FUELSOLUTIONS

FuelSolutions™ Transportation System License Amendment Request LAR 03-01

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Docket No. 71-9276

Prepared by:

BNFL Fuel Solutions Corporation
Campbell, California

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Summary of SAR Changes

SAR	Section	Page	Description
WSNF-120	1.2.3.1	1.2-20	The thermal interface parameters for the TS125 transportation cask are revised.
	Table 1.2-3	1.2-27	The LHGR limit is deleted. A minor typographical error is also corrected.
	Table 1.2-3	1.2-31	Note 2 is added to clarify the thermal interface requirements.
	3.	3-1	The 3rd paragraph is reworded to clarify the definition of the cask and canister thermal ratings, and how they are determined.
	3.1	3.1-1	In the 3rd paragraph, the term "heat flux" is changed to "heat generation."
	3.1.3	3.1-5	The Section 3.1.3 title and text are revised to replace the term "heat flux" with "heat generation," and to replace the term "bounding" with "design basis" when referring to the axial heat generation profile.
	3.1.3	3.1-5	In the 2nd paragraph, the text is revised to clarify that factors other than burnup can affect the total heat load of an SNF assembly.
	3.1.3	3.1-6	In the 2nd paragraph, the term "peaking factor" is replaced by "axial heat profile."
	3.1.3	3.1-6	The last paragraph is largely reworded, to clarify the nature of the Q_{max} and LHGR parameters, and why both limits are necessary.
	3.1.3.1	3.1-6	The Section title and text is revised to replace the term "bounding" with "design basis" when referring to the axial heat generation profiles.
	3.1.3.1	3.1-6	The 1st paragraph is revised to replace the terms "peaking factor" and/or "peaking factor curves."
	3.1.3.1	3.1-6	Paragraph 2, which clarifies the definitions of the "peaking factor" and the normalized axial heat generation profile, is added.
	3.1.3.1	3.1-7	Technical changes include removing the concept of penalty factors on low burnup fuel, clarifying how the Q_{max} and $LHGR_{max}$ profiles are determined and how they are applied, and removing the $LHGR_{max}$ profile case as a basis for the LHGR limit. The new text clarifies that the $LHGR_{max}$ profile case is only used for bounding thermal stress evaluations.

SAR	Section	Page	Description
WSNF-120	3.1.3.2	3.1-7 3.1-8	Section is revised to clarify the basis and the application of the axial heat generation profiles. The "peaking factor" term is replaced with "normalized heat generation" where appropriate. The "max thermal" and "max thermal gradient" profile titles are replaced with "Q_{max}" and "$LHGR_{max}$". The text has been revised to clarify the thermal limits. Text discussing the conservative nature of the applied transport cask axial heat generation profile (with respect to varying axial locations of assembly fuel zones) is added.
	3.1.3.3	3.1-8 3.1-9	Section is added to discuss the total heat (Q_{max}) limit and how it is applied to canisters and discuss how canister heat generation profiles that exceed the maximum LHGR of the TS125 transportation cask design basis Q_{max} heat generation profile must be qualified for transportation. This section also discusses how the Q_{max} limit is calculated using the design "Q_{max}" heat generation profile, and how the "$LHGR_{max}$" profile is only used to determine bounding thermal gradients.
	3.1.4	3.1-9	The section title and text are revised to refer only to cask component temperatures, and not to cask thermal ratings. The 1st paragraph is deleted. Thermal ratings and bounding heat generation profiles are no longer discussed in the section text; only thermal calculations and resulting temperatures are discussed.
	Table 3.1-3	3.1-12	The table caption is revised, and the bottom row of the table is deleted. The table data no longer represents the thermal ratings (or limits) that are placed upon loaded assemblies. Instead, the table data is a description of the two axial heat generation profiles modeled in the thermal licensing evaluations.
	Figure 3.1-2 Figure 3.1-3	3.1-14	Figures deleted and subsequent figures renumbered accordingly.
	3.4	3.4-1	In the 2nd paragraph, the term "heat flux" is replaced by "heat generation."
	3.4.1.1	3.4-7	The term "heat flux" is replaced by "heat generation."
	3.4.2	3.4-9	The 2nd paragraph is revised for clarity, and to state that the $LHGR_{max}$ profile case is only used for thermal gradient and stress analyses.

