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Mr. John Goshen
c/o Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

May 23, 2012

Subject: Submittal of Responses to First Request for Additional Information on License Amendment Request #1 for the Holtec International HI-STORM Flood/Wind Multipurpose Canister Storage System General License Application, USNRC Docket No. 72-1032 (TAC L24321)

References:
[1] Holtec Letter 5018011, LAR 1032-1, dated October 14, 2010
[2] Letter from J. Goshen (NRC) to S. Anton (Holtec), dated March 23, 2012

Dear Mr. Goshen:

By letter dated October 14, 2010 [1], Holtec submitted a License Amendment Request for certification of the HI-STORM FW MPC Storage System Under 10CFR72, Subpart L. Staff requested that we provide additional information on our proposed amendment to our HI-STORM FW FSAR [2]. Holtec International herein submits the response to the request for additional information (RAI).

Attachment 1 to this letter contains the individual responses to the RAI questions. To assist the Staff in their review of the responses, Attachments 2 and 3 respectively contains the list of changes as a result of the RAI responses to the Final Safety Analysis Report (FSAR) and proposed Technical Specifications (TS). Attachment 4 contains the Proposed Revised FSAR Sections – Only Sections 4.4.1.6, 5.1.2 and 5.4 are affected by the RAI responses. Therefore, only those sections are provided. These sections are marked in the footer with "Rev 0.B", updated from "Rev 0.A" in the initial LAR. Deletions are shown in strikeout. Insertions are marked by vertical bars in the right margin. Rev 0.B

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changes are in different font than the Rev 0.A changes. Attachment 5 contains the updated proposed CoC/TS; changes are marked with revision bars in the right hand margin. Attachment 6 contains the Thermal Calculation Package. Attachment 7 contains Thermal Computer Input files. Attachment 8 contains Shielding Computer Input files. Holtec considers the Attachments 5, 6, 7 and 8 to be proprietary information, therefore Attachment 9 to this letter is an affidavit prepared in accordance with 10 CFR 2.390 requesting that they be withheld from public disclosure.

Sincerely,

Stefan Anton

Dr. Stefan Anton
Acting Licensing Manager
Holtec International

cc (letter only):
Mr. Eric Benner, USNRC
Mr. Douglas Weaver, USNRC
Ms. Brooke Poole, USNRC
Holtec Group 1

List of Attachments:
Attachment 1: Responses to Request for Additional Information
Attachment 2: List of Changes to Proposed FSAR
Attachment 3: List of Changes to Proposed Technical Specifications
Attachment 4: Revised Proposed FSAR, Holtec Report No. HI-2114830, Revision 0.B
Attachment 5: Updated Proposed Technical Specification (Proprietary)
Attachment 6: Thermal Evaluation of HI-STORM FW, HI-2094400 Revision 3 (Proprietary)
Attachment 7: Thermal Computer Input files (Proprietary)
Attachment 8: Shielding Input Files (SAS2H, ORIGEN-S, MCNP) (Proprietary)
Attachment 9: Affidavit Pursuant to 10CFR2.390 to Withhold Information from Public Disclosure

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INFORMATION PERTAINING TO COMPACT DISK SUBMITTAL

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Document Components: Three (3) CD-ROM disks are included with this submission. The CD-ROM disk labeled "File for RAI Response 1032-1 (1/2) Attachment 7, File for RAI Response 1032-1 (2/2) Attachment 7, Attachment 8- File for RAI Response 1032-1 Shielding Input Files

Non-document Components: None

Attachment 1 to Letter 5018020- RAI responses

Response to RAI 4-1

We are in agreement with the staff's observation. Section 2.3 in Appendix B of the Technical Specification (TS) is revised to explicitly provide the sub-design basis heat load limits. The MPC helium backfill pressure requirements table (Table 3-2) is also modified in Appendix A of the Technical Specification to reflect these changes.

Response to RAI 4-2

We are in agreement with the staff's observation that different radial gaps between the basket-to-basket shim and basket shim-to-shell were used in the thermal evaluations of HI-STORM FW and HI-TRAC VW Systems.

The maximum combined radial cold gap between the basket and the basket shims, and the basket shims and the inside diameter of the enclosure shell is 9/32" [Drawing 6505 Revision 4].

Based on the thermal expansion calculations presented in Section B.5.2 of Holtec report HI-2094400, Revision 3, when the MPC is in the HI-STORM FW overpack, the combined radial thermal expansion (basket-basket shim and basket shim-MPC shell) region is calculated as 0.112 inches (also see Table 4.4.6 of HI-STORM FW FSAR). Therefore, the maximum combined radial gap under design heat load (hot conditions) is 0.169 inches (4.29mm). Conservatively, the radial gaps between the basket and basket shim, and the basket shim and MPC shell are each set to be 3mm in the HI-STORM FW thermal model, i.e. the combined gap is set as 6mm.

Based on the thermal expansion calculations presented in Section D.5.5 of Holtec report HI-2094400, Revision 3, when the MPC is in the HI-TRAC VW overpack, the combined radial thermal expansion (basket-basket shim and basket shim-MPC shell) region is calculated as 0.107 inches. Therefore, the maximum combined radial gap under design heat load (hot conditions) is 0.174 inches (4.42 mm). Conservatively, the radial gaps between the basket and basket shim, and the basket shim and MPC shell are each set to be 2.5 mm in the HI-TRAC VW thermal model, i.e. the combined gap is set as 5mm.

Therefore, the thermal analyses of the HI-STORM FW and HI-TRAC VW uses conservatively larger radial gaps that bound the actual maximum radial gaps that can

exist under hot conditions. The overstated radial gaps increase the heat transfer resistance and are therefore conservative. Based on the results presented above, the level of conservatism is higher in the HI-STORM FW thermal model.

Response to RAI 4-3

As requested by this RAI, the grid independency study is re-performed based on the procedure described in ASME V&V 20-2009. The grid independency study is documented in Section 4.4.1.6 of the HI-STORM FW FSAR. The GCI calculations are also performed and documented in Appendix H of Holtec Report HI-2094400, Revision 3. It demonstrates a mesh independent solution has been achieved. All the results presented in the HI-STORM FW FSAR remain unchanged with the mesh sensitivity studies.

