March 24, 2006

MEMORANDUM TO: Darrell J. Roberts, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

FROM: Victor Nerses, Senior Project Manager
Plant Licensing Branch I-2 ***/RA by G. Edward Miller for/***
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

SUBJECT: MILLSTONE POWER STATION, UNIT NO. 3 - FACSIMILE TRANSMISSION, DRAFT REQUEST FOR ADDITIONAL INFORMATION TO BE DISCUSSED IN AN UPCOMING CONFERENCE CALL (TAC NO. MC8893)

The attached draft request for additional information (RAI) was transmitted by facsimile on March 24, 2006, to Mr. Paul Willoughby, at Dominion Nuclear Connecticut, Inc. (DNC). This draft RAI was transmitted to facilitate the technical review being conducted by the Nuclear Regulatory Commission (NRC) staff and to support a conference call with DNC in order to clarify certain items in the licensee's submittal. The draft RAI is related to DNC's submittal dated June 9, 2005, requesting approval for the use of an alternative brazed joint assessment methodology. Review of the draft RAI would allow DNC to determine and agree upon a schedule to respond to the RAI. This memorandum and the attachment do not convey a formal request for information or represent an NRC staff position.

Docket No. 50-423

Enclosure:
As stated

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REQUEST FOR ADDITIONAL INFORMATION

MILLSTONE POWER STATION, UNIT NO. 3

(TAC NO. MC8893)

By letter dated June 9, 2005, Dominion Nuclear Connecticut, Inc. (DNC) submitted an approval request for the use of an alternative brazed joint assessment methodology. The Nuclear Regulatory Commission (NRC) staff requests the following additional information to complete its review.

(1) Discuss the hardship in performing an American Society of Mechanical Engineers Boiler and Pressure Vessel (ASME Code) repair or replacement of a leaking brazed joint during normal operation or during a scheduled outage when an ASME Code-required leakage test was performed.

(2) Discuss the feasibility to stop the leakage by applying a fillet brazing at the end surface of the leaking brazed joint or installing a mechanical device to seal or collect the leak during normal operation or during a scheduled outage when an ASME Code-required leakage test was performed. In this case, the structural integrity of the leaking brazed joint is assumed not to be a concern.

(3) Provide the bases for using the ASME Code 1998 Edition of Section XI with No Addenda for the Section XI Repair/Replacement Program activities. The NRC staff notes that in your previous relief request dated May 19, 2005, you performed a temporary non-ASME Code repair to a leaking brazed joint in service water drain line during plant operation at Millstone Power Station, Unit 3 (Millstone). In that relief request, you referenced ASME Code 1989 Edition with no Addenda of Section XI, IWA-4000 as the ASME Code repair requirements which is different from the ASME Code edition you referenced in the current relief request (1998 Edition with no Addenda).

(4) Provide the water chemistry of the service water in the referenced piping systems and discuss its potential corrosion degradation on its adjacent components due to the leaking of the brazed joints. If the service water is sea water, the dripping of seawater on stainless steel components will cause the initiation of stress-corrosion cracking on its surface. Also, discuss the corrective action program that you will implement to inspect and clean up the dripping on the adjacent components.

(5) To support your relief request, you referenced ASME Code Case N-513-1 which permits continued operation of low energy systems with minor leakage when justified by an evaluation of system performance. The NRC staff notes that the referenced ASME Code Case allows the continued operation of the degraded Class 3 piping only for a limited time, not exceeding the time to the next scheduled outage. However, your proposed relief request extends the time limit for the proposed alternative to exceed the next refueling outage interval with justification (Section 5.5 on page 11), which is not consistent with ASME Code Case N-513-1. Confirm in your response that the application of the proposed alternative is limited to the next scheduled outage with

sufficient time for performing an ASME Code repair or replacement, but not beyond the next refueling outage. The NRC staff's review of your June 9, 2005, relief request on the proposed use of a brazed joint assessment methodology is based on this condition being met. A separate relief request should be submitted if this condition cannot be met.

(6) On page 4 of Enclosure 1, you stated that the lack of full braze bonding originates from construction or fabrication, and is not progressive over time. On page 10, you reported from a search and review of external operating experience that corrosion degradation was attributed to braze failures in closed loop and electrical cooling systems. You also stated that there was no operating experience indicating progressive failure for open loop sea water systems. To support your conclusion that no progressive failure mechanism exists in the open loop systems, you performed failure analysis on two brazed joint specimens removed from Millstone seawater service with nearly 20 years of service and no corrosion product was found. However, these specimens were taken from brazed joints that were not leaking. To adequately support your conclusion, the root cause for the leakage needs to be determined since the joint was not leaking when it was first put in service. Furthermore, failure analysis should be performed on samples taken from leaking brazed joints to determine the degradation mechanism that caused leaking. The potential degradation mechanism could be fatigue-related cracking, stress-corrosion cracking, or another mechanism and may not be limited to corrosion. These mechanisms may combine with the fabricated defects and cause leaking when it breaks the outside surface. Lacking sufficient evidence, a time-dependent evaluation, assuming the presence of a degradation mechanism progressive with time, should be performed.