SAR	Section	Page	Description
WSNF-120	3.4.2	3.4-10	Minor editorial corrections. "$LHGR_{max}$ heat loads" is changed to "$LHGR_{max}$ profile heat loads." "Q_{max}" is changed to "the Q_{max} profile." "$LHGR_{max}$" is changed to "the $LHGR_{max}$ profile."
	3.4.2	3.4-10	The term "thermal ratings" in the first sentence of the 4th paragraph is replaced by "the design basis Q_{max} and $LHGR_{max}$ heat generation profiles."
	7.1.4.8	7.1-18	The edition year of the BPVC Code is changed from 1995 to 1998, in the page's footnote.
	7.1.4.8	7.1-19	The edition year of the BPVC Code is changed from 1995 to 1998, in the page's footnote.
WSNF-121	1.2.1.2	1.2-7	The maximum linear heat generation rate (LHGR) is revised from 211 watts/inch to 160.6 watts/inch.
	1.2.1.2	1.2-7	In the 3rd paragraph, a reference to Section 1.2.1.6 is changed to 1.2.3.4 (due to revisions in the WSNF-120 SAR).
	1.2.3.4	1.2-12	The reference to Section 3.1.4 is revised to refer to Section 3.1.3 (due to changes in Chapter 3 of the SAR).
	Table 1.2-4	1.2-20	Revised the "Maximum Heat Load" SNF parameter specification to eliminate discussion of maximum peaking factor and added a table note for clarity.
	2.6.1.1	2.6-1	The MNOP value is revised from 11.7 psig to 11.9 psig so that it is consistent with the value presented in Table 3.1-5.
	3.0	3-1	The original 3rd paragraph is replaced by two new paragraphs. The discussion of canister thermal ratings is deleted, and is replaced by a discussion of how the W21 canister design basis thermal profile is bounded by the design basis thermal profile modeled in the transport cask thermal evaluation.
	3.1	3.1-1	In the 3rd paragraph, the terms "bounding" and "heat flux" are replaced by "design basis" and "heat generation."
	3.1.3	3.1-5 3.1-6	The Section 3.1.3 title and text are revised to replace the term "heat flux" with "heat generation," and to replace the term "bounding" with "design basis" when referring to the axial heat generation profile.
	3.1.3	3.1-5	Some minor editorial corrections and/or improvements are made to the 1st paragraph.
	3.1.3	3.1-6	The 2nd paragraph, which discussed the application of two thermal acceptance criteria (Q_{max} and $LHGR_{max}$), is deleted.

SAR	Section	Page	Description
WSNF-121	3.1.3.1	3.1-6 3.1-7	Section 3.1.3.1 is completely rewritten. The discussion concerning low-burnup assemblies is deleted, along with the discussion of using the "$LHGR_{max}$" thermal profile analysis as the basis of the maximum allowable linear heat generation (LHGR) level for loaded assemblies. The revised section describes the "Q_{max}" and "$LHGR_{max}$" profiles modeled in the W21 canister thermal analyses and clarifies that the $LHGR_{max}$ profile case analysis only used to determine bounding thermal gradients and associated stresses.
	3.1.3.2	3.1-7 3.1-8	Section is revised to clarify the basis and the application of the axial heat generation profiles. The "peaking factor" term is replaced with "normalized heat generation" where appropriate. The "max thermal" and "max thermal gradient" profile titles are replaced with "Q_{max}" and "$LHGR_{max}$". All references to the LHGR limit have been deleted.
	3.1.3.3	3.1-8	Section is added to discuss compliance of the W21 canister design basis axial heat generation profiles with the TS125 transportation cask thermal interface requirements.
	3.1.3.4	3.1-8 3.1-9	Section is added to the relevance of the cooling table limits to the thermal acceptance of fuel assemblies and the associated thermal margin.
	3.1.4	3.1-10	Changed heading title. Deleted first two paragraphs.
	3.1.4	3.1-10	In the 1st paragraph, the term "thermal ratings" is replaced by "the design basis Q_{max} and $LHGR_{max}$ profiles."
	3.1.5	3.1-11	In the 1st paragraph, the term "W21 thermal rating" is replaced by "the maximum W21 canister heat load."
	Table 3.1-2	3.1-13	Revised to match profile data used in the W21 canister thermal evaluation.
	Table 3.1-3	3.1-14	The title of Table 3.1-3 is revised to remove the reference to the thermal ratings.
	Table 3.1-4	3.1-14	Table 3.1-4 has been deleted and subsequent tables have been renumbered accordingly.
	Table 3.1-5	3.1-15	Table is added.
	Table 3.1-6	3.1-16	Table is added.
	Figure 3.1-1	3.1-17	Figure is revised to match Table 3.1-2 data. Caption revised to replace term "profile" with "generation profiles."

