U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

MACCS Consequence Analysis Demonstration Calculations for an Example Heat Pipe Reactor Source Term

Date Published: March 2023

Prepared by:

A.J. Nosek, PhD, U.S. Nuclear Regulatory Commission

EXECUTIVE SUMMARY

MACCS [1][2] is a U.S. Nuclear Regulatory Commission (NRC) computer code for radiological consequence analysis of airborne radioactive material releases into the environment. It has been used and developed over several decades for analyzing atmospheric releases from reactor accidents, spent fuel pool accidents, and dry cask storage accidents; accidents involving multiple release sources; and other accidents.

Current MACCS efforts include developing and demonstrating analytical capabilities to support regulatory readiness for licensing non-LWR technologies under Strategy 2 of the "NRC Non-Light Water Reactor Near-Term Implementation Action Plans" [3], issued July 2017 (Agencywide Documents Access and Management System Accession No. ML17165A069). For example, because of the potential of smaller exclusion area boundaries of non-light water reactor, modeling capabilities have been added to MACCS to provide more accurate plume-concentration predictions at less than 0.50 kilometers (0.31 miles) from the release point.

This report describes a demonstration of MACCS capabilities using as input the core radionuclide inventory and atmospheric release from example SCALE and MELCOR demonstration calculations by Oak Ridge National Laboratories [4] and Sandia National Laboratories [5], respectively, for a publicly available heat-pipe-reactor conceptual design. The example MELCOR demonstration calculations were performed to assess MELCOR's ability to simulate accidents for non-LWRs and enable dialogue with stakeholders. The project included adding models (e.g., a heat pipe model) to extend MELCOR to non-LWRs and performing example MELCOR calculations for publicly available non-LWR conceptual designs. The MELCOR calculations are considered example calculations because they include assumptions regarding certain plant features selected solely to demonstrate MELCOR modeling capabilities. Because the staff used an example atmospheric release from the MELCOR demonstration project as input to MACCS, the radiological consequence results from MACCS are considered example results and are not intended to reflect realistic radiological consequences for an actual non-LWR.

The results of our evaluation confirm that the MACCS code is flexible in analyzing the offsite consequences of an example postulated heat-pipe reactor accident release. The code includes flexible input decks that can be made plant-specific, site-specific, and accident specific by modifying a subset of input parameters and input files. As new information becomes available, RES staff may assess whether further enhancements to the MACCS code are needed.

This report has identified several candidate future research activities:

- continue to demonstrate MACCS capabilities using as input the core radionuclide inventory and atmospheric release from the example SCALE and MELCOR demonstration calculations,
- continue the evaluation of radionuclides in non-LWR inventories important to dose and expanding these evaluations to include ingestion doses,
- develop a method to analyze or conservatively bound accidents with simultaneous release and fission, and
- develop methods to analyze or conservatively bound the impact of additional radionuclide chemical and physical forms and how they may transform in the environment.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

BWR	boiling-oilingwater reactor
EPA	Environmental Protection Agency
HPR	heat pipe reactor
ICRP-60	International Commission on Radiological Protection Publication 60
INL	Idaho National Laboratory
LANL	Los Alamos National Laboratory
LWR	light-water reactor
MTIHM	metric tons of initial heavy metal
NRC	U.S. Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
PAG	Protective Action Guide
PRA	probabilistic risk assessment
RG	regulatory guide
SNL	Sandia National Laboratories
SPR	special purpose reactor
TOP	transient overpower

LIST OF ELEMENTS AND CHEMICALS

BeO	beryllium oxide
B_4C	boron carbide
CsI	cesium iodide
Cs_2MoO_4	cesium molybdate
CsOH	cesium hydroxide
I_2	gaseous iodine
UO_2	uranium oxide
Ag	silver
As	arsenic
Cd	cadmium
Cm	curium
Cs	cesium
Eu	europium
Ge	germanium
I	iodine
In	indium
Nb	niobium
Nd	neodymium
Np	neptunium
Pd	palladium
Pm	promethium
Pr	praseodymium
Pu	plutonium
Ra	radium
Rb	rubidium
Rn	radon
Sb	antimony
Sm	samarium
Tc	technetium
Th	thorium
U	uranium
Xe	xenon
Zr	zirconium

LIST OF UNITS OF MEASURE

BTU/hr	British thermal units per hour
Ci	curies
ft	feet
g	grams
GWd/MTIHM	gigawatt-days per metric ton of initial heavy metal
ha	hectare
J/s	joules per second
K	Kelvin
kJ/kg-K	kilojoules per kilogram-Kelvin
km/h	kilometers per hour
kW	kilowatt
lb	pound
m	meter
mph	miles per hour
MW	megawatt
mSv	millisievert
psi	pounds per square inch

1 INTRODUCTION AND PURPOSE

To ensure readiness to review advanced reactor designs, the U.S. Nuclear Regulatory Commission (NRC) staff continues to assess design information, experimental data, and analytical tools needed for non-light-water reactors (non-LWR) reviews. In 2020-2021, the NRC staff issued "Approach for Code Development in Support of NRC's Regulatory Oversight of Non-Light Water Reactors" [6] and a series of five volumes [7] that document a comprehensive plan for developing computer code capabilities to support non-LWR reviews. This plan describes the code development approach, the codes themselves, knowledge gaps, and necessary development activities. Volume 3 of the series, "NRC Non-Light Water Reactor (Non-LWR) Vision and Strategy–Computer Code Development Plans for Severe Accident Progression, Source Term, and Consequence Analysis," includes the development plan for the MACCS code (Agencywide Documents Access and Management System Accession No. ML20030A178).

The NRC staff continues to develop proof-of-concept reference designs for non-LWRs. This report describes a demonstration project using the MACCS accident consequence analysis code to analyze an accident scenario from a heat pipe reactor (HPR). This report assesses the extent to which the MACCS code can be used to reasonably analyze HPR accident consequences. The HPR design analyzed in this report is a fast-spectrum reactor known as the Idaho National Laboratory (INL) Design A concept.

The MACCS code suite is the NRC's computer code system for probabilistic consequence analysis. The MACCS code models atmospheric releases of radioactive materials into the environment and the subsequent consequences of such releases. MACCS is the only tool for probabilistic modeling of all the technical elements of the Level 3 probabilistic risk assessment standard [8], including radionuclide release, atmospheric transport and dispersion, meteorology, protective actions and site data, dosimetry, health effects, economic factors, and uncertainty. MACCS has a long, active development history and a broad user base, including the NRC, the U.S. Department of Energy, the nuclear industry, academia, and domestic and international research organizations. MACCS applications are numerous and include regulatory cost-benefit analysis, environmental analysis of severe accident mitigation alternatives and design alternatives, level 3 probabilistic risk assessment studies, consequence analyses, and other risk-informed activities.

The MACCS code suite [1][2] has been actively used and developed over several decades. The suite of codes includes the user interface, WinMACCS, and various pre- and post-processor codes, including MelMACCS [9], SecPop [10], COMIDA2 [11], and an animations tool, AniMACCS [12]. MelMACCS is a preprocessor code that converts source term data from MELCOR into MACCS format. SecPop is another preprocessor code that facilitates the use of site-specific population, land use, and economic data. The COMIDA2 preprocessor is used to provide food chain input parameters for MACCS ingestion dose calculations. Lastly, AniMACCS, the MACCS animations tool, enables visualization of atmospheric dispersion and resulting air and ground concentrations around a site for a given weather trial.

The MACCS code suite is a flexible code system. Its input decks can generally be made plant specific, site specific, and accident specific by modifying a subset of the hundreds of input parameters and the handful of input files. MACCS is used for analyzing atmospheric releases from reactors, spent fuel pool accidents, dry cask storage accidents, accidents involving multiple release sources, and other radiological releases, each with its own accident timeline. However,

MACCS has primarily been used to analyze the consequences of atmospheric releases from accidents at conventional large light-water reactors (LWRs).

For consequence analysis, some of the key characteristics for advanced reactors may be reasonably addressed by modifying selected MACCS input parameters and input files. However, other characteristics may be better addressed with MACCS code changes beyond changing input parameter values. Sandia National Laboratories (SNL) evaluated non-LWR-specific modeling challenges for MACCS [13]. Based on these evaluations, SNL has added new models to MACCS version 4.1 to improve the treatment of nearfield atmospheric transport and dispersion and building wake effects. These new MACCS nearfield modeling capabilities have been benchmarked and compared favorably with other atmospheric transport codes [14]. Whereas the standard Gaussian plume and puff models have been questioned for distances of less than 500 meters (m), the new capabilities allow for more detailed probabilistic dose calculations to within 50 m. This capability may help evaluate the exceedance of nearfield dose levels resulting from an accident of a smaller reactor design to inform emergency planning and other types of decisions.

The MACCS analysis of the HPR is based on a SCALE core inventory calculation from Oak Ridge National Laboratories (ORNL) [4] and a MELCOR accident scenario and source term from SNL [5]. The MELCOR model design of the HPR INL Design A uses high-assay, low-enrichment uranium fuel with steel cladding that employs heat pipes to transfer heat to a secondary Brayton air cycle. The core region is surrounded by a stainless-steel shroud, alumina reflector, core barrel, and boron carbide neutron shield. The reactor is secured inside a below-grade cavity, with the operating floor located above the cavity.

The example MELCOR demonstration calculations were performed to assess MELCOR's ability to simulate accidents for non-LWRs and enable dialogue with stakeholders. The project included adding models (e.g., a heat pipe model) to extend MELCOR to non-LWRs and performing example MELCOR calculations for publicly available non-LWR conceptual designs. The MELCOR calculations are considered example calculations because they include assumptions regarding certain plant features selected solely to demonstrate MELCOR modeling capabilities. Because the staff used an example atmospheric release from the MELCOR demonstration project as input to MACCS, the radiological consequence results from MACCS are considered example results and are not intended to reflect realistic radiological consequences for an actual non-LWR.

The INL Design A concept of an HPR originates from the Kilopower project. The Kilopower [15][16] project was a small, 10-kilowatt HPR developed in 2015 by Los Alamos National Laboratory (LANL) and the National Aeronautics and Space Administration to power deep space missions or planetary surface outputs to support human exploration and colonization. Researchers at LANL scaled up the Kilopower design to 5 megawatts (MW) thermal, and it was dubbed the Special Purpose Reactor (SPR) and also known as the Megapower reactor [17]. The SPR design consists of heat pipes and uranium oxide (UO_2) with a uranium (U)-235 fuel enrichment of 19.75 weight percent. These heat pipe and fuel elements are arranged in a hexagonal array and are placed within channels in the grade 316 stainless steel (SS316) monolithic core structure. INL completed a phenomena identification and ranking table assessment of the LANL concept to identify potential technical and safety issues [18]. This assessment identified issues mainly regarding the SS316 monolith. Therefore, INL proposed two alternatives to the SPR design: Design A and Design B [19]. Models for SCALE, MELCOR, and MACCS were developed for the INL Design A concept of the HPR.

2 METHODOLOGY, INPUTS, AND ASSUMPTIONS

This report documents the ability of MACCS to model an advanced reactor design and identify potential gaps that may exist in conducting such an analysis. This report also aims to evaluate the new nearfield modeling capabilities of the MACCS code [14] and a new set of radionuclides based on the HPR core inventory [20]. This code demonstration using MACCS v4.1 continues the work that began with SCALE and MELCOR. ORNL has developed a SCALE model to compute the radionuclide core inventory of the INL Design A of an HPR. Likewise, SNL has developed a MELCOR model to simulate postulated accidents of the INL Design A reactor design. This analysis uses the radionuclide core inventory from the SCALE evaluation [4] and an atmospheric source term from the MELCOR evaluation [5] as part of the analysis.

2.1 Accident Scenario Description

The example source term used in this analysis is from a MELCOR-modeled accident scenario of a transient overpower (TOP) event documented in SAND2022-2745, “MELCOR Accident Progression and Source Term Demonstration Calculations for a Heat Pipe Reactor,” issued March 2022 [5]. Some of the MELCOR modeling conditions in SAND2022-2745 may be based on a decision to examine the capabilities of the code. As such, they are not solely an attempt to represent the most risk-important accident sequences. The MELCOR and MACCS HPR project staff selected the TOP scenario for consequence analysis because the other two postulated scenarios analyzed, the loss of heat sink and anticipated transient without scram, did not result in fuel damage.

The TOP scenario is initiated with an inadvertent rotation of the control drums surrounding the HPR core such that the B4C arcs turn away from the reactor core. The rotation causes an increase in the core reactivity. A complete HPR design would have a reactor protection system for automatic emergency control rod insertion. However, in order to allow for reactor core damage to be able to test computer code capabilities, the modeling of accident progression assumes this automatic emergency control rod shutdown system does not operate. During the accident scenario, the reactor power increases from 5 to 8 megawatts. When the peak fuel temperature reaches 2,200 Kelvin (3,500 degrees Fahrenheit), approximately 1 hour after the event begins, the MELCOR project team assumes that operators manually terminate the fission reaction by inserting the emergency control rods. In this scenario, plume release to the atmosphere begins just before 1 hour, a little before the reactor is shut down.

The MELCOR project team also assumes the following:

- Iodine inventory is 5 percent gaseous iodine (I_2) and 95 percent cesium iodide (CsI).
- The remainder of the cesium inventory is 80 percent cesium molybdate (Cs_2MoO_4) and 20 percent cesium hydroxide (CsOH).
- The baseline building leakage is equivalent to that of a boiling-water reactor (BWR) building (i.e., 100 percent/day at 1700 pascals (0.25 pounds per square inch)).
- The external wind has a negligible impact on atmospheric release.

The MELCOR analysis of the TOP scenario resulted in a very small puff release, with an iodine atmospheric release of just 0.0008 percent of the total iodine fuel inventory within the first

24 hours. However, MELCOR sensitivity calculations evaluated the impact of external wind from 0 to 10 miles per hour (16.1 kilometers per hour) and increased building leakage of up to a factor of 100. These sensitivity calculations resulted in a change in the iodine release fractions by roughly a factor of 100 as shown in Figure 2-1.

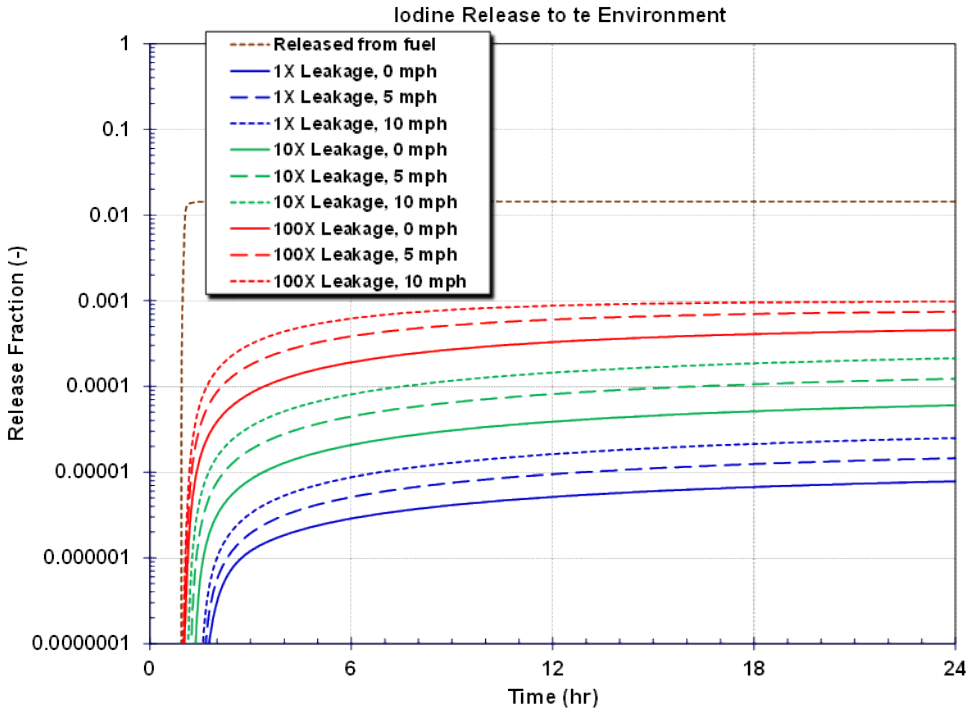

Figure 2-1 Iodine Release to the Environment in the MELCOR TOP Sensitivity Calculations (from figure 4-8 of SAND2022-2745 [5]).

2.2 MACCS Modeling Setup

This analysis begins with a new sample problem being developed at the NRC incorporating input values based on NUREG/CR-7270, “Technical Bases for Consequence Analysis Using MACCS (MELCOR Accident Consequence Code System),” issued October 2022 [21]. The weather for this sample problem is based on the 2012 meteorological data for Sequoyah Nuclear Plant, the same data used for the SOARCA Sequoyah project (NUREG/CR-7245, “State-of-the-Art Reactor Consequence Analyses (SOARCA) Project: Sequoyah Integrated Deterministic and Uncertainty Analyses,” issued October 2019 [22]). Then, the analyst updated many MACCS settings in designing a base case scenario, as discussed in the following sections. Since the project was not intended to create a site-specific analysis, the analysis did not use a site file.

