April 1, 2005

Mr. David A. Christian
Sr. Vice President and Chief Nuclear Officer
Dominion Nuclear Connecticut, Inc.
Innsbrook Technical Center
5000 Dominion Boulevard
Glen Allen, VA 23060-6711

SUBJECT: MILLSTONE POWER STATION, UNIT NO. 2 - RISK-INFORMED INSERVICE INSPECTION PROGRAM (TAC NO. MC1284)

Dear Mr. Christian:

By letter dated November 10, 2003, as supplemented by letters dated July 6 and October 12, 2004, and January 13, 2005, Dominion Nuclear Connecticut, Inc. (DNC) requested approval of an alternative risk-informed inservice inspection (RI-ISI) program for the Millstone Power Station, Unit No. 2 (MP2) inservice inspection (ISI) of American Society for Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Class 1 piping welds. The letter, dated November 10, 2003, included an enclosure describing the proposed program. Additional clarifying information was provided in DNC's supplements dated July 6 and October 12, 2004, and January 13, 2005.

The proposed RI-ISI program, developed in accordance with Westinghouse Owners Group Topical Report WCAP-14572, Revision 1-NP-A, is an alternative to the current ASME Code, Section XI, ISI Program and is applicable to Class 1 piping at MP2. DNC deviated from the approved methodology for estimating the segment failure frequency for piping segments that include piping of different diameters. DNC reevaluated these segments and modified the proposed RI-ISI program so that the final proposed program is the same as would have been developed if the approved methodology had been used. The results of the Nuclear Regulatory Commission (NRC) staff's review indicate that DNC's proposed RI-ISI program is consistent with WCAP-14572, Revision 1-NP-A, and is an acceptable alternative to the requirements of the ASME Code, Section XI, for ISI of ASME Code Class 1 piping, Categories B-F and B-J welds.

Therefore, DNC's request for relief is authorized for the second and third periods of the third 10-year ISI interval for MP2 pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Section 55a(a)(3)(i)) on the basis that the proposed alternative provides an acceptable level of quality and safety. This authorization does not constitute NRC approval of DNC's method to estimate the failure frequency of segments that include piping of different diameters. RI-ISI programs are on-going programs requiring feedback of new relevant information to ensure the appropriate identification of high safety-significant (HSS) piping locations. Any RI-ISI program that uses the results of calculations based on an unapproved method to review or adjust the safety significance of piping locations will require prior NRC review and approval of a request for relief pursuant to 10 CFR 50.55a(a)(3)(i). The details of the NRC staff's review are contained in the enclosed Safety Evaluation (SE).

In addition, DNC requested that the NRC approve performing VT-2 visual examinations each refueling outage as an alternative to the volumetric examinations specified in ASME Code Case N-577 and in WCAP-14572, Revision 1-NP-A, for those HSS ASME Code Class 1 socket welds identified in the RI-ISI program. This request was made pursuant to 10 CFR 50.55a(a)(3)(ii). The NRC staff finds the licensee's request acceptable based on the enclosed SE.

If you have any questions, please contact your NRC Project Manager, Victor Nerses at 301-415-1484.

Sincerely,

/RA/

Darrell J. Roberts, Chief, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-336

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RISK-INFORMED INSERVICE INSPECTION PROGRAM

RR-89-40 AND RR-89-41

DOMINION NUCLEAR CONNECTICUT, INC.

MILLSTONE POWER STATION, UNIT NO. 2

DOCKET NO. 50-336

1.0 INTRODUCTION

By letter dated November 10, 2003 (Reference 1), as supplemented by letters dated July 6, 2004 (Reference 2), October 12, 2004 (Reference 3), and January 13, 2005 (Reference 12), Dominion Nuclear Connecticut, Inc. (DNC or the licensee) proposed, by relief request (RR) RR-89-40, a risk-informed inservice inspection (RI-ISI) program as an alternative to a portion of its current inservice inspection (ISI) program for Millstone Power Station, Unit No. 2 (MP2). The scope of the RI-ISI program would be limited only to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Class 1 piping, Examination Categories B-F and B-J welds.

The licensee's RI-ISI program was developed in accordance with the methodology contained in the Westinghouse Owner's Guide (WOG) Topical Report WCAP-14572, Revision 1-NP-A (the topical report, Reference 4), which was previously reviewed and approved by the Nuclear Regulatory Commission (NRC or the Commission). The licensee proposed the RI-ISI program as an alternative to the requirements in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(i). The licensee requested implementation of this alternative for the second and third period of the third 10-year ISI interval at MP2.

In addition, the licensee submitted RR-89-41 for MP2, which requested performance of VT-2 visual examinations each refueling outage (RFO) as an alternative to the volumetric examinations specified in ASME Code Case N-577 and in WCAP-14572, Revision 1-NP-A, for those high safety-significant (HSS) ASME Code Class 1 socket welds identified in the RI-ISI program. This RR was reviewed by the NRC staff pursuant to 10 CFR 50.55a(a)(3)(ii).

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements set forth in the ASME Code to the extent practical within the limitations of design, geometry, and materials of construction of the components. Section 50.55a(g) of 10 CFR also states that ISI of the ASME Code, Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code and applicable addenda, except where specific written relief has been granted by the NRC. The objective of the ISI program, as described in Section XI of the ASME Code and applicable addenda, is to identify conditions (i.e., flaw indications) that are precursors to leaks and ruptures in the pressure boundary of these components that may impact plant safety.

These regulations also require that, during the first 10-year interval and during subsequent intervals, the licensee's ISI program comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference into 10 CFR 50.55a(b), 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The licensee stated that MP2 is in the third 10-year ISI interval, and that the applicable edition of Section XI of the ASME Code for this 10-year ISI interval is the 1989 Edition with no addenda.

