U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REGULATORY RESEARCH

July 2006
Division 1

DRAFT REGULATORY GUIDE

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DRAFT REGULATORY GUIDE DG-1144

GUIDELINES FOR EVALUATING FATIGUE ANALYSES INCORPORATING THE LIFE REDUCTION OF METAL COMPONENTS DUE TO THE EFFECTS OF THE LIGHT-WATER REACTOR ENVIRONMENT FOR NEW REACTORS

A. INTRODUCTION

In Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10, Part 50, of the *Code of Federal Regulations* (10 CFR Part 50), "Domestic Licensing of Production and Utilization Facilities," General Design Criterion (GDC) 1, "Quality Standards and Records," requires, in part, that structures, systems, and components that are important to safety must be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function performed. In addition, GDC 30, "Quality of Reactor Coolant Pressure Boundary," requires, in part, that components that are part of the reactor coolant pressure boundary must be designed, fabricated, erected, and tested to the highest practical quality standards.

Augmenting those design criteria, 10 CFR 50.55a, "Codes and Standards," endorses the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code for design of safety-related systems and components. In particular, Section 50.55a(c), "Reactor Coolant Pressure Boundary," requires, in part, that components of the reactor coolant pressure boundary must meet the requirements for Class 1 components in Section III, "Rules for Construction of Nuclear Power Plant Components," of the ASME Boiler and Pressure Vessel Code. Specifically, those Class 1 requirements contain provisions, including fatigue design curves, for determining a component's suitability for cyclic service. These fatigue design curves are based on strain-controlled tests performed on small polished specimens, at room temperature, in air environments. Thus, these curves do not address the impact of the reactor coolant system environment.

This regulatory guide is being issued in draft form to involve the public in the early stages of the development of a regulatory position in this area. It has not received staff review or approval and does not represent an official NRC staff position.

Public comments are being solicited on this draft guide (including any implementation schedule) and its associated regulatory analysis or value/impact statement. Comments should be accompanied by appropriate supporting data. Written comments may be submitted to the Rules and Directives Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001. Comments may be submitted electronically through the NRC's interactive rulemaking Web page at http://www.nrc.gov/what-we-do/regulatory/rulemaking.html. Copies of comments received may be examined at the NRC Public Document Room, 11555 Rockville Pike, Rockville, MD. Comments will be most helpful if received by **September 25, 2006**.

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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.

The NRC issues regulatory guides to describe to the public methods that the staff considers acceptable for use in implementing specific parts of the agency's regulations, to explain techniques that the staff uses in evaluating specific problems or postulated accidents, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations, and compliance with regulatory guides is not required. The NRC issues regulatory guides in draft form to solicit public comment and involve the public in developing the agency's regulatory positions. Draft regulatory guides have not received complete staff review and, therefore, they do not represent official NRC staff positions.

This regulatory guide contains information collections that are covered by the requirements of 10 CFR Parts50 and 52, which the Office of Management and Budget (OMB) approved under OMB control numbers 3150-0011 and 3150-0151, respectively. The NRC may neither conduct nor sponsor, and a person is not required to respond to, an information collection request or requirement unless the requesting document displays a currently valid OMB control number.

B. DISCUSSION

The ASME Section III design curves, developed in the late 1960s and early 1970s, are based on tests conducted in laboratory air environments at ambient temperatures. The original code developers applied margins of 2 on strain and 20 on cyclic life to account for variations in materials, surface finish, data scatter, and environmental effects (including temperature differences between specimen test conditions and reactor operating experience). However, the developers lacked sufficient data to explicitly evaluate and account for the degradation attributable to exposure to aqueous coolants. More recent fatigue test data from the United States, Japan, and elsewhere show that the LWR environment can have a significant impact on the fatigue life of carbon and low-alloy steels, as well as austenitic stainless steel.