Appendix A shows all the MACCS settings for the base case scenario. This analysis also included several sensitivity analyses. Appendices B through E document the settings for these sensitivity analyses. Appendix F shows the general settings used to update the sample problem. These settings are redundant to those provided in appendix A but summarize general changes made for this analysis. Appendix G shows the MelMACCS source term file for the HPR, and

appendix H shows the MelMACCS inventory file based on the HPR SCALE depletion calculation.

2.2.1 Heat Pipe Reactor Inventory

The HPR inventory is based on a SCALE calculation documented in ORNL/TM-2021/2021, "SCALE Modeling of the Fast-Spectrum Heat Pipe Reactor," issued in 2021 [4]. The SCALE model contains 1,134 heat pipes surrounded by hexagonal fuel elements with a potassium working fluid; the fuel is UO_2 with 19.75 percent weight enrichment of U-235. The model contains axial beryllium oxide (BeO) reflectors above and below the active fuel region, along with a radial alumina reflector containing 12 boron carbide (B_4C) control drums. The center of the core is left unfueled to make room for two shutdown control rods, one annular and one solid. The core barrel and corrugated support structure are made of grade 316 stainless steel, and the radiation shield is made of B_4C.

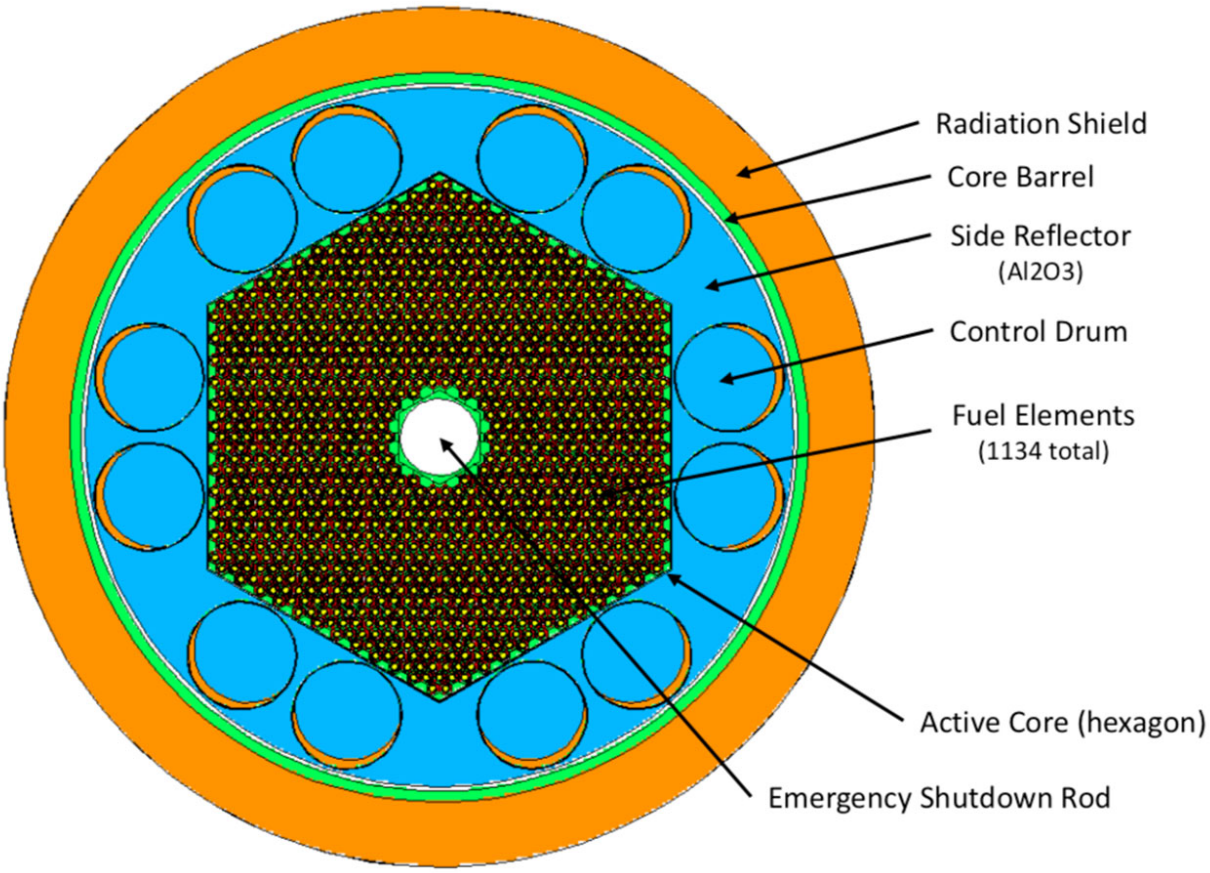

Figure 2-2 INL Design A reactor vessel cross-section. (From figure 3-1 of SAND2022 2745 [5].)

For exchanging nuclide inventory data with the MELCOR and MACCS teams, the SCALE analysts at ORNL developed a new inventory interface file format and Python scripts to process the inventory interface file.[1]

For MACCS analysis, ORNL provided the isotope mass (grams) and activity (curies) of the HPR 5 MW "AT_POWER" response at the beginning, middle, and end of life. This analysis selected the end of life, which corresponds to a time of 5 years and a burnup of 2 gigawatt days/metric ton of initial heavy metal (GWd/MTIHM). The ORNL script uses a radionuclide cutoff of $1x10^{-12}$ grams and $1x10^{-15}$ curies. The analyst formatted the inventory data as MelMACCS inventory data, as seen in appendix H.

One limitation of using these data is that they represent the inventory just before the reactivity accident and the reactor shutdown. MACCS considers only decay and ingrowth from radioactive decay. MACCS assumes that the reactor is shut down at the beginning of the accident scenario and that there is no more production from fission and activation.

The TOP scenario is a reactivity-initiated accident that begins when the inadvertent rotation of the control drums adds positive reactivity to the reactor core. This starts at the beginning of the accident scenario and continues for just more than 1 hour before the reactor is shut down. This period of additional operation and increase in reactor power can change the reactor inventory makeup, which is not accounted for in the analysis.

The analyst conducted a sensitivity analysis of the release timing relative to the time of reactor shutdown. While it does not fully address the issue, it does provide insights into how the time between shutdown and exposure can affect consequences. Section 3.5 shows the results of this sensitivity analysis.

2.2.2 Heat Pipe Reactor Source Term

The source term is based on a MELCOR analysis documented in SAND2022-2745 [5].

This analysis used MelMACCS version 4.0.0 beta to read the plot file from the MELCOR calculation and to create a MACCS patch file containing the source term data. According to the MELCOR analysis, the reactor building is modeled as two compartments, as shown in Figure 2-3. The lower compartment has a model elevation from 8.15 m to 12.725 m (26.7 feet (ft) to 41.75 ft) and a free volume of 2,125 m^3 (75,110 ft^3), and the upper compartment has a model elevation from 12.725 m to 17.3 m (41.75 ft to 56.8 ft) with a free volume of 2,125 m^3 (75,110 ft^3). These model elevations are relative to the inner bottom of the reactor pressure vessel lower head (dummy), which is 8.15 m (26.7 ft) below ground level. Therefore, the bottom of the lower compartment begins at ground level, and the reactor building is 9.15 m (64 ft) high (17.3 – 8.15 = 9.15). Therefore, based on the volume and assuming the reactor building is square, the width and length of the reactor building are each 21.55 m (70.7 ft).

MelMACCS calculates an initial horizontal and vertical plume spread of 5.01 m and 4.26 m (16.4 ft and 14.0 ft), respectively, based on the building dimensions. Depending on the nearfield model, MACCS can use these values as an area source as one way to represent the initial plume spread caused by the building wake. However, some nearfield models explicitly model building wake, in which case the analysis does not use the area source to avoid double

[1] https://code.ornl.gov/scale/analysis/non-lwr-models-vol3/-/tree/master/

counting. Section 2.2.4 addresses this analysis further in the discussion of nearfield modeling options.

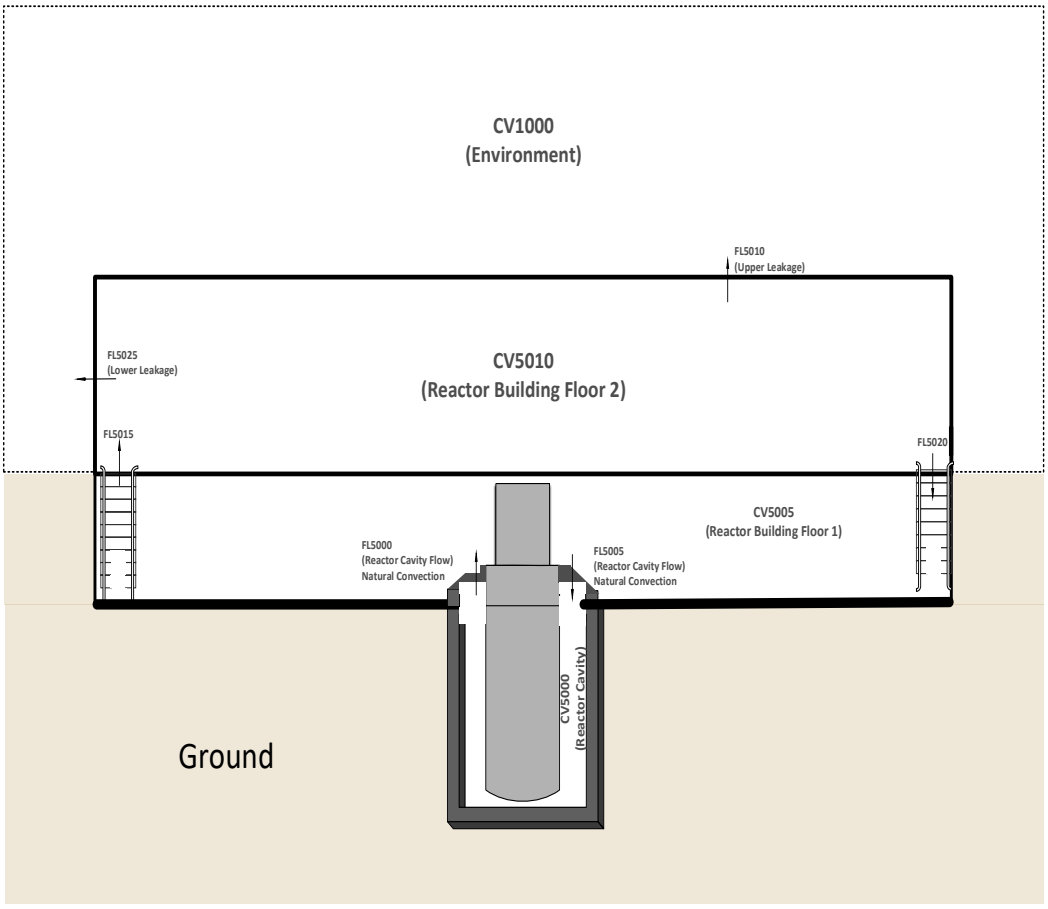

Figure 2-3 HPR Reactor Building Nodalization (from Figure 4-8 of SAND2022-2745 [5]).

In MelMACCS, this analysis selected all 13 chemical groups for analysis, even though MELCOR results did not contain any data in radionuclide class 13 for the boron chemical group. The MELCOR results provide the atmospheric source term in a single aerosol bin size of 0.153 micrometers.

MelMACCS shows that the TOP accident scenario has two release pathways from the HPR reactor building of 5.15 m and 9.15 m (16.9 ft and 64 ft) above ground level. Figure 2-4 shows the cumulative release fraction of the lower release path for the first 24 hours, and Figure 2-5 shows the upper release path.

The source term data from MELCOR has a cutoff time of 24 hours after accident initiation, which includes the full transient period of the plant accident progression. An inspection of the release rate shows a steady release at 24 hours, which indicates the first 24 hours does not reflect the full accident release magnitude. Given that the transient period of accident progression fully occurs within 24 hours, the release rate after 24 hours will eventually decrease to zero if given enough time.

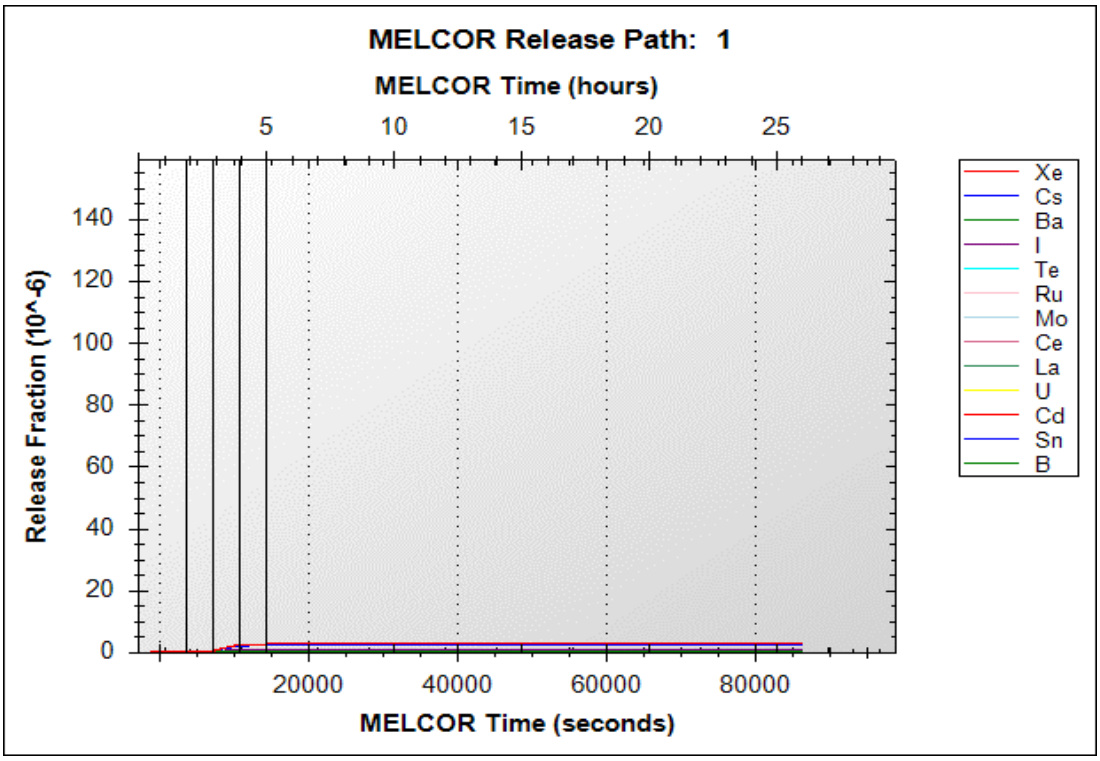

Figure 2-4 Time-Dependent Release Fraction for Release Path 1.

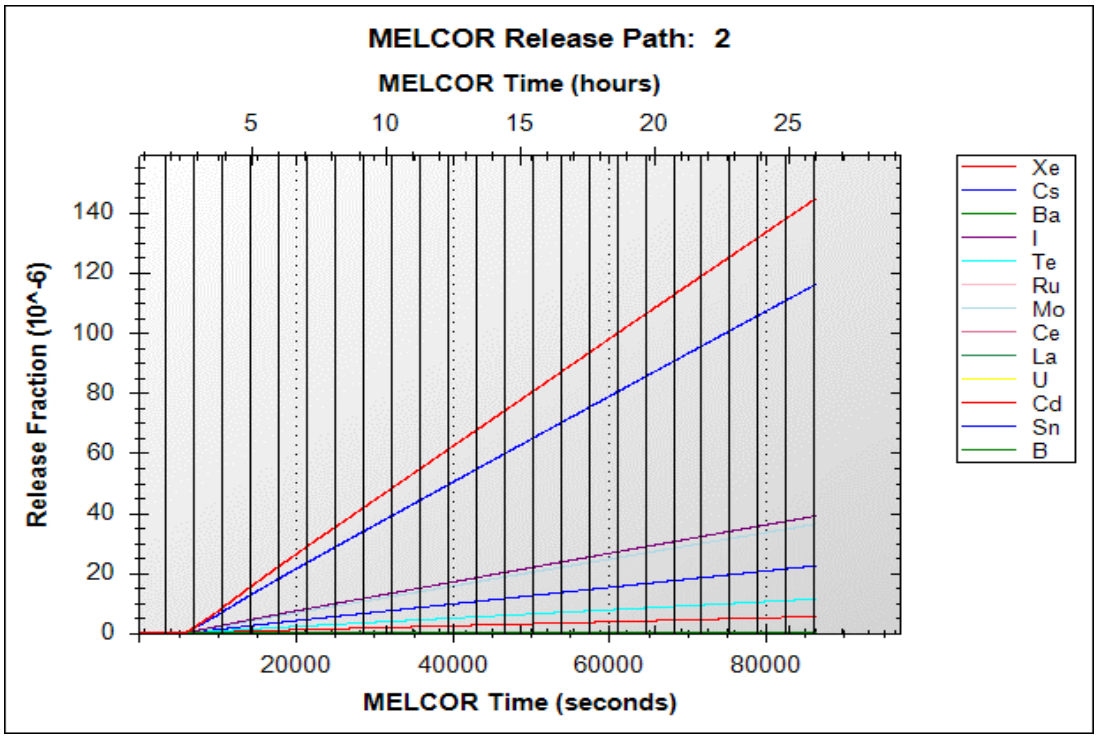

Figure 2-5 Time-Dependent Release Fraction for Release Path 2.

