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Millstone Power Station
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Dominion

December 19, 2003

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

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Docket No.: 50-336
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DOMINION NUCLEAR CONNECTICUT, INC. (DNC)
MILLSTONE POWER STATION UNIT 2
NRC ORDER EA-03-009; RELAXATION REQUEST RR-89-48
SUPPLEMENTAL INFORMATION TO A STRUCTURAL INTEGRITY EVALUATION SUPPORTING ULTRASONIC TEST COVERAGE REQUIREMENTS

On February 11, 2003, the U.S. Nuclear Regulatory Commission (NRC) issued Order EA-03-009 for interim inspection requirements for reactor pressure vessel (RPV) heads at pressurized water reactor facilities. The Order requires specific inspection of the RPV head and associated penetration nozzles. On October 3, 2003, pursuant to the procedure specified in Section IV.F of the Order, Dominion Nuclear Connecticut, Inc. (DNC) requested relaxation from requirements of the Order regarding the ultrasonic test examination (UT) coverage for the control element drive mechanism (CEDM) penetration nozzles (Request Number RR-89-48).

On October 10, 2003, DNC provided the non-proprietary and proprietary versions of a supporting structural integrity evaluation report. In letters dated November 5, 2003, November 20, 2003, and November 21, 2003, supplemental information was provided regarding the structural integrity evaluation report. On December 5, 2003, an additional example of supporting analysis was discussed with the NRC. Attachment 1 of this letter supplements the previously submitted evaluation by documenting the example.

There are no regulatory commitments contained within this letter.

If you should have any questions regarding this submittal, please contact Mr. David W. Dodson at (860) 447-1791, extension 2346.

Very truly yours,

Leslie N. Hartz
Vice President – Nuclear Engineering

cc: See next page

A047

Attachment (1)

cc: U.S. Nuclear Regulatory Commission
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Mr. S. M. Schneider
NRC Senior Resident Inspector
Millstone Power Station

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

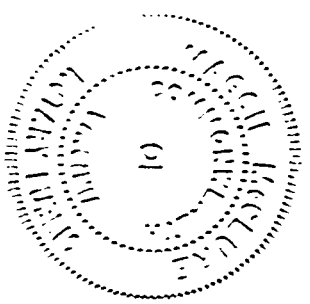
The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Leslie N. Hartz who is Vice President – Nuclear Engineering of Dominion Nuclear Connecticut, Inc. She has affirmed before me that she is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of her knowledge and belief.

Acknowledged before me this 19th day of December, 2003.

My Commission Expires: 3/31/04.

Maggie McClure

Notary Public



Attachment 1

Millstone Power Station, Unit 2

Supplemental Information to a Structural Integrity Evaluation
Supporting Relaxation Request RR-89-48

Supplemental Information to a Structural Integrity Evaluation
Supporting Relaxation Request RR-89-48

BACKGROUND:

On October 3, 2003,[1] Dominion Nuclear Connecticut, Inc. (DNC) requested relaxation from requirements regarding the ultrasonic test examination (UT) coverage for the control element drive mechanism (CEDM) penetration nozzles (Request Number RR-89-48). On October 10, 2003,[2] DNC provided the non-proprietary and proprietary versions of a supporting structural integrity evaluation report[3] for DNC request RR-89-48. In letters dated November 5, 2003,[4] November 20, 2003,[5] and November 21, 2003,[6] supplemental information was provided regarding the structural integrity evaluation report.

On December 5, 2003, a teleconference was held with the U.S. Nuclear Regulatory Commission (NRC) to discuss an additional example of analysis supporting the structural integrity evaluation. The balance of Attachment 1 documents the example discussed and supplements the evaluation.

DESCRIPTION OF EXAMPLE:

In the DNC letter dated November 21, 2003, calculations were completed for cases where the bottom extremity of the flaw is defined to be where either the inside or the outside surface hoop stress drops below 20 ksi. Additional cases were completed for alternate definitions of the flaw size, where the stresses fell below 10 ksi. The discussion in this attachment provides the results of an additional calculation for which the bottom extremity of the flaw is defined to be at 0 ksi for either the inside or the outside surface hoop stress.

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(1) DNC Letter, "Millstone Power Station, Unit No. 2, Order EA-03-009 Relaxation Request Number RR-89-48 for Nozzle Inspection Ultrasonic Test Coverage Requirements," October 3, 2003, (Accession No. ML032880109).

(2) DNC Letter, "Millstone Power Station, Unit No. 2, Supplement to Request Number RR-89-48 for Relaxation From Nozzle Inspection Ultrasonic Test Coverage Requirements in Order EA-03-009," October 10, 2003, (Accession No. ML032930097).

(3) Westinghouse WCAP-15813-P, Revision 1, "Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: Millstone Unit 2," August 2003. (Proprietary)

(4) DNC Letter, "Millstone Power Station, Unit No. 2, Response to Request for Additional Information on RR-89-48 for the Nozzle Inspection Ultrasonic Test Coverage Requirements in Order EA-03-009," November 5, 2003, (Accession No. ML033210128).

(5) DNC Letter, "Millstone Power Station Unit 2, Response to Request for Additional Information on RR-89-48 for the Nozzle Inspection Ultrasonic Test Coverage Requirements in Order EA-03-009," November 20, 2003, (Accession No. ML033360707).