Two distinct methods can be used to incorporate LWR environmental effects into the fatigue analysis of ASME Class 1 components. The first method involves developing new fatigue curves that are applicable to LWR environments. Given that the fatigue life of ASME Class 1 components in LWR environments is a function of several parameters, this method would necessitate developing several fatigue curves to address potential parameter variations. An alternative would be to develop a single *bounding* fatigue curve, which may be overly conservative for most applications. The second method involves using an environmental correction factor (F_{en}) to account for LWR environments by correcting the fatigue usage calculated with the ASME "air" curves. This method affords the designer greater flexibility to calculate the appropriate impacts for specific environmental parameters. In addition, applicants have already used this method in their license renewal applications.

The NRC staff has selected the F_{en} method, as described in NUREG/CR-6909, "Effect of LWR Coolant Environments on the Fatigue Life of Reactor Materials." In particular, Appendix A to that report, "Incorporating Environmental Effects into Fatigue Evaluations," describes a methodology that the staff considers acceptable to incorporate the effects of reactor coolant environments on fatigue usage factor evaluations of metal components. In addition, NUREG/CR-6909 provides a comprehensive review of, and technical basis for, the methodology proposed in this draft regulatory guide, including analysis of each parameter affecting the fatigue evaluations. In developing the underlying statistical models, the researchers analyzed existing data to predict fatigue lives as a function of temperature, strain rate, dissolved oxygen level in water, and sulfur content of the steel. The resultant method postulates a strain threshold, below which environmental effects on fatigue life do not occur. By definition, F_{en} is the ratio of fatigue life of the component material in a room temperature air environment to its fatigue life in LWR coolant at operating temperature. To incorporate environmental effects into the fatigue evaluation, the fatigue usage is calculated using ASME Section III Code provisions, and the fatigue design curve is multiplied by the correction factor.

A second concern regarding the ASME fatigue design curves involves nonconservatism of the current ASME stainless steel air design curve. More recent evaluations of stainless steel test data indicate that the ASME curve is inconsistent with the appropriate test materials and conduct of the fatigue test. Consequently, through this draft regulatory guide, the NRC staff endorses a new stainless steel air design curve. Section 5.1.8 of NUREG/CR-6909 provides a comprehensive review of, and technical basis for, that new design curve. The F_{en} defined for stainless steel in NUREG/CR-6909 should be used in conjunction with the new stainless steel air design curve when evaluating the fatigue usage of ASME Class 1 components.

In addition, Section 6 of NUREG/CR-6909 includes an evaluation of the ASME design curve margins. In conducting that evaluation, the researchers reviewed data available in the literature to assess the subfactors (excluding environment) that are needed to account for the effects of various uncertainties and differences between actual components and laboratory test specimens. The researchers also performed statistical analyses using Monte Carlo simulations to develop fatigue design curves, using the "95/95 criterion" that the curves should provide 95% confidence, and 95% of the population will have a greater fatigue life than predicted by the design curves. This criterion was deemed acceptable because the fatigue design curves are based on crack initiation, rather than component failure and, therefore, there is additional margin between crack initiation and actual component failure. This conclusion is supported by a risk study of fatigue crack initiation and growth in actual LWR components, as documented in NUREG/CR-6674, "Fatigue Analysis of Components for 60-Year Plant Life," which the NRC published in June 2000. That risk study determined that the estimated core damage frequency is low for components that have a relatively high probability of fatigue crack initiation.

The results of the Monte Carlo simulations indicate that for both carbon and low-alloy steels and austenitic stainless steels, the current ASME Code procedure of adjusting the mean test data by a factor of 20 for life is conservative compared to the 95/95 criterion. The results also indicate that a minimum factor of 12 for cyclic life of both carbon and low-alloy steels and austenitic stainless steels will satisfy the 95/95 criterion. The resultant new air design curves, using margins of 12 for life and 2 for stress, are shown in Figures 9, 10, and 37 of NUREG/CR-6909 for carbon steel, low-alloy steel, and austenitic stainless steel, respectively. These new air design curves are used in this draft regulatory guide; thus, if an applicant chooses to use the procedure discussed in this guide to determine the fatigue life of stainless steels, these air design curves should be used. However, the existing ASME air design curves for carbon and low-alloy steels may also be used with the procedure in this guide to determine the fatigue life of those materials, since their use will yield conservative results.