The MELCOR plot file used in this analysis has a total iodine release fraction of 0.0040 percent. This is different than the value in Figure 2-1 from the MELCOR report documenting the analysis, which indicates a factor of 5 lower release fraction. Although the MELCOR data do not seem to fully match the documentation, it still serves useful for code demonstration purposes.

This analysis selected plume segment intervals of 1 hour, leading to the creation of 28 plume segments between the two release pathways. Plume segment 6, the second plume segment for the upper release path, was selected as the maximum risk plume segment for the MACCS parameter MAXRIS. This analysis used default values for all other MelMACCS inputs. Appendix G shows the contents of the MelMACCS output.

Typical analyses for LWRs have considered a set of roughly 71 radionuclides of interest for dosimetry modeling in consequence analysis. Table 2-1 lists the 71 radionuclides given in NUREG/CR-7270 [21].

Table 2-1 Recommended Radionuclide List for LWR Applications (from NUREG/CR-7270, Table 2-2 [21])

Co-58	Y-90	Ru-103	Te-132	Ba-137m	Nd-147
Co-60	Y-91m	Ru-105	I-131	Ba-139	Np-239
Kr-85	Y-91	Ru-106	I-132	Ba-140	Pu-238
Kr-85m	Y-92	Rh-103m	I-133	La-140	Pu-239
Kr-87	Y-93	Rh-105	I-134	La-141	Pu-240
Kr-88	Zr-95	Rh-106	I-135	La-142	Pu-241
Rb-86	Zr-97	Te-127	Xe-133	Ce-141	Am-241
Rb-88	Nb-95	Te-127m	Xe-135	Ce-143	Cm-242
Sr-89	Nb-97	Te-129	Xe-135m	Ce-144	Cm-244
Sr-90	Nb-97m	Te-129m	Cs-134	Pr-143	Sb-127
Sr-91	Mo-99	Te-131	Cs-136	Pr-144	Sb-129
Sr-92	Tc-99m	Te-131m	Cs-137	Pr-144m	

However, since advanced reactors have unique characteristics that can affect the isotopic makeup of the reactor cores and releases, it may be important to reconsider the radionuclides included in advanced reactor consequence analysis. SNL developed a new list of radionuclides to consider for HPR consequence analysis in SAND2022-12018, “Quantitative Assessment for Advanced Reactor Radioisotope Screening Utilizing a Heat Pipe Reactor Inventory,” issued September 2022 [20]. The screening process created a preliminary list of 28 additional radionuclides, shown in Table 2-2, to add to the original list of 71.

Table 2-2 Additional Radionuclides for HPR Consequence Analysis (from draft SAND2022-12018, Table 4-2)

Ag-111	Ge-77	Pm-149	Sn-121
As-77	Nb-95m	Pm-151	Sn-123
Cd-115	Nd-149	Pr-145	Sn-125
Cd-115m	Pd-109	Sb-125	Sn-127
Eu-154	Pm-147	Sm-151	Te-125m
Eu-155	Pm-148	Sm-153	U-234
Eu-156	Pm-148m	Sm-156	U-237

The HPR radionuclide list used in the analysis documented in this report is based on the preliminary list, as the final list was not available at the time. The HPR list in the final version of SAND2022-12018 [20] contains fewer radionuclides than the preliminary list and is unlikely to affect consequences. The radionuclide screening process determined the list of radionuclides of interest for the HPR using the SCALE core inventory results. The radionuclide screening process evaluated the relative dose contributions of radionuclides compared to iodine (I)-131 in the early phase and cesium (Cs)-137 in the late phase using the MACCS code. This evaluation assumed the radionuclide fraction of core inventory released to the atmosphere was the same as I-131 for the early phase or Cs-137 for the late phase. The screening process would include a radionuclide when either the lung dose, red marrow dose, or effective dose (i.e., "ICRP60ED") from the radionuclide was predicted to be more than $1x10^{-2}$ the size of the dose from I-131 in the early phase or from Cs-137 in the late phase.

While this screening process adds to the list of radionuclides included in a MACCS analysis, the evaluation had some potentially important limitations. One limitation is that the screening did not evaluate the ingestion pathway. Therefore, the list may not capture some radionuclides important to food or water ingestion doses.

Another limitation is that the screening excluded radionuclides with half-lives of less than an hour. Because of the delay times between reactor shutdown and public exposure under normal accident conditions, these radionuclides would not have a significant effect. However, the HPR transient overpower scenario is a reactivity accident in which release into the atmosphere begins while the reactor is still critical. Given that the only delay may be the plume transport time, it is unclear if excluding radionuclides with half-lives less than 1 hour is still a robust assumption. This issue could also affect accident scenarios for other advanced reactor designs in which reactor shutdown is not immediately achieved.

Another potential limitation in the screening analysis is that MACCS does not currently model some complex environmental transport mechanisms that can affect doses from certain radionuclides like tritium. Since very little of the HPR core activity is tritium (i.e., less than $2x10^{-5}$ of the total HPR activity), it is unlikely that this would impact the offsite consequences. However, other reactor designs are expected to produce higher quantities of tritium, and it is unclear at what point tritium inventories may become important in a MACCS calculation.

The MACCS code requires the user to account for daughter products in the decay chain. The user can either add the daughter products to the list of radionuclides or specify them as a pseudostable isotope to truncate them from the calculation. This analysis added the five daughter products shown in Table 2-3 to the list for HPR analysis.

Table 2-3 Additional Daughter Radionuclides for HPR Consequence Analysis

In-115m	In-115	Th-230	Ra-226	Rn-222

MACCS considers a maximum of five decays/six generations of radionuclides in a decay chain. MACCS considers fewer than five decays after a radionuclide of interest when it is a daughter product of any other radionuclide in the analysis. For instance, MACCS requires the user to specify radionuclides for only three decays of U-234 (i.e., U-234, thorium (Th)-230, radium (Ra)-226, and radon (Rn)-222) even though Rn-222 is not stable or listed as a pseudostable isotope. This is because a typical analysis also analyzes curium (Cm)-242 and plutonium (Pu)-238, which decay into U-234. This makes Rn-222 the sixth generation, the maximum number MACCS will consider.

The number of radionuclides in the new list for HPR consequence analysis is 104. Four radionuclides on the new HPR list were on the original pseudostable list for the LWR. This analysis removed these four, as shown in Table 2-4, with no additions.

Table 2-4 Pseudostable Radionuclides Corresponding to Radionuclide List for LWR Applications (from NUREG/CR-7270 [21])

I-129	Sm-147	U-237*	Nb-93m
Xe-131m	U-234*	Np-237	Nb-95m*
Xe-133m	U-235	Rb-87	Tc-99
Cs-135	U-236	Zr-93	Pm-147*

* Removed for HPR analysis

While a user can adjust the MelMACCS configuration settings to update the list of radionuclides, associated activities, and pseudostable isotopes, this analysis did not do so. Instead, the analysis created patch files of the HPR inventory settings to import into MACCS (after importing the MelMACCS source term file, not to overwrite the new settings). Using patch files allows the MACCS user to efficiently conduct sensitivity analyses of the two lists and document the inventory settings.

Appendix C documents the two patch files containing the HPR inventory settings. One patch file uses the original list of 71 radionuclides and the other uses the expanded list of 104 radionuclides identified for the HPR. Both files contain identical inventory data for the first 71 radionuclides. The analyst assigned the new radionuclides to chemical groups according to their elemental basis as specified in NUREG/CR-7270 [21] and compiled the core inventories from the HPR SCALE data available in appendix H.

The main analysis uses the new list of 104 radionuclides designed for the HPR. The sensitivity analysis of the set of radionuclides in section 3.3 includes evaluations of both radionuclide lists.

2.2.3 Spatial Grid and Site Data

One of the purposes of this analysis is to demonstrate the new nearfield modeling capability. To better align with the nearfield models, this analysis uses 100 m radial increments for the first kilometer of the spatial grid and regular increments in kilometers after this. A few common distances in miles are also used so report outputs can be consistent with other projects. MACCS required some minor updates in the rain distances and the boundary weather distance to match the new radial intervals, and the analysis updated the MACCS outputs for the new radial intervals as well.

This analysis did not use a site file. Instead, the analysis assumed a uniform population density of 40 people per square kilometer (km^2) (104 people per square mile (mi^2)). The analysis also assumed uniform economic data based on average values in the 80 kilometer (50 mile (mi)) area around the Sequoyah Nuclear Plant in Tennessee (latitude: 35.226657, longitude: -85.091203). This includes the value of farm wealth ($/hectare (ha)) and nonfarm wealth ($/capita), the fraction of land used for farming (dimensionless), annual farm production ($/ha), and the fraction of farm production from dairy (dimensionless). The economic values were derived from spatial data provided by the SecPop v4.3 code using the 2012 county economic data and assume an economic escalation factor of 1.29, based on the increase in the consumer price index from 2012 to 2022. The analysis also specified values for the water ingestion parameters in the MACCS input based on NUREG/CR-7270 [21]. This was required as these values are normally in the site file when the site file is used.

Since the analysis is modeling projected doses in the ambient environment (i.e., assuming no protective actions), parameters typically associated with emergency response were updated so they do not impact results. The analysis models a nonevacuating cohort of a phantom population and increased the dose levels for emergency phase relocation to artificially high levels, so they are not triggered in the scenario. All protection factors have been changed to a factor of 1.0 to represent no shielding protection. This is close to the dose an individual would receive in an outdoor location, although realistically the surface roughness of the ground would still provide a little protection against groundshine radiation.

To be able to obtain “Impacted Population Results” from the Type 14 output, MACCS version 4.1 requires there to be an evacuating cohort. As such, the analysis defines a dummy cohort with an empty population. The MACCS input settings in appendix F show the settings for the dummy cohort (cohort 1) and nonevacuating cohort (cohort 2).

2.2.4 Nearfield Modeling

With MACCS version 4.1, there are new options for modeling nearfield atmospheric transport. This analysis evaluates and compares the following three MACCS nearfield modeling approaches:

(1) Regulatory Guide (RG) 1.145 Partial Model (with Area Source)
(2) RG 1.145 Full Model (with Point Source)
(3) Ramsdell and Fosmire Model (with Point Source)

Both options 1 and 2 are based on NUREG/CR-2260, “Technical Basis for Regulatory Guide 1.145, Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants,” issued October 1981 [23], and RG 1.145, “Atmospheric Dispersion

Models for Potential Accident Consequence Assessments at Nuclear Power Plants," reissued February 1983 [24], and both model plume meander based on stability class and windspeed.

The RG 1.145 Partial Model Is a partial implementation of the nearfield modeling approach described in RG 1.145. This modeling approach considers the effects of both building wake mixing and ambient plume meander. However, the RG 1.145 Partial Model accounts only for plume meander. This partial implementation was the only option available for using RG 1.145 in MACCS version 4.0 and earlier.

To account for building wake in the RG 1.145 Partial Model, users can specify the initial release as an area source. A common method used is the Turner building wake method, which assumes that building wake causes an initial plume to spread such that the plume concentrations at the building edges and roofline are equal to 10 percent of the plume centerline. This corresponds to 2.15 standard deviations from the plume centerline. Users commonly estimate the initial plume dimensions with the following relationship:

$$\sigma_{y,\,init} = \frac{W_b}{4.3} \text{ and } \sigma_{z,\,init} = \frac{H_b}{2.15}$$

where

- $\sigma_{y,\,init}$ is the initial plume width (SIGYINIT)
- $\sigma_{z,\,init}$ is the initial plume height (SIGZINIT)
- W_b is the width (m) of the building from which release occurs
- H_b is the height (m) of the building from which release occurs

With MACCS version 4.1, this area source estimate of the initial plume dimensions can be automatically calculated using the building height and width.

The RG 1.145 Full Model is the full implementation of the nearfield modeling approach discussed in RG 1.145, which became available in MACCS version 4.1. This includes consideration of both building wake and plume meander. In this option, it is not recommended to use an area source to account for building wake, as the full implementation approach already accounts for this.

The Ramsdell and Fosmire Model is a new nearfield modeling approach in MACCS that also became available in version 4.1. SAND2021-6924, "Implementation of Additional Models into the MACCS Code for Nearfield Consequence Analysis," issued June 2021 [14], describes the nearfield modeling capabilities in greater detail. The Ramsdell and Fosmire Model is the nearfield approach used by ARCON96. It includes enhanced dispersion near a building at low and high windspeeds [25]. At low windspeeds, building wakes have a minimal effect, and the major contributor to enhanced dispersion is plume meander. At high windspeeds, building wakes are the major contributor to enhanced dispersion. In this option, it is also not recommended to use an area source to account for building wake, as the approach already accounts for building wake.

The main analysis uses the RG 1.145 Full Model (with point source). The sensitivity analysis of nearfield modeling in section 3.4 evaluates all three nearfield approaches. In each nearfield modeling approach, the analysis uses the recommended set of parameter inputs provided by

SAND2021-6924, with one exception. In the Ramsdell and Fosmire Model, SAND2021-6924 recommends that the distance within which to use the model (RAFDIST) be rounded down to 1,000 m (0.62 mi), and this analysis keeps the distance at 1,200 m (0.75 mi).

This analysis created patch files containing the settings for each of the three nearfield modeling approaches. Appendix D shows these settings. Because of a bug found in WinMACCS version 4.1 that restricted the ability to import some of the nearfield settings, these patch files were not directly used. However, they remain in the appendix as documentation of the nearfield settings used for the analysis.

In addition to the new nearfield modeling capabilities that determine plume spread, MACCS version 4.1 provides a new plume trapping model to determine when plume rise occurs. The original buoyancy flux method evaluates the plume buoyancy and windspeed to determine whether plume rise occurs. In contrast, the new model considers the plume entrainment size using the building dimensions to assess whether plume rise occurs. The analysis evaluated the two plume entrainment models against each other in a sensitivity analysis. Section 3.4 documents the results of this analysis, along with the other nearfield sensitivity analyses.

3 RESULTS

This report documents various output measures, including plume characteristics, air and ground concentrations, doses, and spatial distribution of protective actions. All reported doses are projected doses assuming no protective actions. Also, all reported doses are effective doses using the “L-ICRP60ED” organ in MACCS.

3.1 Main Analysis of the Heat Pipe Reactor Transient Overpower Scenario

The main analysis evaluates the example HPR TOP accident source term using the recommended list of radionuclides for the HPR. For the nearfield model, the analysis uses the full implementation of RG 1.145 developed in MACCS version 4.1, which assumes a point source release.

The example MELCOR source term of the TOP accident scenario is the first 24 hours of a small release from two release locations. Figure 3-1 through Figure 3-3 detail plume segment 6, the second plume segment for the upper release path. The project identified plume segment 6 as potentially being the most risk-significant plume segment, however any plume segment should be able to provide representative release characteristics. Figure 3-1 shows the centerline integrated air concentration (blue curve) in radial intervals between 0 and 40 kilometers (km) (0 and 25 mi) from the source location. MACCS predicts no plume rise to occur, which is discussed in more detail in section 3.4 . Since the plume centerline stays at ground level, the elevated centerline air concentration and ground-level centerline concentration are the same. Also shown is the total centerline ground concentration in orange and the Cs-137 ground concentration in gray. The air and ground concentrations are related to each other and have very similar profiles in Figure 3-1. The figure also shows that Cs-137 is a small fraction of the total ground activity at deposition.

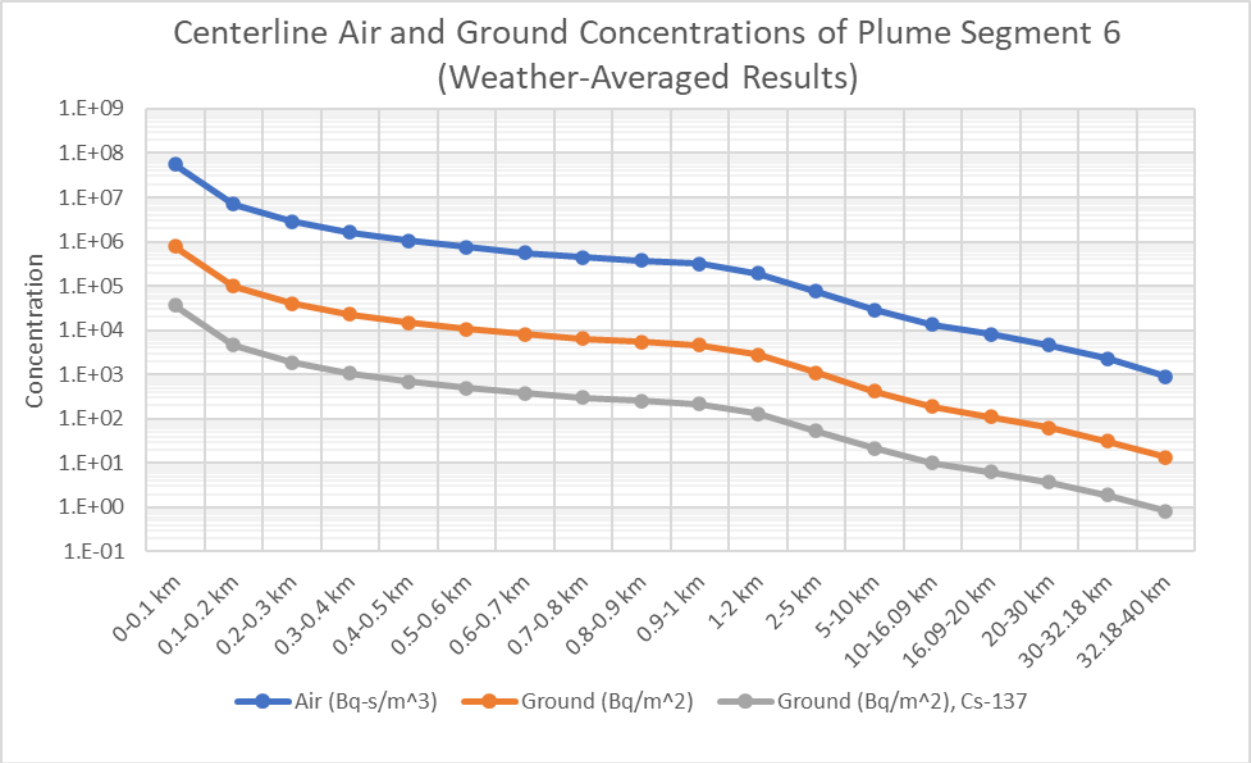

Figure 3-1 Centerline Air and Ground Concentrations of Plume Segment 6 (Weather-Averaged Results).

