September 16, 2005

Mr. Christopher M. Crane, President
and Chief Nuclear Officer
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: BRAIDWOOD STATION, UNIT 2 - SUMMARY OF CONFERENCE CALL REGARDING 2005 STEAM GENERATOR TUBE INSPECTIONS

Dear Mr. Crane:

On April 5, 2005, the U.S. Nuclear Regulatory Commission staff (NRC) held a conference phone call with members of your staff regarding the upcoming steam generator tube inspections at Braidwood Station, Unit 2. The call focused on the planned scope of inspection for the portion of the tube in the tubesheet region during refueling outage 11. A summary of the call is enclosed.

Subsequent to the conference call, you submitted an exigent license amendment concerning your technical specification steam generator tube inspection requirements. The NRC staff reviewed the proposed license amendment and approved it by letter dated April 25, 2005.

Contact me if you have any questions.

Sincerely,

/RA/

Jon B. Hopkins, Senior Project Manager, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. STN 50-457

Enclosure: As stated

cc w/encl: See next page

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APRIL 5, 2005, CONFERENCE CALL SUMMARY

STEAM GENERATOR TUBE INSPECTIONS

BRAIDWOOD STATION, UNIT 2

DOCKET NO. STN 50-457

On April 5, 2005, the Nuclear Regulatory Commission (NRC) staff participated in a conference call with Braidwood Station, Unit 2 representatives regarding their upcoming steam generator tube inspections. The call focused on the licensee's planned scope of inspection for the portion of the tube in the tubesheet region during refueling outage 11 (RFO 11). RFO 11 was scheduled to begin on April 17, 2005. A summary of the information discussed during the call is provided below.

Braidwood Station, Unit 2 has four model D5 steam generators designed and fabricated by Westinghouse. The thermally treated Alloy 600 steam generator tubes have an outside diameter of 0.75-inch and a nominal wall thickness of 0.043-inch. The tubes are hydraulically expanded for the full depth of the tubesheet at each end and are supported by a number of stainless steel tube supports with quatrefoil shaped holes. The tubesheet is 21-inches thick. In the U-bend region, the tubes are supported by anti-vibration bars. The U-bend region of the tubes in rows 1 through 9 were thermally stress relieved after bending. Braidwood Station, Unit 2 operates with a hot-leg temperature of 611-degrees Fahrenheit (611 EF) and will have operated for approximately 14.2 effective full power years (EFPY) at the start of RFO 11. A total of 180 tubes are plugged in the four steam generators.

During RFO 11, the planned scope of inspection includes: (1) a full length inspection with a bobbin coil of 100 percent of the tubes in each of the four steam generators; (2) a rotating probe (+Point™) inspection of the hot-leg top of tubesheet region (from 3-inches above to 3-inches below the top of the tubesheet) of 20 percent of the tubes in each of the four steam generators; (3) a rotating probe (+Point™) inspection of 25 percent of the expanded pre - heater baffle locations in one steam generator; (4) a rotating probe (+Point™) inspection of the portion of one tube where an Alloy 600 plug was removed (i.e., the tube was de - plugged and returned to service); (5) a visual inspection of all previously installed plugs; (6) a visual inspection of the waterbox cap plate in all four steam generators; and (7) a visual inspection of the steam drum and a portion of the auxiliary feedwater header. In addition, sludge lancing and a foreign object search and retrieval (FOSAR) at the top of the tubesheet will be performed in all four steam generators. A FOSAR will also be performed in the pre - heater region of one steam generator.

In another plant (Catawba Nuclear Station, Unit 2) with Westinghouse model D5 steam generators, crack-like indications were recently found in the portion of the tube in the tubesheet region. These crack-like indications were found in bulges (or over - expansions) in the tubesheet region, in the tack roll region, and in the tube-to-tube sheet weld. Crack-like indications were found in a bulge in one tube and in the tack expansion in nine tubes. Approximately 6 of the 190 tube-to-tube sheet weld indications extended into the parent tube.

ENCLOSURE

Catawba Nuclear Station, Unit 2 operates at a hot-leg temperature of 615 EF and had operated for 14.7 EFPY at the time the crack-like indications were detected. At Catawba Nuclear Station, Unit 2, the bottom portion of the tube in the tubesheet was tack expanded into the tubesheet by mechanical rolling of the tubes. At Braidwood Station, Unit 2, the tubes were tack expanded through the use of a urethane plug. The urethane plug tack expansion is believed to result in a much lower stress which reduces the susceptibility to primary water stress corrosion cracking. The bulges (or overexpansions) are a result of tubesheet drilling anomalies.