SAR	Section	Page	Description
WSNF-121	Figure 3.1-2	3.1-18	Replaced with new figure that pertains to the analysis presented in the new Section 3.1.3.4.
	3.4	3.4-1	In the 2nd paragraph, the term "heat flux" is replaced with "heat generation."
	3.4.2	3.4-8	In the 2nd paragraph, the term "bounding" is replaced with "design basis" in reference to the axial heat generation profiles.
	8.0	8-1	Text is added to the section describing an inspection that must be performed if the W21 canister is loaded directly in the fuel pool inside a TS125 transportation cask.
	8.0	8-1	A second footnote, which references the TS125 cask base SAR (WSNF-120), is added at the bottom of page 8-1. This footnote relates to text that is added to the section.
	1.2.1.2	1.2-6	In the 2nd sub-section, the maximum linear heat generation rate (LHGR) is revised from 205 watts/inch to 192 watts/inch (the correct value, based upon the heat generation profile modeled in the W74 thermal evaluation).
WSNF-123	1.2.1.2	1.2-6	In the 2nd sub-section, changed maximum LHGR from 205 watts/inch to 192 watts/inch and changed "Section 1.2.1.6" to "Section 1.2.3.4."
	1.2.1.2	1.2-8	Editorial corrections to replace missing word and correct typographical error.
	Table 1.2-4	1.2-19 through 1.2-24	Deleted maximum axial peaking factor requirement from the "Maximum Heat Load" payload designation.
	1.3.1	Drawing No. 3319	Drawing revised to include alternate configuration of Lid Assembly.
	2.7.1.4.4.1	2.7-70	The "d" term in the equation (in the middle of the page) is changed to "x".
	3.0	3-1	Minor editorial changes are made to the first sentence of the 3rd paragraph. The words "based on" are changed to "limited by," and the word "fabrication" is deleted.
	3.0	3-1	The discussion in the 3rd paragraph about thermal ratings, and how the W74 thermal profile is enveloped by the transport cask profile, is replaced by a statement that the assembly heat generation profile must be compliant with the transport cask thermal requirements given in Section 3.1.3.3 of the WSNF-120 cask SAR.

SAR	Section	Page	Description
	3.1	3.1-1	In the 3rd paragraph, the term "heat flux" is replaced with "heat generation."
WSNF-123	3.1.3	3.1-5 3.1-6	The Section 3.1.3 title and text are revised to replace the term "heat flux" with "heat generation," and to replace the term "bounding" with "design basis" when referring to the axial heat generation profile.
	3.1.3	3.1-6	Minor changes are made to the last paragraph for clarity. The terms "Q_{max}" and "$LHGR_{max}$" are replaced by "Q" and "LHGR," and "linear heat generation rate" is replaced with "LHGR."
	3.1.3.1	3.1-6 3.1-7	The section title and text are revised to refer to "heat generation" as opposed to "heat flux"; to replace the term "bounding" with "design basis" when referring to the axial heat generation profile; to refer to a single, not multiple, profiles; and to replace "linear heat generation rate" with "LHGR."
	3.1.3.1	3.1-6	In the 2nd paragraph, "vs." is revised to "versus."
	3.1.3.2	3.1-7	The section text and formula are revised to replace the concept of "local peaking factor," or "peaking factor profile," with the concept of "local normalized heat generation."
	3.1.3.2	3.1-7	The 2nd formula is replaced by a text discussion. The terms "Q_{max}" and "$LHGR_{max}$" are replaced with "Q_{Total}" and "LHGR."
	3.1.3.3	3.1-8	Section 3.1.3.3 is added to discuss compliance of the W74 canister design basis axial heat generation profile with the thermal requirements of the TS125 transportation cask.
	3.1.4	3.1-8	The title of Section 3.1.4 is changed to remove the reference to the thermal rating.
	3.1.4	3.1-8	The first two paragraphs of the original Section 3.1.4 have been deleted. These paragraphs had discussed the canister thermal rating and the penalty factors that were applied for low-burnup fuel assemblies.
	Table 3.1-2	3.1-12	The table heading is changed and the table data is revised to match the profile used for the W74 canister thermal evaluation.

