

**Enclosure 2 to E-54423**

**RAI Responses**

**(Non-Proprietary)**

**RAI TR-1:*****Provide an analysis of radiological impacts to workers from transportation.***

*The analyses of radiological impacts from transportation in ER Sections 4.2.6; 4.2.7; 4.2.8; and Attachment 4-1 do not appear to specifically describe radiological impacts or any dose calculations applicable to transportation workers such as vehicle crew members and escorts, cargo handlers and inspectors, rail yard workers, or to emergency response personnel. For example, the ER incident-free population dose estimate is described as applying to “residents,” and accident calculations do not provide details as to whether the exposed population includes transportation workers. Because workers would be exposed to radiation and risks from the proposed transportation shipments, an analysis of radiological impacts that addresses workers should be included as part of the transportation impact analysis. This is consistent with NRC guidance in NUREG–1748, which states that radiological impacts to both the public and workers should be evaluated (NRC, 2003).*

This information is needed in accordance with 10 CFR 51.45(c), which requires analyses in ERs to be quantitative to the fullest extent practicable.

**Response to RAI TR-1:**

The Environmental Report has been revised to add Section 4.2.7.2, *Incident Free Occupational Doses*. The new section address occupational doses for transportation workers, including vehicle crew members and escorts, cargo handlers and inspectors, rail yard workers, and emergency response personnel. The spreadsheet used to calculate the occupational doses is presented in Table 4.1-4 of Attachment 4-1.

**Impact:**

ER Section 4.2.7.2 has been added and Attachment 4-1 is updated as described in the response.

RAI TR-2:

**Provide additional information on RADTRAN code transportation dose and risk assessment input parameter selections.**

*A subset of RADTRAN code input parameters is tabulated or otherwise described in the ER (Sections 4.2.6; 4.2.7, 4.2.8, and Attachment 4-1). If any other RADTRAN input parameters that were used in any ER transportation radiological risk assessment calculations (addressing both incident-free transportation and accidents) were modified from code defaults, these parameters should be identified along with the technical bases and applicable source references for parameter values. Complete documentation of the calculation inputs is necessary for the NRC staff to evaluate the technical correctness and applicability of these calculations to the proposed action.*

This information is needed in accordance with 10 CFR 51.45(c), which requires ERs to contain sufficient data to aid the NRC in its development of an independent analysis.

**Response to RAI TR-2:**

In responding to the Transportation RAIs, ISP reviewed the original calculation and decided to regenerate the basis transportation evaluation consistent with the TN Americas Quality Assurance Requirements for licensing activities. Although there are small changes to the output values, the conclusions remain the same as the original evaluation described in Section 4.2 of the ER.

None of the default values used in RADTRAN 6 are modified in the original or revised ISP evaluation for incident-free transportation and accidents. These default values are listed in the RADTRAN 6 User Guide on pages 114 and 115, starting with the input parameter MODSTD and ending with RPCTHYROID.

The non-default input parameters that were used in the ISP RADTRAN 6 analysis are summarized in Table 4.2-1 of Attachment 4-1 of the Environmental Report.

**References:**

1. RADTRAN6/RadCat 6 User Guide, SAND2013-8095. September 2013.

**Impact:**

ER Attachment 4-1 has been revised as described in the response.

**RAI TR-3:**

**Provide the input and output files for transportation dose and risk calculations conducted with the RADTRAN and WebTRAGIS codes and provide links to the applicable ER analyses.**

*ER Sections 4.2.6, 4.2.7, 4.2.8, and Attachment 4-1 indicate that transportation doses and risks were calculated using the RADTRAN code for risk assessment and the WebTRAGIS code for routing. Code input and output files will allow the NRC staff to verify that the computer code runs support the calculation methods, assumptions, input parameters, and results that are described in the ER. Because the ER includes several different transportation dose/risk calculations, information should also be provided that links specific files to the applicable ER analysis results (e.g., 3 incident-free representative routes; 3 types of accident analyses; 12 short-distance heavy-haul truck or barge routes).*

This information is needed in accordance with 10 CFR 51.45(c), which requires ERs to contain sufficient data to aid the NRC in its development of an independent analysis.

**Response to RAI TR-3:**

The RADTRAN and WebTRAGIS input/output files that were used in the ISP environmental report are summarized below and included in Enclosure 5 of this submittal.