Response to RAI 5-1

Holtec agrees with the NRC staff that burnup and gamma dose rates are linearly related. However, the objective of this sentence is to affirm that the same heat load can be achieved either with high burnup and long cooling time or low burnup and short cooling time combinations. If the dose rate at a specific location is neutron dominated, higher burnup and corresponding longer cooling time combination may result in higher dose rate due to the non-linear relation between burnup and neutron sources. However for gamma dominated dose locations, low burnup and short cooling time combination may show higher dose rates.

It is noted that the phrase "on the other hand..." is related to the previous statements on page 5-6. Hence, it is to be taken in the context of the entire paragraph. For clarification, the sentence is revised in the chapter.

Response to RAI 5-2

It can be inferred from Table 3.4.6 of Chapter 3 of the FSAR that an intermediate missile with a side strike on HI-STORM FW outer shell can cause a penetration of about 8 inches. Such a local reduction in concrete thickness will cause local increase in dose rates, especially at locations in close proximity with the penetration. However, the site boundary dose increase is expected to be negligible.

For such an accident condition, the increased adjacent and one meter dose rates for the HI-STORM FW are difficult to estimate, however, they are not expected to be higher than the dose rates for the HI-TRAC system under accident conditions listed in Table 5.1.4 of Chapter 5.

To clarify this, the sentence "Therefore, the site boundary, adjacent and one meter doses ... are equivalent to the normal condition dose rates" is revised to state that only the site boundary dose remains unchanged, but that local dose rate increases are expected adjacent to the cask, and that this should be considered in any post-accident activities.

Response to RAI 5-3

The figure and the strike through line on page 5-23 are part of the tracked changes in the document. The figure is from the original FSAR, and will not be shown in the final version of the chapter (once all tracked changes are accepted). The figure is replaced with the updated figure on page 5-24.

Response to RAI 5-4

ENDF/B-V and ENDF/B-VI are the libraries which are used for the majority of isotopes. Additionally, ENDL92 is used for Sn isotopes, and LANL/T16 is used for the uranium isotopes. These are the default libraries used by the MCNP5-1.4 code. The statement on page 5-64 has been revised accordingly.

Response to RAI 5-5

Appendix A has been updated now to include the new ORIGEN-S input file for 4.5 years cooling time. Note that for this Amendment Request no new MCNP models were created nor were any new MCNP runs performed. This is due to Holtec's approach for shielding analysis where the dose per starting particle is calculated by MCNP and then adjusted for the source strength (generated using SAS2H/ORIGEN-S from the SCALE code) in the post processing phase as described in section 5.4. All input files listed in Appendix A are also supplied as text files on CD and provided with these RAI responses.

Response to RAI 11-1

Table 11.2.1 has been updated, and the text referring to regionalized loading has been updated, clarifying that regionalized loading is still required by some but not all loading configurations, but always preferred from an ALARA perspective.

Attachment 2 to letter 5018020- Summary of Proposed Changes to FSAR

Changes to HI-STORM FW SAR (HI-2084289)- Rev 0.B

FSAR Section Number	Description of Change
4.4.1.6	Rewritten the entire section due to the RAI responses
Section 5.4 and Input files	Updated Origen-S input files to add cooling time 4.5 years
Table 11.2.1	Reworded to address RAI responses

ATTACHMENT 3 TO LETTER 5014020

Changes to HI-STORM FW Technical Specifications

Technical Specification Section Number	Description of Change
Appendix A, Table 3-2	The MPC helium backfill pressure requirements table (Table 3-2) is also modified in Appendix A of the Technical Specification to reflect the changes below.
Appendix B, Section # 2.3	Section 2.3 in Appendix B of the Technical Specification (TS) is revised to explicitly provide the sub-design basis heat load limits.

4.4.1.6 Grid Sensitivity Studies

The discretization of the MPC and the HI-STORM/MPC annulus region must be sufficiently dense to insure a converged solution. Because the flow field in the annulus is in the transition and turbulent regimes, the grid size and layout are critical to insuring a converged solution. In the MPC internal space, however, the flow is uniformly laminar (no laminar boundary layer to turbulent zone transition effects) and therefore, the grid size is relatively unimportant. The sensitivity study was accordingly performed on the annulus region outside the MPC and the grid size in the axial direction within the MPC. All sensitivity analyses were carried out for the case of limiting Pattern A heat load in the MPC-37 canister (See Subsection 4.4.4.1).

a. The HI-STORM FW annulus grid sensitivity results are tabulated below.

Run No	Number of Radial Cells	y^+	PCT (°C)	Permissible Limit (°C)	Clad Temperature Margin (°C)
1	6	21	353	400	47
2	10	5	357	400	43
3	11	4	364	400	36
4	12	3	376	400	24
5	17	0.7	375	400	25
Note 1: The y^+ reported in the third column above is a measure of grid adequacy provided by the FLUENT code. Values of $y^+ \sim 1$ indicate an adequate level of mesh refinement is reached to resolve the viscosity affected region near the wall. Note 2: The annulus grid is refined in two ways, namely, by increasing the number of radial cells and also by clustering the cells near the MPC and overpack innershell walls.					

As can be seen from the above table, the thermal solution is quite sensitive to the grid density in the annulus region. The above results show that Run No 5 is reasonably converged. To provide further assurance of convergence, the sensitivity results are evaluated in accordance with the ASME Journal procedure for control of numerical accuracy [4.4.3]. Towards this end the Grid Convergence Index (GCI), which is a measure of the solution uncertainty, is computed. The GCI for the finest grid (i.e. 17 radial cells) computes to be 1.3×10^{-5}% which provides further assurance of grid convergence. Having obtained grid convergence in the annulus region, the Run No 5 grid is adopted for further grid sensitivity studies below.

b. The results of axial grid refinement in the fueled region are summarized below.

