RESPONSE TO PUBLIC COMMENTS

COMMENT LETTERS RECEIVED ON DRAFT REGULATORY GUIDE 1.65, Revision 1 (DG-1211)			
Commenter Number	**Name**	**Affiliation**	**ADAMS Accession Number**
1	T.A. Moser	Strategic Teaming and Resource Sharing (STARS)	ML091700026
2	Jim Gresham	Westinghouse Electric Corporation (Westinghouse)	ML091700027

RESPONSE TO PUBLIC COMMENTS ON REGULATORY GUIDE 1.65, PROPOSED REVISION 1

The U.S. Nuclear Regulatory Commission (NRC) published Draft Regulatory Guide DG-1211, “Materials and Inspections for Reactor Vessel Closure Studs” (proposed Revision 1 of Regulatory Guide 1.65), in the *Federal Register* (74 FR 17547) on April 15, 2009. The NRC proposed to update Regulatory Guide 1.65 relative to the goal of providing a regulatory structure to enhance the effectiveness and efficiency of new plant licensing. The agency requested comments on the proposed revisions to the regulatory guide by June 12, 2009. Two comment letters were received.

COMMENTER 1: T.A. Moser, STARS

Comment 1:

Section C, Sub-section 2, Paragraph 2, last sentence—please clarify the wording of the last sentence in paragraph 2 so that it is clear that fasteners should not be plated with zinc, tin, or cadmium.

Response to Comment 1:

The staff agrees with the suggestion to clarify the wording and has revised the paragraph to indicate that the guidance relative to zinc, tin, or cadmium is related to bolt plating.

Comment 2: (same comment received from Jim Gresham, Westinghouse (Comment 1))

The fourth paragraph in section B, Discussion, incorrectly states the position of NUREG-1801 relative to the limitation of 170 ksi [kilopounds per square inch] measured ultimate tensile strength.

Response to Comment 2:

The staff agrees that the position was awkwardly worded and accepts Mr. Moser’s suggested wording, as follows:

> Therefore, design conservatism should be exercised in determining the sizing of the studs so that the strength level of the material selected will not result in a measured yield strength exceeding 1,034 MPa (150 ksi).

Comment 3:

The discussion regarding inservice examinations of Section XI, as presented in the first three paragraphs on page 4 of DG-1211, incorrectly states the current Section XI requirements. Also, the discussion in section B is not consistent with the proposed changes in section C.

Response to Comment 3:

The staff agrees that the discussion in Section B did not distinguish between the required volumetric examination of reactor vessel closure studs and the required visual examination of closure head nuts, as described in Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code. The first paragraph of Section B indicates that closure stud bolting is defined to include all studs (stud bolts), nuts, and washers used to fasten the pressure vessel head to the pressure vessel. This definition was carried forward from the original regulatory guide. However, the discussion would have been clearer if it had noted that the required Section XI examination methods differed based on the component. The staff has clarified this section in the final regulatory guide. In addition, the staff has addressed the inconsistencies between Section B and the proposed changes in Section C discussed in the comment letter. Finally, as suggested, the NRC added a discussion of Supplement 8, "Qualification Requirements for Bolts and Studs," to Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," and Section XI Code Case N-307-3, "Ultrasonic Examination of Class 1, Bolting, Table IWB-2500-1, Examination Category B-G-1, Section XI, Division 1"; and Code Case N-652-1, "Alternative Requirements to Categories B-G-1, B-G-2, and C-D Bolting Examination Methods and Selection Criteria, Section XI, Division 1." The NRC approved the use of Code Cases N-307-3 and N-652-1 in Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," issued October 2007.

Comment 4:

As a minor comment, at the end of the third paragraph on page 4 of DG-1211, it states, "Revision 3 of the code case was approved March 28, 2001 (Supplement 1 of the 2007 Edition...." The "2007 Edition" should be replaced with "2001 Edition."

Response to Comment 4:

The staff agrees and has corrected this typographical error in the final guide.

Comment 5:

The second bullet in C.1 on Bolting Materials should be deleted. This simply states what Section III already requires. Therefore, it does not supplement the requirements of Section III and does not need to be included.

Response to Comment 5:

The staff agrees that the second bullet merely restates certain requirements in Section III, "Rules for Construction of Nuclear Power Plant Components," of the ASME BPV Code and has deleted this bullet in the final regulatory guide. Paragraph NB-2321.2 contains the requirement to use ASME SA-370 for a Charpy V notch test, whereas a separate paragraph contains the requirement to conduct Charpy V notch tests. Although the second bullet might prove useful, the staff agrees that the inclusion of the bullet is not necessary.

Comment 6:

The first bullet in C.2, "Protection Against Corrosion," should be deleted. This simply states what Section III NB-2122 already requires. Therefore, it does not need to be included.

Response to Comment 6:

The staff agrees that it is not necessary to restate the requirements in paragraph NB-2122 of ASME BPV Code Section III and has therefore deleted the first bullet in the final regulatory guide.