(6) DNC Letter, "Millstone Power Station, Unit 2, Supplemental Information to a Structural Integrity Evaluation Supporting the Request RR-89-48 for the Ultrasonic Test Coverage Requirements in NRC Order EA-03-009," November 21, 2003, (Accession No. ML033360704).

RESULTS:

The crack growth was calculated using MRP-55, Revision 1, [7] incorporating a stress intensity factor expression from Tada,[8] as described in the DNC letter dated November 21, 2003. The resulting time for the crack to grow to the bottom of the weld for the worst case penetration is 1.45 Effective Full Power Years (EFPY) or 1.6 years using operational availability of 0.9 for the plant. The calculated times for the flaw to reach the bottom of the weld in the other penetrations are longer, as shown below:

Time for Crack Growth, Lower Extremity at 0 ksi			
Nozzle Angle (Deg)	Initial Thru-Wall Flaw Length (in)	EFPY to reach weld bottom	Calendar Years to reach weld bottom (availability = 0.9)
29.1	0.86	1.45	1.6
37.1	0.71	1.61	1.8
42.5	0.47	2.27	2.5

CONSERVATISM IN THE CALCULATION:

The results tabulated above are considered to be very conservative for the following reasons.

1. Conservatism in Assumed Crack Geometry:

   There is nearly universal agreement that high stresses, on the order of the material yield strength, are necessary to initiate Primary Water Stress Corrosion Cracking (PWSCC). There is no known case of stress corrosion cracking of Alloy 600 below the yield stress.[9] Typical yield strengths for wrought Alloy 600 head penetration nozzles are in the range of 37 ksi to 65 ksi. Weld metal yield strengths are generally higher. The yield strength of the head penetration nozzles for Millstone Unit No. 2 varies from 37.5 ksi to 60 ksi.[10] The use of a stress level of 20 ksi is a conservative value below which PWSCC initiation is extremely unlikely. Further, the assumption of a through-wall flaw in the unlikely PWSCC crack initiation regions of the head

(7) "Materials Reliability Program (MRP) Crack Growth Rates for Evaluating Primary Water Stress Corrosion Cracking (PWSCC) of Thick-wall Alloy 600 Material," EPRI MRP Report MRP-55, Revision 1, November 2002.

(8) "The Stress Analysis of Cracks Handbook," Hiroshi Tada, 2nd Edition, solution 34.1.

(9) "Effect of Strain Rate on SCC in High Temperature Primary Water, Comparison Between Alloys 690 and 600, ANS 11th Environmental Degradation Meeting, August 2003, K.M. Boursier et al (EDF).

(10) Westinghouse WCAP-15813-P, Revision 1, "Structural Integrity Evaluation of Reactor Vessel Upper Head Penetrations to Support Continued Operation: Millstone Unit 2," August 2003. (Proprietary).

penetration nozzles is an additional conservatism, since the penetration tubes were inspected with good coverage on the tube Inside Diameter (ID) and no indications were found.

2. Conservatism in Recommended PWSCC Crack Growth Rate:

From Table 5-3 of MRP 55 Revision 1, the mean crack growth amplitude (α) for each Huntington Alloy 600 heat is summarized below:

Heat	Material Supplier	Mean α (SI units)
NX8101	Huntington	1.37×10^{-12}
NX8664	Huntington	1.29×10^{-12}
NX6420G	Huntington	7.21×10^{-13}
NX9240	Huntington	4.97×10^{-13}
NX8168G	Huntington	1.93×10^{-13}

Huntington is the material supplier for the head penetrations for Millstone Unit No. 2. Since the crack growth amplitude, α, from the NRC flaw evaluation guidelines[11] is 2.67×10^{-12}, the crack growth rate amplitude used in the evaluation is in contrast about a factor of 1.9 higher than that obtained from the test data for any of the Huntington material heats.

3. Conservatism in the Stress Level Assumed for the Entire Crack Surface:

The crack growth was calculated by assuming the high stress at the upper extremity of the postulated through-wall flaw acts uniformly along the full length of the crack surface. Based on the hoop stress distribution plots in Appendix B of the structural integrity evaluation, WCAP-15813-P, the hoop stress in general drops significantly as a function of distance away from the bottom of the weld.

Furthermore, the stresses used for this evaluation are based upon the stresses calculated for the as-designed weld location. Measurements of the as-built weld locations have shown in other plants that the as-built weld extends 0.5 to 0.75 inches below the as-designed weld. Analyses of these as-built configurations have shown that the additional weld does not increase the stresses, but in fact can decrease the stresses significantly. Therefore, assuming the as-designed stresses apply as a function of distance below the as-built weld is extremely conservative.

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[11] Letter from Office of Nuclear Reactor Regulation, R. Barrett to A. Marion (NEI), "Flaw Evaluation Guidelines," April 11, 2003, (Accession No. ML030980327).

CONCLUSION:

The results described above include considerable conservatism. Based on the conservatism applied in the assumed crack growth rate alone, a more realistic time for a crack to grow to the bottom of the weld in Millstone Unit 2 CEDMs is about twice that calculated herein. Considering the more realistic analysis results previously provided using a threshold of 20 ksi and 10 ksi, and the inherent conservatism in the calculation of this attachment that uses 0 ksi, the operation of Millstone Unit 2 during Cycle 16 poses no undue risk to the public health and safety.