Several methods for calculating F_{en} were reviewed and found acceptable. Only the types of stress cycles or load set pairs that exceed strain threshold criteria for carbon and low-alloy steels and austenitic stainless steels need to be considered for F_{en} calculations. The evaluation options depend on the complexity of the analyzed transient condition and the detail of the evaluation. For example, in an evaluation where the results of detailed transient analyses are available to determine the necessary parameters (strain rate, temperature, and others), the "modified rate approach" (presented and referenced in Section 4.2.14 of NUREG/CR-6909) is an acceptable methodology for determining the F_{en} values. This methodology involves a strain-based integral for evaluating conditions for which temperature and strain rate change, resulting in variation of F_{en} over time. This detailed approach calculates the F_{en} values based on the strain history for each load set in the fatigue analysis evaluation, considering the effects of strain rate and temperature variations for each incremental segment in the strain history. Such results may be used to reduce the conservatism in the calculated F_{en} values. For a simplified calculation yielding a more conservative result for a complex or poorly defined set of transients, the temperature is equal to the average temperature in the transient or segment. The calculated F_{en} values are then used to incorporate environmental effects into ASME fatigue usage factor evaluations.

C. REGULATORY POSITION

This section describes the methods that the staff considers acceptable for use in performing fatigue evaluations, considering the effects of LWR environments on carbon and low-alloy steels, as well as austenitic stainless steels. Specifically, these methods include calculating the fatigue usage in air using ASME Code analysis procedures, and then employing the environmental correction factor (F_{en}), as described in NUREG/CR-6909, "Effect of LWR Coolant Environments on the Fatigue Life of Reactor Materials." In particular, Appendix A to that report, "Incorporating Environmental Effects into Fatigue Evaluations," includes detailed descriptions and additional guidance concerning the overall methodology and all equations referred to in this section.

1. Carbon and Low-Alloy Steels

The following procedure should be used to calculate the environmental fatigue usage of carbon and low-alloy steel components in LWR environments.

1.1 Fatigue Usage in Air

Calculate the fatigue usage in air using ASME Code analysis procedures and the fatigue curves provided in NUREG/CR-6909, Section 4.1.9, Figures 9 and 10.

1.2 Environmental Correction Factor (F_{en})

Calculate the environmental correction factor, F_{en}, using Equation A.2 of NUREG/CR-6909 for carbon steels, or Equation A.3 of NUREG/CR-6909 for low-alloy steels. The respective parameters should be calculated using Equations A.4 through A.7 of NUREG/CR-6909. The strain threshold is shown in Equation A.8 of NUREG/CR-6909.

1.3 Environmental Fatigue Usage

Calculate the environmental fatigue usage using Equation A.14 of NUREG/CR-6909.

2. Austenitic Stainless Steels

The following procedure should be used to calculate the environmental fatigue usage of austenitic stainless steel components in LWR environments.

2.1 Fatigue Usage in Air

Calculate the fatigue usage in air using ASME Code analysis procedures and the new fatigue curve provided in NUREG/CR-6909, Section 5.1.8, Figure 37.

2.2 Environmental Correction Factor (F_{en})

For all types of austenitic stainless steels (e.g., Types 304, 310, 316, 347, and 348), calculate F_{en} using Equation A.9 of NUREG/CR-6909. The respective parameters are defined in Equations A.10 through A.12 of NUREG/CR-6909. The strain threshold is provided in Equation A.13 of NUREG/CR-6909.

2.3 Environmental Fatigue Usage

Calculate the environmental fatigue usage using Equation A.14 of NUREG/CR-6909.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this draft regulatory guide. This draft regulatory guide only applies to new plants and no backfitting is intended or approved in connection with its issuance.

The NRC has issued this draft guide to encourage public participation in its development. Except in those cases in which an applicant or licensee proposes or has previously established an acceptable alternative method for complying with specified portions of the NRC's regulations, the methods to be described in the final guide will reflect public comments and will be used in evaluating submittals in connection with applications for construction permits, standard plant design certifications, operating licenses, early site permits, and combined licenses.