According to 10 CFR 50.55a(a)(3), the NRC may authorize alternatives to the requirements of 10 CFR 50.55a(g) and, by extension, ASME Code Section XI 1989 Edition with no addenda, if the applicant demonstrates that the proposed alternatives would provide an acceptable level of quality and safety, or that the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant-Specific Changes to the Licensing Basis," (Reference 6) defines the following safety principles that should be met in an acceptable RI-ISI program:

(1) The proposed change meets current regulations unless it is explicitly related to a requested exemption.
(2) The proposed change is consistent with the defense-in-depth philosophy.
(3) The proposed change maintains sufficient safety margins.
(4) When proposed changes result in an increase in risk, the increases should be small and consistent with the intent of the Commission's Safety Goal Policy Statement (Reference 13).
(5) The impact of the proposed change should be monitored using performance measurement strategies.

RG 1.178, "An Approach For Plant-Specific Risk-Informed Decisionmaking - Inservice Inspection of Piping," (Reference 7) describes methods acceptable to the staff for integrating insights from probabilistic risk assessment (PRA) techniques with traditional engineering analyses into ISI programs for piping, and addresses risk-informed approaches that are consistent with the basic elements identified in RG 1.174.

The licensee has proposed to use an RI-ISI program for ASME Code Class 1 piping (Examination Categories B-F and B-J) welds as an alternative to the ASME Code Section XI requirements. The licensee states that this proposed program was developed using RI-ISI methodology described in the topical report. The staff's safety evaluation report (SER) of December 15, 1998, approving the methodology described in WCAP-14572, Revision 1-NP-A and concluded that this methodology conforms to the guidance provided in RGs 1.174 and 1.178 in that applying the methodology results in risk-neutrality or risk-reduction for the piping addressed in the RI-ISI program. It also concluded that the proposed RI-ISI program as described in WCAP-14572, Revision 1, conditioned upon the changes to be incorporated as discussed in Reference 10, letter from Louis F. Liberatori, Jr., Chairman (WOG), to Peter C. Wen (NRC), Transmittal of Responses to NRC Open Items on WOG RI-ISI Program and Reports WCAP-14572, Revision 1, and WCAP-14572, Revision 1, Supplement 1, September 30, 1998, will provide an acceptable level of quality and safety. Subsequent to this, the WOG published and distributed revision 1-NP-A (accepted revision) to WCAP-14572, which contains the methodology employed by the licensee.

Pursuant to 10 CFR 50.55a(a)(3)(i), the staff has reviewed and evaluated the licensee's proposed RI-ISI program based on guidance and acceptance criteria provided in the following documents:

(1) RGs 1.174 and 1.178 (References 6 and 7)
(2) NRC NUREG-0800, Chapter 3.9.8 (Reference 8)
(3) WCAP-14572, Revision 1-NP-A (Reference 4)
(4) NRC SER for WCAP-14572, Revision 1-NP-A (Reference 5)
(5) Provision of ASME Code Case N-577 as an alternative to ASME Code requirements

3.0 TECHNICAL EVALUATION

3.1 RR-89-40

3.1.1 Proposed Changes to the ISI Program

The scope of the proposed changes to the licensee's ISI program is limited to ASME Class 1 piping welds for the following Examination Categories: B-F for pressure-retaining dissimilar metal welds in vessel nozzles, and B-J for pressure-retaining welds in piping. The RI-ISI program is proposed as an alternative to the existing ISI requirements of ASME Code, Section XI.

The end result of the program changes is that the number and locations of non-destructive examination (NDE) inspections based on ASME Code Section XI requirements will be replaced by the number and locations of these inspections based on the RI-ISI guidelines. The ASME Code requires, in part, that for each successive 10-year ISI interval, 100% of Category B-F welds, and 25% of Category B-J welds for the ASME Code Class 1 non-exempt piping be selected for volumetric and/or surface examination based on existing stress analyses and cumulative usage factors. The proposed RI-ISI program for MP2 selects 55 of 1045 Class 1 piping welds for NDE. The surface examinations required by ASME Code, Section XI, will be discontinued while system pressure tests and VT-2 visual examinations shall continue. In addition to the 55 NDEs, 72 additional VT-2 examinations are proposed in lieu of NDEs in RR-89-41. These results are consistent with the concept that, by focusing inspections on the most safety-significant welds, the number of inspections can be reduced while at the same time maintaining protection of public health and safety.

The licensee stated in Section 2.2 of their submittal (Reference 1) that there are currently no augmented piping inspection programs within the ASME Class 1 piping at MP2. Therefore, the guidelines in the topical report about augmented inspection programs were not used.

3.1.2 Engineering Analysis

In accordance with the guidance provided in RGs 1.174 and 1.178 (References 6 and 7), the licensee provided the results of an engineering analysis of the proposed changes, using a combination of traditional engineering analysis and supporting insights from the PRA. The licensee performed an evaluation to determine susceptibility of components (i.e., pipe welds) to a particular degradation mechanism that may be a precursor to a leak or rupture, and then performed an independent assessment of the consequences of a failure at that location. The results of this analysis assure that the proposed changes are consistent with the principles of defense-in-depth, because the WCAP-14572, Revision 1-NP-A methodology requires that every HSS pipe segment, regardless of failure importance, receive at least one weld examination. There are no changes to the evaluation of design-basis accidents in the licensee's final safety analysis report needed as a result of the RI-ISI process. Therefore, sufficient safety margins will be maintained.

3.1.2.1 Scope of Program

The licensee stated that the RI-ISI program at MP2 is limited to ASME Code Class 1 Categories B-F and B-J piping welds, and that other non-related portions of the ASME Code, Section XI, ISI program will be unaffected by this program.

3.1.2.2 Segment Definition

Piping systems defined by the scope of the RI-ISI program were divided into piping segments. In the topical report, pipe segments are defined as lengths of pipe whose failure leads to the same consequence, are separated by flow splits and locations of pipe size changes, and include piping to a point at which a pipe break could be isolated.

In Reference 3, the licensee stated that 14 segments out of 130 total segments have piping with different diameters. The NRC staff identified this treatment as a potential deviation from the methodology approved in the topical report. This is discussed further in Section 3.1.2.4.