The concentration profiles above are based on the average results for a set of various weather conditions (i.e., “weather-averaged results”). Figure 3-2 shows the distribution of centerline air concentrations based on the weather.

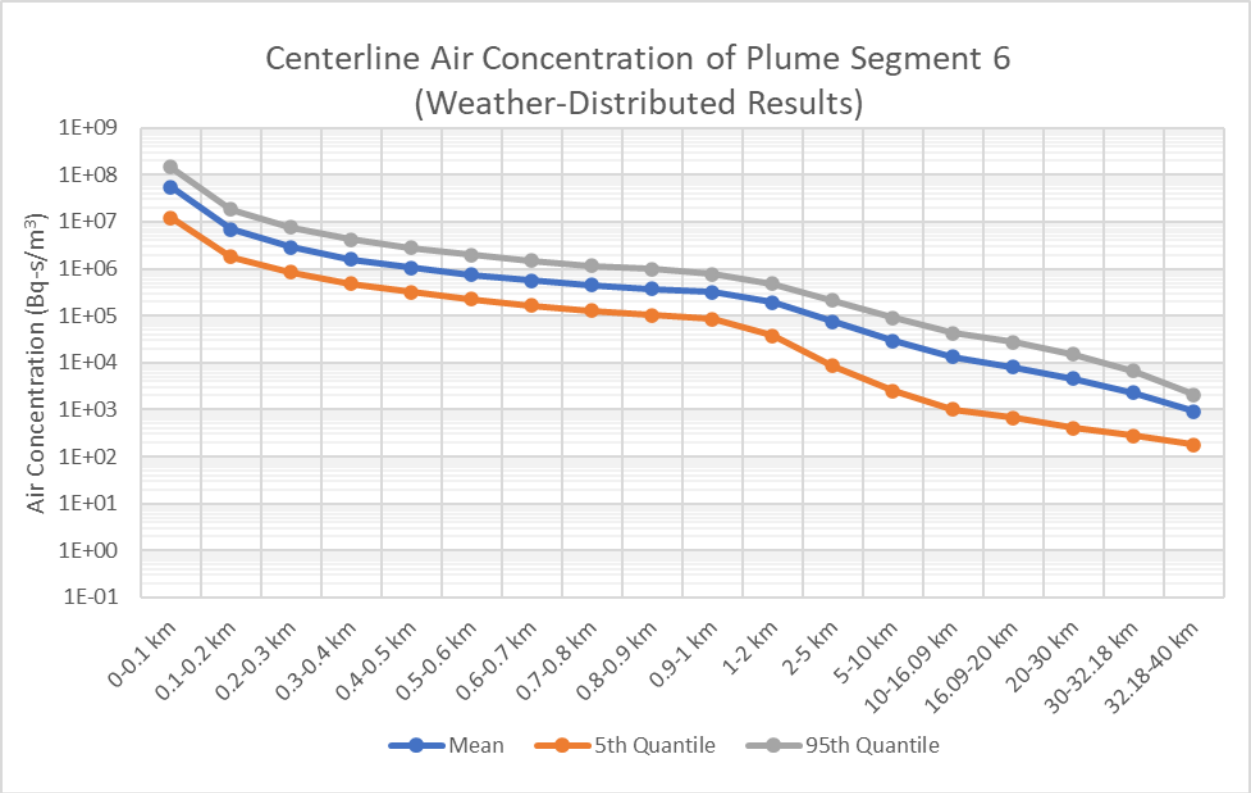

Figure 3-2 Centerline Air Concentration of Plume Segment 6 (Weather-Distributed Results).

The plume disperses as it travels downwind. Figure 3-3 shows the vertical and horizontal deviation of the air concentrations for distances between 0 and 5 km (0 and 3.1 mi). The amount of plume spread considers the atmospheric stability class, the surface roughness of the ground, and nearfield model representing the full implementation of RG 1.145, which considers building wake effects and plume meander.

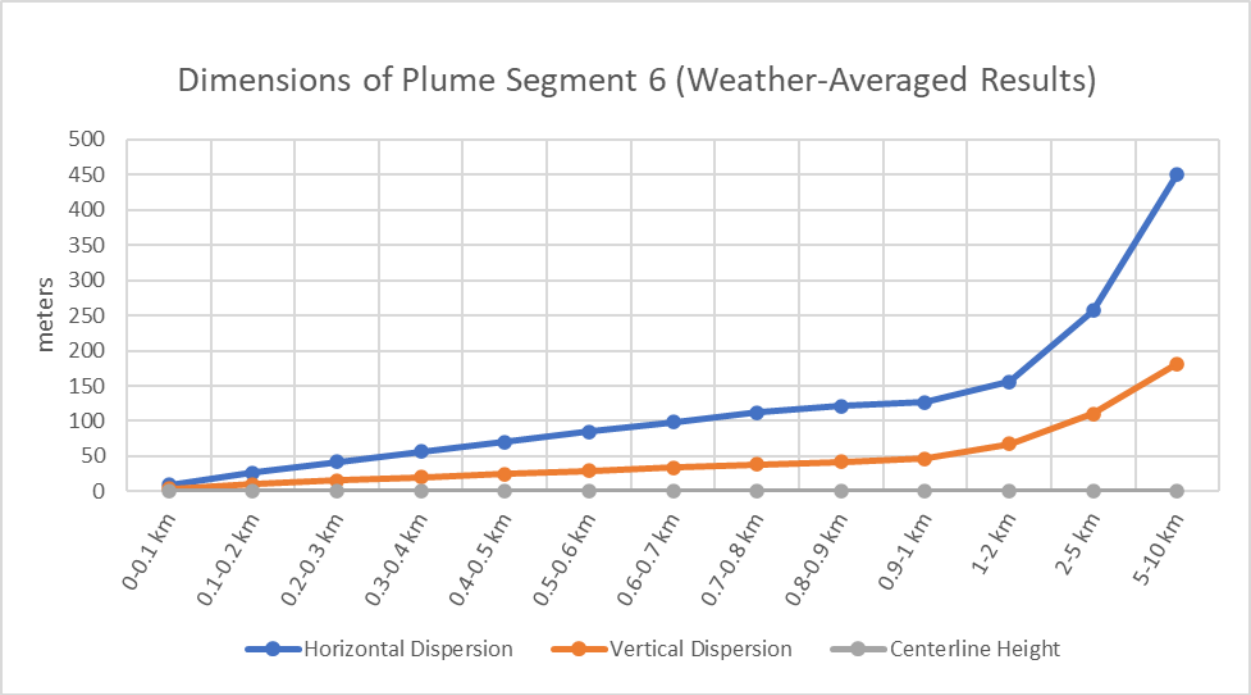

Figure 3-3 Gaussian Dimensions and Centerline Height of Plume Segment 6 (Weather-Averaged Results).

The main analysis results show very small impacts relative to traditional analyses of hypothetical nuclear power plant accidents. This is because the HPR-INL Design A has a small core inventory compared to large LWRs, and the TOP scenario is calculated to produce a source term with small release fractions to the environment. Figure 3-4 shows the projected peak dose in radial intervals between 0 and 40 km (0 and 25 mi). The projected dose is the anticipated dose for a phantom individual with no protection and who takes no actions to reduce exposure. The projected dose considers reductions in exposure that naturally occur with time due to radioactive decay and weathering. According to the analysis of the example HPR TOP source term, the projected 4-day dose is anticipated to remain below the U.S. Environmental Protection Agency's (EPA's) emergency phase protective action guide (PAG) recommendation (i.e., 1 to 5 rem (10 to 50 millisievert [mSv])) in all locations. Recall, however, that this source term evaluates only the first 24 hours of the accident. The peak dose in the first radial interval from 0 to 0.1 km (0 to 0.06 mi) has a mean weather result of 0.44 rem (4.4 mSv) and a 95th percentile weather result of 0.88 rem (8.8 mSv). Since the peak dose in the closest radial interval is very close to the EPA PAG, a longer analysis without a time cutoff may affect this finding at distances close to the release location.

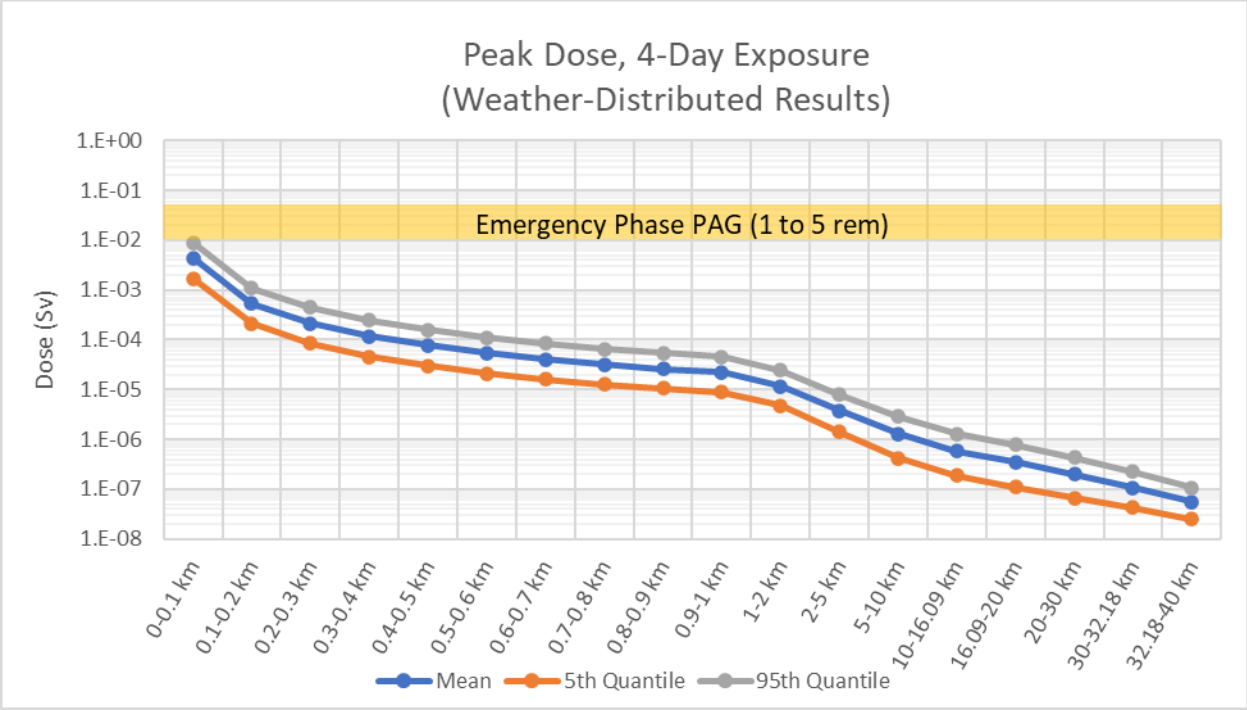

Figure 3-4 Projected Peak Dose in Radial Intervals within 40 km (25 mi) for a 4-Day Exposure Period (Weather-Distributed Results).

While the offsite consequences of the example HPR source term are unlikely to reach the emergency phase PAG dose levels, the release would likely require long-term protective actions to be taken very close to the release location in some weather scenarios. Table 3-1 and Table 3-2 summarize long-term protective actions in farmland and nonfarmland areas, respectively.

In Table 3-1, milk and crop disposal refer to an economic loss from farm work initiated before the accident occurred, but the products cannot be realized because of farmland contamination. Farmland interdiction refers to the stoppage of future farm work the first year after the accident occurs and potentially longer. Farmland interdiction can be caused either by ingestion dose limits of farm produce (i.e., dose exceedance of farmability criteria) or by relocation restrictions (i.e., dose exceedance of the habitability criterion). MACCS assumes that farmland decontamination occurs only when contamination exceeds the habitability criterion, which tends to be less strict than the farmability criteria. Farmland that is interdicted will remain unfarmable until contamination levels drop to acceptable levels. If contamination levels exceed farmability criteria after 8 years, or if decontamination cannot cost-effectively reduce doses to below the habitability criterion, MACCS assumes the farmland is permanently condemned.

The results of the example analysis show that the extent of protective actions in farmland is very small or zero. The average extent is less than the outer distance of the first radial interval (i.e., 0.1 km (0.06 mi)), and farmland condemnation never occurs in any analyzed weather scenario.

Table 3-1 Long-Term Protective Actions in Farmland Areas

Type of Land Area	Farmland				
Type of Impact	**Milk Disposal**	**Crop Disposal**	**Interdiction**	**Decontamination**	**Condemnation**
Probability of Occurrence (Anywhere on Spatial Grid)	70 percent	70 percent	70 percent	30 percent	0 percent
Weather-Averaged Extent of Impact (km)	0.07	0.09	0.09	0.03	0
Weather-Averaged Area of Impact (ha)	0.10	0.20	0.02	0.02	0

Table 3-2 shows that similar results occur in nonfarmland areas. Nonfarmland areas refer to any land use that is not farming and the portion of the land where individuals may reside. Nonfarmland area is subject to the same habitability criterion as farmland area. For this reason, the two regions have common protective actions of interdiction, decontamination, and condemnation. Likewise, the two types of land areas have the same probability and extent of decontamination and condemnation, at least in this case. However, unlike farmland areas, nonfarmland is not subject to farmability criteria, which tend to be stricter than the habitability criterion. For this reason, the probability and extent of interdiction are greater for farmland than for nonfarmland. While the probability and extent and certain protective actions are the same, the area is not. This is because this analysis assumes the fraction of nonfarmland is greater than farmland.

For nonfarmland, the interdiction and decontamination produce the same values. This is because, in MACCS version 4.1, interdiction and decontamination are both based on the habitability criterion. However, decontamination may also occur in habitable areas, and new MACCS development may be able to better address this using a decontamination criterion.

Table 3-2 Long-Term Protective Actions in Nonfarmland Areas

Type of Land Area	Nonfarmland			
Type of Impact	**Early Fatality**	**Interdiction**	**Decontamination**	**Condemnation**
Probability of Occurrence (Anywhere on Spatial Grid)	0 percent	30 percent	30 percent	0 percent
Weather-Averaged Extent of Impact (km)	0	0.03	0.03	0
Weather-Averaged Area of Impact (ha)	-	0.04	0.04	0

The projected dose in a spatial grid element is dependent on the meteorological conditions at the time of the accident, particularly the wind direction. Figure 3-5 shows the projected dose in each compass direction in the 0.2 to 0.3 km (0.12 to 0.19 mi) radial interval due to exposure during the first week of the accident. There are 64 compass directions in the analysis. Direction 1 represents north, and ascending numbers represent a clockwise direction. The distribution of dose projections results from a random sampling of weather conditions. The blue curve shows that, on average, certain compass directions are affected more than others. For example, the double peak results from the meteorological conditions at the Sequoyah Nuclear Plant site, which has two dominant wind directions. However, a release does not always cause a dose, even for the dominant wind directions. This is clear from the orange curve of the 5th percentile results, which shows zero dose. The orange curve represents weather scenarios in which no plume segments travel in that direction, whereas the gray curve represents weather scenarios in which potentially many plume segments travel in that direction.

