Attachment 1 to Holtec Letter 5014932
Holtec International Responses to Requests for Supplemental Information
Topical Report on Methodology for Fuel Qualification

RSI-1

Update Table 2.2 of the topical report that defines the Area of Applicability to:

a) Provide supplemental information on the baseline depletion parameters associated with "design basis" fuel. This includes things such as boron concentration (PWR), insert/control blade insertion, moderator density, fuel density, burnup profile, specific power, minimum enrichment, assembly classes, etc. Staff understands that some of these parameters may be of less importance to a shielding evaluation and can be changed if site specific parameters are defined and justified, however, the area of applicability should still be established so that the staff can determine that the method proposed in the topical is capable of simulating the range of fuel operations proposed. In addition, default parameters associated with "design basis" fuel should be established if site specific parameters are not justified.
b) Provide supplemental information related to Part 72 of Title 10 of the *Code of Federal Regulations* (10 CFR 72) 72.236(a) to include fuel mass, fuel condition, (damaged fuel), and cladding materials.

This information is needed so the staff can determine if the method described in the topical report can be used to satisfy 10 CFR 72.236(a) and (d).

Holtec Response:

The general goal of the TR is to establish an unambiguous method to qualify content for dry storage systems. But it is equally important that the process is not more complicated than necessary for the given purpose. In its initial form (Revision 0) the TR provided various options that, on further investigation, complicated the process without providing corresponding benefits (in terms of flexibility). Consequently, we have removed some of these options. Most importantly, the TR now requires all source term and radiation transport evaluations to be performed solely for the design basis assemblies specified in the report. This was informed by the approach in the currently approved systems referenced in the TR, and by a review of NUREG/CR-6716. With this, no additional assembly-specific or site-specific TRITON analyses are needed, so principal inputs to the calculations are just burnup, enrichment, and cooling times. This is also consistent with the overall intent of this process, i.e. to replace those specifications from the FSAR and TS with a new criteria, namely a set of dose rate limits.

a) A new Section 2.8 has been added to discuss the area of applicability in more detail, and Table 2.2 is updated accordingly.

With respect to the list of the information requested, please note that the burnup profile is only used in the radiation transport calculations that are documented and approved through the corresponding approval of the CoC. Hence this information is not included in this table.

With respect to site specific parameters, the only parameters that may be specific to a site are ranges of burnups, enrichments and cooling times to represent the inventory at the site.

b) Cladding material is specified in Table 2.2. Fuel mass and fuel condition would be addressed in the FSAR/TS where the TR is referenced, since they depend on the specifics of the respective storage system (fuel to be qualified, conditions to be qualified).

RSI-2

Provide supplemental information on the value and location of the dose rate points used as the "acceptance criteria" for the method of evaluation (MOE).

While there is some discussion in various parts of the topical report (Section 2.5, App B Acceptance Criteria, 2nd Section C.2), the discussion does not address how the dose rate locations and values are to be determined. The discussion should include:

- discussion about features of the transfer and storage casks for which the dose rate locations will be meaningful.
- the numbers of such points on those features and distance, or considerations involved in determining the number and distance from the cask and information discussing how this sufficiently captures the heterogeneity of the loading patterns.
- the area, and justification for which, over which the dose rates will be averaged, including justification for why averaging is appropriate, if such an approach is used.
- how the values of acceptance criteria (dose rates) will be used to demonstrate compliance with 10 CFR 72.236(d).
- criteria to indicate that when design changes do not align with the utility of the dose locations or dose rate values and would require the appropriate regulatory change process to adjust the dose locations or dose rate values to be at appropriate locations on the cask system or appropriate values as modified by the design changes.
- clarification if the statements in Section C.2 of the topical report are considered to be part of the method for establishing the acceptance criteria.

This information is needed so the staff can determine if the method described in the topical report can be used to satisfy 10 CFR 72.236(a) and (d).

Holtec Response:

This TR does not define any dose locations or dose rate limits. These will be defined in the FSAR / CoC / TS for each system that the TR is applied to, as a separate licensing action, since all these very specific to the designs. To support this, general guidance on the information that is needed in the FSAR is provided in Appendix B, with an example provided in Appendix C. This approach is taken to make the method independent from the individual design details of the transfer and storage casks. The discussion on the detailed information listed in the RSI will be part of the LAR for the FSAR.

RSI-3

Provide supplemental information on SCALE 6.2.1 as well as the process for determining if other newer versions of the code system are allowed.