COMMENTER 2: Jim Gresham, Westinghouse

Comment 2:

Westinghouse understands that Rev. 1 of Regulatory Guide 1.65 will not apply to the Design Certification for AP1000. The Design Certification was granted based on conformance to the guidelines in the Regulatory Position of Rev. 0. Therefore, this proposed requirement is not currently reflected in the AP1000 reactor vessel design specification. The maximum ultimate tensile strength is instead specified to be 170 ksi, based on RG 1.65, Rev. 0.

Response to Comment 2:

The commenter is correct that the NRC granted the design certification based on Regulatory Guide 1.65, "Materials and Inspections for Reactor Vessel Closure Studs," Revision 0, issued October 1973. However, based on research that has been conducted, it would be prudent to adopt the criterion in Regulatory Guide 1.65, Revision 1 (i.e., stud material with a yield strength greater than 1,034 MPa (150 ksi) should be considered vulnerable to stress-corrosion cracking). The agency documented this position in NUREG-1339, "Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants," issued June 1990. The basis for the limitation was established, in part, on information provided by the Electric Power Research Institute (EPRI). The Atomic Industrial Forum, in cooperation with the Materials Properties Council, organized a task group in June 1982 to resolve Generic Safety Issue 29. EPRI, supported by the Atomic Industrial Forum/Materials Properties Council task group, prepared and issued a two-volume report, EPRI NP-5769, "Degradation and Failure of Bolting in Nuclear Power Plants," Volumes 1 and 2, issued April 1988. EPRI NP-5769 proposed a screening limit of $S_y \leqslant 150$ ksi (1,034 MPa) (i.e., a yield strength greater than 150 ksi should be considered vulnerable to stress-corrosion cracking).

The NRC staff again reviewed this position and subsequently adopted it for license renewal as provided in NUREG/CR-1801, "Generic Aging Lessons Learned (GALL) Report," Chapter IX, "Selected Definitions and Use of Terms For Structures, Components, Materials, Environments, Aging Effects, and Aging Mechanisms," issued September 2005 (page IX-9).

Comment 3:

Westinghouse recommends that the regulatory guide maintains its existing limitation on material tensile strength. Data for SA-540 bars used for reactor pressure vessel (RPV) studs, nuts, and washers was compiled from six utilities for twelve reactor vessels (discussion and data evaluation follows). Review of this data confirms that it would be difficult for material suppliers to comply with the proposed yield strength restriction. While the tensile data rarely exceeded the 170 ksi guideline, yield strength values greater than 150 ksi were observed in approximately 10% of the test cases. A complicating factor from these test results is that the material specification requires tensile specimens taken from both ends of each bar. In many cases where the yield strength result from one end of a bar exceeded 150 ksi, the test result from the other end was less than 150 ksi. Such results could lead to increased rejection rates and higher costs with no significant benefit to structural integrity or safety. Combining this observation with the fact that RPV studs are tensioned, not torqued, so as to minimize potential overloads, and that use of deleterious lubricants, particularly those containing molybdenum disulfide compounds, has been eliminated, the proposed regulatory guide position to limit maximum yield strength to 150 ksi has limited or no benefit. Based on the supplier input Westinghouse has received and reviewed, Westinghouse suggests that the limitation be on the ultimate strength value (170 ksi).

Response to Comment 3:

The NRC rejects the argument that the regulatory position on maximum yield strength should be relaxed. The basis for the position has been well documented. In addition, it is asserted that it will be difficult for material suppliers to meet the 150-ksi yield strength criterion. The data used to support that position appear to be from operating plants that used the ultimate tensile strength criterion of 170 ksi from Regulatory Guide 1.65, Revision 0. Finally, the NRC disagrees with the argument that minimizing potential overloads and eliminating the use of deleterious lubricants, in combination with the material supplier assertion, means that limiting yield strength to 150 ksi provided limited or no benefit. NUREG-1339 clearly states the safety case that "[f]ailure of these bolts or studs could result in the loss of reactor coolant and jeopardize safe operation of the plant." An increasing incidence of reported failures in high-strength bolting in Class 1 components led to the industry effort to determine the causes and to resolve the issue. NUREG-1339 notes that the reported incidents have many common characteristics, including high sustained tensile stresses, aqueous environments caused by high humidity, primary and borated water leakage, and materials that were overly hard. The most common failure mechanism was stress-corrosion cracking. Although it is true that licensees have taken steps to reduce the incidences of stress-corrosion cracking, such as tensioning studs and not torquing them and eliminating molybdenum disulfide compounds, the potential combination of high stress and moisture (aqueous environment or leakage) still exists, and this combination is known to result in stress-corrosion cracking when the yield strength exceeds 150 ksi. Although it is not possible to totally eliminate moisture, it is possible to manage yield strength, which has been shown to control the vulnerability to stress-corrosion cracking. Therefore, the final regulatory guide retains the screening limit of $S_y \leq 150$ ksi (1,034 MPa).