REFERENCES

ASME Boiler and Pressure Vessel Code, Section III, "Rules for Construction of Nuclear Power Plant Components," American Society of Mechanical Engineers, New York, NY, 1992.[1]

Chopra, O.K., "Effect of LWR Coolant Environments on Fatigue Life of Reactor Materials," NUREG/CR-6909 (draft), ANL-06/08, U.S. Nuclear Regulatory Commission, Washington, DC, April 2006.[2]

Khaleel, M.A., et al., "Fatigue Analysis of Components for 60-Year Plant Life," NUREG/CR-6674, U.S. Nuclear Regulatory Commission, Washington, DC, June 2000.[2]

VanDerSluys, W. Alan, "PVRC Position on Environmental Effects on Fatigue Life in LWR Applications", *Welding Research Council Bulletin 487*, Welding Research Council, Inc., New York, NY.[3]

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1 Copies may be purchased from the American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990; phone (212) 591-8500; fax (212) 591-8501; www.asme.org.

2 Copies are available at current rates from the U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20402-9328 (telephone 202-512-1800); or from the National Technical Information Service (NTIS) by writing NTIS at 5285 Port Royal Road, Springfield, VA 22161; http://www.ntis.gov; telephone 703-487-4650. Copies are available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555 (telephone: 301-415-4737 or 800-397-4209; fax: 301-415-3548; email: PDR@nrc.gov). Draft NUREG-series reports for public comment are also available electronically through the NRC's public Web site at http://www.nrc.gov/reading-rm/doc-collections/nuregs/docs4comment.html. NUREG/CR-6674 is also available through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html, under Accession No. ML003724215, and NUREG/CR-6909 is available in ADAMS under Accession No. ML061650347.

3 *Welding Research Council Bulletin 487* is available for purchase from Welding Research Council, Inc., PO Box 201547, Shaker Heights, Ohio (telephone: 216-658-3847). Purchase information is available online at http://www.forengineers.org/cgi-bin/wrcbulletin/bulletin.pl?action=view;id=497.

REGULATORY ANALYSIS

1. Issue

The staff of the U.S. Nuclear Regulatory Commission (NRC) proposes to develop and issue a new regulatory guide, entitled "Guidelines for Evaluating Fatigue Analyses Incorporating the Life Reduction of Metal Components Due to the Effects of the Light-Water Reactor Environment for New Reactors." This new guide is a means to provide guidance to support license applications for new nuclear reactor construction by determining acceptable fatigue life assessments of reactor vessel pressure boundary components, with consideration for the effects of a light-water reactor (LWR) environment. The staff proposes to issue a draft guide for public review and comment, resolve any stakeholder comments, and then finalize and implement the guide.

On September 25, 1995, the NRC staff submitted for Commission approval a Fatigue Action Plan (SECY-95-245), which addressed issues associated with assessing fatigue performance of structural components in LWR environments. The related Generic Safety Issue (GSI) 166, "Adequacy of the Fatigue Life of Metal Components," evaluated concerns regarding the conservatism of the fatigue curves used in designing existing LWR components. Both SECY-95-245 and GSI-166 concluded that the NRC need not take any major actions regarding the environmental effects for current nuclear power plants, and the staff resolved the issue addressed in GSI-166 for the initial 40-year design life of operating components. Nonetheless, to address license renewal, the staff subsequently identified GSI-190, "Fatigue Evaluation of Metal Components for 60-Year Plant Life."

The NRC closed GSI-190 in December 1999, concluding that no generic regulatory action was required. The staff based this conclusion primarily on the negligible calculated increases in core damage frequency in extending a plant's operating life from 40 to 60 years. However, the calculations supporting the resolution of this issue, which included consideration of environmental effects and the nature of age-related degradation indicate the potential for an increase in the frequency of pipe leaks as plants continue to operate. Thus, the staff concluded that, consistent with existing requirements in 10 CFR 54.21, "Contents of Applications — Technical Information," licensees should address the effects of the coolant environment on component fatigue life as they formulate their aging management programs in support of license renewal.