To calculate the neutron and gamma source terms from spent nuclear fuel the topical report states that ORIGAMI and TRITON modules of the SCALE 6.2.1 system or newer will be used, as long as the newer codes demonstrate that for a small set of burnup, enrichment and cooling times (BECTs) that the results are within 5% of the SCALE 6.2.1-generated results. The staff requests the following supplemental information:

a) Include references to the appropriate SCALE 6.2.1 code manual.
b) Define the "small set" of BECTs that are used to determine that newer versions of SCALE are acceptable and justify that this is sufficient to determine acceptability of the new version.
c) Define "results" that are within 5%. Does "results" mean source term magnitude for every energy group or total source strength or some kind of dose rate results? Discuss how that approach is sufficient to determine the results from the new code version are acceptable.
d) Define cross sections sets that are allowed to be used.

This information is needed so the staff can determine if the method described in the topical report can be used to satisfy 10 CFR 72.236(a) and (d).

Holtec Response:

a) We apologize for the oversight. The reference to SCALE 6.2.1 has been added to the reference section.

b) A definition of the number and specifications of the "small set" has been provided.

c) The intent is to base the comparison on dose rates, and this has been clarified.

d) The cross section set to be used has been clarified.

RSI-4

Provide supplemental information on TRITON modeling when standard ORIGAMI libraries are not available.

The topical report states: "the standard TRITON libraries supplied with the code shall be used, unless no suitable library is available for the respective fuel type, in which case it is acceptable to specifically generate libraries."

a) State exactly what the “standard TRITON libraries supplied with the code” are and the conditions that would require a new library to be generated. This can be a reference to specific tables in the specific versions of the SCALE manual that contain the applicable information.
b) Provide supplemental information discussing how the TRITON modeling will be performed. Include procedures that will be followed taking in consideration information similar to what is in Section 5.3.2 of the SCALE manual. Provide specific SCALE sequences that will be used such as requirements to use NEWT or 2D or 3D geometry and specific T-DEPL sequence, etc. Provide specific instructions and discussions regarding selection of parameters important to the depletion itself, including whether depletion is to be done as a single full power cycle or divided into multiple cycles. For the latter, provide and justify the cycle burn and down times. Also, provide directions on how the number of subdivisions of the cycle burn (for example, in earlier versions, parameters such “nlib,” which is the number of libraries per depletion cycle) will be determined to ensure adequate convergence and precision of the output source.
c) Provide specific instructions related to the necessary fuel assembly descriptions and parameters for this modelling. The topical should describe the level of specificity needed for the rods and rod array to perform analyses in cases where the libraries provided with SCALE are not used. For example, state if partial length rods and non-circular cross section water rods will be modeled explicitly or have simplifications, etc. Direction should be provided regarding selection of specific power, whether this is a general process, site specific or based on the assembly.

Note that some of the items described above should also be addressed when the libraries provided with the SCALE code system for use with ORIGAMI are used as well.

This information is needed so the staff can determine if the method described in the topical report can be used to satisfy 10 CFR 72.236(a) and (d).

Holtec Response:

This option has been removed, see response to RSI-1. The libraries that must be used have been added to Tables 3.1 and 3.2.

RSI-5

Provide requirements for the format and contents of the fuel qualification report or modify the topical report to choose a single example for the qualification report and state that the format and contents of the qualification report must follow this example.

The topical report does not contain requirements for the format and content for the qualification report. Although Appendix A and Appendix D both give examples of the fuel qualification report, it is confusing as to what the fuel qualification report will look like given there are two separate examples, and the fact that these are listed as examples and not stated as requirements for format and content. The applicant needs to revise the topical report to clearly state the format and contents of the qualification report. The report should consider the fact that some of the allowable contents will be located in other documents and should maintain a pointer to those

documents as appropriate, i.e., technical specifications (TS), final safety analysis report (FSAR), or a reference from the TS to the FSAR.

This information is needed so the staff can determine if the method described in the topical report can be used to satisfy 10 CFR 72.236(a) and (d).

Holtec Response:

With respect to the requirements for the qualification report, we have reviewed the example and concluded that it outlines everything that is required to be present in the qualification report. Hence we have revised the introduction to Appendix D to specify the content and outline of the appendix this as a requirement, not just an example.

RSI-6

Provide a method for calculating the source term for site specific inserts.

The topical report states that site specific inserts (e.g. thimble plug devices (TPDs) and burnable poison rod assemblies (BPRAs)) can be modeled. Include a method for performing these calculations.

This information is needed so the staff can determine if the method described in the topical report can be used to satisfy 10 CFR 72.236(a) and (d).

Holtec Response:

It is not the intent to allow site specific source term calculations for NFH. It does not appear that there would be any benefit that would justify such an option. Hence all NFH source terms must be calculated as specified in the TR.

The only option that is discussed is using a lower mass of the NFH than the design basis listed in the TR, with appropriate reference and documentation.

RSI-7

Provide the analysis process for the method to determine the acceptable contents, including the source term calculation.