RADTRAN files

The RADTRAN calculations are based on the development of a unit risk factor. The concept is explained in Section 5.20 of the RADTRAN 5 User Guide and was used in NRC's risk study, NUREG-2125. The unit risk factor is used in analyzing doses along the three incident-free representative routes and twelve short-distance heavy-haul truck or barge routes. The results in the RADTRAN output are also used in the accident analysis.

1. UNIT RISK FACTOR.INPUT
2. UNIT RISK FACTOR.OUTPUT
3. UNIT RISK FACTOR2.INPUT
4. UNIT RISK FACTOR2.OUTPUT

The only difference between the two RADTRAN input/output files are that the UNIT RISK FACTOR files calculate doses for accidents with releases and UNIT RISK FACTOR2 files calculate accident doses for Loss of Shielding. Both sets of files are identical as they relate to occupational and incident free transport.

Web TRAGIS Files

The WebTRAGIS files provide route data (distance and population density) along the three incident-free representative routes and twelve short-distance heavy-haul truck or barge routes.

1. Big Rock Point
  - a. Big Rock Point to Cadillac MI (Heavy Haul Truck)

- b. Cadillac MI to Monahans TX (Rail)
2. Connecticut Yankee
  - a. Haddam Neck to Middletown Junction (Heavy Haul Truck)
  - b. Middletown Junction to Monahans TX (Rail)
  - c. Haddam Neck to New Haven CT (Barge)
  - d. New Haven CT to Monahans TX (Rail)
3. Crystal River
  - a. Crystal River to Monahans TX (Rail)
4. Humboldt Bay
  - a. Humboldt Bay to San Francisco, CA (Barge)
  - b. San Francisco, CA to Monahans TX (Rail)
5. Kewaunee
  - a. Kewaunee to Green Bay, WI (Heavy Haul Truck)
  - b. Green Bay, WI to Monahans TX (Rail)
6. LaCrosse
  - a. LaCrosse to Genoa WI (Barge)
  - b. Genoa WI to Monahans TX (Rail)
  - c. LaCrosse to Monahans TX (Rail)
7. Maine Yankee
  - a. Maine Yankee to Portland ME (Barge)
  - b. Portland ME to Monahans TX (Rail)
  - c. Maine Yankee to Monahans TX (Rail)
8. Rancho Seco
  - a. Rancho Seco to Monahans TX (Rail)
9. San Onofre
  - a. San Onofre to Monahans TX (Rail)

10. Trojan

- a. Trojan to Willamette River, Portland OR (Barge)
- b. Willamette River, Portland OR to Monahans TX (Rail)
- c. Trojan to Monahans TX (Rail)

11. Yankee Rowe

- a. Yankee Rowe to Albany NY (Heavy Haul Truck)
- b. Albany NY to Monahans TX (Rail)
- c. Yankee Rowe to Monahans TX (Rail)

12. Zion

- a. Zion to Rock Island-Davenport (Barge)
- b. Rock Island-Davenport to Monahans TX (Rail)
- c. Zion to Monahans TX (Rail)

13. WCS to Yucca Mountain

**References:**

- 1. RADTRAN 5 User Guide, SAND2003-2354, July 2003

**Impact:**

No change as a result of this RAI.

**RAI TR-4:****Provide post- processing dose and risk calculation spreadsheets used to assess radiological impacts from transportation.**

*ER Sections 4.2.6.1 and Attachment 4-1 indicate that transportation dose results were calculated using spreadsheets. These ER Sections indicated that these spreadsheets incorporated the results of RADTRAN code output (unit risk factors) and WebTRAGIS output (routing details) to calculate transportation doses. The requested information will allow the NRC staff to verify that the calculations are technically correct and consistent with the methods, assumptions, input parameters, and results described in the ER.*

This information is needed in accordance with 10 CFR 51.45(c), which requires ERs to contain sufficient data to aid the NRC in its development of an independent analysis.

**Response to RAI TR-4:**

The post-processing dose and risk calculation spreadsheets used to assess radiological impacts from transportation are included in Enclosure 5 of this submittal.

Copies of the pertinent section of the updated spreadsheets are also included in Table 4.1-3 of Attachment 4-1.

**Impact:**

ER Attachment 4-1 has been revised as described in the response.