The evaluations used in resolving GSI-166 and GSI-190 relied on conservatism in the existing component fatigue analyses. However, fatigue analyses for components of new reactors may not contain the same degree of conservatism. By letter to the Chairman of the ASME Board of Nuclear Codes and Standards, dated December 1, 1999, the NRC staff requested that ASME modify its Boiler and Pressure Vessel Code to include environmental effects in the fatigue design of components. In response, ASME initiated the PVRC Steering Committee on Cyclic Life and Environmental Effects, which recommended revising the Code fatigue design curves (*Welding Research Council Bulletin 487*, "PVRC Position on Environmental Effects on Fatigue Life in LWR Applications"); however, despite years of deliberation concerning the recommended methods and approaches to resolve concerns regarding environmental effects on fatigue life under LWR conditions, the ASME Subcommittee on Environmental Fatigue has not reached a decision. Consequently, to move ahead, the NRC staff needs to develop a regulatory position for use in reviewing applications for new plant construction.

In 10 CFR 50.55a, "Codes and Standards," the NRC endorses the ASME Boiler and Pressure Vessel Code for design of safety-related systems and components. Section III, Subsection NB, of the Code contains guidance for the design of Class 1 nuclear power plant components, as well as criteria for determining a component's suitability for cyclic service. Figures I-9.1 through I-9.6 of Appendix I to Section III specify Code fatigue design curves that are used in making this determination. These fatigue design curves, which were developed in the late 1960s and early 1970s, are based on strain-controlled tests performed on small polished specimens, at room temperature, in air environments. The test specimen "best-fit" data curves were adjusted for mean stress effects and then lowered by a factor of 2 for stress or 20 for cycles (whichever was more conservative) to establish the design curves. These factors of 2 and 20 do not constitute safety margins; these factors were simply applied to the experimental data, in order to estimate the fatigue life of actual reactor components. Moreover, Section III, Subsection NB-3121, of the ASME Code specifies that experimental data used to develop the fatigue design curves do *not* include tests of specimens exposed to simulated LWR coolant, which might accelerate fatigue failure. (At the time, it was not possible to account for the degradation attributable to exposure to aqueous coolants.)

After about 20 years of research effort addressing the environmental degradation of fatigue crack nucleation, it has become apparent that exposure to LWR environments has a detrimental effect on the fatigue life of metal components, which affects the major categories of structural materials (i.e., carbon steel, low-alloy steel, and austenitic stainless steel). On the basis of that revelation, the NRC completed a multi-year study to develop and evaluate the environmental fatigue test data. In conducting this study, Argonne National Laboratory (ANL) developed statistical correlations that can be used to evaluate the fatigue life of ASME Code components in LWR environments. The results of this study appear in NUREG/CR-6583, "Effects of LWR Coolant Environments on Fatigue Design Curves of Carbon and Low-Alloy Steels," dated February 1998, and NUREG/CR-5704, ""Effects of LWR Coolant Environments on Fatigue Design Curves of Austenitic Stainless Steels," dated April 1999. In general, the study results show that degradation is exacerbated by increasing temperature, decreasing loading rate, increasing sulfur content of the materials, and oxygen content of the coolant (for carbon and low-alloy steels), and decreasing oxygen content of the coolant (for austenitic stainless steels). Notably, the models developed by ANL are well-recognized in the international community, although other researchers in both the domestic and international communities (Japan) have developed other approaches and methodologies for assessing the environmental effect on fatigue analyses.

The NRC staff has not previously issued a regulatory guide on the matter of acceptable fatigue life assessments of ASME pressure boundary components, with consideration for the effects of an LWR environment. The staff anticipates that this regulatory guidance will be applicable to future applicants 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.

2. Alternative Approaches

The NRC staff considered the following alternative approaches:

(1) Do not provide guidance.

(2) Endorse the ASME Code Case Standard initiative addressing the environmental effect on fatigue life reduction of metal components.

(3) Issue a new regulatory guide.