3.1.2.3 Consequence Evaluation

The licensee stated that the consequences of pressure boundary failure (PBF) were evaluated for their contribution to PBF-related core damage frequency (CDF) and large early release frequency (LERF). Both direct and indirect effects of pipe ruptures were evaluated and included in the consequence characterization. The licensee did not report any deviations from the consequence characterization methodology in the topical report. Therefore, its analyses are acceptable.

3.1.2.4 Failure Assessment

The NRC staff reviewed the licensee's failure assessment against the guidelines contained in WCAP-14572, Revision 1-NP-A, which state, in part, that the structural reliability and risk assessment (SRRA) computer models are to be used to estimate the failure probabilities of the structural elements in each of the piping segments. The licensee stated that it had trained a team in failure probability assessment methodology and in the Westinghouse SRRA Code, including identification of the capabilities and limitations as described in WCAP-14572, Revision

1-NP-A, Supplement 1. This team assessed industry and plant experience, plant layout, materials, operating conditions and then identified the potential failure mechanisms and causes. The licensee states that the SRRA Code was then used to calculate failure probabilities for the failure modes, materials, degradation mechanisms, input variables and uncertainties it was programmed to consider, as discussed in the above WCAP supplement. However, the licensee also noted, in their submittal, that the SRRA Code could not be used for all failure mechanisms or piping materials. In these instances, values were determined using “alternative means.” The licensee provided an example of an “alternative means” to address the case of thermal fatigue in socket welds, which is not modeled in the SRRA Code. However, the licensee stated that the SRRA Code does model thermal fatigue in butt welds; and because, for thermal fatigue, the failure probability in butt welds bounds the failure probability for socket welds, an upper and lower bound failure probability was established for the socket welds. The licensee used these bounding failure probabilities and industry experience to evaluate the appropriateness of the final failure probability results. The licensee stated that the team also performed sensitivity studies to aid in determining representative input values when sufficient information was not available. In Reference 3, the licensee provided additional clarification about the use of “alternative means” to indicate that the SRRA Code was, in fact, used to calculate failure probabilities for all segments. In some cases (e.g., for MP2's 3.75-inch thick hot legs), it was determined that using the SRRA Code’s simplified inputs program would not be appropriate, and that additional work was required to develop the appropriate detailed input data for direct use by the SRRA Code. The staff finds this acceptable in that the SRRA Code was appropriately used to determine the failure frequency of all segments, either directly or through bounding calculations.

In Reference 3, the licensee described how it evaluated the failure frequency of segments with multiple pipe sizes. The licensee divided this population of segments into two groups. The first group of eight segments is composed of single lines of piping in which each contains a single in-line reducer. Hence, these segments contain two pipe sizes. The second group of six segments contains a uniformly sized “main subsegment” with one or more 3/4-inch or 1-inch nominal pipe diameter (NPD) vent/drain branches tapping off these main subsegments.

For both groups, the licensee discussed in Reference 3 the rationale for selecting the weld size to be input into the SRRA Code during the initial calculations, and then the licensee discussed the sensitivity calculations that it performed.

For the first group of segments, the licensee indicated that there were two diameters of interest) 2 ½-inch and 4-inch NPD. The licensee stated that during the original calculations, it used the characteristics of the larger pipe size because that usually results in higher failure probabilities. Also during the original calculations, the licensee stated that it performed a sensitivity calculation on two of the segments, using the inputs from the smaller pipe size, and found that this resulted in higher failure probabilities by a factor of about 1.5. For those two segments, the licensee input the higher failure probability into the risk calculations. The licensee then stated in Reference 3 that it re-performed all of the calculations for both subsegments for all eight segments. This resulted in only one segment having a failure probability about twice what was used for the original risk ranking. For all other segments, calculated failure probabilities were the same as, or lower than, the originally calculated failure probabilities. This one segment with the higher failure probability was already designated HSS, with one weld selected for NDE. Because this factor of two is not considered excessively conservative, the staff concurs that the initial segmentation and failure assessment of the first group of segments is appropriate.

For the second group of segments, the licensee indicated in Reference 3 that for the original calculations, the licensee used the inputs from the main (largest) subsegment in determining failure probability. An engineering evaluation determined that the branch subsegments were in a more benign environment, with either an absence of active degradation mechanisms, or with active mechanisms of less severity than those associated with the main subsegment (such as thermal fatigue). Hence, failure probability calculations using the inputs from the branch subsegments were not originally performed on the basis of these engineering considerations.

The licensee also notes in Reference 3 that two segments of the second group of segments have all socket-welded branches. If failure probabilities were to be calculated for these branches, they would significantly elevate these two segments' failure probabilities, and possibly distort the overall risk profile relative to other segments. The licensee makes the point that each one of the socket welds receives a VT-2 examination anyway (volumetric NDEs are not performed on socket welds, as requested in RR-41). Hence, calculating failure probabilities for these two segments using inputs from the all socket-welded branch lines could possibly reduce the risk importance of other segments currently classified as HSS, perhaps changing some from HSS to low safety significant (LSS). Regardless, the staff finds that not inputting all of the damage mechanisms in each of the segments into that weld judged as the worst from a structural integrity perspective, even if it is a socket weld, represents a deviation from the approved methodology in the topical report. If the failure probability results are excessively conservative, then the methodology calls for subdividing the segment of interest into smaller segments, and re-running the SRRA Code evaluations for each of the new segments. However, since excessively conservative results are expected only from those all socket-welded subsegments, breaking these subsegments off and making them into new segments would not increase the number of volumetric NDEs in the program, since the licensee's program, as requested in RR-41, will require only a VT-2 examination of socket welds in HSS segments every RFO. Therefore, if the two subsegments were separated and made into their own segments, there would be no additional volumetric NDEs in the licensee's RI-ISI program.