Grid Refinement	Number of Axial Cells	PCT (°C)	Permissible Limit (°C)	Clad Temperature Margin (°C)
Baseline run	84 Note 1	375	400	25

~~(Run No 5 adopted from above)~~				
~~Refined Grid~~	~~101~~	~~376~~	~~400~~	~~24~~
~~Note 1: As explained below the baseline grid is adopted for thermal evaluation of the HI-STORM FW.~~				

To achieve ~~the~~ grid independent CFD results, a grid sensitivity study is performed on the HI-STORM FW thermal model. The grid refinement is performed in the entire domain i.e. for both fluid and solid regions in ~~the~~ both axial and radial directions ~~to capture the effects of fluid-solid interaction inside the MPC and in the annular region between the MPC and HI-STORM overpack~~. ~~The n~~Non-uniform meshes~~es~~ with grid cells clustered near the wall regions are generated to resolve the boundary flow near the walls.

A number of grids are generated to study the effect of mesh refinement on the fuel and component temperatures. All sensitivity analyses were carried out for the case of MPC-37 with minimum fuel length. Following table gives a brief summary of the different sets of grids evaluated and PCT results.

Mesh No	Total Mesh Size	PCT (°C)	Permissible Limit (°C)	Clad Temperature Margin (°C)
5	1,536,882	375	400	25
6	2,213,908	377	400	23
7	2,908,788	377	400	23
8	3,901,638	377	400	23
Note: Because the flow field in the annulus between MPC shell and overpack inner shell is in the transitional turbulent regime, the value of y^+ at the wall-adjacent cell should be on the order of 1 to ensure the adequate level of mesh refinement is reached to resolve the viscosity affected region near the wall. Therefore, a y^+ of ~~about~~ 0.7 is maintained for all the above meshes.				

As can be seen from the above table, the PCT is essentially the same for all the four meshes. The solutions from the different grids used are in the asymptotic range. The PCT for Mesh No 5 is slightly different from the other meshes, but the difference is negligible compar~~ing~~ed ~~with~~ to the available PCT safety margin. Therefore, it can be concluded that the Mesh 5 is reasonably converged. To provide further assurance of convergence, the sensitivity results are evaluated in accordance with the ASME V&V 20-2009 [4.4.3]. Towards this end, the Grid Convergence Index (GCI) for ~~the~~ Meshes 5, 6 and 7 computes to be 0.015%, while GCI for Meshes 6, 7 and 8 computes to be 0.165%.

~~The above results show that the solution is essentially unchanged by further grid refinement in the axial direction. This result is in keeping with the fact that the flow field in the MPC internal space is uniformly laminar.~~
Based on the above results, Run No 5 grid layout is adopted for the thermal analysis of the HI-STORM FW.

4.4.2 Effect of Neighboring Casks

HI-STORM FW casks are typically stored on an ISFSI pad in regularly spaced arrays (See Section 1.4, Figures 1.4.1 and 1.4.2). Relative to an isolated HI-STORM FW the heat dissipation from a HI-STORM FW cask placed in an array is somewhat disadvantaged. However, as the analysis in this Sub-section shows, the effect of the neighboring casks on the peak cladding temperature in the "surrounded" cask is insignificant.

(i) Effect of Insolation
The HI-STORM FW casks are subject to insolation heating during daytime hours. Presence of surrounding casks has the salutary effect of partially blocking insolation flux. This effect, results in lower temperatures and in the interest of conservatism is ignored in the analysis.

(ii) Effect of Radiation Blocking
The presence of surrounding casks has the effect of partially blocking radiation heat dissipation from the Overpack cylindrical surfaces. Its effect is evaluated in Sub-section 4.4.2.1.

(iii) Effect of Flow Area Reduction
The presence of surrounding casks have the effect of reducing the access flow area around the casks from an essentially unbounded space around it to certain lateral flow passages defined by the spacing between casks (See Figures 1.4.1 and 1.4.2). A reduction in flow area for ventilated casks is not acceptable if the access area falls below the critical flow area in the ventilation flow passages. The HI-STORM FW critical flow area is reached in the narrow annular passage. The lateral flow passages access flow area defined by the product of minimum gap between casks and cask height is computed below. The calculation uses the lowerbound 180 inch cask pitch defined in Table 1.4.1.

Annulus Area (A_{min}):
- MPC OD: 75.5 in
- Overpack ID: 81 in
- A_{min}: 676.0 in^2

Lateral Access Area (A_o):
- Cask Pitch: 180 in
- Overpack OD: 139 in
- Overpack Body Height: 187.25 in
- Min. cask spacing: 180 – 139 = 41 in

212792, December 2005.

[4.4.1] NUREG-1536, "Standard Review Plan for Dry Cask Storage Systems," USNRC, (January 1997).

[4.4.2] "Pressure Loss Charactersistics for In-Cell Flow of Helium in PWR and BWR Storage Cells", Holtec Report HI-2043285, Revision 6, Holtec International, Marlton, NJ, 08053.

[4.4.3]~~Procedure for Estimating and Reporting of Uncertainty due to Discretization in CFD Applications", I.B. Celik, U. Ghia, P.J. Roache and C.J. Freitas (Journal of Fluids Engineering Editorial Policy on the Control of Numerical Accuracy).~~ "Standard for Verification and Validation in Computational Fluid Dynamics and Heat Transfer", ASME V&V 20-2009.

[4.6.1] United States Code of Federal Regulations, Title 10, Part 71.

[4.6.2] Gregory, J.J. et. al., "Thermal Measurements in a Series of Large Pool Fires", SAND85-1096, Sandia National Laboratories, (August 1987).

- cooling time. In the case of the MPC-89 the burnup and cooling time combination is selected as a representative average for the entire basket.

While Loading Pattern B for the MPC-37 allows assemblies with higher heat loads and therefore higher source terms in the outer region (Region 3) of the MPC, the guiding principle in selecting fuel loading should still be to preferentially place assemblies with higher source terms in the inner regions of the basket as far as reasonably possible.