Appendix A provides examples of fuel qualification determinations, with the examples laying out in a stepwise manner the process for that determination. However, it is not clear that the appendix is simply to be understood as examples that illustrate how the process is followed or the actual analysis process. The body of the topical report itself does not describe that process. Thus, the topical report should be revised to clearly layout the process for the determinations of fuel qualifications, fuel loading patterns and so forth, that are the purpose of the method. The description should include sequential descriptions of the essential elements of the process.

This information is needed so the staff can determine if the method described in the topical report can be used to satisfy 10 CFR 72.236(a) and (d).

Holtec Response:

A description of the entire analysis process has been added as new Section 4, and the previous Section 4 is renumbered as Section 5.

Observations:

OBS-1

The topical report does not contain a method for including some contents commonly seen in dry storage systems such as reconfigured fuel, damaged fuel, reconstituted fuel, stainless steel clad fuel, and other types of fuel such as MOX fuel, etc. If the qualification method is to be used for systems that store these contents, the applicant will need to provide a method for qualifying these contents.

Holtec Response:

With respect to cladding and fuel type, the report is limited to zirconium type cladding, and UO_2 fuel (see Table 2.2), hence stainless-steel cladding or MOX fuel cannot be qualified using the approach in the TR. This is reasonable, since both steel clad and MOX fuel are too rare to justify their inclusion here, which would create significant complications of the method.

With respect to fuel conditions, the main aspect is the spatial modeling of those in the radiation transport calculations, which are not part of this TR, but discussed in Appendix B and Appendix C. The need to consider this in the FSAR/TS has been included in Appendix B.

OBS-2

The staff currently has the following observations related to non-fuel hardware:

a) Section 3.4.1 of the report states that BPRAs were determined to be bounding for the HI-STORM 100. In Section 5.4.6 of the HI-STORM 100 FSAR, this was determined by comparing TPDs to BPRAs, and this section states that the TPD was bounding for the top of the cask therefore the conclusion that this is applicable to all HI-STORM and HI-STAR systems. However, this conclusion may not be appropriate, especially for HI-STORM UMAX or a transfer cask that may have significant loading operations near the top of the cask. The source terms from TPDs are concentrated at the top of the pressurized water reactor (PWR) assemblies and the sources from BPRAs are at the both ends of the fuel assemblies.
b) Section 3.4.3 of the topical report states that: “If an evaluation is performed that shows that the neutron source term from an NSA [neutron source assembly] is negligible, there is no limit on the nufmber or location of NSAs in the basket.” This may be true for the

neutron aspect of this, but not for the gamma, which as stated earlier in the topical report could have as much source as a BPRA. This statement should be qualified to include the assumption that BPRAs are already allowed in all locations. In other words, while the neutron source may not limit the allowable numbers and basket locations for NSAs, the gamma source may still limit the allowable numbers and locations. Also, the topical report should define what is considered "negligible" and what is necessary to show the neutron source term is negligible. As noted in the topical report, there are multiple NSA types, some of which have non-negligible neutron sources by nature of their design. The report should provide clear guidance on how a situation where multiple NSA types are to be loaded, such as whether they should all be treated as the bounding NSA type or handled uniquely and how that would work.

c) The topical report should include materials and other needed specifications for all the non-fuel hardware inserts that are within the scope of the topical report as well as clarification on the scope of non-fuel hardware such as TPD, axial power shaping rod, and NSA varieties. The report provides information for TPDs and BPRAs in Table 3.4. Similar information should also be provided for the other inserts as well. Also, the version of DOE/RW-0184 available to the staff, indicates that some varieties of TPDs have rod(let)s that extend into the active fuel zone and that some NSAs also have absorber rod(let)s. The topical report needs to be explicit on these varieties of TPDs and NSAs as well as a more definition of the scope of other non-fuel hardware.

Holtec Response:

a) The discussion has been revised and requires that both BPRA and TPDs be considered separately to establish independently the acceptance criteria for both (burnup and cooling time), which may be different between the two.

b) It has been clarified that both neutron and gamma source from the NSAs need to be considered to determine the number and location of qualified NSAs. Additionally, a criteria for "negligible" has been added.

c) Materials for other NFHs have been added.

OBS-3

The staff currently has the following observations related to the Co-60 activation source of fuel and non-fuel hardware (NFH):

a) The appropriateness of the 800 ppm Co-59 impurity should be justified for the breadth of spent fuel and nonfuel hardware contents within the scope of the topical report. Assemblies and NFH that were fabricated prior to the late 1980s, the cobalt levels have been measured to be significantly higher than 800 ppm, in some cases in excess of 2,000 ppm. The appropriateness of cobalt level assumed for Inconel should also be justified beyond referencing something that was used in another calculation. Justification of the cobalt level for Inconel should be based on data showing it is reasonable for this material, such as measurements of impurities.

b) There should be clarification of the process for determining the Co-60 activation source including the scaling given in Sections 3.2 and 3.4 of the topical report. The calculation description and scaling discussion do not clearly describe how the code is used to determine the cobalt-60 source (the primary nuclide in the activation source). The use of the depletion code for determining the activation source should clearly describe items, such as, the amount of cobalt mass input into the code, how scaling of the source is done to account for the mass in different axial zones, and the flux factors for those zones in Table 3.3 of the topical report.