For three other segments that do have butt welds in their branches, the licensee indicated in Reference 3 that while it is possible that the limiting inputs for a failure probability calculation could come from one of these branches, it was judged that the failure probabilities from these branches would "not be much higher" than those of the main subsegments, especially in view of the relatively benign environments associated with the branches. The staff finds this rationale to also be a deviation from the approved methodology in that the licensee applied all of the damage mechanisms to a main subsegment weld, judging that failure probabilities from these branches would yield a somewhat higher failure probability (albeit "not ÿ much higher") than those of the main subsegments. Therefore, the weld selected for the SRRA calculation for this segment was not the worst from a structural integrity perspective.

However, in Reference 3, the licensee stated that it re-performed the calculations for the above three segments with butt-welded branches of the second group, using branch pipe size inputs. The licensee stated that the calculated failure probabilities did increase, but by no more than a factor of two. Therefore, the failure probabilities for these segments did not become excessively conservative, and the staff concurs that no further subdividing of these three segments (which would likely increase the number of required volumetric NDEs) within these segments is needed.

The licensee explained in Reference 3 that of the 14 multiple pipe-size segments, 13 of them were originally classified HSS, and one LSS. This LSS segment (Segment RC-89) is also the sixth of the second group of segments. In Reference 3, the licensee explained that segment RC-89's failure probability calculation was not consistent with that of another segment, CH-03, which is physically very similar to RC-89, and performs very similar functions. The licensee clarified in Reference 11 that it discovered that there was an error in the original failure probability calculation for segment RC-89. The revised failure assessment of this last segment caused it to be reclassified as HSS.

The licensee indicated in Reference 3, and reaffirmed in Reference 11, that for both the original and the re-performed failure probability calculations all of the active mechanisms within the segment were “assigned” to the weld chosen for the calculation; i.e., the limiting weld concept was observed. The licensee also confirmed in Reference 11 that, among the initial and sensitivity calculations performed for each multiple pipe-size segment, the highest failure probability calculated for a given segment was used for risk-ranking purposes. The staff notes that this is exclusive of failure probabilities associated with socket welds.

Based on the foregoing, the NRC staff concludes that, while the licensee’s failure assessment process deviates from the methodology described in the topical report by not always identifying the worst weld within a segment from a structural integrity perspective for the purposes of applying all of the degradation mechanisms in the segment and then performing an SRRA calculation on that weld in order to estimate the segment’s failure probability, the number of required NDEs is the same as what would have been calculated if the licensee had strictly conformed to that methodology. The staff finds the results are consistent with the application of the approved methodology and, therefore, are acceptable.

3.1.2.5 PRA

As stated in References 1 and 2, the licensee used an update of the individual plant examination (IPE) model to evaluate the consequences of pipe rupture for the RI-ISI assessment. This version of the risk model, MP2 PRA model Version M2021114, represents the fifth major revision to the IPE model and is a full-scope Level 1 and Level 2 PRA model. It addresses accidents initiated by internal events at full power, including internal flooding. The licensee stated that the baseline CDF estimated from this PRA model is 6.48E-05/year, and the baseline LERF estimated is 7.26E-07/year.

3.1.2.5.1 Staff/Industry Review of the PRA

The original MP2 IPE was submitted to the NRC in December 1993. The NRC staff's SER of the IPE, dated May 1996, concluded that the IPE satisfied the intent of Generic Letter (GL) 88-20, "Individual Plant Examination for Severe Accident Vulnerabilities." However, the November 10, 2003 (Reference 3) submittal notes that in the May 1966 SER the NRC staff raised concerns about plant-specific data and the post-initiator human reliability analysis. In the November 10, 2003 submittal, the licensee stated that these concerns were addressed by the licensee in their first IPE revision (January 2000) and in their second IPE revision (June 2000), respectively. A Combustion Engineering Owners Group Probabilistic Safety Assessment Peer Review/Certification Review was performed in October 1999, on a draft of the first upgrade to the IPE model and its supporting documentation, from which a number of A (important and necessary to address immediately) and B (important and necessary to address by next PRA update) level comments were generated. These comments have been partially addressed in subsequent model revisions. In Reference 2, the licensee provided a compilation of those A and B level comments which have been resolved in subsequent revisions, and of those which have not. For those which have not, the licensee provided a brief impact assessment, concluding that each of these not-yet-resolved A and B level comments has "negligible impact on RI-ISI." The staff reviewed the licensee's dispositions of these comments, and concluded that they are reasonable.

The staff concludes that the licensee has adequately demonstrated that significant comments from the staff's review of the MP2 IPE have been addressed, and that significant comments from the industry peer review of the licensee's PRA have either been addressed in a subsequent revision, or will not measurably affect this RI-ISI application. The staff did not review the current PRA models to assess the accuracy of the quantitative estimates. The staff recognizes that the quantitative results of the PRA model are used as order of magnitude estimates to support the assignment of segments into three broad consequence categories. Inaccuracies in the models or in assumptions large enough to invalidate the broad categorizations developed to support the RI-ISI should have been identified during the staff's review of the IPE, and/or by the licensee's model update control program that included peer review/certification of the PRA model. Minor errors or inappropriate assumptions will affect only the consequence categorization of a few segments and will not invalidate the general results or conclusions.

3.1.2.5.2 Risk Evaluation

The licensee stated that each pipe segment in the scope of the program was evaluated to determine its CDF and LERF due to the postulated piping failure. The licensee provided CDF and LERF results by system for two different cases: (1) where operator recovery actions are not credited; and (2) where these actions are credited. The licensee also stated that an uncertainty analysis of the above (point estimate) results was performed, in accordance with page 125 of the topical report. Table 3.5-1 of the licensee's submittal (Reference 1) indicates that, of the three systems in MP2 ASME Class 1 scope (reactor coolant, charging, and safety injection), virtually all of the PBF-associated risk contribution comes from the reactor coolant system (RCS). Total ASME Code Class 1 PBF-associated CDF is 1.53E-05/year (with and/or without crediting operator recovery actions), and ASME Code Class 1 PBF-associated LERF is 3.53E-07/year without operator recovery actions, and 3.52E-07/year with operator recovery actions. The staff notes that these results appear to be reasonable when compared with results from other combustion engineering plants.