~~As stated in Section 5.0, the HI-STORM FW System offers a three-region regionalized loading configuration. Based on this configuration, fuel assemblies with higher heat loads would be loaded in the inner region allowing the user to take advantage of self-shielding from fuel assemblies with lower heat loads in the outer regions (see Tables 1.2.3 and 1.2.4). A more detailed description of the benefits of regionalized loading can be found in Section 5.4. However, for simplification, the shielding analyses are performed for a single region, i.e. assuming all assemblies in the basket have the same burnup and cooling time. The burnup and cooling time combination is selected as a representative average for the entire basket. This way, dose rates on the outer radial surface of the cask and at distances from the cask will be slightly overestimated, since the basket periphery has assemblies with below average burnup and/or above average cooling times. For the top of the cask, the average burnup and cooling time is expected to result in more realistic dose rate. The representative burnup and cooling time is then selected based on the other limiting fuel parameter, namely the average heat load per assembly.~~

It is recognized that for a given heat load, an infinite number of burnup and cooling time combination could be selected, which would result in slightly different dose rate distributions around the cask. For a high burnup with a corresponding longer cooling time, dose locations with a high neutron contribution would show ~~increased~~ *higher* dose values, due to the non-linear relationship between burnup and neutron source term. ~~*On the other hand, for very short cooling times, with corresponding lower burnups, dose locations that are gamma dominated may show increased dose rates.*~~ *At other locations dose rates are more dominated by contribution from the gamma sources. In these cases, short cooling time and lower burnup combinations with heat load comparable to the higher burnup and corresponding longer cooling time combinations would result in higher dose rates.* However, in those cases, there would always be a compensatory effect, since for each dose location, higher neutron dose rates would be partly offset by lower gamma dose rates and vice versa.

Based on these considerations, representative burnup and cooling time values are selected for all calculations for normal conditions. The selected values are shown in Table 5.0.1. For the accident conditions however, it is recognized that the bounding accident condition is the loss of water in the HI-TRAC VW, a condition that is neutron dominated due to the removal of the principal neutron absorber in the HI-TRAC VW (water). For this case, the upper bound burnup is selected, in order to maximize the neutron source strength of all assemblies in the basket, and a corresponding higher cooling time is selected in order to meet the overall heat load limit in the cask. The resulting burnup and cooling times values for accidents are therefore different from

is negligible. Therefore, the site boundary~~, adjacent, and one meter~~ *doses* for the loaded HI-STORM FW overpack for accident conditions are equivalent to the normal condition doses, which meet the 10CFR72.106 radiation dose limits. . *However, the adjacent and one meter dose rates may be increased, which should be considered in any post-accident activities near the affected cask.*

The design basis accidents analyzed in Chapter 11 have one bounding consequence that affects the shielding materials of the HI-TRAC transfer cask. It is the potential for damage to the water jacket shell and the loss of the neutron shield (water). In the accident consequence analysis, it is conservatively assumed that the neutron shield (water) is completely lost and replaced by a void.

Throughout all design basis accident conditions the axial location of the fuel will remain fixed within the MPC because of the MPC's design features (see Chapter 1). Further, the structural evaluation of the HI-TRAC VW in Chapter 3 shows that the inner shell, lead, and outer shell remain intact throughout all design basis accident conditions. Localized damage of the HI-TRAC outer shell is possible; however, localized deformations will have only a negligible impact on the dose rate at the boundary of the controlled area.

The complete loss of the HI-TRAC neutron shield significantly affects the dose at mid-height (Dose Point #2) adjacent to the HI-TRAC. Loss of the neutron shield has a small effect on the dose at the other dose points. To illustrate the impact of the design basis accident, the dose rates at Dose Point #2 (see Figure 5.1.2) are provided in Table 5.1.4 (MPC-37) for the HI-TRAC VW at a distance of 1 meter and at a distance of 100 meters. The normal condition dose rates are provided for reference. The dose for a period of 30 days is shown in Table 5.1.9, where 30 days is used to illustrate the radiological impact for a design basis accident. Based on this dose rate and the short duration of use for the loaded HI-TRAC transfer cask, it is evident that the dose as a result of the design basis accident cannot exceed 5 rem at the controlled area boundary for the short duration of the accident.

Analyses summarized in this section demonstrate that the HI-STORM FW system, including the HI-TRAC VW transfer cask, is in compliance with the 10CFR72.106 limits.

5.4 SHIELDING EVALUATION

The MCNP-5 code was used for all of the shielding analyses [5.1.1]. MCNP is a continuous energy, three-dimensional, coupled neutron-photon-electron Monte Carlo transport code. Continuous energy cross section data are represented with sufficient energy points to permit linear-linear interpolation between points. The individual cross section libraries used for each nuclide are those recommended by the MCNP manual. ~~All of these data are based on ENDF/B data.~~ *Cross section libraries are based on ENDF/B-V and ENDF/B-VI, except for Sn isotopes where the ENDL92 library is used, and uranium isotopes where LANL/T16 libraries are used. These are the default libraries for the MCNP code version used here [5.1.1].* MCNP has been extensively benchmarked against experimental data by the large user community. References [5.4.2], [5.4.3], and [5.4.4] are three examples of the benchmarking that has been performed.

The energy distribution of the source term, as described earlier, is used explicitly in the MCNP model. A different MCNP calculation is performed for each of the three source terms (neutron, decay gamma, and ^{60}Co). The axial distribution of the fuel source term is described in Table 2.1.5 and Figures 2.1.3 and 2.1.4. The PWR and BWR axial burnup distributions were obtained from References [5.4.5] and [5.4.6], respectively and have previously been utilized in the HI-STORM FSAR [5.2.17]. These axial distributions were obtained from operating plants and are representative of PWR and BWR fuel with burnups greater than 30,000 MWD/MTU. The ^{60}Co source in the hardware was assumed to be uniformly distributed over the appropriate regions.

It has been shown that the neutron source strength varies as the burnup level raised by the power of 4.2. Since this relationship is non-linear and since the burnup in the axial center of a fuel assembly is greater than the average burnup, the neutron source strength in the axial center of the assembly is greater than the relative burnup times the average neutron source strength. In order to account for this effect, the neutron source strength in each of the 10 axial nodes listed in Table 2.1.5 was determined by multiplying the average source strength by the relative burnup level raised to the power of 4.2. The peak relative burnups listed in Table 2.1.5 for the PWR and BWR fuels are 1.105 and 1.195 respectively. Using the power of 4.2 relationship results in a 37.6% ($1.105^{4.2}/1.105$) and 76.8% ($1.195^{4.2}/1.195$) increase in the neutron source strength in the peak nodes for the PWR and BWR fuel, respectively. The total neutron source strength increases by 15.6% for the PWR fuel assemblies and 36.9% for the BWR fuel assemblies.

