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Chief, Rules Review and Directives Branch
Office of Administration
U. S. Nuclear Regulatory Commission
Mail Stop T6-D59
Washington, DC 20555-0001

GL06-037/039

SUBJECT: Comments on Draft Regulatory Guide DG-1144 and Draft NUREG/CR-6909

Virginia Electric and Power Company (Dominion), Dominion Nuclear Connecticut, Inc. (DNC), and Dominion Energy Kewaunee, Inc. (DEK) appreciate the opportunity to comment on the drafts of Regulatory Guide DG-1144 and NUREG/CR-6909. Our comments are enclosed for your consideration.

If you have any questions or would like further information, please contact:

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Respectfully,

C. L. Funderburk, Director
Nuclear Licensing & Operations Support
Dominion Resources Services, Inc. for
Virginia Electric and Power Company,
Dominion Nuclear Connecticut, Inc. and
Dominion Energy Kewaunee, Inc.

Enclosure

SUNSI Review Complete
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E-RIDS = ADM-03
Add = H. J. Gonzalez (HJG)

Comments on Draft Regulatory Guide DG-1144 and
Draft NUREG/CR-6909

Dominion has reviewed Draft Regulatory Guide DG-1144 and Draft NUREG/CR-6909. The following comments have resulted from that review:

Comments Specific to Draft DG-1144

Comment #1
The term's "life" and "number of cycles" have been used interchangeably throughout the text.

Recommended change – Page 4, Paragraph 2, Line 3: change "life" to "number of cycle".

Comment #2
In the Introduction of DG-1144, the NRC states:

> *"This draft regulatory guide provides guidance for use in determining the acceptable fatigue life of ASME pressure boundary components, with consideration of the light-water reactor (LWR) environment. In so doing, this guide describes a methodology that the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable to support reviews of applications that the agency expects to receive for new nuclear reactor construction permits or operating licenses under 10 CFR Part 50, design certifications under 10 CFR Part 52, and combined licenses under 10 CFR Part 52 that do not reference a standard design. Because of significant conservatism in quantifying other plant -related variables (such as cyclic behavior, including stress and loading rates) involved in cumulative fatigue life calculations, the design of the current fleet of reactors is satisfactory, and the plants are safe to operate."*

During the August 2006 meetings of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code in Henderson, NV, the NRC clarified that DG-1144 requirements only applied to new plant construction, and that the requirements did not apply to replacement component design for operating reactors.

Recommended change – Explicitly clarify that DG-1144 does not apply to repaired or replaced components for currently operating plants.

Comment #3
DG-1144 does not provide any specific methods for evaluating Ni-Cr-Fe material. Alloy 600 and Alloy 690 materials, to name a few, have regularly been used in operating nuclear plants. It is assumed that this practice will continue for new reactors.

Ni-Cr-Fe rules that have previously been applied by some license renewal applicants are specified in O. Chopra, "Status of Fatigue Issues at Argonne National Laboratory," Presented at EPRI Conference on Operating Nuclear Power Plant Fatigue Issues & Resolutions, Snowbird, UT, August 22-23, 1996. These rules are similar to those found in EPRI TR-105759, "An Environmental Factor Approach to Account for Reactor Water Effects in Light Water Reactor Pressure Vessel and Piping Fatigue Evaluations," December 1995.

Recommended change – Clarify that these rules are acceptable for use to evaluate Ni-Cr-Fe materials (including Alloy 690).

Comment #4
DG-1144 specifies rules for fatigue analysis for new reactor design. It is assumed that new reactors will need to be certified in accordance with ASME Code, Section III, in order to receive an N-stamp or similar certification prior to entry into service. The fatigue rules specified in DG-1144 currently differ from the fatigue rules specified in ASME Code, Section III. At this point in time, there is no reason to believe that the ASME Code will adopt methodology into Section III that is consistent with the methodology specified in DG-1144.

Recommended change – Clarify how these differences will be reconciled to allow proper certification of nuclear components for new reactors.

Comment #5
DG-1144 does not provide guidance for how analyses of rapid thermal cycling fatigue, such as those typically evaluated for boiling water reactor (BWR) feedwater nozzles, are to be evaluated for environmental effects?

Recommended change – Clarify that environmental effects do not apply to fatigue from sufficiently rapid cycles such as the thermal cycling fatigue noted.

Comments Specific to Draft NUREG/CR-6909

Comment #6
Page 4, Paragraph 2, Lines 5-8: It is stated that Figures 9, 10 and 37 in NUREG/CR-6909 are prepared using margins of 12 for life and 2 for stress for carbon steel, low alloy steel, and austenitic stainless steel respectively. It appears from page 47 of Draft NUREG/CR-6909 a margin of 20 on cycles was used in Figure 37. It is possible that Figure 37 of NUREG/CR-6909 was constructed with a margin of 12 on cycles and the text in page 47 is in error. Please clarify.