At another plant with similar steam generators to Braidwood Unit 2, two tubes were found to have cracks associated with bulges.

In response to these recent findings, the licensee evaluated the safety significance of degradation in the portion of the tube in the tubesheet region. From a structural standpoint, the major concern associated with degradation is the potential for the tube to pullout of the tubesheet. Tube pullout is resisted as a result of the contact pressure between the tube and the tubesheet. The contact pressure between the tube and the tubesheet is a result of the hydraulic expansion process, the internal pressure of the tube, the differential thermal expansion of the tube and the tubesheet, and the bowing of the tubesheet as a result of the differential pressure across it. Since the amount of bow (and the resultant decrease in the contact pressure) is a function of the position of the tube (i.e., more bow in the center of the tubesheet than at the periphery), the tube bundle was divided into three zones to determine the amount of defect free tubing needed to resist pullout of the tube from the tubesheet. In zone 1, 2.95-inches of defect free tube is needed to resist pullout whereas in zones 2 and 3, 6.00-inches and 8.61-inches of defect free tubing are needed.

To assess the amount of leakage expected under postulated accident conditions, the licensee indicated they would assume that the number of indications observed in all four steam generators would occur in one steam generator. In addition, they would assume that there were flaws in the tube ends of 600 tubes. With this approach, they estimate that the accident-induced leakage would be approximately 0.24 gallons per minute (gpm).

The licensee also indicated that another approach for addressing leakage under postulated accident conditions would be to estimate the accident induced leakage based on the amount of leakage observed during normal operation. For example, if there was no leakage during normal operation, no leakage would be expected under postulated accident conditions if all the flaws were located below the mid-plane of the tubesheet. This is because below the mid-plane of the tubesheet, tubesheet bow results in an increase in the tube-to-tube sheet contact pressure (above the mid-plane, tubesheet bow reduces the contact pressure due to the dilation of the tubesheet hole). Alternatively, if the normal operating leakage was 0.1 gpm, the accident induced leakage would be 0.2 gpm if all the flaws were located below the mid-plane of the tubesheet and the increase in contact pressure as a result of the postulated accident is ignored. If the additional contact pressure below the mid-plane of the tubesheet is not ignored, a 0.1 gpm normal operating leak would result in approximately 0.07 gpm under postulated accident conditions.

To address the recent findings of flaws in the tubesheet region, the licensee indicated that they planned the following inspections in the tubesheet region during RFO 11 based on the above analysis: (1) a rotating probe (+Point™) inspection of the hot-leg top of tubesheet region (from 3-inches above to 3-inches below the top of the tubesheet) of 20 percent of the tubes in each of

the four steam generators; a rotating probe (+Point™) inspection of 20 percent of the bulges (measuring greater than 18 volts) and overexpansions (greater than 1.5 mils) in the top 17-inches of the tubesheet region on the hot-leg side of each of the four steam generators. If crack-like indications are found in these initial 20 percent samples, an inspection of the 100 percent of the tubes will be performed in the particular steam generator where the crack-like indications are found. The 100 percent inspection will be of the particular region where the crack-like indications are found (e.g., from 3-inches above to 3-inches below the top of the tubesheet if indications are found in the top of tubesheet sample or in all of the bulges/overexpansions if indications are found in the 20 percent sample of bulges/overexpansions). The inspection extent of 17-inches was selected to add additional conservatism to the analysis and to account for potential uncertainties in the analysis.

The licensee further indicated that following the Braidwood Station, Unit 2 outage, they planned to submit a license amendment revising the inspection requirements in their technical specifications. The change would apply to both Braidwood Station, Unit 2 and Byron Station, Unit 2 and would reflect the portion of tube that needs to be inspected. They further indicated that they would not be proposing to leave flaws within the inspection distance in service.

During the conference call, the NRC staff discussed the position outlined in Generic Letter 2004-01, "Requirements for Steam Generator Tube Inspections." Based on this feedback, the licensee subsequently submitted an exigent amendment for Braidwood Station, Unit 2 revising their technical specification inspection requirements. The NRC staff reviewed the request and approved it on April 25, 2005 (ADAMS ML051110573). For Byron Station, Unit 2, the licensee submitted a license amendment request by letter dated May 24, 2005 (ADAMS ML051860117).

Principal Contributor: K. Karwoski

Date: September 16, 2005