MCNP was used to calculate doses at the various desired locations. MCNP calculates neutron or photon flux and these values can be converted into dose by the use of dose response functions. This is done internally in MCNP and the dose response functions are listed in the input file in Appendix 5.A. The response functions used in these calculations are listed in Table 5.4.1 and were taken from ANSI/ANS 6.1.1, 1977 [5.4.1].

ORIGEN-S SAMPLE INPUT FILE

```
#ORIGENS
' W17V1 3.6 wt.% U-235 20.4 mw/assembly
' 45000 MWD/MTU
0$$  A4 33 A8 26 A11 71  E
1$$  1 T
W17V1 FUEL -- FT33F001 -
'
' SUBCASE  1 LIBRARY POSITION  1
'
'   lib      pos      grms   photon group
3$$ 33  A3  1  0  A16 2   E T
35$$ 0 T
56$$  5  5  A6 3  A10  0  A13 9  A15 3 A19 1 E
57** 0.0 A3 1.E-5 0.05556 E T
 FUEL 3.6
W17V1 0.469144 MTU
58** 20.4 20.4 20.4 20.4 20.4
60**  1.0000   3.0000  15.0000  30.0000  57.4931
66$$ A1 2 A5 2 A9 2  E
73$$  922350  922340  922360  922380  80000  500000
      260000  240000  400000
74** 16889.17 150.31 77.69 452026.53 63006.6 1874.74
     264.67 143.36 107996.27
75$$  2  2  2  2  4  4  4  4  4  T
'
' SUBCASE  2 LIBRARY POSITION  2
'
3$$ 33  A3   2  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   5  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  3 LIBRARY POSITION  3
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3$$ 33  A3   3  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
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58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
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3$$ 33  A3   4  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
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 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
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' SUBCASE  5 LIBRARY POSITION  5
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3$$ 33  A3   5  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
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W17V1
58** 20.4 20.4 20.4
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66$$ A1 2 A5 2 A9 2  E T
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' SUBCASE  6 LIBRARY POSITION  6
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3$$ 33  A3   6  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  7 LIBRARY POSITION  7
'
3$$ 33  A3   7  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  8 LIBRARY POSITION  8
'
3$$ 33  A3   8  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  9 LIBRARY POSITION  9
'
```

```
3$$ 33  A3   9  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  10 LIBRARY POSITION  10
'
3$$ 33  A3   10  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  11 LIBRARY POSITION  11
'
3$$ 33  A3   11  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  12 LIBRARY POSITION  12
'
3$$ 33  A3   12  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  13 LIBRARY POSITION  13
'
3$$ 33  A3   13  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
```

```
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  14 LIBRARY POSITION  14
'
3$$ 33  A3   14  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  15 LIBRARY POSITION  15
'
3$$ 33  A3   15  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  16 LIBRARY POSITION  16
'
3$$ 33  A3   16  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  17 LIBRARY POSITION  17
'
3$$ 33  A3   17  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE 18 LIBRARY POSITION 18
'
3$$ 33  A3  18  A4 7 0  A16 2  A33 18  E T
35$$ 0 T
56$$  3  3  A6 1  A10  3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
```

```
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE - decay
'
54$$ A8 0 E
56$$ 0 10 A6 1 A10 3 A14 3 A15 0 A19 1 E
57** 0.0 0 1.E-5  E T
60** 0.5 0.8 1.0 4.0 8.0 12.0 24.0 48.0 72.0 96.0
61** F1.0e-5
65$$
'GRAM-ATOMS   GRAMS    CURIES      WATTS-ALL  WATTS-GAMMA
     3Z     0  1  0     1 0 0      1 0 0          3Z          6Z
     3Z     0  1  0     1 0 0      1 0 0          3Z          6Z
     3Z     0  1  0     1 0 0      1 0 0          3Z          6Z
81$$ 2 0 26 1 E
82$$ 2 2 2 2 2 2 2 2 2 2
83**  1.1E+7  8.0E+6 6.0E+6 4.0E+6 3.0E+6 2.5E+6 2.0E+6 1.5E+6
      1.0E+6  7.0E+5 4.5E+5 3.0E+5 1.5E+5 1.0E+5 7.0E+4 4.5E+4
      3.0E+4  2.0E+4 1.0E+4
84**  20.0E+6 6.43E+6 3.0E+6 1.85E+6 1.40E+6 9.00E+5 4.00E+5 1.0E+5 T
' 0.5 hours
' 0.75 hours
' 1.0 hours
' 4.0 hours
' 8.0 hours
' 12.0 hours
' 24.0 hours
' 48.0 hours
' 72.0 hours
' 96.0 hours
'
' SUBCASE - decay
'
54$$ A8 0 E
56$$ 0 9 A6 1 A10 10 A14 4 A15 0 A19 1 E
57** 4.0 0 1.E-5  E T
60** 10.0 20.0 30.0 60.0 90.0 120.0 180.0 240.0 365.0
61** F1.0e-5
65$$
'GRAM-ATOMS   GRAMS    CURIES      WATTS-ALL  WATTS-GAMMA
     3Z     0  1  0     1 0 0      1 0 0          3Z          6Z
     3Z     0  1  0     1 0 0      1 0 0          3Z          6Z
     3Z     0  1  0     1 0 0      1 0 0          3Z          6Z
81$$ 2 0 26 1 E
82$$ 2 2 2 2 2 2 2 2 2 2
83**  1.1E+7  8.0E+6 6.0E+6 4.0E+6 3.0E+6 2.5E+6 2.0E+6 1.5E+6
      1.0E+6  7.0E+5 4.5E+5 3.0E+5 1.5E+5 1.0E+5 7.0E+4 4.5E+4
      3.0E+4  2.0E+4 1.0E+4
84**  20.0E+6 6.43E+6 3.0E+6 1.85E+6 1.40E+6 9.00E+5 4.00E+5 1.0E+5 T
' 10 days
' 20 days
' 30 days
```

```
' 60 days
' 90 days
' 120 days
' 180 days
' 240 days
' 365 days
'
' SUBCASE - decay
'
54$$ A8 0 E
56$$ 0 10 A6 1 A10 9 A14 5 A15 0 A19 1 E
57** 1.0 0 1.E-5  E T
60** 1.5 2.0 3.0 4.5 5.0 6.0 7.0 8.0 9.0 10.0
61** F1.0e-5
65$$
'GRAM-ATOMS   GRAMS    CURIES     WATTS-ALL  WATTS-GAMMA
     3Z     0  1  0     1 0 0     1 0 0         3Z         6Z
     3Z     0  1  0     1 0 0     1 0 0         3Z         6Z
     3Z     0  1  0     1 0 0     1 0 0         3Z         6Z
81$$ 2 0 26 1 E
82$$ 2 2 2 2 2 2 2 2 2 2
83**  1.1E+7  8.0E+6 6.0E+6 4.0E+6 3.0E+6 2.5E+6 2.0E+6 1.5E+6
      1.0E+6  7.0E+5 4.5E+5 3.0E+5 1.5E+5 1.0E+5 7.0E+4 4.5E+4
      3.0E+4  2.0E+4 1.0E+4
84**  20.0E+6 6.43E+6 3.0E+6 1.85E+6 1.40E+6 9.00E+5 4.00E+5 1.0E+5 T
' 1.5 year
' 2 years
' 3 years
' 4.5 years
' 5 years
' 6 years
' 7 years
' 8 years
' 9 years
' 10 years
'
' SUBCASE - decay
'
54$$ A8 0 E
56$$ 0 10 A6 1 A10 10 A14 5 A15 0 A19 1 E
57** 10.0 0 1.E-5  E T
60** 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0
61** F1.0e-5
65$$
'GRAM-ATOMS   GRAMS    CURIES     WATTS-ALL  WATTS-GAMMA
     3Z     0  1  0     1 0 0     1 0 0         3Z         6Z
     3Z     0  1  0     1 0 0     1 0 0         3Z         6Z
     3Z     0  1  0     1 0 0     1 0 0         3Z         6Z
81$$ 2 0 26 1 E
82$$ 2 2 2 2 2 2 2 2 2 2
83**  1.1E+7  8.0E+6 6.0E+6 4.0E+6 3.0E+6 2.5E+6 2.0E+6 1.5E+6
      1.0E+6  7.0E+5 4.5E+5 3.0E+5 1.5E+5 1.0E+5 7.0E+4 4.5E+4
      3.0E+4  2.0E+4 1.0E+4
84**  20.0E+6 6.43E+6 3.0E+6 1.85E+6 1.40E+6 9.00E+5 4.00E+5 1.0E+5 T
' 11 years
' 12 years
```

```
' 13 years
' 14 years
' 15 years
' 16 years
' 17 years
' 18 years
' 19 years
' 20 years
'
' SUBCASE - decay
'
54$$ A8 0 E
56$$ 0 10 A6 1 A10 10 A14 5 A15 0 A19 1 E
57** 20.0 0 1.E-5  E T
60** 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0
61** F1.0e-5
65$$
'GRAM-ATOMS   GRAMS    CURIES     WATTS-ALL  WATTS-GAMMA
     3Z     0  1  0     1 0 0      1 0 0         3Z         6Z
     3Z     0  1  0     1 0 0      1 0 0         3Z         6Z
     3Z     0  1  0     1 0 0      1 0 0         3Z         6Z
81$$ 2 0 26 1 E
82$$ 2 2 2 2 2 2 2 2 2 2
83**  1.1E+7  8.0E+6 6.0E+6 4.0E+6 3.0E+6 2.5E+6 2.0E+6 1.5E+6
      1.0E+6  7.0E+5 4.5E+5 3.0E+5 1.5E+5 1.0E+5 7.0E+4 4.5E+4
      3.0E+4  2.0E+4 1.0E+4
84**  20.0E+6 6.43E+6 3.0E+6 1.85E+6 1.40E+6 9.00E+5 4.00E+5 1.0E+5 T