Recommended change –The DG-1144 statement will be correct if the draft NUREG/CR-6909, page 47, Paragraph 5.1.8, Line 10, "20 on cycles" is changed to "12 on cycles".

Comment #7
Page 1, Paragraph 2, The last sentence should read, "The cumulative usage factor (CUF), calculated on the basis of Miner's rule, is the ... ... exceed 1."

Recommended change – Insert, ", calculated on the basis of Miner's rule,".

Comment #8
In Appendix A of NUREG/CR-6909, reference is made to two papers that may be used for guidance:

(1) Mehta, H. S., "An Update on the Consideration of Reactor Water Effects in Code Fatigue Initiation Evaluations for Pressure Vessels and Piping," Assessment Methodologies for Preventing Failure: Service Experience and Environmental Considerations, PVP Vol. 410-2, R. Mohan, ed., American Society of Mechanical Engineers, New York, pp. 45–51, 2000.

(2) Nakamura, T., M. Higuchi, T. Kusunoki, and Y. Sugie, "JSME Codes on Environmental Fatigue Evaluation," Proc. of the 2006 ASME Pressure Vessels and Piping Conf., July 23–27, 2006, Vancouver, BC, Canada, paper # PVP2006–ICPVT11–93305.

While both of these papers describe F_{en} methodologies and their application to fatigue analyses, the methodologies differ from those specified in DG-1144 and supporting document NUREG/CR-6909.

Recommended change – Please clarify that the F_{en} methods specified in either of the above two documents are an acceptable alternative to the methodology specified in DG-1144 providing that the F_{en} formulas provided in DG-1144 are used in lieu of those in the referenced documents.

Joint Comments to Draft Regulatroy Guide DG-1144 and Draft NUREG/CR-6909

Comment #9
The methodology used by DG-1144 is an environmental fatigue multiplier (F_{en}) approach, very similar to the approach being used by license renewal applicants, as documented in NUREG/CR-5704 (ANL-98/31), "Effects of LWR Coolant Environments on Fatigue Design Curves of Austenitic Stainless Steels," April 1999, and NUREG/CR-6583 (ANL-97/18), "Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low-Alloy Steels," March 1998.

The MRP provided guidance for performing plant specific environmental fatigue evaluations for plants pursuing license renewal in EPRI TR-1012017, "Guidelines for Addressing Fatigue Environmental Effects in a License Renewal Application (MRP-47 Revision 1)," April 2005, which Dominion understands is being provided to the NRC by the MRP as part of its comments to the draft Regulatory Guide and NUREG. The intent of MRP-47, Rev. 1 was to unify the process used by applicants to address environmental effects in the License Renewal Application, and provide specific guidance on the use of currently accepted environmental fatigue evaluation methodologies. As a result of industry application of the F_{en} relationships, MRP-47, Rev. 1 identified several practical issues associated with the application of the F_{en} methodology to typical industry fatigue evaluation problems. These issues have led to application of a variety of different solutions applied by analysts depending upon the analyst or the level of detail available in the existing fatigue evaluations. This varied approach has led to non-consistent application of the F_{en} approach between plants, and some amount of confusion amongst the industry.

Since DG-1144 utilizes a similar F_{en} methodology to that evaluated in MRP-47, Rev. 1, the issues identified in MRP-47, Rev. 1 are considered to be equally applicable to the DG-1144 methodology. Some, but not all, of the issues raised in MRP-47, Rev. 1 have been specifically

addressed in DG-1144. Based on this, clarification on the remaining issues included in DG-1144 or the supporting document (DRAFT REPORT FOR COMMENT NUREG/CR-6909 (ANL 06/08), "Effect of LWR Coolant Environments on the Fatigue Life of Reactor Materials," July 2006.) are appropriate.

Please clarify the following specific issues:

a. "Linking" of transients pairs is not straight-forward and can lead to significant differences in results (refer to Figure 1) in part due to the following items:
   - Treatment of cases where the starting and ending stress points are not equal needs to be clarified
   - The rate of change assumed for the discontinuity between transient's needs to be addressed?
   - What is strain rate?

   Recommended change – Clarify that the recommendations made in Section 4.2.2 of MRP-47, Rev. 1 for addressing linking of transients are an acceptable approach.

