Response to Public Comments on Draft Regulatory Guide DG-3050, "Spent Fuel Heat Generation in an Independent Spent Fuel Storage Installation" Proposed Revision 2 of Regulatory Guide 3.54

On December 23, 2016, the U.S. Nuclear Regulatory Commission (NRC) published a notice in the *Federal Register* (81 FR 94431) announcing that Draft Regulatory Guide DG-3050 (proposed Revision 2 of Regulatory Guide 3.54) was available for public comment. The public comment period closed on February 21, 2017 and the NRC staff received comments from the individuals and organizations listed below. The following Table documents the public comments and NRC staff's responses. The received comment documents are available in the Agencywide Document Access and Management System (ADAMS) under the indicated accession numbers below.

The NRC staff received comments from the following:

Mr. David Cullison, NRC Clearance Officer, Customer Service Division, Office of the Chief Information Officer, NRC, e-mail: DavidCullison@nrc.gov U.S. Nuclear Regulatory Commission 11545 Rockville Pike, Rockville, MD 20852, Dated: January 13, 2017 ADAMS Accession No.: ML18052A048	Mr. MyeongSoo Lee email: fiatluxkr@khnp.co.kr, South Korea Dated: December 23, 2016 ADAMS Accession No.: ML17048A161	Mr. John Garza Address: VC Summer Nuclear Station Unit I Jenkinsville, SC, 29065 Email: jgarza@scana.com Dated: December 12, 2017 ADAMS Accession No.: ML18052A049
Mr. Justin T. Wheat Nuclear Licensing Manager Southern Nuclear Operating Company (SNC) Email: jtwheat@southernco.com Dated: February 21, 2017 ADAMS Accession No.: ML18052A050	Mr. Jesse J. Klingensmith Westinghouse Electric Company **Address:** Cranberry Township, PA **Email:** klingejj@westinghouse.com Dated: June 27, 2017 ADAMS Accession No.: ML18219B840	

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1	Mr. David Cullison, NRC	Revised link to access Nuclear Fuel Data. We had noticed that the subject document, U.S. Department of Energy (DOE) Form GC-859, "NUCLEAR FUEL DATA SURVEY FORM GC-859" at https://www.eia.gov/survey/form/gc_859/form.pdf." had expired prior to publication of the guide.	The NRC staff agreed with the comment and the paragraph of interest was changed as follows: Figure 2 illustrates the range of application of the guide and compares it with the existing and projected commercial spent fuel inventory of the United States, as published in NUREG/CR-7227 (ORNL/TM-2015/619), "US Commercial Spent Nuclear Fuel Assembly Characteristics: 1968–2013," issued September 2016.

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2	Mr. MyeongSoo Lee South Korea	Revise the calculation method on Appendix A of the DG-3050. Also, it is recommended that 1) all of the values in Appendix A sample calculation should be displayed in scientific format for user support, and 2) the total power fraction of each isotopes for each cycle should be one (1). So it is recommended that the guide describe the notice as following. "If the total power fraction of each cycle is less than the one (1), add some value for the U235 isotope to make the total power fraction is one (1).	The NRC staff agreed with the comment to display the values in the RG Tables in a scientific format. The Tables were changed to reflect this change. Also, the NRC staff agrees that the total power for each fraction should be 1. The RG in section C.1.1 was changed to state: "The user should ensure that the fuel burnup obtained from the time-integrated specific power of the histogram in Figure 1 equals the actual burnup of the fuel. The user should also ensure that the sum of relative power fractions S_i/S for each irradiation interval should be 1 (because of interpolation error). In this case, the user should increase the power fraction of U-235 to preserve the correct total operating power for the interval."
3	Mr. John Garza VC Summer Nuclear Station Unit I Jenkinsville, SC, 29065	Clarify whether Rev. 1 to RG 3.54 is being superseded by Rev. 2. Rev. 1 methodology should remain an acceptable method, but the draft Rev. 2 implies that Rev. 1 is being superseded.	The NRC staff agreed with the comment. Revision 1 to RG 3.54 is superseded by Revision 2. Current licensees may continue to use guidance the NRC found acceptable for complying with the identified regulations (e.g., RG 3.54 Revision 1) as long as their current licensing basis remains unchanged. For new applications, Revision 2 is an acceptable methodology, but use of Revision 1 could also be used if justified.
4	Mr. John Garza VC Summer Nuclear Station Unit I Jenkinsville, SC, 29065	Rev. 2 methodology seems to be largely based on ANS-5.1-2005 and/or ANS-5.1-2014. If that is correct, then ANS will have to be compensated for publishing their standard in a publicly-available document. Instead, Rev. 2 could just endorse the ANS standard as an acceptable option (while not re-publishing the	The NRC staff partially agreed with the comment. The NRC licensees do not have to separately review the ANSI/ANS 5.1-2014 standard since the staff obtained permission from ANS to use 9 coefficients from the standard as reflected in the RG. Therefore, instead of using the 23 coefficients listed in DG-3050, the final RG 3.54 uses only 9 coefficients (see Section C.1.1,

