July 9, 2001

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SUBJECT: NRC Comments Regarding Draft ASME Code Case

Dear Ken:

Recently, you proposed a draft code case entitled, “Direct Use of Master Fracture Toughness Curve for Pressure Retaining Materials for Vessels of Section XI, Division 1, Class 1,” and its associated technical basis document within Section XI of the American Society for Mechanical Engineers (ASME) Code. My staff and I have developed the enclosed comments regarding the draft code case and technical basis document. I look forward to further discussions on this topic as part of ASME Code activities.

Sincerely,

/ra/

Keith R. Wichman
U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Mailstop OWFN 9H6
Washington D.C., 20555

cc: Edward Friedman
Russell C. Cippola

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COMMENTS REGARDING DRAFT TECHNICAL BASIS AND ASME CODE CASE

Comment 1 - The text of the draft code case, as written, appears to blur the line between the requirements of ASME Section XI, Appendix G and ASME Section III, Subsubarticle NB-2330. It provides direction as to how to test material samples (similar to Section III, NB-2330) and direction on how to use the results (similar to Section XI, Appendix G). The draft code case does not specify whether it is applicable to unirradiated samples, irradiated samples, or both. From a practical sense, one would have to conclude that if test results are to be directly applied to the evaluation of an operating RPV, the draft code case must apply only to K_{JC} testing of irradiated samples (with no discussion provided in the draft code case for how to handle data from the testing of unirradiated samples which will need to be adjusted for the irradiation condition of the RPV).

However, if this is the case, then the draft code case would lead the user to the false impression that if one follows this method, one ends up with a K vs.T relationship that is directly applicable to the RPV without needing to do anything else. This omits the issues of margins and uncertainties, systematic chemical compositional differences between the samples being tested and the RPV material being used to evaluate, differences in fluence between the samples and the RPV, etc. These are essential topics which the ASME Code has traditionally passed on addressing with the statement in Section XI, Appendix G, G-2110, "the effect of radiation on the K_{Ia} curve shall be determined for the material. This information shall be documented by the Owner." However, because this draft code case attempts to specify how alternatives to the K_{Ia} and K_{Ic} curves may be developed for Section XI, Division 1, Class 1 pressure retaining materials, these issues cannot be overlooked.

Comment 2 - Item (5) from the draft code case postulates that an alternative K_{Ia} curve my be developed by adding 53 °F to the T_0 value based on static K_{JC} data from the same material. This is not believed to be correct based on results that have been generated in conjunction with the PTS reevaluation project. This work has shown that for high T_0 materials the separation between the static and dynamic/crack arrest Master Curves ought to be about which is currently reflected in the separation between the K_{Ia} and K_{Ic} curves today (approximately 60 °F), and the separation should get larger for lower T_0 materials. This distinction has not been important in the current framework since the RT_{NDT} indexing methodology positions a material conservatively with respect to the results that would be obtained from fracture-based testing, hence "covering up" this apparent non-conservatism in the code for "tough" materials. When moving to a master curve-based methodology, the issue of variable separation between the static and dynamic/crack arrest toughness curves ought to be addressed as well.

Comment 3 - The principle, underlying flaw in the draft code case is found in Section 2 of the technical basis document. Why is direct use of a method based on 1T normalized K_{JC} data applicable to the evaluation of a 4 to 10 inch thick RPV? Note that the use of Code Cases N-629 and N-631 has been found to be acceptable because the indexing method used in those code cases is fundamentally tied back to the positioning of a fracture toughness curve (in this case the existing K_{IC} curve) relative to ASTM E 399 valid K_{Ic} data. The method proposed in the draft code case simply elects to use a 5 percent lower bound master curve based on 1T normalized data to be acquired by the users testing procedure. Further, although the technical basis document suggests that the choice of a 3 or 5 percent lower bound "does not change much of the overall fitting characteristics except at a very low temperature range," this "very low temperature range" could be of importance particularly as it concerns pressure-temperature limits and RPV susceptibility to brittle fracture for highly irradiated vessels.

Comment 4 - The editorial aside in Section 3 of the technical basis document, "[i]t is noted that Code Case N-629 allows an equivalency between a RT_{NDT} shift and a corresponding T_0 shift in given material," overstates the information contained in Code Case N-629. Code Case N-629 appears to be silent on this point, and as such, the determination of what is an appropriate way in which to account for the shift in material properties due to irradiation when using the a master curve-based indexing method on unirradiated samples is a question of "implementation" and left up to the Owner and the regulatory authority.