 Col-52	Wire 1.0" x 0.125"	Retrieved
2C	TSP 2-Cold	Row-3 Col-62	Wire 0.75" x 0.125"	Retrieved
2C	TSP 2-Cold	Row-1 Col-61	Wire 0.312" x 0.015"	Retrieved
2D	TTS	Row-1 Col-2	Slag 1.0" x 0.75" x 0.75"	Retrieved

TSP = Tube Support Plate  
 TTS = Top of Tubesheet

As can be seen from the preceding tables, the size of the foreign objects identified in the secondary side of the Braidwood Station Unit 2 SGs during A2R12 were relatively small and had not caused identifiable tube damage. Braidwood has an aggressive FOSAR

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program aimed at identifying and removing even small secondary side foreign objects before they have the potential of causing tube damage. The inspection results were entered into the Braidwood Corrective Action Program and provided to the Braidwood Foreign Material Control Program Owner. The material identified in the secondary side of the SGs does not indicate abnormal degradation of the secondary side of the SGs or connecting plant systems.

#### Response to 3(b):

During the Braidwood Station Unit 2 A2R12 100% full-length bobbin eddy current inspection of all four SGs, two tubes were identified with indications of wear from potential secondary side foreign objects.

The first location was in the 2A SG in tube Row 12 Column 70 with an indication of 16% through wall wear located at minus 0.77 inches below the centerline of the 5<sup>th</sup> tube support plate on the hot leg side. The second location was in the 2C SG in tube Row 8 Column 18 with an indication of 22% through wall wear at minus 0.81 inches below the centerline of the 7<sup>th</sup> tube support plate on the hot leg side.

Review of historical eddy current data showed no signs of wear or a foreign object in this location in previous outages. The area where the wear occurred on these two tubes was not accessible for visual inspection. Review of eddy current +Point™ data for the subject and surrounding tubes showed no evidence of a foreign object remaining in the area. No anomalies were identified with the support plate or surrounding structures. The +Point™ inspection results support the belief that a foreign object had entered the location, caused minor tube wear of 16% and 22% through wall and is no longer present in the area.

As recommended by the Westinghouse Steam Generator Engineering Department the two tubes with wear were stabilized through the area of wear and removed from service by mechanical tube plugging.