Holtec Response:

a) We understand that older hardware may have had higher Co-59 levels, but consider that the long cooling time of those would be sufficient to make the effect of this insignificant. Corresponding text has been added to the TR.

The justification for the cobalt level for Inconel is still under investigation and will be discussed later. Since this is an observation, not an RSI, we expect to have further discussion during the RAI phase.

b) A new Section 3.5 has been added to provide clarification on the process.

OBS-4

The staff is unsure of the purpose of the design basis fuel tables, Table 3.1 and 3.2 of the topical report. Are these determined to be bounding for certain assembly groups? Do these correspond to standard ORIGAMI libraries that will be used?

Holtec Response:

The TR has been revised and requires these to be used in all analyses. Text has been updated accordingly. See also the response to RSI-1. The tables have been expanded to indicate the TRITON library to be used.

OBS-5

Appendix C of the topical report has a statement about modeling minimum lead thickness in the HI-TRAC for the loss of water accident being the bounding accident and condition and "no further site-specific accident evaluations are therefore necessary." Although the staff does not disagree with using minimum lead thicknesses and that the loss of water accident being bounding for some systems, to avoid confusion, this statement should be modified because in other systems, there may be conditions where additional accident evaluations are needed. It is not clear that further site-specific accident evaluations would not be necessary if the source used in the FSAR analyses is a representative source, however considering this is part of the example, the intent may not be for this to be generically applicable.

Holtec Response:

Correct, Appendix C is an example for a possible addition to an FSAR to introduce the application of this TR into that FSAR, and is not generically applicable. For a specific system, the appropriate selection of the modeling approach would have to be specified in the FSAR.

OBS-6

Section C.4 of the topical report states: “For details on which information in this subsection can or cannot be modified under 72.48 see Section C.2.” The staff did not find this information in Section C.2. It is unclear if this criteria were meant to be requirements that are part of the topical report and are missing, or if this is just part of the example and is meant to be filled in the a FSAR to implement the topical report.

Holtec Response:

We apologize for the confusion. There was an error in the numbering of Appendix C, with two sections listed as C.2. This has been corrected and the reference should now be clear.

OBS-7

There are various statements made in the topical report that deal with aspects of the dose rate calculations whose method will be part of the FSAR. It would improve the clarity of this topical report if these statements were gathered into a single location, or section, within the report (in addition to their current locations) to ensure the user of the topical report is clearly aware of these points and they are followed. These points include Section 3.1 item 3 and the last two paragraphs of both Sections 3.4.1 and 3.4.2.

Holtec Response:

Appendix B is intended as the location where all the requirements for the FSAR are summarized. Item 5 in the discussion on the calculational model refers to credit of assembly masses. Note that the alternatives discussed in Section 3.1 item 3, and in the last paragraphs of Sections 3.4.1 and 3.4.2 have been removed. See response to RSI-1 for a discussion on the removal of options.

OBS-8

The topical report should describe the criteria for determining alternatives to specific items described in the topical report may be acceptable. In Section 1 of the topical report, it is stated that criteria for accepting alternative methods may be discussed in the report. Any spots for which alternatives are considered for use in the report should be identified and the criteria for determining the alternative is acceptable need to be described in the report. One example where this does not appear to have been done is Sections 3.2 and 3.3 for source term group structures.

Holtec Response:

For sections 3.2 and 3.3, the criterion is the statement that number and range of the energy structure should be similar. We consider this sufficiently descriptive, so no numerical criteria would be needed.

The only other alternatives, with their justification are as follows:

- Scale Version (5% dose rate criteria)
- NFH weight for source terms (reference and documentation)
- Alternative use of Table 3.1 or 3.2 as design basis fuel (see Section 2.4)

OBS-9

It would improve clarity of the topical report if more examples were included in Appendix A that exercise the variety of alternatives (such as the need to build a TRITON library for a nonstandard fuel assembly, different energy group structures, etc.) allowed by the topical report. This would be beneficial to understanding the intended application of the method and alternatives. The topical report discusses alternatives for a number of aspects of the information covered by the topical report; however, none of the current examples in Appendix A, either individually or collectively illustrate the implementation of all the alternatives considered in the topical report.

Holtec Response (Partial):

We will review Appendix A in the future to see if additional examples are needed. Given that the TRITON alternative has been removed, the current set of example may be sufficient, but more information on those examples may be beneficial. Since this is an observation, not an RSI, we expect to have further discussion during the RAI phase.