' 21 years
' 22 years
' 23 years
' 24 years
' 25 years
' 26 years
' 27 years
' 28 years
' 29 years
' 30 years
'
' SUBCASE - decay
'
54$$ A8 0 E
56$$ 0 10 A6 1 A10 10 A14 5 A15 0 A19 1 E
57** 30.0 0 1.E-5  E T
60** 31.0 32.0 33.0 34.0 35.0 36.0 37.0 38.0 39.0 40.0
61** F1.0e-5
65$$
'GRAM-ATOMS   GRAMS    CURIES     WATTS-ALL  WATTS-GAMMA
     3Z     0  1  0     1 0 0      1 0 0         3Z         6Z
     3Z     0  1  0     1 0 0      1 0 0         3Z         6Z
     3Z     0  1  0     1 0 0      1 0 0         3Z         6Z
81$$ 2 0 26 1 E
82$$ 2 2 2 2 2 2 2 2 2 2
83**  1.1E+7  8.0E+6 6.0E+6 4.0E+6 3.0E+6 2.5E+6 2.0E+6 1.5E+6
      1.0E+6  7.0E+5 4.5E+5 3.0E+5 1.5E+5 1.0E+5 7.0E+4 4.5E+4
      3.0E+4  2.0E+4 1.0E+4
84**  20.0E+6 6.43E+6 3.0E+6 1.85E+6 1.40E+6 9.00E+5 4.00E+5 1.0E+5 T
```

```
' 31 years
' 32 years
' 33 years
' 34 years
' 35 years
' 36 years
' 37 years
' 38 years
' 39 years
' 40 years
'
' SUBCASE - decay
'
54$$ A8 0 E
56$$ 0 10 A6 1 A10 10 A14 5 A15 0 A19 1 E
57** 40.0 0 1.E-5  E T
60** 41.0 42.0 43.0 44.0 45.0 46.0 47.0 48.0 49.0 50.0
61** F1.0e-5
65$$
'GRAM-ATOMS   GRAMS    CURIES     WATTS-ALL  WATTS-GAMMA
     3Z      0  1  0     1 0 0      1 0 0          3Z         6Z
     3Z      0  1  0     1 0 0      1 0 0          3Z         6Z
     3Z      0  1  0     1 0 0      1 0 0          3Z         6Z
81$$ 2 0 26 1 E
82$$ 2 2 2 2 2 2 2 2 2 2
83**  1.1E+7  8.0E+6 6.0E+6 4.0E+6 3.0E+6 2.5E+6 2.0E+6 1.5E+6
      1.0E+6  7.0E+5 4.5E+5 3.0E+5 1.5E+5 1.0E+5 7.0E+4 4.5E+4
      3.0E+4  2.0E+4 1.0E+4
84**  20.0E+6 6.43E+6 3.0E+6 1.85E+6 1.40E+6 9.00E+5 4.00E+5 1.0E+5 T
' 41 years
' 42 years
' 43 years
' 44 years
' 45 years
' 46 years
' 17 years
' 48 years
' 49 years
' 50 years
'
' SUBCASE - decay
'
54$$ A8 0 E
56$$ 0 10 A6 1 A10 10 A14 5 A15 0 A19 1 E
57** 50.0 0 1.E-5  E T
60** 51.0 52.0 53.0 54.0 55.0 56.0 57.0 58.0 59.0 60.0
61** F1.0e-5
65$$
'GRAM-ATOMS   GRAMS    CURIES     WATTS-ALL  WATTS-GAMMA
     3Z      0  1  0     1 0 0      1 0 0          3Z         6Z
     3Z      0  1  0     1 0 0      1 0 0          3Z         6Z
     3Z      0  1  0     1 0 0      1 0 0          3Z         6Z
81$$ 2 0 26 1 E
82$$ 2 2 2 2 2 2 2 2 2 2
83**  1.1E+7  8.0E+6 6.0E+6 4.0E+6 3.0E+6 2.5E+6 2.0E+6 1.5E+6
      1.0E+6  7.0E+5 4.5E+5 3.0E+5 1.5E+5 1.0E+5 7.0E+4 4.5E+4
```

```
      3.0E+4  2.0E+4 1.0E+4
84**  20.0E+6 6.43E+6 3.0E+6 1.85E+6 1.40E+6 9.00E+5 4.00E+5 1.0E+5 T
' 51 years
' 52 years
' 53 years
' 54 years
' 55 years
' 56 years
' 57 years
' 58 years
' 59 years
' 60 years
'
' END
'
56$$ F0 T
END
#ORIGENS
' W17V1 3.6 wt.% U-235 20.4 mw/assembly
' 45000 MWD/MTU
0$$  A4 33 A8 26 A11 71  E
1$$  1 T
W17V1 FUEL    FT33F001
'
' SUBCASE  1 LIBRARY POSITION  1
'
'    lib     pos       grms    photon group
3$$ 33  A3   1  0  A16 2    E T
35$$ 0 T
56$$  5  5  A6 3  A10   0  A13 9  A15 3 A19 1 E
57** 0.0 A3 1.E-5 0.05556 E T
 FUEL 3.6
W17V1 0.469144 MTU
58** 20.4 20.4 20.4 20.4 20.4
60**  1.0000   3.0000  15.0000  30.0000  57.4931
66$$ A1 2 A5 2 A9 2  E
73$$  922350  922340  922360  922380  80000  500000
           260000  240000  400000
74** 16869.17 150.31 77.69 452026.53 63006.6 1874.74
          264.67 143.36 107996.27
75$$  2  2  2  2  4  4  4  4  4  T
'
' SUBCASE  2 LIBRARY POSITION  2
'
3$$ 33  A3    2  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10    5  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  3 LIBRARY POSITION  3
'
3$$ 33  A3    3  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10    3  A15 3 A19 1 E
```

```
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  4 LIBRARY POSITION  4
'
3$$ 33  A3    4  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  5 LIBRARY POSITION  5
'
3$$ 33  A3    5  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  6 LIBRARY POSITION  6
'
3$$ 33  A3    6  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  7 LIBRARY POSITION  7
'
3$$ 33  A3    7  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  8 LIBRARY POSITION  8
'
3$$ 33  A3    8  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10   3  A15 3 A19 1 E
```

```
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
!
! SUBCASE  9 LIBRARY POSITION  9
!
3$$ 33  A3    9  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10    3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
!
! SUBCASE  10 LIBRARY POSITION  10
!
3$$ 33  A3    10  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10    3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
!
! SUBCASE  11 LIBRARY POSITION  11
!
3$$ 33  A3    11  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10    3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
!
! SUBCASE  12 LIBRARY POSITION  12
!
3$$ 33  A3    12  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10    3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
!
! SUBCASE  13 LIBRARY POSITION  13
!
3$$ 33  A3    13  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10    3  A15 3 A19 1 E
```

```
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  14 LIBRARY POSITION  14
'
3$$ 33  A3    14  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10    3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  15 LIBRARY POSITION  15
'
3$$ 33  A3    15  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10    3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  16 LIBRARY POSITION  16
'
3$$ 33  A3    16  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10    3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE  17 LIBRARY POSITION  17
'
3$$ 33  A3    17  0  A16 2  A33 0  E T
35$$ 0 T
56$$  3  3  A6 3  A10    3  A15 3 A19 1 E
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
'
' SUBCASE 18 LIBRARY POSITION 18
'
3$$ 33  A3  18  A4 7 0  A16 2  A33 18  E T
35$$ 0 T
56$$  3  3  A6 1  A10  3  A15 3 A19 1 E
```

```
57** 0.0 A3 1.E-5  0.05556 E T
 fuel
W17V1
58** 20.4 20.4 20.4
60** 18.5 37.0 57.4931
66$$ A1 2 A5 2 A9 2  E T
!
! SUBCASE - decay
!
54$$ A8 0 E
56$$ 0 10 A6 1 A10 3 A14 5 A15 0 A19 1 E
57** 0.0 0 1.E-5  E T
60** 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0
61** F1.0e-5
65$$
!GRAM-ATOMS   GRAMS     CURIES      WATTS-ALL  WATTS-GAMMA
      3Z      0  1  0     1 0 0       1 0 0        3Z        6Z
      3Z      0  1  0     1 0 0       1 0 0        3Z        6Z
      3Z      0  1  0     1 0 0       1 0 0        3Z        6Z
81$$ 2 0 26 1 E
82$$ 2 2 2 2 2 2 2 2 2 2
83**  1.1E+7  8.0E+6 6.0E+6 4.0E+6 3.0E+6 2.5E+6 2.0E+6 1.5E+6
      1.0E+6  7.0E+5 4.5E+5 3.0E+5 1.5E+5 1.0E+5 7.0E+4 4.5E+4
      3.0E+4  2.0E+4 1.0E+4
84** 20.0E+6 6.43E+6 3.0E+6 1.85E+6 1.40E+6 9.00E+5 4.00E+5 1.0E+5 T
! 5.0 years
! 10.0 years
! 15.0 years
! 20.0 years
! 25.0 years
! 30.0 years
! 35.0 years
! 40.0 years
! 45.0 years
! 50.0 years
!
! SUBCASE - decay
!
54$$ A8 0 E
56$$ 0 9 A6 1 A10 10 A14 5 A15 0 A19 1 E
57** 50.0 0 1.E-5  E T
60** 55.0 60.0 65.0 70.0 75.0 80.0 85.0 90.0 95.0
61** F1.0e-5
65$$
!GRAM-ATOMS   GRAMS     CURIES      WATTS-ALL  WATTS-GAMMA
      3Z      0  1  0     1 0 0       1 0 0        3Z       6Z
      3Z      0  1  0     1 0 0       1 0 0        3Z       6Z
      3Z      0  1  0     1 0 0       1 0 0        3Z       6Z
81$$ 2 0 26 1 E
82$$ 2 2 2 2 2 2 2 2 2
83**  1.1E+7  8.0E+6 6.0E+6 4.0E+6 3.0E+6 2.5E+6 2.0E+6 1.5E+6
      1.0E+6  7.0E+5 4.5E+5 3.0E+5 1.5E+5 1.0E+5 7.0E+4 4.5E+4
      3.0E+4  2.0E+4 1.0E+4
84** 20.0E+6 6.43E+6 3.0E+6 1.85E+6 1.40E+6 9.00E+5 4.00E+5 1.0E+5 T
55 years
60 years
65 years
70 years
75 years
80 years
```

```
85 years
90 years
95 years
1
1 END
1
56$$ F0 T
END
```