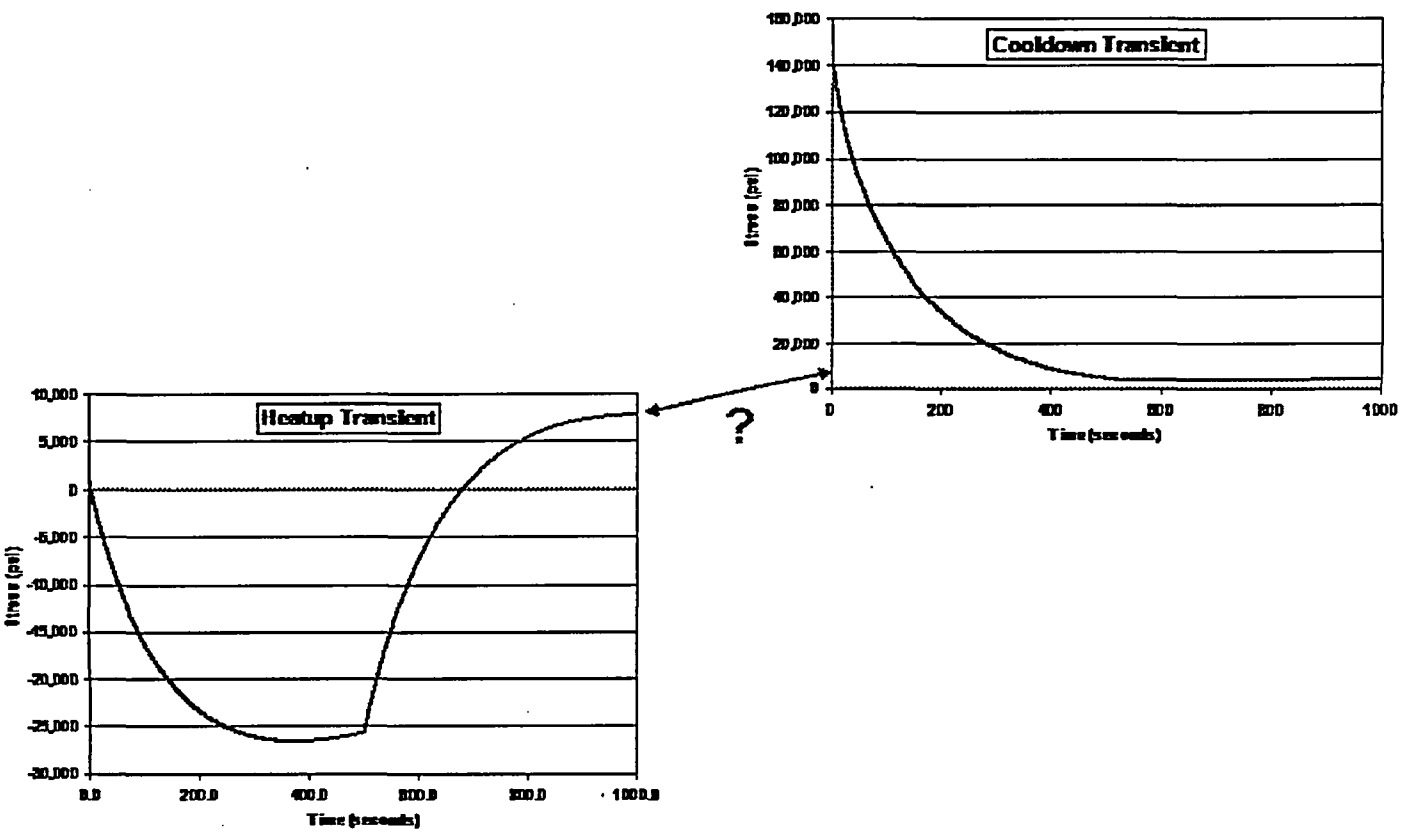

Figure 1. Issue of Transient Linking

b. **Recommended change** – Clarify that cycle counting methods other than those typically employed in ASME Code Section III calculations, such as Rainflow Cycle Counting, are acceptable for use in fatigue analyses associated with DG-1144.

c. There is an effect on strain rate from the elastic-plastic correction factor (K_e). How should this be evaluated?

   Recommended change – Clarify that the recommendations made in Section 4.2.6 of MRP-47, Rev. 1 for addressing K_e effects are acceptable.

d. How are stratification loads to be addressed using the F_{en} methodology?

   Recommended change – Clarify that the recommendations made in Section 4.2.6 of MRP-47, Rev. 1 for addressing stratification loads are acceptable.

e. How are seismic loads to be addressed using the F_{en} methodology?

   Recommended change – Clarify that the recommendations made in Section 4.2.6 of MRP-47, Rev. 1 for addressing stratification loads are acceptable.

f. How are pressure and moment loads to be addressed using the F_{en} methodology?

   Recommended change – Clarify that the recommendations made in Section 4.2.6 of MRP-47, Rev. 1 for addressing stratification loads are acceptable.

g. **Recommended change** – Environmental fatigue is typically linked to dissolved oxygen. As noted in MRP-47, Rev. 1, this involves inappropriate over-simplification and ignores the key role of other water chemistry parameters such as conductivity (or more correctly, level of dissolved anionic impurities) and pH. NUREG/CR-6909 notes (for example, in Section 5.2.6) that water chemistry effects have been appropriately incorporated into the model except for off-normal water chemistry conditions. Please define off-normal water chemistry conditions and provide specific guidance on what should be done to evaluate such conditions.

h. **Recommended change** – NUREG/CR-6909 includes definitions for temperature for use with the F_{en} expressions. Please clarify whether the temperature to be used should be the metal temperature or the fluid temperature. If it is the metal temperature, please provide guidance on alternatives for cases when metal temperature is not available.