**RAI TR-5:****Provide the transportation study that is referenced in ER Section 4.2.6 as Attachment 4.1.**

*ER Section 4.2.6 describes that the transportation analysis evaluated both incident-free transportation and accidents and references a study entitled “Transportation of Spent Nuclear Fuel to and from the Waste Control Specialists Proposed Consolidated Interim Storage Facility” in “Attachment 4.1” for the analysis. ER Section 4.2.8 (Impacts from Transportation Accidents) also references Attachment 4.1 for more details on accident dose risks. The ER does not appear to have an attachment with that number or title. The ER does include an Attachment 4-1 that contains information supporting RADTRAN incident-free calculations and WebTRAGIS routing, but does not appear to describe accident analysis methods or calculations.*

*As a result, please provide further information on the methodology or calculations used to determine the impacts of transportation accidents. If this information is included in an analysis that was omitted from the Environmental Report, that may be used to satisfy this request. The requested information will allow the NRC staff to verify that the application contains complete and accurate references.*

This information is needed in accordance with 10 CFR 51.45(c), which requires ERs to contain sufficient data to aid the NRC in its development of an independent analysis.

**Response to RAI TR-5:**

The reference to the transportation study, “Transportation of Spent Nuclear Fuel to and from the Waste Control Specialists Proposed Consolidated Interim Storage Facility” has been removed from Section 4.2.6 of the Environmental Report. The information on the methodology and calculations used to determine the impacts of transportation accidents are contained in Attachment 4-1 *Explanation of Transportation Analysis* as revised. Attachment 4-1 has been revised to include the pertinent portions of the spreadsheets used to calculate transportation impacts.

The methods and calculations used to estimate the radiological impacts from transportation are further described in ISP Calculation WCS01-0506, Revision 0, *Radiological Impacts of Transportation – Environmental Report*, which is included in Enclosure 4 of this submittal

**Impact:**

ER Section 4.2.6 and Attachment 4-1 have been revised as described in the response.

**RAI TR-6:****Clarify the source documents that were used for calculating transportation accident impacts.**

*ER Section 4.2.8.2 (Accident Involving a Release of Radioactive Materials) states that accidents involving release of radioactive materials were evaluated by the RADTRAN code but the section does not appear to state whether ISP conducted these code calculations, or if they were from another source. If the RADTRAN calculations were from a prior analysis, the applicable analysis documentation should be referenced. If the RADTRAN calculations were conducted specifically for the ER, that should be clarified and information supporting the code runs including methods, assumptions, inputs, and results should be provided. The requested information will allow the NRC staff to evaluate the technical correctness and applicability of these calculations to the proposed action.*

This information is needed in accordance with 10 CFR 51.45(c), which requires ERs to contain sufficient data to aid the NRC in its development of an independent analysis.

**Response to RAI TR-6:**

Section 4.2.8.2 of the Environmental Report has been revised to clarify that the transportation impacts are based on calculations performed by ISP. The RADTRAN input and output files are included in Enclosure 5 of this submittal, and ISP Calculation WCS01-0506, Revision 0, Radiological Impacts of Transportation – Environmental Report, which is included in Enclosure 4 of this submittal, includes the calculation for transportation accident impacts.

**Impact:**

ER Section 4.2.8.2 has been revised as described in the response.

**RAI TR-7:****Provide the radionuclide inventory used in transportation accident release calculations.**

*ER Section 4.2.8.2 (Accident Involving the Release of Radioactive Material) states that the radionuclide inventory used for estimating transportation accident consequences is provided in Attachment 4-1. The inventory information is not provided in Attachment 4-1. The RADTRAN code uses package release fractions in these accident calculations; therefore, the calculated release and dose are a function of the radionuclide inventory. The requested information will allow the NRC staff to review the technical correctness of the transportation accident dose calculations.*

This information is needed in accordance with 10 CFR 51.45(c), which requires ERs to contain sufficient data to aid the NRC in its development of an independent analysis.

**Response to RAI TR-7:**

The radionuclide inventory used in the RADTRAN calculations performed by ISP to calculate releases during transportation accidents is provided in Table 4.1-2 of Attachment 4-1 entitled "Transportation of Spent Nuclear.