Table 11.2.1 DESIGN MEASURES IN THE HI-STORM FW SYSTEM COMPONENTS THAT MITIGATE DOSE			
	Component	**Description of Design Feature**	**The Design Measure is Effective in Reducing the (A) Site Boundary Dose (B) Occupational Dose**
8.	HI-STORM FW overpack/MPC	The dose from a HI-STORM FW storage system is minimized because of the following advantages: a. Regionalized storage of fuel (cold fuel in the peripheral storage cells) possible because of the Metamic-HT fuel basket and the thermosiphon action-enabled MPC provides self-shielding. *(Note that while loading hotter fuel in the inner cells is a requirement for some but not all loading configurations, it is preferred from an ALARA perspective)* b. Tight packing of overpacks on the ISFSI (that maximizes self-shielding) is possible because a large spacing between the modules is not necessary.	A,B
9.	MPC, HI-TRAC VW	The occupational dose from loading a HI-STORM FW overpack is minimized because of: a. A well-shielded HI-TRAC VW transfer cask. b. Regionalized fuel loading. *(Note that while loading hotter fuel in the inner cells is a requirement for some but not all loading configurations, it is preferred from an ALARA perspective).* c. A short water draining time (less than 2 hours) for the MPC. d. Reduced overall MPC welding time because the welding machine does not have to be removed and replaced to weld the secondary lid. e. Reduced time and personnel needed to install the MPC in the HI-STORM FW overpack due to vertical (gravity-aided) insertion. f. Reduced drying time because of use of porosity-free Metamic-HT.	B