(7) Based on your discussion in Section 5.6, "Augmented Examination" (page 12 of Enclosure 1), the guidance provided is not consistent with that provided in AMSE Code Case N-513-1. In ASME Code Case N-513-1, a sample size of at least five of the most susceptible and accessible locations, or if fewer than five are available, then all susceptible and accessible locations shall be examined. To exempt the previously-examined joints from re-examination could be non-conservative, since the joints may have been examined a long time ago or a technique used that may not have been able to identify the degraded condition. Furthermore, if additional degradation was found in the expanded sample, the referenced ASME Code Case requires this process to be repeated until no significant degradation is detected or until 100% of susceptible and accessible locations have been examined. Please justify this difference or revise the guidance in Section 5.6 and in the Millstone procedures or Corrective Action Program regarding the requirement to determine the extent of condition in similar brazed joints. The guidance should be consistent with that provided in ASME Code Case N-513-1.

(8) Provide a copy of NAVSEA 0900-LP-001-700, "Fabrication and Inspection of Brazed Piping Systems," dated January 1, 1973. The NRC staff understands that your ultrasonic testing (UT) procedure MP-UT-45, "Ultrasonic Examination Procedure for Examination of Brazed Joints - Millstone Unit 3 Service Water Piping," Rev. 000-00 (Attachment E to Enclosure 1) was developed based on the NAVSEA procedure. Identify the differences between the two procedures (NAVSEA vs. MP-UT-45) and discuss the reasons for the differences.

(9) Using an example, describe how the average bond level of a brazed joint was determined by UT examination. Also, describe how the average threshold bond level of 60% was determined to be acceptable without further evaluation for brazed piping.

(10) Describe in detail the trial demonstrations of the UT procedure you mentioned on page 5 of Enclosure 1. Describe the samples used for the demonstrations and identify the range of data scattering and standard deviation pertaining to readings reported by qualified examiners. Also, describe the qualification of the examiners participating in the demonstrations including a discussion as to how they were qualified and what were the qualification requirements.

(11) Describe the qualification programs that you already have in-house to qualify your Level II or III technicians, including procedures and equipment to perform the UT examination of the brazed joints. Also, describe your in-house training program for your UT examiners to obtain adequate knowledge and skill to determine the bond in the brazed joints.

(12) To ensure the performance of a qualified UT examination of brazed joints, was a performance demonstration program used? Discuss how this program was implemented to qualify the ultrasonic examination procedures, equipment and the personnel to perform the examination of brazed joints including data collection and evaluation. Discuss how this program followed the approach delineated in Appendix VIII to ASME Code Section XI. Describe whether the sample sets prepared for the performance demonstration consisted of fabricated samples or field samples (if available, with joint configuration, pipe/fitting size and wall thickness) similar to that of the brazed joints to be examined, and contained representative flaws.

(13) Describe in detail how the adjustment of bond readings ($b_{adj}$) to account for UT uncertainties was determined, including the database to support the UT data adjustment discussed in page 7 of Enclosure 1.

(14) In Section 5.3.2 (page 7 of Enclosure 1), you stated that for bond readings that are significantly non-uniform around the circumference of the braze, an effective (lower) bond is computed based on the equivalent moment of the adjusted bond areas. For clarification, provide an example to demonstrate this calculation and discuss the reasons and conservatism of this approach.

(15) Assuming the worst-case scenario that a complete failure of a 3-inch pipe/fitting braze joint occurred, what would be the upper-bound leakage rate at 100 psig? Discuss its potential impact on the functional requirements of the system and the reduction of the system margins of safety.

(16) Discuss how the average UT bond readings of 60% or more, as the acceptance criteria, was determined. Discuss the conservatism of this acceptance criteria in terms of the mechanical properties of the brazing materials and the uncertainties of the UT bond readings.

(17) Identify the Construction Code qualification stress analysis reports that were reviewed to determine the design-basis loadings at the subject braze joint (page 7 of Enclosure 1,

5.3.3). Confirm that these are NRC-accepted piping stress analysis reports.

