ANS Issues a Response to an Inquiry on ANSI/ANS-5.1-2005, "Decay Heat Power in Light Water Reactors."

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Inquiry:
I'm currently working on a project that concentrates on setting up a code that can calculate the decay power of a reactor using ANSI/ANS-5.1-1979, 1994, and 2005. I have been using the examples in the appendices to validate the code. I have come across a problem in the 2005 version of the standard in regards to the total uncertainty, $\Delta P'_d/P_d$. It appears that the 1979 and 1994 versions calculate the uncertainty correctly, but not the 2005 version. I only encounter the problem with the $\Delta P'_d/P_d$ values. I am able to reproduce all other values of Example 2 (only Example 1 worked with so far).

Unless otherwise stated, the equations, appendices, etc., refer to the 2005 standard. The problem I found is as follows: The standard states that the uncertainty could be calculated using Equations (5a), (5b), (9), and (10). The problem appears to be with the application of Equation (5b) in Appendix B. It appears that in Example 2 of Appendix B, Equation (5b) was not used correctly. Does that indicate that there was an error in the calculation of the results in the example, or is there an error in Equation (5b)? However, this problem is not present in Equation (5b) of the 1979 or 1994 versions of this standard. Please let me know what has caused the discrepancy, or if I am miscalculating or misinterpreting the text.

Response:
Thank you for documenting a very thorough analysis of discrepancies noted in the example problems of Appendix B. The working group has confirmed that the total one sigma uncertainty values listed in Tables B.1 and B.2 are calculated in a way that is inconsistent with Equation (5b) of the standard. The method for combining the uncertainties from different nuclides [Equation (5b)] in the ANSI/ANS-5.1-2005 standard is correct. The total uncertainty values listed for Examples 1 and 2 in Appendix B are not correct. As appendices are not considered a part of the standard and are provided for information only, the errors in Tables B.1 and B.2 of ANSI/ANS-5.1-2005 do not affect the accuracy of the standard.

During the development of the 2005 standard, a revised method for combining the uncertainties from different fissioning nuclides was proposed. Instead of adding the uncertainty contribution from each nuclide, as done in the 1994 version, it was proposed to use the square root of the sum-of-the-squares, or RSS method, of combining uncertainty components. The example problems were prepared using this method. However, since the RSS method requires each component of uncertainty to be independent, and this cannot be established for the fission decay heat power curves of different nuclides, the uncertainty method ultimately reverted to what was used in the 1994 standard. Unfortunately, the change was made just prior to publication, and the examples were not recalculated. Corrected Tables B.1 and B.2 in Appendix B will be issued formally in the form of an erratum.