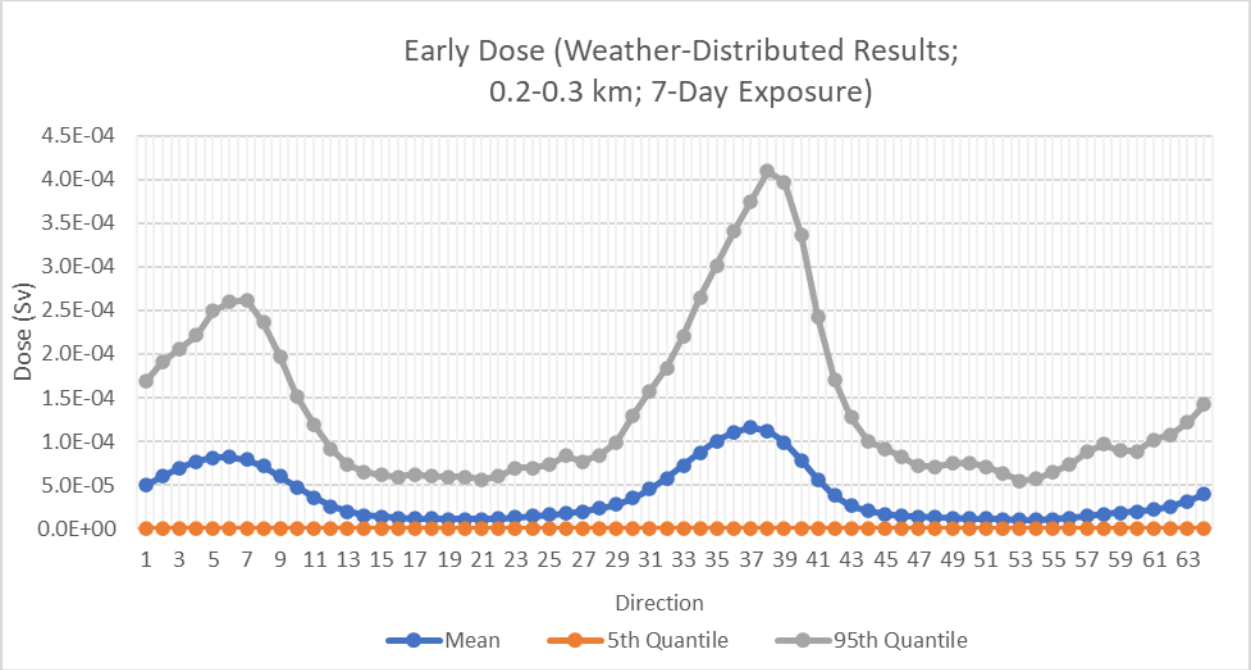

Figure 3-5 Direction-Dependent Dose Projection for a 7-Day Exposure in the 0.2 to 0.3 km (0.12 to 0.19 mi) Radial Interval (Weather-Distributed Results).

Figure 3-6 compares how average doses in different directions change with downwind distance. The blue curve is for the 0.2 to 0.3 km (0.12 to 0.19 mi) radial interval, which matches the blue curve in Figure 3-5. In all directions, the dose is anticipated to decrease with distance. This is to be expected because 0.2 to 0.3 km (0.12 to 0.19 mi) is very close to the source and because plume dispersion and depletion increase with distance. The figure also shows that the profiles of each curve are very similar.

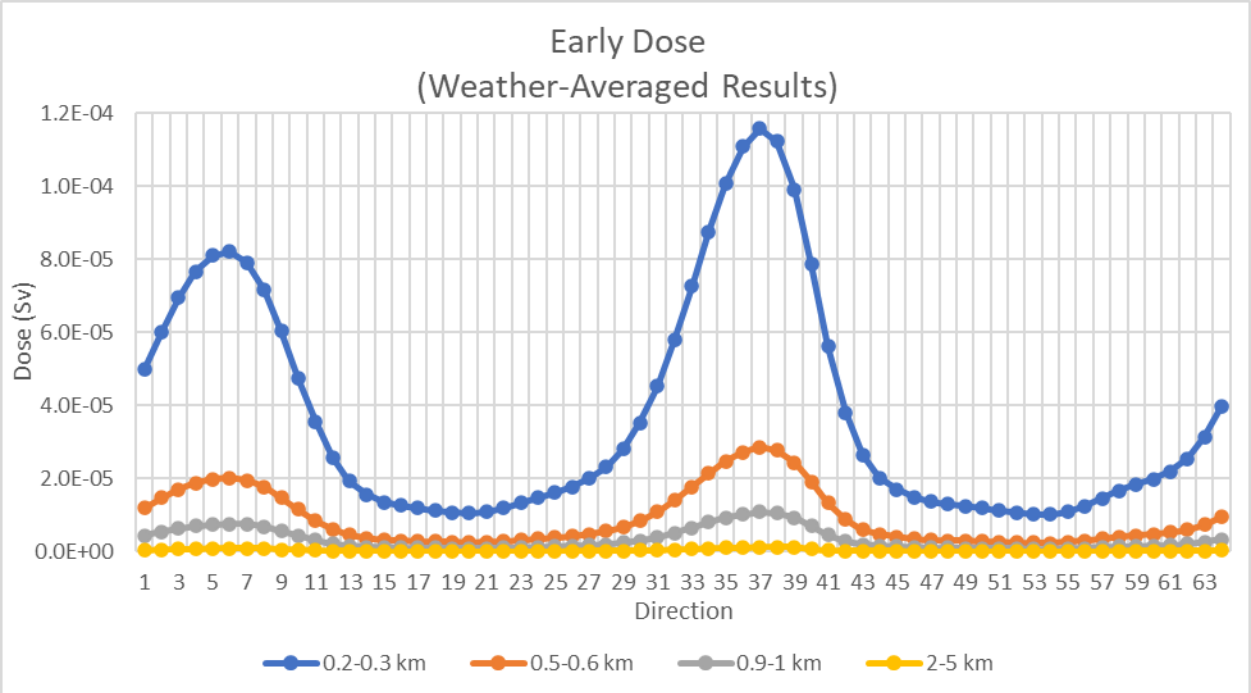

Figure 3-6 Direction-Dependent Mean Dose Projection for a 7-Day Exposure in Select Radial Intervals.

3.2 Sensitivity Analysis of Dose Exposure Period

This project included a sensitivity analysis of different exposure periods to evaluate how the projected dose may vary with time. Calculating different dose projection exposure periods is not a typical calculation in MACCS. The original intent was to perform the calculations for 2 hours, 1 day, 4 days, 30 days, and 51 years (50 years for the long-term phase plus 1 year for the intermediate phase). Cyclical files were created with different early-phase periods to analyze 1 day, 4 days, and 30 days. MACCS does not allow an early phase less than 1 day. To obtain a 2-hour exposure period, the analysis created a separate realization that redefined cohort 2 to represent an evacuating cohort with a 2-hour alarm time and no delay in sheltering or evacuating. The analysis then assigned an evacuation protection factor of 0 for all dose pathways to represent complete protection so that the cohort would receive no residual doses after the 2-hour period. In this way, cohort 2 can represent a 2-hour dose projection. The patch files in appendix B show the MACCS settings for these realizations. For a lifetime dose of

51 years, the analysis ran an additional separate realization with intermediate and long-term phase habitability criteria set to artificially high values (DSCRTI=1E05; DSCRLT=1E05). This changes the long-term cohort so that it can also represent a dose projection with no protective actions, this time for a 51-year period. Changing protective action criteria in the long-term phase was done only for this realization, as these criteria also affect the results related to protective actions.

Figure 3-7 shows the projected peak dose with distance for the exposure periods beginning at the start of the accident when the control drums begin to inadvertently add positive reactivity. Release begins quickly at less than 1 hour. As expected, the lifetime dose (blue curve) is the largest as it has the longest period of dose accumulation. The green curve representing a 2-hour exposure is many orders of magnitude lower than the rest and ceases after 5 km (3.1 mi). This is because only a fraction of the release has occurred within the first 2 hours, and no plume segments have traveled beyond 5 km (3.1 mi).

The 4-day dose exposure in this figure (yellow curve) matches the blue curve in Figure 3-4 above. Curves representing 1 day, 4 days, and 30 days (light blue, yellow, and orange, respectively) cluster together. Albeit small, this middle cluster of curves is more spread out at far distances than at close distances. This difference may be because the arrivals of some plume segments at far distances are sometimes incomplete. Results state that plume segments, on average, take 10 hours to travel out to 40 km (25 mi) and may take as many as 19 hours.

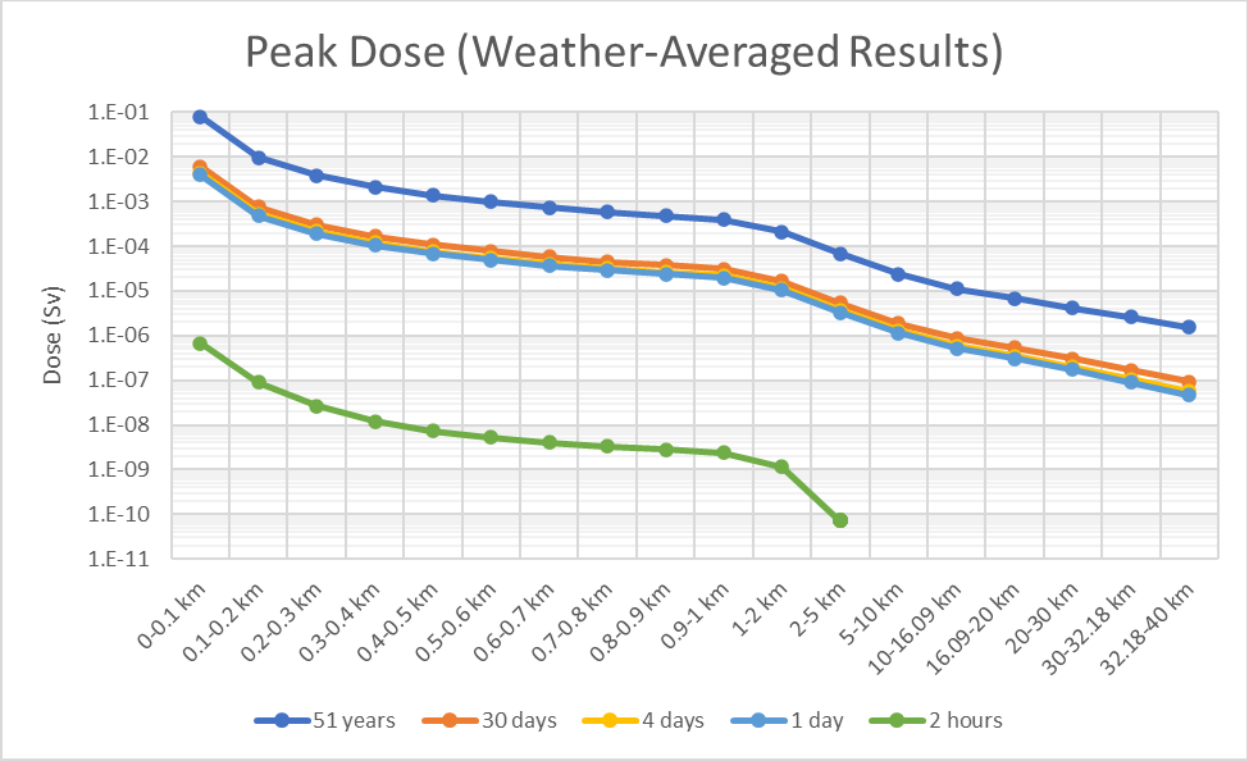

Figure 3-7 Comparison of Projected Peak Dose Using Various Exposure Periods in Radial Intervals within 40 km (25 mi).

Overall, the exposure periods in the early phase of the accident represent a fraction of the total projected dose. Figure 3-8 shows the dose accumulation at 2 hours, 1 day, 4 days, and 30 days relative to 51 years assuming no protective actions (including shielding). Even though exposures during plume passage and exposures to short-lived radionuclides occur only in the early phase of the accident, exposure to ground contamination over the long term is the largest potential contributor of the overall lifetime dose projection. Nevertheless, early doses are important as they can be more difficult to avert and accumulate quickly.

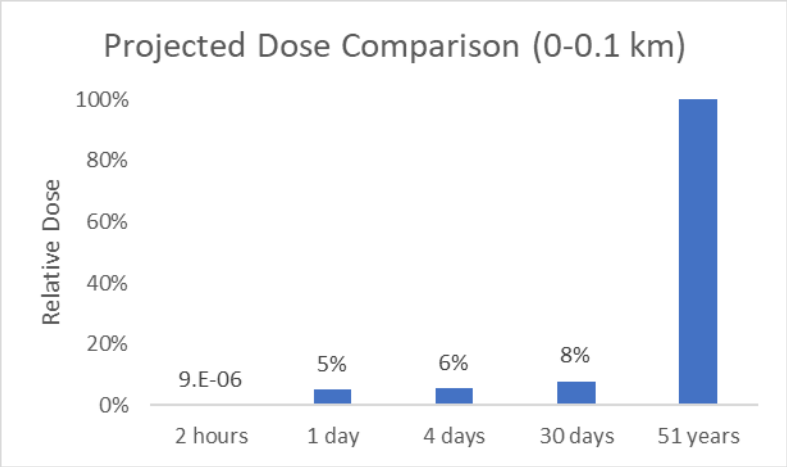

Figure 3-8 Projected Dose Comparison for Different Exposure Durations.

3.3 Sensitivity Analysis of Radionuclides

Most MACCS analyses for LWRs evaluate the offsite consequences from roughly the 71 radionuclides expected to be most important. This sensitivity analysis evaluates an expanded list of 104 radionuclides based on a preliminary evaluation of the HPR core inventory from a draft version of SAND2022-12018 [20].

To better understand the difference between using the two lists, this project included a sensitivity analysis using the LWR and the HPR list of radionuclides for each exposure period. Figure 3-9 shows the peak dose from the HPR TOP scenario using the expanded list of radionuclides for the HPR relative to the LWR list. The HPR peak dose increased by less than 1 percent for all evaluated radial intervals and exposure periods. The HPR radionuclide list had a little more impact on early doses than it did on the 51-year exposure period, which shows a difference of less than 0.1 percent. While this analysis is based on a preliminary list, the final HPR list in SAND2022-12018 contains fewer radionuclides than the preliminary list due to a slightly updated screening methodology and is unlikely to have significantly different MACCS results.

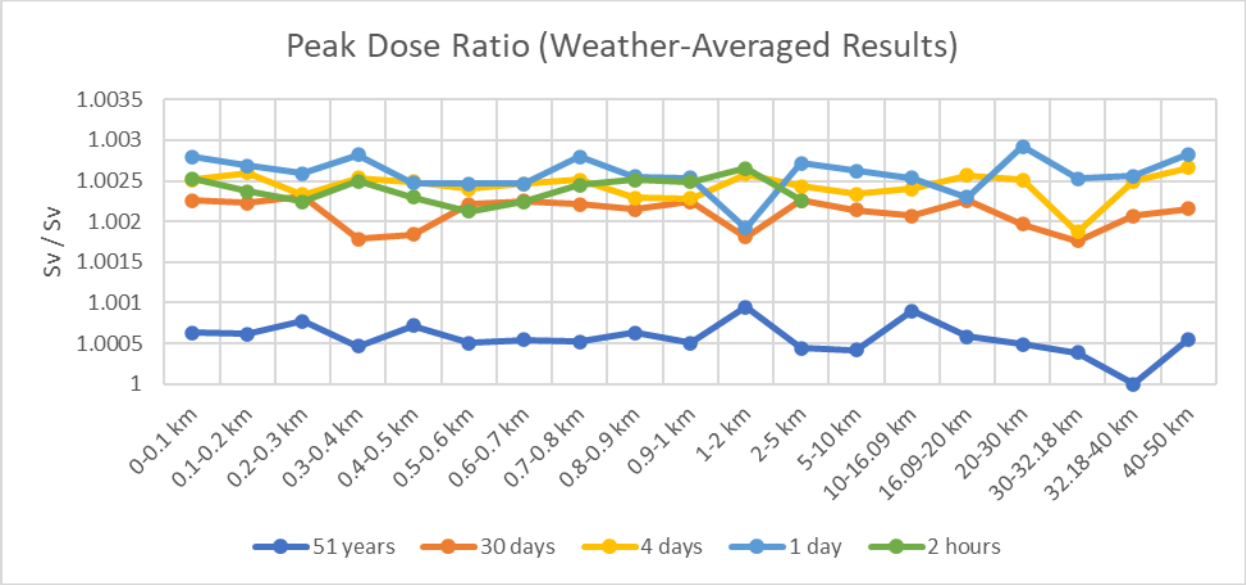

Figure 3-9 Ratio of the Peak Dose of the HPR Radionuclides Relative to the LWR Radionuclides Using Various Exposure Periods in Radial Intervals within 40 km (25 mi).

This sensitivity analysis did not test different radionuclides for the ingestion pathway, which are not part of the peak dose results in MACCS. Given that the radionuclides of importance could be significantly different for ingestion, it is unclear if the small differences shown in Figure 3-9 would similarly carry over to ingestion doses.

3.4 Sensitivity Analysis of Nearfield Modeling

This sensitivity analysis evaluated three approaches for nearfield modeling resulting in different levels of dispersion and dose projections. The RG 1.145 Full Model is new with MACCS version 4.1. It represents the full implementation RG 1.145, including equations for building wake. The RG 1.145 Partial Model is the model available before MACCS version 4.1. The RG 1.145 Partial Model does not directly model building wake, but the user can still account for building wake by creating an area source representing the initial plume spread caused by the building wake. This is how this analysis evaluated the RG 1.145 Partial Model.

Figure 3-10 and Figure 3-11 compare the vertical plume spread using the three nearfield modeling approaches. All nearfield approaches have a similar profile with distance. The Ramsdell and Fosmire Model and the RG 1.145 Partial Model show roughly 3 times and 2 times the initial vertical spread of the RG 1.145 Full Model. The two RG 1.145 models quickly align within 1 km (0.62 mi). All three nearfield approaches effectively show no difference in vertical plume spread after 10 km (6.2 mi).