The licensee stated that the safety significance of each piping segment was then assessed by calculating its risk reduction worth (RRW) and risk achievement worth. Table 3.7-1 of the licensee's submittal (Reference 1) displays the binning of the in-scope piping segments into three groups of RRW thresholds: greater than 1.005, between 1.001 and 1.005, and less than 1.001. Of the three systems in the MP2 ASME Code Class 1 scope, 37 of 38 segments with RRW calculated to be greater than 1.005 are from the RCS.

In References 3 and 12, the licensee identified one additional segment of the RCS as HSS, due to an error in the original calculation. Although the elevation of this segment could downwardly influence the RRWs of other segments, the licensee chose not to perform this impact evaluation to determine if other segments might be able to be reclassified from HSS to LSS. Therefore, the overall risk-ranking of the in-scope pipe segments at MP2 may be slightly conservative. The staff finds this treatment to be acceptable.

3.1.2.5.3 Change in Risk

The licensee stated in their submittal (Reference 1) that change-in-risk calculations were performed according to the guidance provided on page 213 of the topical report (part of Section 4.4.2). The licensee's reported aggregate estimates of PBF-related CDF and LERF[1] resulting in the transition from the ASME Code Section XI ISI to RI-ISI program, is shown in Table 1 below. The operator actions credited in RI-ISI analyses are ones that the operators would take to mitigate the effects of segment ruptures. For example, loss of inventory and diversion of flow can be stopped following a rupture in some segments by closing an isolation valve upstream of the rupture. Because operator actions mitigate the effects of ruptures, the estimated CDFs and LERFs without crediting these actions are greater than those that credit these actions. Consequently, the absolute magnitude of the estimated changes in CDF and LERF, due to the implementation of an RI-ISI program, may be greater for the "without operator action" estimates than for the "with operator action" estimates. The licensee stated that all four criteria for evaluating the results on pages 214-215 of the topical report, were met with no further adjustments needed. Based on the use of the approved methodology and on the reported results, the staff finds that any change in risk associated with the implementation of the RI-ISI program will be small and consistent with the intent of NRC RGs 1.174 and 1.178, as well as the Commission's Safety Goal Policy Statement. Therefore, the staff finds the overall risk associated with the proposed RI-ISI program acceptable.

In Reference 11, the licensee indicated that the overall impact on change of risk, as a result of the re-performed calculations discussed in Section 3.2.4, is negative. This is so because there is a net increase of one HSS segment, requiring one additional NDE in the program. Given the acceptability of the calculated change in risk in the licensee submittal (Reference 1), the staff

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[1] These aggregate estimates differ from those reported in Section 3.2.5.1 owing to the rules for estimating overall CDF and LERF on page 213 of the WCAP (e.g. - leak detection probabilities are credited).

finds this additional impact on change in risk acceptable.

TABLE 1 - Aggregate Change-in-Risk Results

ISI Program	Overall CDF		Overall LERF	
	Without Op Action Credited	With Op Action Credited	Without Op Action Credited	With Op Action Credited
ASME Section XI	5.01E-06/yr	4.99E-06/yr	1.17E-07/yr	1.16E-07/yr
RI-ISI	4.52E-06/yr	4.50E-06/yr	1.05E-07/yr	1.05E-07/yr
Change in risk	-4.90E-07/yr	-4.90E-07/yr	-1.20E-09/yr	-1.20E-09/yr

3.1.2.6 Integrated Decisionmaking

The licensee used an integrated approach in defining the proposed RI-ISI program by considering the traditional engineering analysis, the risk evaluation, the implementation of the RI-ISI program, and performance monitoring of piping degradation. This is consistent with the guidelines given in RG 1.178.

3.1.2.6.1 Categorization of Piping Elements

The licensee states that it established a multi-disciplined expert panel to provide final categorization of the piping elements. This panel reviewed the results of the risk evaluation, and together with other operational considerations, determined the final safety significance of all elements. Table 3.7-1 of the licensee submittal (Reference 1) provides a summary of the results of this determination. Within the RCS, 24 of 29 pipe segments with RRW between 1.001 and 1.005 were placed in HSS Regions 1 or 2, and 7 of 24 pipe segments with RRW less than 1.001 were also placed into one of these regions. The licensee indicates that defense-in-depth concerns caused it to designate many of the segments with RRW less than 1.005 as HSS. Specifically, smaller reactor coolant piping segments and larger reactor coolant piping segments with dissimilar metal welds were so designated. The panel then determined those pipe segments of high failure importance by identifying those with a large leak probability in 40 years greater than 1E-04. This enabled the team to separate the segments between Regions 1 versus 2, and 3 versus 4. Table 3.4-1 of the licensee submittal (Reference 1) provides summary information about pipe break probabilities for the in-scope systems. As a result, the licensee states that the 129 in-scope pipe segments were categorized as follows:

Region 1 – 17 segments
Region 2 – 56 segments
Region 3 – 0 segments
Region 4 – 56 segments

In References 3 and 12, the licensee stated that one additional segment was reclassified from

LSS to HSS. Therefore, only 55 segments are currently in Region 4, while either Region 1 or 2 has one more additional segment.

The staff notes that this distribution is reasonable compared with that of other combustion engineering plants submitting an ASME Code Class 1 application.

3.1.2.6.2 Structural Element and NDE Selection

The process of selecting pipe elements to be inspected is described in Section 3.8 of the licensee's submittal. The licensee stated that the selection of elements to be examined within each segment was determined using the guidance provided in the topical report. However, the licensee indicated that the number of weld locations for each segment was determined using the Perdue Model in only 31 of the 73 HSS segments (all in Region 2). The number of weld locations within the remaining 42 HSS segments was determined using the guidance in Section 3.7.3 of the topical report.