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		details of the ANS standard), while retaining the Rev. 1 methodology as another acceptable option.	Table 1). This reduction of the number of coefficients from 23 to 9 as listed in Table 1 does not alter the calculations for fission products. Section C.1.1 reflects the change.
5	Mr. Justin T. Wheat Southern Nuclear Operating Company (SNC)	In Appendix A, Section A.1.4, Page A-3: $\hat{\beta}_1$ is incorrectly reported as 1.848 x 10^{-2} W/kgU in Table A.5	The NRC staff agreed with the comment. The typo was corrected in Table A-5 in Appendix A to RG 3.54 to read: $\hat{\beta}_1$ as 1.848 x 10^{-1} W/kgU.
6	Mr. Justin T. Wheat Southern Nuclear Operating Company (SNC)	Section C.1.2.2, Page 12: The third and final condition for values of H(t) to be conservative is: "The power density, in units of kilowatts per kilogram of uranium, is less than 5 times the enrichment in wt% U-235." This does not *cover* the relevant parameter ranges given in Table 7 for enrichment and average power density [2 ≤ Es < 5 and 12 ≤ Savg ≤ 50]. Assembly C-64, the subject of Appendix A's sample calculation, does not meet the aforementioned condition either.	The NRC staff agreed with the comment. Section C.1.2.2 has been changed to read: "The power density, in units of kilowatts per kilogram of uranium, is greater than 5 times the enrichment in wt% U-235." This change now covers the relevant parameter ranges given in Table 7 for enrichment and average power density [2 ≤ Es < 5 and 12 ≤ Savg ≤ 50].
7	Mr. Justin T. Wheat Southern Nuclear Operating Company (SNC)	Section. C.1.1, Page 6: The 23-group coefficients a_{ij} and λ_{ij} of Equation 3 are referred to in the text as "aij" and "Aij" rather than with the i and j indices as subscripts	The NRC staff agreed with the comment and corrected the typo. The 23-group coefficients changed in Section C.1.1 as suggested by the commenter.
8	Mr. Justin T. Wheat Southern Nuclear Operating Company (SNC)	Section C.1.2.1, Page 11-12: ΦK is defined as being dependent on the average specific power (Savg) in Equation 11. Based on the usage of ΦK in Equation 9, it would make more sense to define it based on SK Change Equation 11 to be the following: ΦK = (Sk/α) x 2.58 x 1010	The NRC staff agreed with the comment. The subscript "k" was applied to the specific power S in the equation. The other uses of the variable should be verified to be consistent. The equation #11 was changed as a result of this comment.