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I, P. Stefan Anton, being duly sworn, depose and state as follows:

(1) I have reviewed the information described in paragraph (2) which is sought to be withheld, and am authorized to apply for its withholding.

(2) The information sought to be withheld is information provided in Attachments 5 6, 7 and 8 to Holtec letter Document ID 5018020. This Attachment contains Holtec Proprietary information.

(3) In making this application for withholding of proprietary information of which it is the owner, Holtec International relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4) and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10CFR Part 9.17(a)(4), 2.390(a)(4), and 2.390(b)(1) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential" (Exemption 4). The material for which exemption from disclosure is here sought is all "confidential commercial information", and some portions also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

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(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by Holtec's competitors without license from Holtec International constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.

c. Information which reveals cost or price information, production, capacities, budget levels, or commercial strategies of Holtec International, its customers, or its suppliers;

d. Information which reveals aspects of past, present, or future Holtec International customer-funded development plans and programs of potential commercial value to Holtec International;

e. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs 4.c, 4.d and 4.e, above.

(5) The information sought to be withheld is being submitted to the NRC in confidence. The information (including that compiled from many sources) is of a sort customarily held in confidence by Holtec International, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by Holtec International. No public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have

been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within Holtec International is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his designee), and by the Legal Operation, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside Holtec International are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information classified as proprietary was developed and compiled by Holtec International at a significant cost to Holtec International. This information is classified as proprietary because it contains detailed descriptions of analytical approaches and methodologies not available elsewhere. This information would provide other parties, including competitors, with information from Holtec International's technical database and the results of evaluations performed by Holtec International. A substantial effort has been expended by Holtec International to develop this information. Release of this information would improve a competitor's position because it would enable Holtec's competitor to copy our technology and offer it for sale in competition with our company, causing us financial injury.

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(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to Holtec International's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of Holtec International's comprehensive spent fuel storage technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology, and includes development of the expertise to determine and apply the appropriate evaluation process.

The research, development, engineering, and analytical costs comprise a substantial investment of time and money by Holtec International.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

Holtec International's competitive advantage will be lost if its competitors are able to use the results of the Holtec International experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to Holtec International would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive Holtec International of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing these very valuable analytical tools.

AFFIDAVIT PURSUANT TO 10 CFR 2.390

STATE OF NEW JERSEY)
) ss:
COUNTY OF BURLINGTON)

P. Stefan Anton, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of her knowledge, information, and belief.

Executed at Marlton, New Jersey, this 23rd day of May, 2012.

P. Stefan Anton
Holtec International

Subscribed and sworn before me this 23rd day of May, 2012.

MARIA C. MASSI
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires April 25, 2015