The licensee stated that the primary reason for not using the Perdue Model for the remaining 42 segments was that the weld types and conditions in these segments were not applicable to using this model. For example, all of these segments contained some socket welds, eight segments are subject to vibratory fatigue, and one to stress-corrosion cracking. None of these conditions are applicable to the Perdue Model. In Reference 2, the licensee indicates that, for segments with fewer than 25% socket welds, the Perdue Model was used and generally a circumferential butt weld consisting of Alloy 82/182/600 material was identified for NDE. For segments with more than 25% socket welds, the Perdue model was not used. Rather, the licensee took credit for pressure testing and VT-2 examinations. The use of this approach is justified in the licensee's RR-89-41. Regardless of the fraction of socket welds in a segment, the licensee indicated, in Reference 2, that at least one circumferential butt weld was selected for examination in each HSS segment containing butt welds. In addition, the licensee stated in Reference 2 that all 28 Examination Category B-F welds in the RCS which contain Inconel 82/182 weld metal are selected for NDE under the RI-ISI program, regardless of its consequence or failure potential, based on having a potential for primary water stress-corrosion cracking.

The staff asked the licensee if the selected socket welds and branch connections can be substituted with larger butt welds of the same materials in the same system, segment, environment, and risk category, so that a volumetric examination can be performed. In its response, the licensee stated that butt welds were chosen over socket welds for volumetric examination where possible. However, since MP2 is an early-constructed plant, many of the HSS segments are made up entirely of socket welds, and such a choice does not exist. Since the licensee made its selection of butt welds to the extent possible, the staff finds its response acceptable. In Reference 3, the licensee also discussed the potential degradation mechanisms in the subject socket welds and states that a surface examination would not be effective because the welds are not subject to any degradation mechanism which causes outside diameter initiated flaws.

Table 5-1 of the licensee submittal (Reference 1) provides a summary of the selected weld locations, by system, in comparison with ASME Code Section XI requirements. In Reference 11, the licensee explained that the number of butt welds and socket welds shown in Table 5-1 represents the number in the entire system, not just in the HSS segments of the system. With regard to the charging (CH) system, the licensee stated that the 11 butt welds indicated for the CH system are all contained in LSS segments, and that the sole HSS segment within the CH system is entirely socket-welded. This explains the choice of performing only VT-2 examinations within that segment. Reference 12 provides a clarifying explanation of those columns in Table 5-1 that denote the total number of butt and socket welds in each system.

In total, for HSS pipe segments, 54 weld locations have been selected for NDE, and another 72 weld locations have been selected for VT-2 examination during pressure testing. In Reference 3, the licensee indicated that as a result of re-categorizing segment RC-89 from LSS to HSS, one additional location has been selected for NDE, for a total of 55 weld locations. Reference 3 also provides a revised Table 5-1 showing the additional location.

The staff's review of the weld location selection process concludes that it is consistent with the guidance given on pages 182-184 of the topical report. Therefore, the staff considers the licensee's selection of element locations, which includes consideration of degradation mechanisms, in addition to those covered by augmented inspection programs, to be acceptable.

3.1.2.6.3 Examination Methods

As noted in Section 2 of this SE, the objective of ISI is to identify conditions (i.e., flaw indications) that are precursors to leaks and ruptures in the pressure boundary that may impact plant safety. To meet this objective, the risk-informed location selection process, in accordance with WCAP-14572, Revision 1-NP-A, employs an "inspection for cause" approach. To address this approach, Section 4 of the topical report provides guidelines for the areas and/or volumes to be inspected, as well as the examination method, acceptance standard, and evaluation standard for each degradation mechanism. The licensee stated that Table 4.1-1 of the topical report was used as guidance for determining the examination requirements for the HSS piping segments. It also states that socket welds selected for examination with no degradation mechanism or only with the thermal fatigue mechanism will receive a VT-2 examination, as stated above.

In response to a staff question regarding performing a VT-2 examination on insulated pipes, the licensee stated that it will follow the Section XI ASME Code requirements and will implement a four-hour hold time during a pressure test before performing the examination. The staff finds this acceptable because the licensee's examination method is consistent with the ASME Code Section XI requirements, and if a leak were to exist, it would likely be detected after a four-hour hold time even though the pipe is insulated.

Based on its review and acceptance of WCAP-14572, Revision 1-NP-A, the staff concludes that these examination methods are appropriate since they are selected based on specific degradation mechanisms, pipe sizes, and materials of concern.

3.1.2.6.4 Program RRs

The licensee did not indicate that any current RRs need to be withdrawn. Therefore, any current RRs continue to be necessary and will remain in place.

The licensee states that, at this time, all RI-ISI-selected examination locations have provided greater than 90% volumetric coverage. It notes that for any future examination location where greater than 90% volumetric coverage cannot be obtained, the process outlined in Section 4.1 of the topical report will be followed. The staff finds that the licensee's proposed treatment of potential future RRs acceptable.

3.1.2.7 Implementation and Monitoring

Implementation and performance monitoring strategies require careful consideration by the licensee and are addressed in Element 3 of RG 1.178 and the Standard Review Plan 3.9.8. The objective of Element 3 is to assess performance of the affected piping systems under the proposed RI-ISI program by utilizing monitoring strategies that confirm the assumptions and analyses used in the development of the RI-ISI program. Pursuant to 10 CFR 50.55a(a)(3)(i), a proposed alternative, in this case the implementation of the RI-ISI program, including inspection scope, examination methods, and methods of evaluation of examination results, must provide an acceptable level of quality and safety.

The licensee stated that upon approval of the RI-ISI program, procedures that comply with WCAP-14572, Revision 1-NP-A guidelines will be prepared to implement and monitor the RI-ISI program. The licensee confirms that the applicable aspects of the ASME Code not affected by the proposed RI-ISI program would be retained.