SAR	Section	Page	Description
	Table 3.1-3	3.1-13	Table 3.1-3 is reformatted for clarity. The "Max. Thermal gradient" row is deleted. The maximum allowable LHGR value is revised from 0.205 kW/inch for the canister and 0.211 kW/inch for the cask, to 0.192 kW/inch for the canister and 0.1606 kW/inch for the cask. Two notes are added to the table to clarify the basis of the cask thermal profile, and to explain why a canister LHGR that exceeds that of the cask is allowable.
WSNF-123	Table 3.1-4	3.1-13	Table 3.1-4 is revised for better clarity and accuracy. The "Q_{max}" column is replaced by a "Q_{Total}" column at the far right. As the new table shows, the maximum LHGR, which is calculated based upon the thermal profile of the highest burnup shown in the table, is always the limiting constraint for the lower assembly burnups, which correspond to higher profile peaking factors. Due to the penalty factors, "Q_{Total}" must decrease for the lower burnup levels, in order to maintain the (fixed) LHGR. Note 1 of the table is revised accordingly.
	Figure 3.1-1	3.1-15	Revised to match Table 3.1-2 data and profile used for the W74 canister thermal evaluation.
	3.4	3.4-1	In the 2nd paragraph, the term "heat flux" is replaced with "heat generation."
	3.4.2	3.4-7	In the 2nd paragraph, "bounding" is replaced by "design basis" in reference to the axial heat generation profile.
	3.4.2	3.4-8	In the 3rd paragraph, "linear heat generation rate" is replaced by "LHGR."
	3.4.2	3.4-8	Minor editorial changes are made in the 4th paragraph: "22 kW" is changed to "22.0 kW"; "heat load" is changed to "heat generation"; and "Linear heat generation rate" is changed to "LHGR."
	3.4.2	3.4-8	In the 4th paragraph, the LHGR limit for the W74 canister is revised from 0.205 to 0.192, and the total heat load for the canister profile is revised from 23.5 kW to 22.0 kW.
	3.4.2	3.4-8	Text is added to the 4th paragraph, which explains why a W74 canister thermal profile with an LHGR level (of 0.192 kW/inch) that exceeds that of the analyzed cask analysis profile is acceptable.
	3.4.6	3.4-13	Editorial correction to add missing word.

SAR	Section	Page	Description
	Table 3.4-1	3.4-14	The term "at Q_{max}" is deleted from the title of Table 3.4-1. Table Note 1 is also moved from the title to the "NCT Thermal Load Condition" text in the table header section.
	Table 3.5-1	3.5-6	In table Note 1, the term "axial heat profile" is revised to "axial heat generation profile," which is more accurate and clear. The Note (1) callout is moved from the Table caption to the columns header.
WSNF-123	3.6.4.2	3.6-9 3.6-10	The title and text of Section 3.6.4.2 are revised to replace the term "heat flux" with "heat generation." The term "bounding" is replaced by "design basis" in reference to the axial heat generation profile.
	3.6.5.2	3.6-12	The section title and text are revised to replace the term "heat flux" with "heat generation." The term "bounding" is replaced by "design basis" in reference to the axial heat generation profile.
	Table 3.6-1	3.6-21	Table Note 1 is revised to refer to the "design basis BRP profile," as opposed to the "max. thermal" profile.
	8.0	8-1	Text is added to the section describing an inspection that must be performed if the W74 canister is loaded directly in the fuel pool inside a TS125 transportation cask.
	8.0	8-1	A second footnote, which references the TS125 cask base SAR (WSNF-120), is added at the bottom of page 8-1. This footnote relates to text that is added to the section.