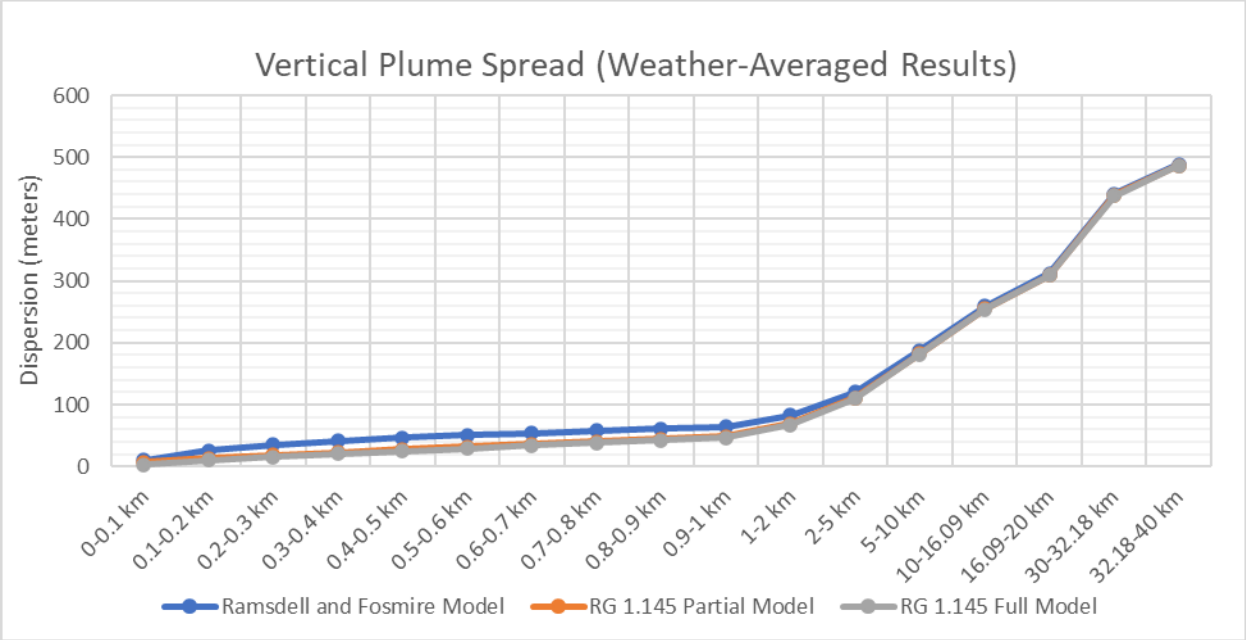

Figure 3-10 Comparison of Vertical Plume Spread for Three Nearfield Models in Radial Intervals within 40 km (25 mi).

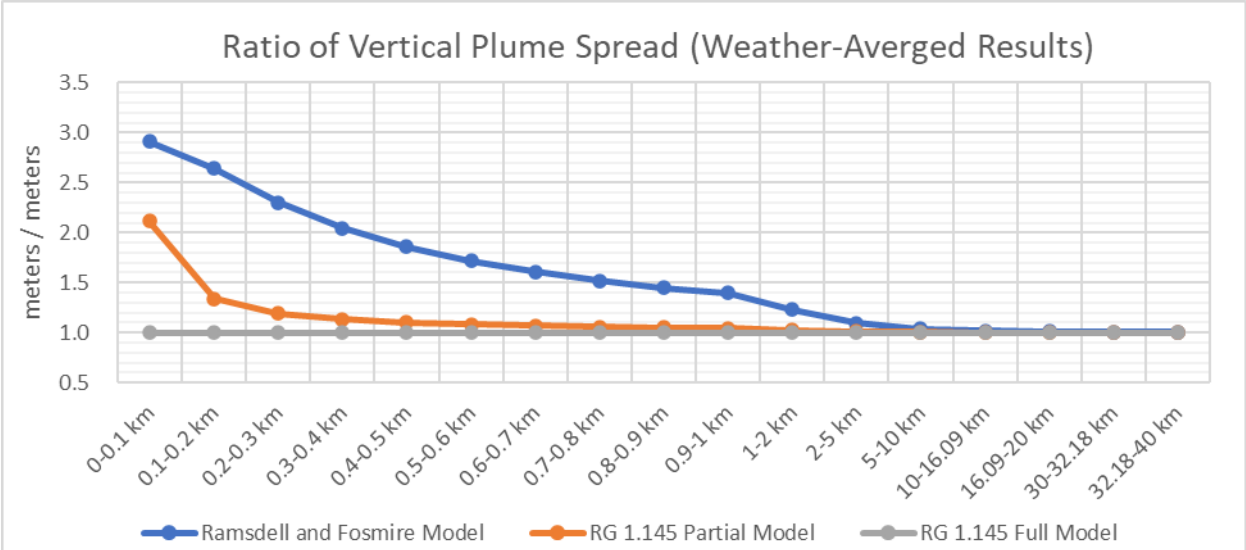

Figure 3-11 Ratio of Vertical Plume Spread for Three Nearfield Models in Radial Intervals within 40 km (25 mi).

Figure 3-12 and Figure 3-13 compare the horizontal plume spread using the three nearfield modeling approaches. All nearfield approaches have a similar profile with distance. The Ramsdell and Fosmire Model and the RG 1.145 Partial Model show roughly 3 times and 1.5 times the initial horizontal spread of the RG 1.145 Full Model. The two RG 1.145 models quickly align within 0.3 km (0.19 mi). The relative difference between the Ramsdell and Fosmire Model and the RG 1.145 models becomes very small after 40 km (25 mi).

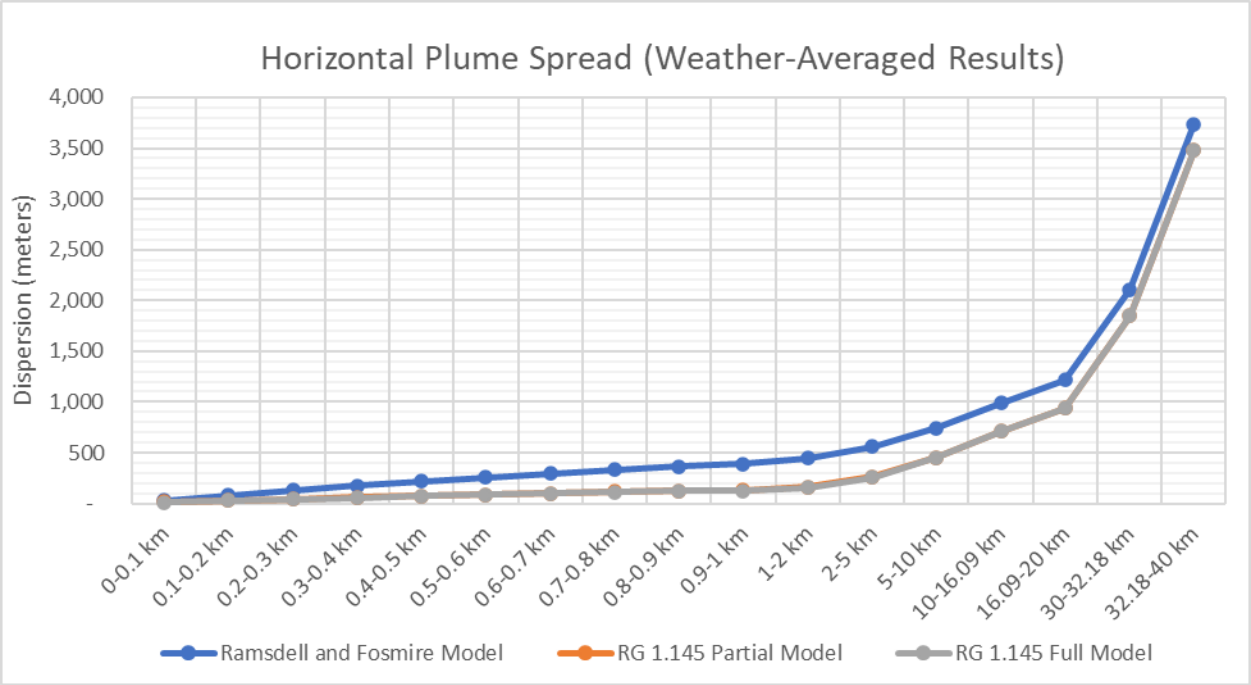

Figure 3-12 Comparison of Horizontal Plume Spread for Three Nearfield Models in Radial Intervals within 40 km (25 mi).

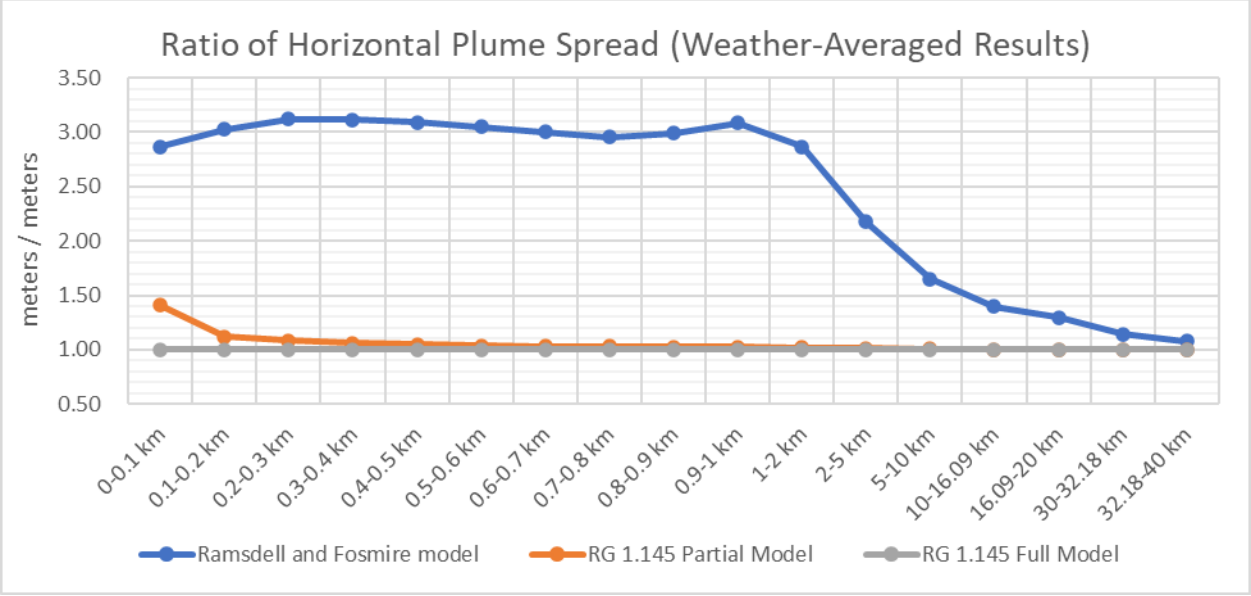

Figure 3-13 Ratio of Horizontal Plume Spread for Three Nearfield Models in Radial Intervals within 40 km (25 mi).

Figure 3-14 and Figure 3-15 compare the peak doses using the three nearfield modeling approaches.

The amount of plume spread in the different approaches notably impacts doses in the first 40 km (25 mi). Because the Ramsdell and Fosmire Model has the most spread, it has the lowest peak doses of the three nearfield modeling approaches. The two RG 1.145 models have similar peak doses after roughly 1 km (0.62 mi), whereas the Ramsdell and Fosmire Model does not have the same peak doses until approximately 40 km (25 mi).

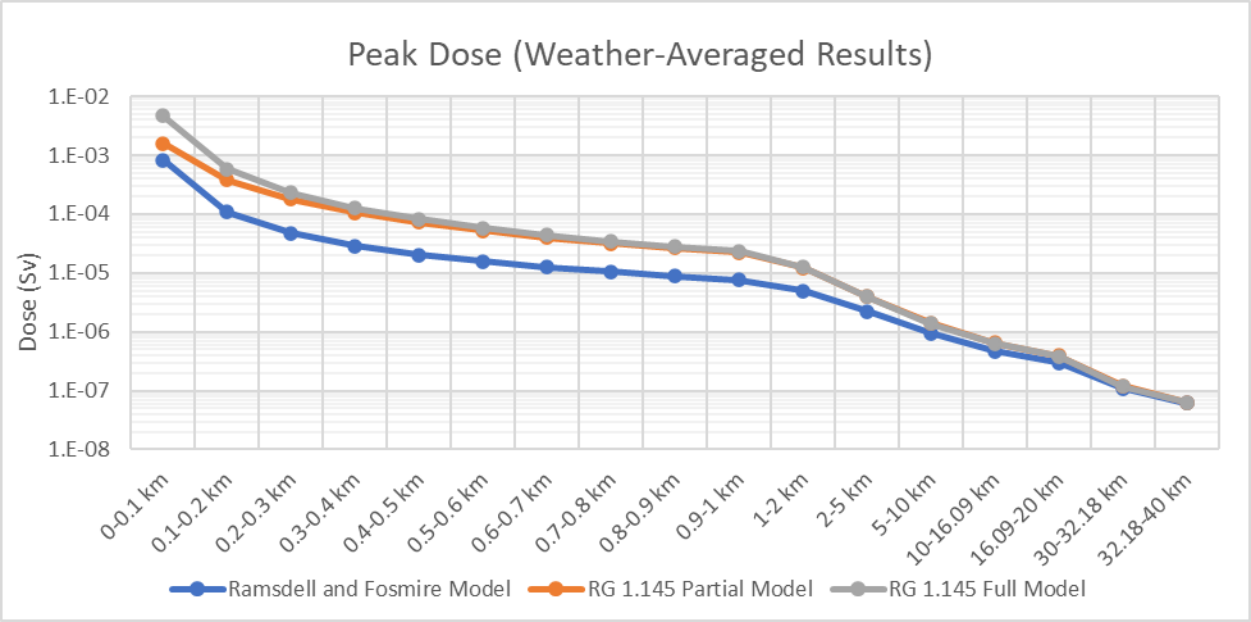

Figure 3-14 Comparison of Peak Dose for Three Nearfield Models in Radial Intervals within 40 km (25 mi).

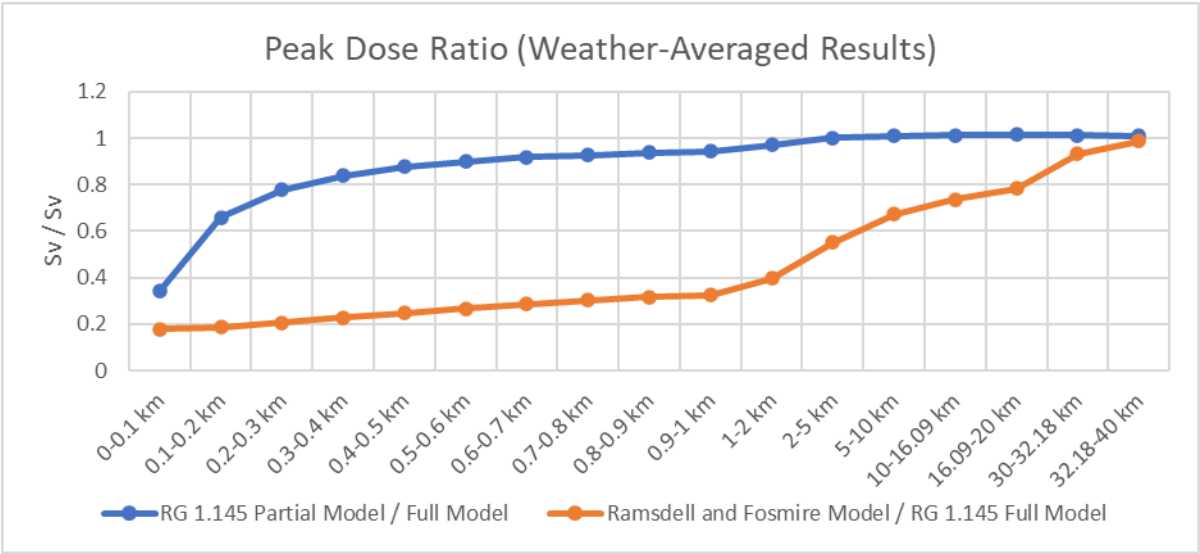

Figure 3-15 Ratio of Peak Dose Compared to RG 1.145 Full Model in Radial Intervals within 40 km (25 mi).

Figure 3-16 compares the doses in different directions using the three nearfield modeling approaches in the 0.2 to 0.3 km (0.12 to 0.19 mi) radial interval. The gray curve representing the RG 1.145 Full Model is the same data as the blue curves in Figure 3-5 and Figure 3-6. The RG 1.145 Full Model has the narrowest plume, and therefore it has the highest peaks. In the nondominant wind directions, the three nearfield modeling approaches show similar results. This is because the Ramsdell and Fosmire Model has more horizontal plume spread, which decreases the dose along the centerline and increases the dose in off-centerline locations relative to a narrow plume. However, the Ramsdell and Fosmire Model still shows a slightly lower dose in the nondominant wind directions and a lower dose on average, likely because of vertical plume spread. In these analyses, there is no plume rise; therefore, vertical plume spread always has a dilution effect on ground-level doses. As discussed previously, the Ramsdell and Fosmire Model has more vertical spread than the other models, as shown in Figure 3-13.