Upon approval of this request, the initial RI-ISI program will be implemented in the inspection period current at the time of program approval and corresponding ASME Code Class 1, Section XI examinations will cease. This is currently planned to take place in support of the second RFO of the second inspection period (RFO 16), during the current third 10-year inspection interval that will occur in the spring of 2005. (Note: The second inspection period of the third 10-year inspection interval for MP2 ends on November 30, 2005, and it is anticipated that the RI-ISI program will be in effect for the spring 2005 RFO16). Some locations that have been selected for examination under the RI-ISI program will have already been examined for the existing ISI program in RFO15, which occurred in the fall of 2003. These previously examined locations will be credited under the new RI-ISI program provided the failure mechanisms(s) of concern were covered by the completed examinations. Regardless of the initial start date of the RI-ISI program, 100% of the examinations required by the RI-ISI program will be completed by the end of the current 10-year inspection interval based on the interval requirements of the current ASME Code Section XI ISI program

The licensee stated that the RI-ISI program is a living program and its implementation will require feedback of new relevant information to ensure the appropriate identification of safety-significant piping locations. The licensee also stated that, at a minimum, risk ranking of piping segments will be reviewed and adjusted on an ASME Code period basis and that significant changes may require more frequent adjustment as directed by NRC Bulletin or GL requirements, or by industry and plant-specific feedback. This periodic review and adjustment of the risk-ranking of segments ensure that changes to the PRA which the licensee will make to incorporate the remaining peer review results will also be incorporated into the RI-ISI program as necessary.

The licensee's submittal stated that examinations performed that reveal flaws or relevant conditions exceeding the applicable acceptance standards shall be extended to include additional examinations. These examinations will be performed during the current outage on these elements up to a number equivalent to the number of elements initially required to be inspected on the segment or segments. If acceptable flaws or relevant conditions are again found similar to the initial problem, the remaining elements identified as susceptible will be examined. In Reference 2, the licensee clarified that all additional examinations or sample expansions will be completed during the outage that identified the flaws or relevant conditions. The staff finds the licensee's approach acceptable since the additional examinations, if required, will be performed during the outage that the indications or relevant conditions are identified.

In Reference 2, the licensee provided a listing of the types of future program changes that would require NRC notification and approval. This list came from Reference 9, and is consistent with the listing of changes previously approved in prior plant submittals.

The staff finds that the proposed process for RI-ISI program implementation, monitoring, feedback, and update meets the guidelines of RG 1.174 which states that risk-informed applications should include performance monitoring and feedback provisions. Therefore, the licensee's proposed process for program implementation, monitoring, feedback, and update is judged to be acceptable.

3.2 RR-89-41

DNC submitted RR-89-41 for MP 2, which requested performing VT-2 visual examinations during each RFO as an alternative to the volumetric examinations specified in ASME Code Case N-577 and in WCAP-14572, Revision 1-NP-A, for those HSS ASME Code Class 1 socket welds identified in the RI-ISI program. The licensee indicates that Code Case N-577 has been revised to allow the substitution of the VT-2 examination method for all damage mechanisms on socket welds selected as HSS.

The staff agrees that volumetric examination of socket welds is inconclusive and meaningless due to the geometric limitations imposed by a socket weld, and that performing volumetric examination on socket welds will create hardship without a compensating level of quality and safety. Based on the information provided, the staff finds that the licensee has made selections of butt welds over socket welds as much as possible in order to perform a volumetric examination instead of a VT-2 examinations. Since some of the HSS segments are entirely made up of socket welds, socket welds were the only welds available for selection, and have to be selected.

Also, the staff notes that Table IWB-2500-1 of the ASME Code requires surface examination, not volumetric examination, at the socket welds; and surface examination (e.g. - liquid penetrant examination) is an effective method for discovering potential surface flaws on the outside surface. The licensee indicates that the ASME Code Class 1 socket weld piping is not subject to an outside surface-initiated degradation mechanism. For inside-diameter initiated flaws, a surface examination will not be able to detect the flaw until it becomes through-wall. Therefore, the staff concludes that performance of a VT-2 visual examination is sufficiently effective for the socket welds. For insulated components which require a VT-2 examination, the licensee has committed to utilize a four-hour hold during the pressure test of insulated pipes before performing the VT-2 examination. The staff finds this acceptable because if a leak were to exist, it would likely be detected after four hours of hold time even though the pipe is insulated.

The staff notes that the revised ASME Code Case N–577 has neither been issued nor been reviewed and approved by the NRC. Thus, the approval of this request is based on the technical merit of applying VT-2 visual examinations to specific conditions at MP2, and should not be considered as an endorsement of the ASME Code case. The staff concurs that performing volumetric or surface examinations of these socket welds would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Therefore, the request to conduct VT-2 examinations as an alternative in each RFO for Category B-J socket welds is acceptable pursuant to 10 CFR 50.55a(a)(3)(ii).

4.0 CONCLUSIONS

Pursuant to 10 CFR 50.55a(a)(3)(i), alternatives to the requirements of 10 CFR 50.55a(g) may be used, when authorized by the NRC, if the licensee demonstrates that the proposed alternatives will provide an acceptable level of quality and safety. In this case, the licensee has proposed an alternative to use the risk-informed process described in NRC-approved WCAP-14572, Revision 1-NP-A.

RG 1.174 establishes requirements for risk-informed decisions involving a change to a plant's licensing basis. RG 1.178 establishes requirements for risk-informed decisions involving alternatives to the requirements of 10 CFR 50.55a(g) (ISI program requirements), and its directive to follow the requirements of the ASME Code, Section XI. These two RGs, taken together, define the elements of an integrated decision-making process that assesses the level of quality and safety embodied in a proposed change to the ISI program. WCAP-14572 RI-ISI methodology contains the necessary details for implementing this process. This methodology provides a systematic identification of safety-significant pipe segments, a determination of where inspections should occur within these segments (i.e., identification of locations), and a determination of how these locations will be inspected. The failure of such segments/locations would be expected to result in a significant challenge to safety.

