August 23, 2002

Mr. J. A. Price
Site Vice President - Millstone
Dominion Nuclear Connecticut, Inc.
Mr. David A. Smith
Rope Ferry Road
Waterford, CT 06385

SUBJECT: MILLSTONE POWER STATION, UNIT NO. 3 (MP3) - REVIEW OF STEAM GENERATOR TUBE INSERVICE INSPECTION REPORT FOR THE 2001 OUTAGE (TAC NO. MB4885)

Dear Mr. Price:

By letter dated February 15, 2002, Dominion Nuclear Connecticut, Inc. (DNC) submitted the steam generator tube inservice inspection report for MP3 in accordance with the Technical Specifications (TSs). This report presented the results of DNC's inspection that was performed during the seventh refueling outage (January/February 2001).

The U.S. Nuclear Regulatory Commission staff's review of this submittal is enclosed. As documented in the enclosed evaluation, the staff concluded that DNC provided the information required by their TSs and that no additional follow-up is required at this time.

Sincerely,

/RA/

Victor Nerses, Senior Project Manager, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-423

Enclosure: Evaluation

cc w/encl: See next page

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EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

STEAM GENERATOR INSERVICE INSPECTION REPORT FOR 2001 OUTAGE

MILLSTONE POWER STATION, UNIT NO. 3

DOMINION NUCLEAR CONNECTICUT, INC.

DOCKET NO. 50-423

By letter dated February 15, 2002, Dominion Nuclear Connecticut, Inc. (licensee or DNC) submitted the steam generator (SG) tube inservice inspection (ISI) report for the Millstone Power Station, Unit No. 3 (MP3) in accordance with the Technical Specifications (TSs). This special report presented the results of DNC's inspection that was performed during the seventh refueling outage (January/February 2001). By letter dated April 24, 2002 (ADAMS accession # ML021160254), the U.S. Nuclear Regulatory Commission (NRC) staff requested additional information pertaining to the SG inspection findings. A conference call was held on May 1, 2002 to discuss the licensee's responses to the questions. A summary of the call and the inspection results are provided below.

MP3 has four Westinghouse Model F steam generators. These steam generators have thermally treated Alloy 600 tubes. During refueling outage seven in 2001, 100% of the tubes in SGs B and D were inspected full length with a bobbin coil. In addition to the bobbin coil inspections, a rotating probe was used to inspect various locations in SGs B and D, including the hot-leg expansion transition region in approximately 50% of the tubes, the U-bend region in approximately 50% of the row 1 and 2 tubes, and all previously reported dents and dings in the hot-leg portion of the tube. A depiction of the SG is included as Figure 1 to the licensee's February 15, 2002, submittal.

As a result of the inspections, 51 tubes were plugged. Of the 51 tubes plugged, 16 tubes were plugged as a result of wear at the anti-vibration bars (AVBs), 29 tubes were plugged as a result of volumetric indications (one of these indications also had a pluggable AVB wear indication and is included in the 16 tubes previously discussed) and 7 tubes were plugged because they were close to tubes with loose parts indications (as identified by eddy current testing). The maximum reported depth of any of the AVB wear indications was 47% through-wall.

Of the 29 tubes plugged as a result of volumetric indications, 12 were at the cold-leg flow distribution baffle, 1 was at the hot-leg flow distribution baffle, 13 were at the top of the tubesheet on the hot-leg side, and 3 were at the top of the tubesheet on the cold-leg side. The licensee attributed most of these indications to foreign object wear based on the presence of adjacent loose part indications in many of the affected tubes, and on their clustering and locations within the tube bundle. Most, but not all, of these indications were at or near the