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9	Mr. Justin T. Wheat Southern Nuclear Operating Company (SNC)	Section C.1.2.1, Page 12: Savg is defined in 'Equation 7 as the average specific power over the entire operating history of the fuel, but later in Equation 11 as the specific power density. This repeated elsewhere in the document. Be consistent in the definition of Savg, whether it be using both specific power and specific power density as the definitions or choosing only one to use.	The NRC staff agreed with the comment. Use of a similar variable for different parameters may cause confusion in the implementation. The absolute power (MW) will be modified to use variable P and specific power (MW/MTU) will use S. The equation #12 (DG-3050 Equation 11) was changed as a result of this comment.
10	Mr. Justin T. Wheat Southern Nuclear Operating Company (SNC)	Section C.1.3, Page 14: The actinide coefficient β_n is written as "βn": Correct it to βn	The NRC staff agreed with the comment. The typo in Section C.1.3 was corrected.
11	Mr. Justin T. Wheat Southern Nuclear Operating Company (SNC)	Section C.1.1: Explicitly defining as $S_{ik}=S_k * S_i/S$ would make this section more clear.	The NRC staff agreed with the comment. Section C.1.1 was corrected.
12	Mr. Justin T. Wheat Southern Nuclear Operating Company (SNC)	Section C.1.4, Page 16: Equation 6, is written with an extra parenthesis: $Ps(t, T) = A(t)P_F((t, T)$ Remove the extra parenthesis from the equation	The NRC staff agreed with the comment. The typo in Section C.1.4 was corrected. This is listed as equation 17 in the final RG 3.54.
13	Mr. Justin T. Wheat Southern Nuclear Operating Company (SNC)	In Section C.1.2.1: The statement "When applied to BWR fuel, they yield conservative results" suggests that the overall conservatism for BWR (vs PWR) is increased due to the use of the PWR fuel spectrum. How does this compare.to the Correction Factors computed with Table 4? Perhaps F_s could be redefined for PWR ·and BWR separately to yield more accurate results for BWR.	The NRC staff disagreed with the comment. Currently the DG does not distinguish between PWR and BWR designs for the factor Fs. Indeed, it results in some conservatism for BWR designs. The amount of conservatism is nominally 1-5%. Expanding the factors to account explicitly for BWRs could be addressed, however the factor is very dependent on the void fraction and under high void fractions this factor approaches the value for PWR. No change was made to the RG as a result of this comment.

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14	Mr. Justin T. Wheat Southern Nuclear Operating Company (SNC)	In Appendix A: Adding some more input parameters with the corresponding output -decay heats would be very beneficial in qualifying in-house implementations. Suggest an example I/O table for both PWR and BWR.	The NRC staff disagreed with the comment. Additional examples could potentially be confusing. No change was made to the RG as a result of this comment.
15	Mr. Justin T. Wheat Southern Nuclear Operating Company (SNC)	In Section C.1.1, Page 8: "The user should also ensure that the sum of relative power fractions S/S for each irradiation interval is not less than unity (because of interpolation error)" In the case of interpolation error, how should interpolation be handled? Are there severely non-linear regions of Table 3 that should be interpolated differently?	The NRC staff agreed with the comment. This comment was addressed in an earlier comment (No. 2 of this Table on responses to public comments) from KHNP, Korea. As noted in the NUREG/CR, the fission rates should be normalized to unity by assuming U-235 fissions.
16	Mr. Justin T. Wheat Southern Nuclear Operating Company (SNC	In Section C.2, Page 18: The applicability of SS clad fuel is mentioned, what about the applicability of SS dummy rods? An assembly average Cobalt concentration could be specified so the user can determine if a non-standard assembly is applicable.	The NRC staff agreed with the comment, but no change to the document is necessary. The applicability of the standard did not consider the use of stainless steel rods and contribution of decay heat from their cobalt content. Applicants can, however, address cobalt content as part of their application. As stated in Section C.2, “An assembly parameter that may restrict application of the guide is the cobalt 59 (Co-59) content of the clad and structural materials.” In cases where this is a concern, the condition can be addressed relatively easily by the applicant. Defining the limiting cobalt content for an assembly as part of the application, including the extra calculations that would be needed to calculate additional heat to confirm the value. No change was made to the RG as a result of this comment.
17	Jesse J. Klingensmith	In Section A.1.4 states that “[a] small correction factor of 0.989…” Using an input average power of 24.96	The NRC staff agreed with the comment.

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	Westinghouse Electric Company	kW/kgU, we are calculating a correction factor of 0.991 using the second term in Equation 15: $1.82[S_{avg}]^{-0.06} \rightarrow 1.82(24958)^{-0.06} = 0.9914$	A change was made in Section A.1.4 of the RG to change the value of 0.0989 to 0.9914.