The WCAP-14572, Revision 1-NP-A methodology also provides for implementation and performance-monitoring strategies, to insure a proper transition from the current ISI program, and to assure that changes in plant performance, and new information from the industry and/or the NRC is incorporated into the licensee's ISI program, as needed.

Other aspects of the licensee's ISI program, such as system pressure tests and visual examination of piping structural elements will continue to be performed on all Class 1, 2, and 3 systems in accordance with ASME Code, Section XI. This provides a measure of continued monitoring of areas that are being eliminated from the NDE portion of the ISI program. With the WCAP-14572, Revision 1-NP-A methodology, the existing ASME Code performance measurement strategies will remain in place. In addition, WCAP-14572, Revision 1-NP-A methodology provides for increased inspection volumes for those locations that are included in the NDE portion of the program.

The staff concludes that the licensee's development of its RI-ISI program is consistent with the methodology described in the topical report with the exception of the staff-identified deviation regarding the selection of welds for SRRA calculations. After reviewing Reference 3 and following Reference 11, the staff concludes that the licensee's deviation would not have changed the final results of the evaluation had the licensee strictly conformed to the topical report's requirements for pipe segment definition. However, the licensee's approach is not endorsed by the staff as a generally acceptable modification of the WCAP methodology. In References 3 and 11, the licensee demonstrated that the final proposed RI-ISI program produced the same results that would have been obtained if the approved methodology had been used. Consequently, the results of the review indicate that the licensee's proposed RI-ISI program is overall consistent with WCAP-14572, Revision 1-NP-A. In addition, the licensee identified one deviation, separately described and justified under RR-41. The staff and the licensee identified no other deviations from the topical report.

The staff concludes that the licensee's proposed program, which is consistent with the methodology described in the topical report (with the exception of above noted deviation), will provide an acceptable level of quality and safety pursuant to 10 CFR 50.55a(a)(3)(i) for the proposed alternative to the piping ISI requirements with regard to (1) the number of locations, (2) the locations of inspections, and (3) the methods of inspection.

Therefore, the staff concludes that the licensee's proposed RI-ISI program, submitted under RR-89-40, is an acceptable alternative to the current ISI program for Class 1 piping welds at MP2. The proposed RI-ISI program is authorized for the second and third periods of the third 10-year ISI interval pursuant to 10 CFR 50.55a(a)(3)(i) on the basis that this alternative will provide an acceptable level of quality and safety.

In addition, DNC submitted RR-89-41 for MP2, which requested performing VT-2 visual examinations each RFO as an alternative to the volumetric examinations specified in ASME Code Case N-577 and in WCAP-14572, Revision 1-NP-A, for those HSS ASME Code Class 1 socket welds identified in the RI-ISI program. The staff concurs that performing volumetric examination of these socket welds would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The staff also concurs that to perform code-required surface examination of socket welds is not useful due to the absence of an environment that would cause outside surface-initiated flaws. Therefore, the licensee's proposed alternative examination method is authorized pursuant to 10 CFR 50.55a(a)(3)(ii) on the basis that performing either volumetric or surface examinations of these socket welds would result in unusual difficulty without a compensating increase in the level of quality and safety, and that the licensee's proposed alternative provides reasonable assurance of structural integrity.

6.0 REFERENCES

1. Letter from Leslie N. Hartz, DNC, to NRC, "Dominion Nuclear Connecticut, Inc. (DNC) Millstone Power Station, Unit No. 2 Request to Implement a Risk-Informed Inservice Inspection Program Plan as an Alternative to the ASME Code Section XI Requirements," dated November 10, 2003.

2. Letter from Eugene S. Grecheck, DNC, to NRC, “Dominion Nuclear Connecticut, Inc. (DNC) Millstone Power Station, Unit 2 Response to Request for Additional Information; Request to Implement a Risk-Informed Inservice Inspection Program Plan as an Alternative to the ASME Code Section XI Requirements,” dated July 6, 2004.

3. Letter from Leslie N. Hartz, DNC, to NRC, “Dominion Nuclear Connecticut, Inc. (DNC) Millstone Power Station, Unit 2 Response to Request for Additional Information; Request to Implement a Risk-Informed Inservice Inspection Program Plan as an Alternative to the ASME Code Section XI Requirements,” dated October 12, 2004.

4. WCAP-14572, Revision 1-NP-A, “Revised Risk-Informed Inservice Inspection Evaluation Procedure, Final Report,” December 1999.

5. NRC Staff SE on WCAP-14572, Revision 1-NP-A, Revision B-A, dated December 15, 1998.

6. NRC RG 1.174, “An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis,” Revision 1, November 2002.

7. NRC RG 1.178, “An Approach for Plant-Specific Risk-Informed Decisionmaking for Inservice Inspection of Piping,” Revision 1, September 2003.

8. NRC NUREG-0800, Chapter 3.9.8, “Standard Review Plan For the Review of Risk-Informed Inservice Inspection of Piping,” Revision 1, September 2003.

9. NEI 04-05 “Living Program Guidance To Maintain Risk-Informed Inservice Inspection Programs for Nuclear Plant Piping Systems,” April 2004.

10. Letter from Louis F. Liberatori, Jr., Chairman (WOG), to Peter C.Wen (NRC), Transmittal of Responses to NRC Open Items on WOG RI-ISI Program and Reports WCAP-14572, Revision 1, and WCAP-14572, Revision 1, Supplement 1, September 30, 1998.

11. Conference call between DNC and the NRC, January 4, 2005.

12. Letter from Eugene S. Grecheck, DNC, to NRC, “Dominion Nuclear Connecticut, Inc. (DNC) Millstone Power Station, Unit 2 Supplement to Response to Request for Additional Information; Request to Implement a Risk-Informed Inservice Inspection Program Plan as an Alternative to the ASME Code Section XI Requirements,” dated January 13, 2005.

13. NRC, “Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities; Final Policy Statement,” Federal Register, Vol. 60, p. 42622, August 16, 1995.

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