2.1 Alternative 1: Do Not Provide Guidance

Under this "no action" alternative, the staff would not issue regulatory guidance regarding the assessment of ASME pressure boundary components, with consideration for the effects of an LWR environment. This alternative will result in unnecessary burden for NRC staff and licensees, in connection with preparing and responding to requests for additional information (RAIs), as well as re-analyses and supplementation of license amendment applications. This alternative does not support any of the NRC's safety performance goals.

2.2 Alternative 2: Endorse the ASME Code Case Standard Initiative

Under this alternative, the staff would not develop its own regulatory guidance, but would endorse an acceptable industry standard. The ASME Board of Nuclear Codes and Standards, Subcommittee on Environmental Fatigue, is still developing a Code Case and non-mandatory procedure to provide guidance regarding the application of an environmental correction factor for fatigue analyses. This task was assigned to the PVRC Steering Committee on Cyclic Life and Environmental Effects, which recommended revising the Code fatigue design curves (*Welding Research Council Bulletin 487*, "PVRC Position on Environmental Effects on Fatigue Life in LWR Applications"); however, despite years of deliberation, the ASME Subcommittee on Environmental Fatigue has not yet approved this proposal and has not reached a consensus regarding the approach or methodology that will be used for guidance.

The NRC staff, with support from ANL, has reviewed these proposed methodologies. Although some aspects (e.g., the F_{en} approach) are considered acceptable, the staff still has concerns regarding the bases and adequacy of other aspects (e.g., the Z factor).

The staff does not anticipate imminent development or consensus to finalize the industry-standard guidance; therefore, this alternative is no longer viable.

2.2 Alternative 3: Issue a New Regulatory Guide

Under this alternative, the staff would develop a new regulatory guide as a means to provide guidance to support license applications for new nuclear reactor construction by determining acceptable fatigue life assessments of reactor vessel pressure boundary components, with consideration for the effects of an LWR environment. As such, this alternative supports three of the NRC's five nuclear reactor safety performance goals.[4] (The two remaining goals, namely Security and Management, are not applicable to this guide.) Specifically, issuing a new regulatory guide would (1) ensure protection of public health and safety and the environment by ensuring that safety analyses use appropriate analysis assumptions and methods, (2) ensure openness by involving the public in the development of this regulatory guidance through the public comment period, and (3) improve efficiency and effectiveness by providing licensees with the staff's regulatory position, thereby minimizing RAIs and resubmittals, and ensuring the adequacy of safety analyses. Also, this alternative will ensure availability of guidance for industry and NRC staff reviews upon the anticipated receipt of new reactor construction license applications. Thus, the staff has determined that this alternative is the most advantageous way to address the need for regulatory guidance to enable both the industry and NRC staff to perform adequate fatigue analyses that appropriately incorporate the reduced fatigue life of metal components attributable to an LWR environment.

In developing this regulatory guidance, the staff will allow a public comment period to resolve ongoing issues between the staff and industry/public stakeholders on the methodology and approach endorsed by the guidance.

3. Values and Impacts

The proposed action is to issue a new regulatory guide. Therefore, compliance with the regulatory position set forth in the guide will be voluntary for new reactor construction license applicants. As with all regulatory guides, an applicant may propose alternative approaches to demonstrate compliance with the NRC's regulations.

This guidance will complement and be consistent with current established practices applied throughout the commercial nuclear power industry for license renewal evaluations. Therefore, costs associated with implementing this guidance are expected to be minimal. This guidance will apply to new nuclear power plants.

4. Conclusion

Experience in reviewing licensee renewal applications has demonstrated the need for guidance in performing adequate fatigue analyses that incorporate the reduced fatigue life of metal components attributable to an LWR environment. Recent expressions of interest related to future licensing of new reactors also indicate a need for new regulatory guidance. Based on this regulatory analysis, the staff recommends that the NRC (1) prepare a new regulatory guide to support license applications for new nuclear reactor construction by determining acceptable fatigue life assessments of reactor vessel pressure boundary components, with consideration for the effects of an LWR environment, (2) issue the draft regulatory guide for public comment, and (3) finalize the regulatory guide upon resolution of public comments.

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[4] This alternative is not relevant to the NRC's two remaining performance goals of Security and Management.