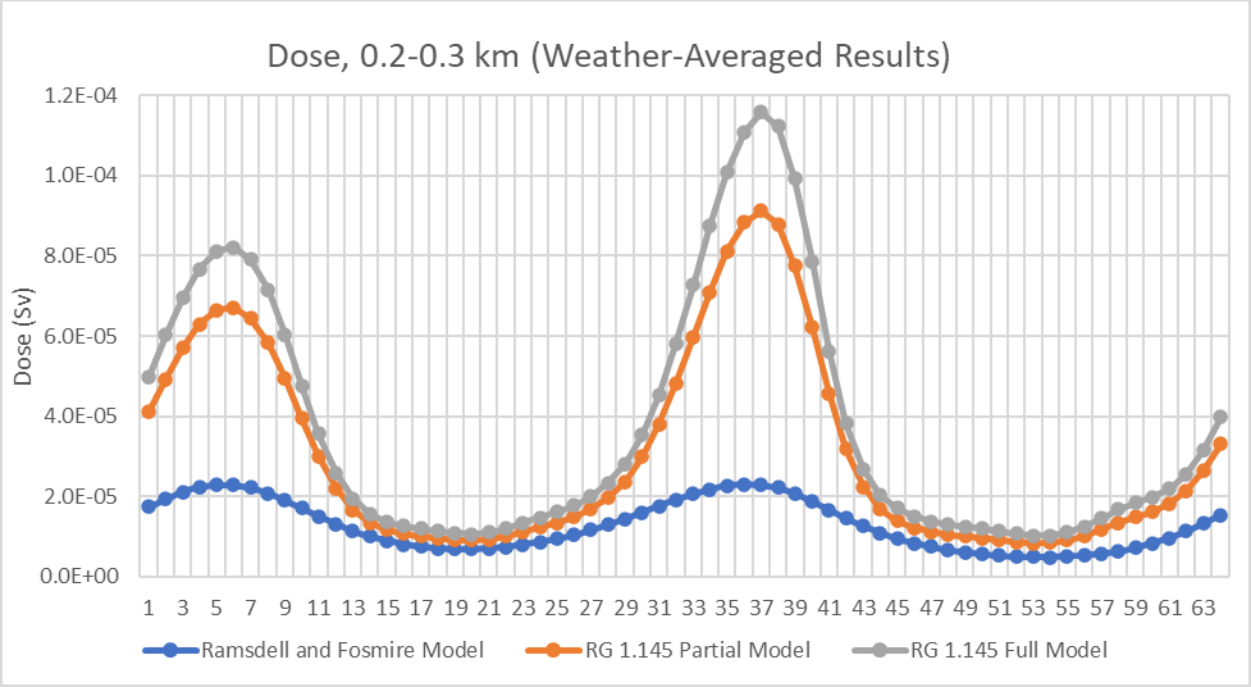

Figure 3-16 Comparison of Direction-Dependent Dose for Three Nearfield Models in the 0.2 to 0.3 km (0.12 to 0.19 mi) Radial Interval.

In addition to the nearfield modeling, the analysis evaluated the impact of two plume trapping models and two methods for calculating plume buoyancy. In MACCS, plume buoyancy is a variable in the original plume trapping model to determine when liftoff will occur, and a variable in the plume rise model to determine how much the plume will rise when liftoff does occur.

Figure 3-17 compares the peak dose using the four combinations of plume trapping and buoyancy flux. The analysis found that for the HPR TOP scenario, peak dose results are identical, likely because liftoff never occurs in either plume trapping model for this HPR source term. This is supported by a look at the centerline height of plume segment 6, which shows zero value for all distances. The new Briggs trapping model (TDWMOD=BRGBLD) is based on the elevation of the release height compared to the building height. Since the HPR source term is

not released from an elevated location higher than the building, the model assumes that downwash entrains the plume in the building wake regardless of other factors.

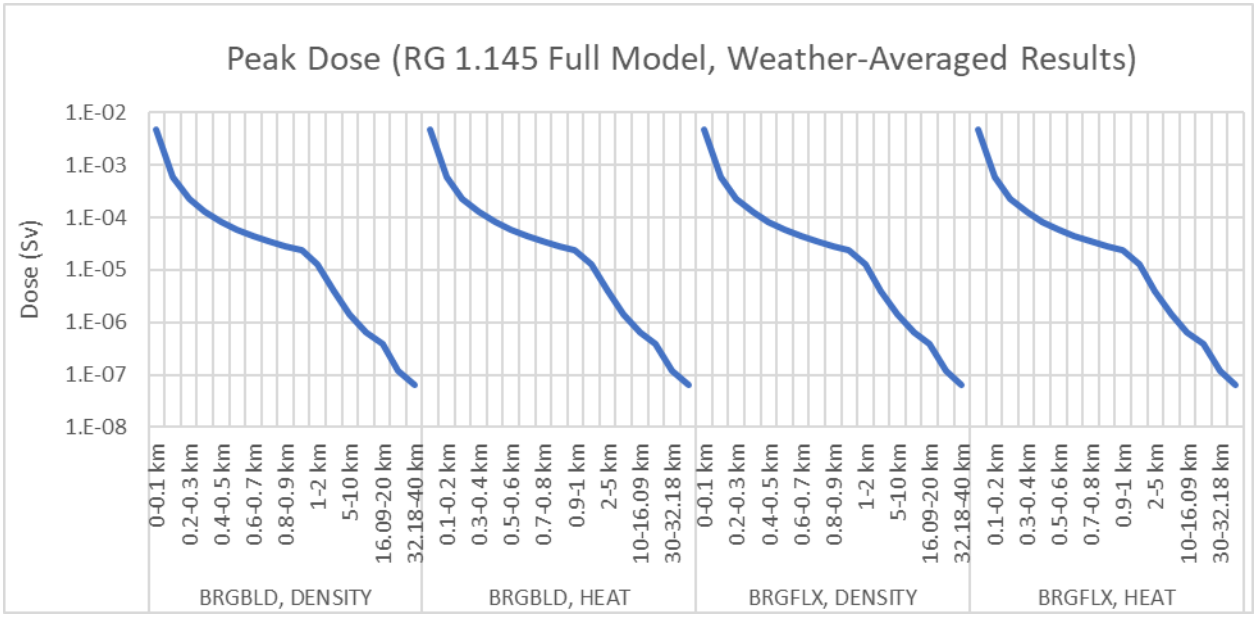

Figure 3-17 Comparison of Peak Dose Using Two Plume Trapping Models and Two Methods for Calculating Buoyancy Flux for Radial Intervals within 40 km (25 mi).

The original trapping model (TDWMOD=BRGFLX) uses the buoyancy flux of the plume and the building height to calculate a critical windspeed. When the actual windspeed is less than the critical windspeed, the model assumes liftoff can occur. Figure 3-18 shows the distribution of windspeeds used in this analysis.

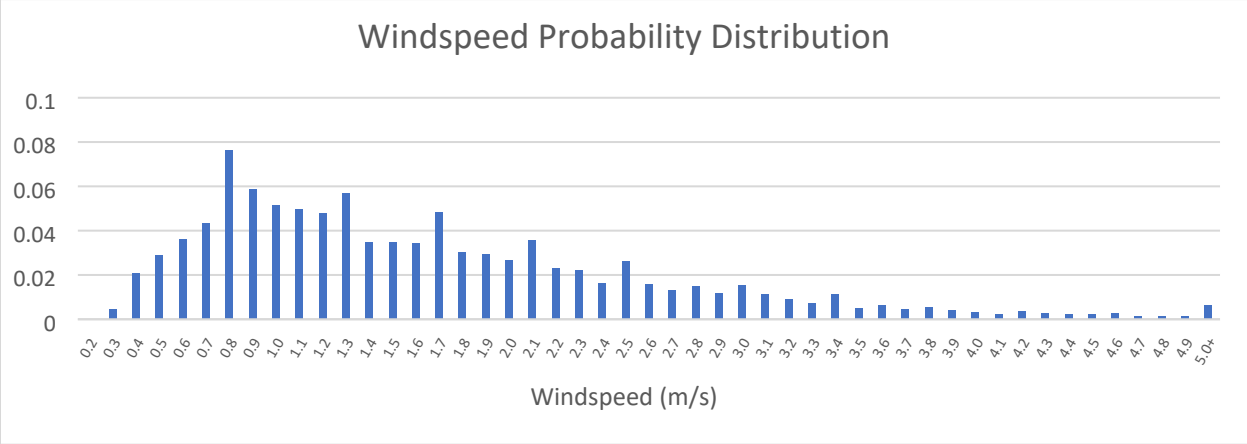

Figure 3-18 Distribution of Hourly Windspeeds at Sequoyah Nuclear Plant in 2012.

Because there is a distribution of potential windspeeds, a buoyant plume will typically achieve liftoff sometimes. However, in the case of the HPR TOP source term, there is likely never enough plume buoyancy to achieve liftoff, even for very low windspeeds.

To determine how close the HPR TOP source term is to achieving liftoff using the buoyancy flux method, the analysis evaluated the critical windspeed of the plume. MACCS calculates the critical windspeed, u_c, as follows:

$$u_c = \left(\frac{9.09F}{H_b}\right)^{\frac{1}{3}} \quad \textbf{(3-1)}$$

where

- u_c is the critical windspeed (m/s)
- H_b is the height (m) of the building from which the plume escapes (BUILDH)
- *F* is the buoyancy flux (m^4/s^3) of the plume segment

There are two models to calculate the buoyancy flux. The "Power Model" uses the sensible heat release rate of a plume segment. The buoyancy flux *F* is related to the sensible heat release rate $\dot{Q}$ according to the following formula:

$$F = \frac{g}{\pi C_p \rho_a T_a}\dot{Q} \quad \textbf{(3-2)}$$

where

- *F* is the buoyancy flux (m^4/s^3) of the plume segment
- g is acceleration due to gravity (9.8 m/s^2)
- C_p is specific heat of air at constant pressure at ambient temperature and pressure (1.005 kJ/kg-K)
- ρ_a is density of air at ambient temperature and pressure (1.178 kg/m^3)
- T_a is ambient temperature (300 Kelvin)
- $\dot{Q}$ is sensible heat release rate (watts) of a plume segment, as given by the parameter PLHEAT

The "Density and Flow Model" instead uses the density and mass flow rate of the plume segment to determine the buoyancy flux using the following formula:

$$F = \frac{g}{\pi}\left[1 - \frac{\rho}{\rho_a}\right]\frac{\dot{m}}{\rho} \quad \textbf{(3-3)}$$

where

- ρ is the density of the plume segment (kg/m^3), as given by the parameter PLMDEN
- $\dot{m}$ is the mass flow rate of the plume segment (kg/s), as given by the parameter PLMFLO
- ρ_a and g are the same as before

The two methods produce significantly different buoyancy fluxes using the plume segment data for the HPR TOP scenario. Plume segment 4, which produces the highest buoyancy values using either method, has a sensible heat release rate of 2.85E+03 joules per second (J/s) (9,720 British thermal units per hour), a mass flow rate of 7.04E-04 kg/s (1.55E-03 lb/hr), and a density of 1.146 kg/m^3 (0.0715 lb/ft^3). When manually replicating the buoyancy calculations, this results in a buoyancy flux of 2.51E-02 m^4/s^3 (2.91 ft^4/s^3) and a critical windspeed of 0.29 m/s (0.95 ft/s) using the "Power" model (PLMMOD=HEAT), and a buoyancy flux of 5.27E-05 m^4/s^3 (6.10E-03 ft^4/s^3) and a critical windspeed of 0.037 m/s (0.12 ft/s) using the "Density and Flow" model (PLMMOD=DENSITY). Both models predict that plume liftoff essentially never occurs for any windspeed in this analysis, which explains why the HPR TOP scenario results are the same regardless of the plume trapping model and the method of calculating plume buoyancy.

However, it appears the "Power" model with a top critical windspeed of 0.29 m/s (0.95 ft/s) is close to predicting buoyant plume rise for very low windspeed conditions, whereas the "Density and Flow" model is not. The discrepancy between these two methods is not currently well understood. It is also unclear which model is more appropriate, given that the two are expected to produce similar results. The models should be further investigated to understand if this is cause for concern.

3.5 Sensitivity Analysis of Release Timing

MACCS assumes that reactor shutdown occurs at the beginning of an accident scenario. At this time, MACCS begins calculating decay and ingrowth using the core inventory data provided as input. However, the TOP scenario is uncommon in that shutdown does not immediately occur. Instead, the reactor is postulated to operate for roughly an hour when the reactor power level steadily increases. This presents a few issues in computing offsite consequences:

- Since reactor shutdown does not immediately occur, the time between reactor shutdown and the start of release is shorter.
- The calculation of the core inventory assumes steady-state operation. If the reactor power level changes, it may not fully represent the new composition from the shift in fission rate before shutdown.
- Release can begin before reactor shutdown. MACCS is designed only to calculate decay and ingrowth from a core inventory given at a fixed time. It does not model production of fission and activation products during release.

While the second two items may be ongoing challenges, a sensitivity analysis may help address the first item. A shorter time between shutdown and release means less time for decay and ingrowth before release.

To better understand how earlier and later release times affect the projected dose, this analysis conducted a sensitivity analysis shifting the release time by -0.94, 0, 1, 2, 4, 8, 24, and 96 hours. The base case used for this sensitivity is the main analysis discussed in section 3.1 ,

which uses the new HPR inventory list. Because the first plume segment of the base case (0 hours) has a release start time of 0.94 hours, a shift of -0.94 hours sensitivity represents an immediate release. Likewise, a change of 96 hours represents a delayed release of 4 days. For each realization, the analysis shifted the release of all plume segments by the same period, not just the first plume segment. The analysis also shifted the length of the 7-day early phase by the same amount so that the exposure period starting from the first plume segment release would remain the same, and the only change would be due to the amount of decay and ingrowth.

Figure 3-19 compares the peak dose of the release time sensitivities relative to the base case scenario. Despite a shift in the release time by up to 4 days, the projected dose remained within about 6 percent. However, nearly half of this range (3 percent) can be attributed to a change in release start time of just 3 hours (i.e., from -0.94 to 2 hours). This shows that the impact of a release timing that may occur in the first few hours is relatively important, but still limited. However, this has the potential to increase with the consideration of more radionuclides. During the evaluation process to create the HPR radionuclide list, radionuclides with half-lives less than 1 hour were screened out. These short-lived radionuclides may affect accident scenarios with exposures in these short timeframes, although it is unclear how much.

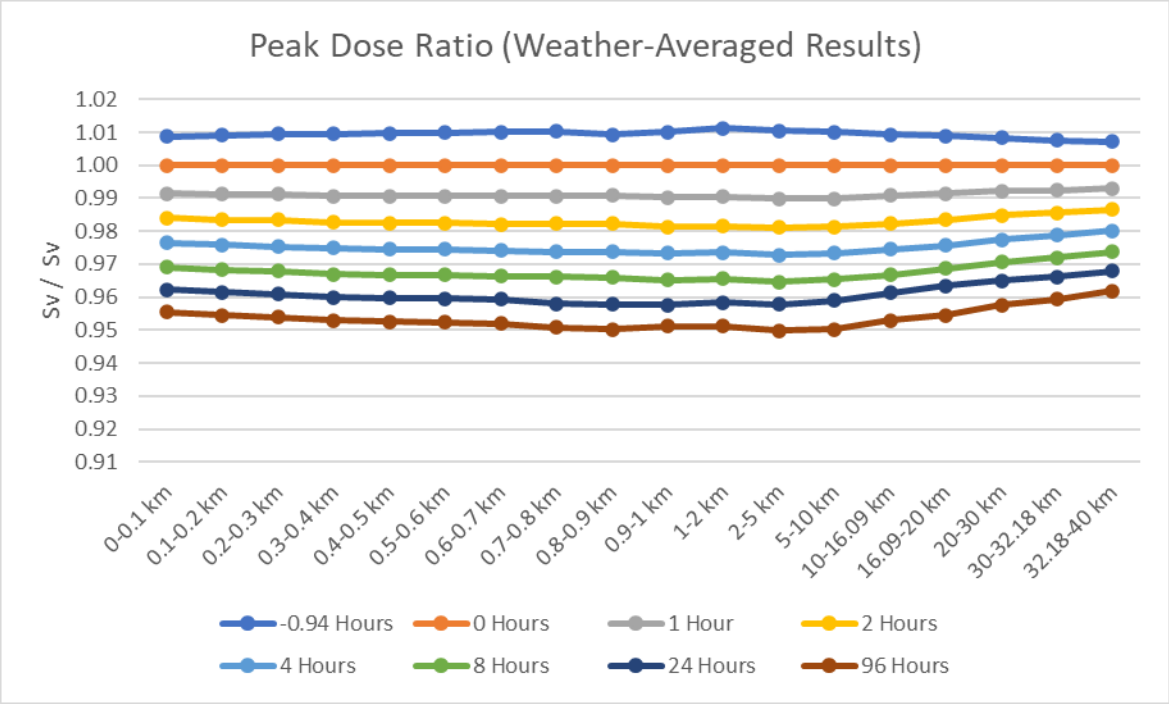

Figure 3-19 Ratio of Peak Dose Compared to the Base Case (0 hours) for Various Time Shifts in the Release.