(18) It appears that no stress intensification factors were applied in the stress analysis of the subject brazed joints (page 8 of Enclosure 1, 5.3) as discussed in 2.0 of Attachment B to Enclosure 1. Is this approach consistent with the applicable Construction Code requirements for stress analysis of the brazed joints? If not, please elaborate.

(19) For equation (3) in Figure 2 of Attachment A to Enclosure 1:

(i) Describe briefly how these equations were developed and identify the references.

(ii) For the applicable braze materials, provide the ASME Code-allowable mechanical properties including the allowable shear stress, the certified mechanical test data of the braze alloy used in the fabrication of the referenced components and the minimum mechanical properties based on the material specifications referenced in purchasing.

(20) Attachment D (Mechanical Tests) to Enclosure 1

(i) The NRC staff notes that all brazed joints in the program were tested by three-point bending with the brazed fitting in the middle of the configuration. Provide the technical bases for the selection of this testing method to evaluate the strength of the subject braze joints. Also, discuss the limitations and uncertainties of using this testing method to evaluate the bond strength of the braze joints given that the test sample is a composite of fitting, piping and braze materials and a bending load is applied to the sample. In AWS C3.2, "Standard Method for Evaluating the Strength of Brazed Joints," a tensile testing method is recommended. Describe in detail, including sketches as applicable, how the three-point bending test was performed and provide a sample calculation to show how the test data was collected and evaluated. You stated in page 1 of Attachment B to Enclosure 1 that the load transfer between pipe and fitting is primarily by shear through the braze filler. Provide a discussion of why the three-point bending test is an acceptable method to evaluate the bond strength of the brazed joints.

(ii) You stated in Section 4.1 that all test items (refer to Figure 4 in Attachment A) achieved their test collapse load at a load well above that which would be predicted for a 5-ksi braze shear strength. Provide details regarding how the test collapse load is calculated from an assumed 5-ksi braze shear strength. Show how the test collapse load, piping collapse load and the bond failure load was determined. In the three-point bending test, explain how the failure of the bond, as to both local bond failure and total bond failure, was determined.

(iii) Provide a detailed description of how the data in Table 1 were derived. Also, describe how the bond failure, test collapse load and shear capacity loads were determined from the mechanical testing. Discuss whether the specimens were destructively examined or re-UT examined to determine the level of bond failure resulting from the testing.

(iv) The NRC staff notes that there is significant data scattering in the test results of field samples of brazed joints as shown in Figure 7 of Attachment A to Enclosure 1. Provide reasons for the observed data scattering and discuss its impact on the reliability of bond level determined by UT examination.

(21) Figures 8 and 9 in Attachment A to Enclosure 1

(i) Describe how the shear (Sh) limit was determined and what the 2.4 Sh limit means.

(ii) Describe how the equivalent pipe stress was determined from the test load.

(iii) Describe how no bond failure was determined and whether destructive examination to support the determination was performed. How was the local bond failure differentiated from the gross bond failure? Was it based on the shape of the test curves or the appearance of the test samples?

(22) For Attachment C to Enclosure 1 (Example Structural Assessment), a more detailed description of the assessment methodology should be provided. It would be helpful to provide sketches to show the dimensions. For Part 2, it is not clear how the effective bond was calculated and its relationship to the bond level determined by UT. Further explanation is needed for the plot, and the definition and calculation of Dxx, Dyy, Doffset, Alpha, Bxx, Byy Bbend and Bpress. Provide a sketch to show the locations of the 20 UT readings at Joint 1A and how the average reading at each location was obtained. For Part 3, additional explanation is needed for the definition and calculation of Sxx, Syy, Sallow and the use of the Lookup Table. For Part 4, describe in detail the method, the input data and the equations used in the calculation of the max nominal stress of 4370 psi. Discuss whether this stress calculation shown was based on data taken from NRC-approved piping stress analysis reports.

(23) The NRC staff notes that your proposed use of the alternative brazed joint assessment methodology in lieu of an ASME Code repair or replacement, when leakage is found in a brazed joint resulting from the performance of a system leakage test performed in a scheduled outage, is not consistent with the purpose of the ASME Code-required system leakage testing. The ASME Code-required system leakage test should be scheduled in such a manner that there is sufficient time to perform an ASME Code repair or replacement of the affected component. Allowing a plant to start up with known leakage will not provide an acceptable level of quality including defense in depth in the operation of the plant. The proposed alternative should not be implemented on a generic basis during a scheduled outage. Therefore, given this, it is not clear to the staff what the acceptable level of quality, including defense in depth in the operation of the plant, that this proposed change represents. Please clarify the NRC staff's understanding of this.