periphery of the tube bundle. There was a cluster of 10 tubes with volumetric indications at the top of the tubesheet on the hot-leg side which the licensee attributed to SG fabrication since eddy current testing identified outside diameter axial scratches within the expanded portion of some of the tubes within the cluster (a condition considered by the licensee to have been created during fabrication prior to tube expansion). These 10 tubes were all located in columns 23 or 24. Sixteen of the 29 indications were detected during the bobbin coil inspections, and the remaining 13 indications were detected as a result of rotating probe inspections performed on tubes adjacent to the 16 tubes with bobbin indications (i.e., as part of the expanded inspection scope as a result of identifying the bobbin indications). Of the seven tubes plugged for indications of loose parts (i.e., where the eddy current data indicated a loose part was present (six tubes) or where a visual inspection indicated a loose part (one tube)), six were in tubes adjacent to tubes with the volumetric indications discussed above, and one was isolated and in the interior of the bundle. For most of the 36 tubes with volumetric indications and/or loose parts indications (attributed to loose parts or fabrication), no loose parts were visually confirmed since sludge lancing was performed concurrent with eddy current testing (which may have moved the loose parts from the location they were at during operation). During the outage, two machine curls were removed and a third part was identified visually but could not be removed. The licensee postulated that loose parts may have been a result of an upper bundle flush performed in 1999 (i.e., the flush may have freed foreign objects that were previously stationary). None of these 36 tubes were stabilized.

The 29 single volumetric indications were sized using a technique qualified for sizing wear at tube supports (i.e., the technique was qualified-by-extension). As previously discussed, many of these indications were attributed to wear from loose parts or to fabrication-related defects. Based on the sizing performed and other analyses, it was concluded that all indications of tube degradation identified during the examination were well below the applicable structural integrity limits with required allowances for non-destructive examination sizing uncertainty.

Based on our review of the information provided by the licensee, the staff concludes that the information that the licensee was required to submit by the TSs was provided and that no additional follow-up is required at this time. However, in future evaluations the licensee should consider the following:

Confirming the Nature of the Indications

The licensee's conclusions regarding the nature of the single volumetric indications are feasible; however, they are not conclusive since no tubes were pulled for destructive examination nor were loose parts confirmed (visually) to be present at the locations where degradation was identified.

To the staff's knowledge, no tubes have ever been pulled from the MP3 steam generators to confirm the nature of these or similar indications. Although prior operating experience with thermally treated Alloy 600 can be used to provide some insights on the possible nature of the indications, the limited number of thermally treated Alloy 600 tube pulls and the plant-specific nature of the indications in these pulled tubes (i.e., many/all were fabrication related) may not provide conclusive results. If prior operating experience with thermally treated Alloy 600 is used to disposition indications of this type, the circumstances under which a volumetric indication (as identified by eddy current inspection) would be attributed to corrosion (prior to confirming with a

tube pull) should be identified. The destructive examination of pulled tubes may conclusively identify the cause and severity of the indications.

In addition, since sludge lancing was performed prior to or concurrent with the eddy current examination, loose parts could not be verified visually to be the cause of the degradation.

Accounting for All of the Uncertainty in a Sizing Technique "Qualified-by-Extension"

Given the potential uncertainty in the cause of the degradation (as discussed above), evaluating the size of the degradation using techniques qualified-by-extension may introduce additional elements of uncertainty into the tube integrity assessments that should be accounted for. For example, the "original" sizing technique was based on sizing wear indications at the tube support plates. Since this technique was used to size wear indications from loose parts (potentially), the uncertainty associated with a tube support plate wear sizing technique providing accurate sizing measurements for wear indications from loose parts should be accounted for. This may require additional data to be developed through the use of mockups.

In addition, since the degradation mechanism could not be conclusively identified, the uncertainty associated with assuming the indications were caused by loose parts rather than intergranular attack or some other form of volumetric corrosion (as evidenced by eddy current testing) should be addressed in the condition monitoring analysis. This may require sizing the indications with numerous sizing techniques and taking the most limiting answer (in terms of tube integrity).

Presumably, these sources of uncertainty would be in addition to the uncertainty associated with sizing wear indications at tube supports.

Principal Contributor: K. Karwoski

Date: August 23, 2002