The radionuclides and values are based on a NUHOMS<sup>®</sup> 61BT canister containing sixty-one 7x7 BWR assemblies in the NUHOMS<sup>®</sup> MP197 shipping cask. The SNF has a burnup of 40,000 MWd/MTU, an initial average bundle enrichment of 3.3 weight percent and is 10 year cooled. The source for this data is Table 4-1, *Radionuclide Inventory*, in *NUHOMS<sup>®</sup> MP197 Transportation Package Safety Analysis Report*, Revision 17 (April 2014). Section 4.2.8.2 is updated to include the above basis for the radionuclides.

**Impact:**

ER Sections 4.2.8.2 and 9.0 along with Attachment 4-1 have been revised as described in the response.

**RAI TR-8:****Review tabulated loss-of-shielding transportation accident risk analysis results and make necessary corrections.**

*ER Section 4.2.8.3 [Loss-of-Shielding (LOS) Accidents] refers to results in ER Table 4.2-9 and states that the highest calculated dose is 0.12 rem; however, the table shows a higher calculated dose of 0.26 rem for the Maine Yankee Route. Inconsistent statements in the ER should be corrected.*

This information is needed in accordance with 10 CFR 51.45(c), which requires ERs to contain sufficient data to aid the NRC in its development of an independent analysis.

**Response to RAI TR-8:**

ISP revised Section 4.2.8.3 to recalculate LOS accident dose rates and dose risk for the maximum exposed individual (MEI), which are not route specific. This includes revision to Table 4.2-9 (now Table 4.2-16) and the addition of Table 4.2-17 which contains the pertinent portions of the spreadsheet used to calculate the impacts from accidents resulting in loss of shielding. The MEI is evaluated for an unshielded individual located with a range of 1 to 100 meters from the cask for a period of 1 hour.

**Impact:**

ER Section 4.2.8.3 and Table 4.2-16 (previously Table 4.2-9) and Table 4.2-17 have been revised as described in the response.

**RAI TR-9:**

**Provide a missing reference for a cited NRC study in the non-radiological transportation risk analysis and describe the applicability of the analysis to the ISP proposal.**

*ER Section 4.2.9 (Non-radiological Risks) refers to an NRC analysis of non-radiological transportation risks from shipping SNF to a repository without reference to the analysis. Additionally, this entire section is based on analysis and discussion that is not specific to the ISP proposal with no discussion that links the referenced analyses to the impact analyses and conclusions. The incomplete reference information in the ER should be provided. Additionally, a description of the applicability of referenced analyses to the proposed project should be added so that the technical basis for adoption of results in the ER is clear and transparent with clear linkage of these analyses to any specific impact conclusions.*

This information is needed in accordance with 10 CFR 51.45(c), which requires ERs to contain sufficient data to aid the NRC in its development of an independent analysis.

**Response to RAI TR-9:**

Section 4.2.9 of the Environmental Report has been revised to clarify the source of all information used in the non-radiological transportation impact analysis. The analysis also provides a clearer description of how the analysis is directly applicable to transportation of SNF to the WSC CISF.

**References:**

1. The Final Waste Management Programmatic Environmental Impact Statement for Management, Storage and Disposal of Radioactive and Hazardous Materials, Volume IV, Appendix E, Radioactive and Hazardous Waste Transportation Risk Assessment, DOE/EIS-0200-F.

**Impact:**

ER Section 4.2.9 has been revised as described in the response.

**RAI TR-10:****Revise transportation sections to clarify attribution.**

*ER Sections 4.2.6, 4.2.7, 4.2.8, 4.2.9, and Attachment 4-1 are written in passive voice that lacks information about attribution (specifically, what parties conducted which analyses). These sections should be reviewed and revised to unambiguously attribute all ISP methods, analyses, assumptions, and conclusions to ISP and attribute other analyses to properly referenced sources.*

This information is needed in accordance with 10 CFR 51.45(c), which requires ERs to contain sufficient data to aid the NRC in its development of an independent analysis.

**Response to RAI TR-10:**

Sections 4.2.6, 4.2.7, 4.2.8, 4.2.9, and Attachment 4-1 of the Environmental Report is revised to clearly identify the source for all of the input/information that is used to develop the transportation evaluations performed by ISP with applicable justification for its use.

**Impact:**

ER Section 4.2.6, 4.2.7, 4.2.8, 4.2.9, and Attachment 4-1 have been revised as described in the response.