4 CONCLUSIONS

This report documents the MACCS analysis of an example HPR source term from a TOP accident scenario. The example MELCOR demonstration calculations were performed to assess MELCOR's ability to simulate accidents for non-LWRs and enable dialogue with stakeholders. The project included adding models (e.g., a heat pipe model) to extend MELCOR to non-LWRs and performing example MELCOR calculations for publicly available non-LWR conceptual designs. The MELCOR calculations are considered example calculations because they include assumptions regarding certain plant features selected solely to demonstrate MELCOR modeling capabilities. Because the staff used an example atmospheric release from the MELCOR demonstration project as input to MACCS, the radiological consequence results from MACCS are considered example results and are not intended to reflect realistic radiological consequences for an actual non-LWR.

The results of this evaluation indicate that the projected offsite dose consequences from the example HPR TOP source term are expected to be very small compared to consequences from typical large LWR severe accident scenarios. The projected doses are anticipated to remain below the 1 to 5 rem (10 to 50 mSv) emergency phase PAG regardless of weather conditions and below dose thresholds for early fatalities. In the long-term phase, protective actions on farmland and relocation in populated areas are expected to remain within 0.1 km (0.06 mi) of the release location, and there may no need for these actions when weather conditions are favorable.

Variations in the example HPR TOP source term could change these results. The MELCOR analysis truncated the release at 24 hours in part because that time is sufficient to produce a release that's useful for code demonstration purposes. The release rate at 24 hours indicates it would be expected to continue. However, since release in the first 24 hours is small, the use of a source term extending past this time likely would not drastically change the results. On the other hand, sensitivity calculations from the MELCOR analysis regarding the leakage and external wind speed indicate that different accident assumptions could increase the source term by one or two orders of magnitude (see Figure 2-1). These variations would require analysis to see how significantly they could change consequence results.

The MACCS sensitivity calculations of the HPR analysis provide useful insights. The sensitivity analysis of the dose exposure period shows that most of the projected dose is attributed to ground contamination in the late phase. Nevertheless, doses from short-lived radionuclides and doses from plume passage can still be important as they can be more challenging to avert and they accumulate quickly.

MACCS does not analyze offsite consequences from every type of radionuclide in a reactor core. The sensitivity analysis of radionuclides analyzed the HPR TOP accident scenario using a set of 71 radionuclides commonly used for LWR accident scenarios and an expanded set of 104 radionuclides developed after an evaluation [20] of the HPR inventory. The sensitivity analysis indicates that the use of the expanded set of 104 radionuclides results in an increase of the projected peak dose of less than 1 percent. This indicates that the additional radionuclides included for the HPR analysis are not a significant contributor to the consequences. It is unclear if the same would be true for radionuclides important to ingestion doses, which were not evaluated by this analysis nor by the evaluation of radionuclides for the HPR inventory.

The sensitivity analysis of the MACCS nearfield models indicates that the Ramsdell and Fosmire Model tends to have more plume spread and lower peak doses. The differences between the two nearfield models based on RG 1.145 become negligible after approximately 1 km (0.62 mi) from the source location, and the differences between all the models become negligible around 40 km (25 mi).

The sensitivity analysis of the two plume trapping models and the two buoyancy calculations in MACCS shows plume rise did not occur in any combination of models. In addition, evaluation of the buoyancy flux model indicates that plume rise was not possible because there was not enough plume buoyancy from the HPR source term, even when windspeeds were very low.

The sensitivity analysis of release timing evaluated the impact of a delay between shutdown and release. The sensitivity analysis shows that the difference between an immediate release and a 3-hour delay is about 3 percent in the peak dose in the early phase. The difference between an immediate release and a 4-day delay is roughly a 6 percent change in the peak dose.

The MELCOR HPR analysis indicates that fission and plume release occur simultaneously for a brief time. This is negligible in the TOP scenario because the overlap is very brief. However, this highlights a potential limitation in modeling reactivity-initiated accidents in MACCS, as MACCS is not designed for scenarios in which the production of fission products and release occur simultaneously. This may also be important in variations of the TOP scenario and other advanced reactor designs. For instance, high-temperature gas reactors intend to achieve passive safety without reactor shutdown by allowing the reactor temperatures to increase to a point where the fission rate decreases. Reactor shutdown does not immediately occur in this scenario, making this a potentially challenging scenario to analyze in MACCS if there is a release and may require additional research to assess whether additional MACCS enhancements are appropriate.

The MACCS demonstration confirms that the MACCS code is flexible in analyzing the offsite consequences of an example postulated heat-pipe reactor accident release. Many aspects, such as reactivity-initiated events, new reactor inventory compositions, and transformation of radionuclide physical and chemical forms, are anticipated to present difficulties in analyzing advanced reactor accident scenarios. Nevertheless, these are also limitations in analyzing LWR accident scenarios. While new reactor designs present new challenges, they may not differ fundamentally from those in previous analyses.

This report identifies a candidate for future research in continuing to demonstrate MACCS capabilities using as input the core radionuclide inventory and atmospheric release from the example SCALE and MELCOR demonstration calculations. Even though accident source terms of non-LWR reference designs can be very small relative to source terms from LWR severe accidents, assessing the capabilities of MACCS with other novel non-LWR designs may still be useful. Additionally, source terms for non-LWR applications may be larger or smaller than the one analyzed in this project. It may also be useful to establish a measure below which releases are not expected to require protective actions or below which public consequences are limited. Future projects may include sensitivity analyses of core scaling as a measure of safety margin before certain important break points are reached. These safety margin evaluations could illustrate how much extra release is required before the accident reaches certain levels, such as the potential to induce early fatalities, to exceed a dose limit, or to trigger relocation at a given distance from the release.

This report also identifies a candidate for future research in continuing the evaluation of radionuclides in non-LWR inventories important to dose and expanding these evaluations to include ingestion doses. This evaluation would also serve as a verification of the current list of radionuclides considered in the ingestion models for LWR applications. Recent work has established a process for evaluating radionuclides in a non-LWR core inventory that are important to doses from inhalation, groundshine, and cloudshine. However, a similar process is not available for ingestion doses. Furthermore, food interdiction limits tend to occur at lower concentrations than other protective actions. This indicates that there is less safety margin before an accident requires extensive food interdiction. Therefore, the radionuclides important to food doses may be relatively important.

This report identifies a candidate for future research in including both food interdiction limits and cleanup limits in safety margin analyses. Like food interdiction limits, a cleanup limit for contaminated areas likely has less safety margin than other protective actions. For this reason, a sensitivity analysis of the potential cleanup limit may be important to understand the safety margin and the potential extent of decontamination.

This report also identifies a candidate for future research in developing a method to analyze or conservatively bound accidents with simultaneous release and fission. The HPR TOP scenario has illustrated that reactivity-initiated accidents may be challenging to analyze in MACCS.

Finally, the report identifies a candidate for future research in developing methods to analyze or conservatively bound the impact of additional radionuclide chemical and physical forms and how they may transform in the environment. MACCS currently assumes that radionuclide aerosols are released as oxides or hydroxides. Some radionuclides such as tritium may have different release forms or may change forms in the environment. The HPR tritium inventory is very small, and therefore unlikely to be a concern. However, it is unclear at what point tritium inventory could be significant in an accident scenario.

5 REFERENCES

[1] A. Nosek and N. Bixler, “MACCS Theory Manual,” SAND2021-11535, Sandia National Laboratories, Albuquerque, New Mexico, September 2021, Agencywide Documents Access and Management System Accession No. ML22118B153.

[2] Sandia National Laboratories, “MACCS (MELCOR Accident Consequence Code System) User Guide—Version 4.0, Revision 1,” SAND2022-7112, Sandia National Laboratories, Albuquerque, New Mexico, May 2022.

[3] Nuclear Regulatory Commission, “NRC Non-Light Water Reactor Near-Term Implementation Action Plans,” July 2017, ML17165A069.

[4] E. Walker, S.E. Skutnik, W.A. Wieselquist, A. Shaw, and F. Bostelmann, “SCALE Modeling of the Fast-Spectrum Heat Pipe Reactor,” ORNL/TM-2021/2021, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2021, ML22158A054.

[5] K. Wagner, C. Faucett, R. Schmidt, and D. Luxat, “MELCOR Accident Progression and Source Term Demonstration Calculations for a Heat Pipe Reactor,” SAND2022-2745, Sandia National Laboratories, Albuquerque, New Mexico, March 2022, ML22144A188.

[6] Nuclear Regulatory Commission, “Approach for Code Development in Support of NRC’s Regulatory Oversight of Non-Light Water Reactors,” Rev. 1, 2020, ML20030A174.

[7] Nuclear Regulatory Commission, “NRC Non-Light Water Reactor (Non-LWR) Vision and Strategy,” Volume 1-5, 2020-2021; ML20030A176, ML20030A177, ML20030A178, ML21085A483, ML21088A047.

[8] American Society of Mechanical Engineers & American Nuclear Society, "Standard for Radiological Accident Offsite Consequence Analysis (Level 3 PRA) to Support Nuclear Installation Applications (ASME/ANS RA-S-1.3-2017)," American Nuclear Society, La Grange Park, IL, 2017.

[9] K. McFadden and N. Bixler, “MelMACCS Models Document (MELCOR to MACCS Interface Description),” Draft, Sigma Software LLC, October 2016, ML22118B150.

[10] S. Weber, N. Bixler, and K. McFadden, “SecPop Version 4: Sector Population, Land Fraction, and Economic Estimation Program—User Guide, Model Manual, and Verification Report,” NUREG/CR-6525, Rev. 2, U.S. Nuclear Regulatory Commission, Washington, DC, 2019, ML19182A284.

[11] D. Chanin and M. Young, “Code Manual for MACCS2: Preprocessor Codes COMIDA2, FGRDCF, IDCF2,” NUREG/CR-6613, Vol. 2, U.S. Nuclear Regulatory Commission, Washington, DC, May 1998, ML17047A444.

[12] D.J. Clayton, J. Leute, N. Bixler, D. Whitener, and L. Eubanks, “AniMACCS User Guide,” SAND2022-0403, Sandia National Laboratories, Albuquerque, New Mexico, January 2022, ML22118B151.

[13] N. Bixler, “Evaluation of Potential MACCS Model and Data Improvements Needed to Support Consequence Analyses of Advanced Reactors,” U.S. Nuclear Regulatory Commission, Washington, DC, January 2018.

[14] D.J. Clayton, “Implementation of Additional Models into the MACCS Code for Nearfield Consequence Analysis,” SAND2021-6924, Sandia National Laboratories, Albuquerque, New Mexico, June 2021, ML21257A120.

[15] National Aeronautics and Space Administration, Kilopower [Online]. Available: https://www.nasa.gov/directorates/spacetech/kilopower, 2021.

[16] M.A. Gibson, S.R. Oleson, D.I. Poston, and P. McClure, "NASA's Kilopower Reactor Development and the Path to Higher Power Missions," 2017 IEEE Aerospace Conference, Big Sky, Montana, March 2017.

[17] P.R. McClure, D.I. Poston, V.R. Dasari, and R.S. Reid, "Design of Megawatt Power Level Heat Pipe Reactors," LA-UR-15-28840, Los Alamos National Laboratory, Los Alamos, New Mexico, November 2015.

[18] J.W. Sterbentz, J.E. Werner, M.G. McKellar, A.J. Hummel, J.C. Kennedy, R.N. Wright, and J.M. Biesdorf, "Special Purpose Nuclear Reactor (5 MW) for Reliable Power at Remote Sites Assessment Report," INL/EXT-16-40741, Idaho National Laboratory, Idaho Falls, Idaho, April 2017.

[19] J.W. Sterbentz, J.E. Werner, A.J. Hummel, J.C. Kennedy, R.C. O'Brien, A.M. Dion, R.N. Wright, and K.P. Ananth, "Preliminary Assessment of Two Alternative Core Design Concepts for the Special Purpose Reactor," INL/EXT-17-43212, Idaho National Laboratory, Idaho Falls, Idaho, May 2018.

[20] K.A. Clavier, D.J. Clayton, and C. Faucett, "Quantitative Assessment for Advanced Reactor Radioisotope Screening Utilizing a Heat Pipe Reactor Inventory," SAND2022-12018, Sandia National Laboratories, Albuquerque, New Mexico, September 2022, ML22270A046.

[21] Sandia National Laboratories, "Technical Bases for Consequence Analysis Using MACCS (MELCOR Accident Consequence Code System)," NUREG/CR-7270, U.S. Nuclear Regulatory Commission, Washington, DC, October 2022, ML22294A091.

[22] Sandia National Laboratories, "State-of-the-Art Reactor Consequence Analyses (SOARCA) Project: Sequoyah Integrated Deterministic and Uncertainty Analyses," NUREG/CR-7245, U.S. Nuclear Regulatory Commission, Washington, DC, October 2019, ML19296B786.

[23] W.G. Snell and R.W. Jubach, "Technical Basis for Regulatory Guide 1.145, 'Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants,'" NUREG/CR-2260, NUS-3854, NUS Corporation, U.S. Nuclear Regulatory Commission, Washington, DC, October 1981, ML12045A197.

[24] U.S. Nuclear Regulatory Commission, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Regulatory Guide 1.145, Rev. 1, U.S. Nuclear Regulatory Commission, Washington, DC, November 1982 (reissued February 1983), ML003740205.

[25] J.V. Ramsdell Jr. and C.A. Simonen, "Atmospheric Relative Concentrations in Building Wakes," NUREG/CR-6331, Rev. 1, U.S. Nuclear Regulatory Commission, Washington, DC, May 1997, ML17213A190.

APPENDIX A
MACCS SETTINGS—HEAT PIPE REACTOR (INL DESIGN A)
TRANSIENT OVERPOWER SCENARIO

A.1 ATMOS.inp

```
* File created using WinMACCS version 4.1.0 SVN:8280 8/23/2022 12:47:50 PM
*
* This is an analysis for the Advanced Reactor Demonstration Project of the Heat Pipe Reactor
(HPR).
* Most inputs are based on the recommendations of the draft NUREG/CR-7270 (TECHNICAL BASES FOR
CONSEQUENCE ANALYSES USING MACCS).
* The source term in this problem is the HPR transient overpower scenario.
* A uniform population density of 40 / km2 is used.
* Other site specific data (economic and meteorological) represent the Sequoyah NPP site region.
* Uniform site data of the Sequoyah NPP is derived from SecPop results.
* Meteorological data is the 2012 Sequoyah dataset used in the SOARCA Sequoyah analysis
(NUREG/CR-7245).
*
*
*
* Form 'Atmos Description' Comment:
* ATMOS problem description.
*
* ATNAM1, identifies this MACCS calculation
RIATNAM1001    'HPR Advanced Reactor Demonstration Project'
*
* Form 'Output Units' Comment:
* Units are based on typical MACCS usage.
*
* ACTIVITY_UNITS, model results are displayed in these units
UNITACTI001    Bq
*
* DIST_UNITS, model results are displayed in these units
UNITDIST001    km
*
* AREA_UNITS,  model results are displayed in these units
UNITAREA001    ha
*
* DOSE_UNITS,  model results are displayed in these units
UNITDOSE001    Sv
*
* Form 'Spatial Grid' Comment:
* Grid definition of 64 sectors and distances for evaluating nearfield effects in km
* Form 'Site File' Comment:
* Site file update to reflect 64 sectors and 29 intervals
*
* NUMRAD, number of radial spatial elements
GENUMRAD001    31
*
* SPAEND, spatial endpoint distances (km)
GESPAEND001    0.1
GESPAEND002    0.2
GESPAEND003    0.3
GESPAEND004    0.4
GESPAEND005    0.5
GESPAEND006    0.6
GESPAEND007    0.7
GESPAEND008    0.8
GESPAEND009    0.9
GESPAEND010    1.
GESPAEND011    2.
```

```
GESPAEND012    5.
GESPAEND013    10.
GESPAEND014    16.09
GESPAEND015    20.
GESPAEND016    30.
GESPAEND017    32.18
GESPAEND018    40.
GESPAEND019    50.
GESPAEND020    60.
GESPAEND021    70.
GESPAEND022    80.45
GESPAEND023    90.
GESPAEND024    100.
GESPAEND025    160.9
GESPAEND026    200.
GESPAEND027    500.
GESPAEND028    804.5
GESPAEND029    1000.
GESPAEND030    1500.
GESPAEND031    1609.
*
* NUMCOR, number of angular compass directions
GENUMCOR001    64
*
* Form 'Radionuclides' Comment:
* Place holder
* Form 'Radionuclides' Comment:
* Radionuclide list is consistent with expanded HPR list based on the draft HPR radionuclide
screening report.
*
* NUMISO, number of nuclides
ISNUMISO001    104
*
* Form 'Chemical Names' Comment:
* Chemical groups are consistent with source term
* Form 'Chemical Names' Comment:
* Place holder
*
* MAXGRP, number of chemical groups
ISMAXGRP001    13
*
* GRPNAM, chemical group names
ISGRPNAM001    Xe
ISGRPNAM002    Cs
ISGRPNAM003    Ba
ISGRPNAM004    I
ISGRPNAM005    Te
ISGRPNAM006    Ru
ISGRPNAM007    Mo
ISGRPNAM008    Ce
ISGRPNAM009    La
ISGRPNAM010    U
ISGRPNAM011    Cd
ISGRPNAM012    Sn
ISGRPNAM013    B
*
* Form 'Property Form Parameters' Comment:
* Property form parameters are defined in the properties box and cannot be changed in this form.
They are reproduced here for the user A-2vacuationA-2.
*
* MSMODL, multi source term model (TRUE, FALSE)
ISMSMODL001    .FALSE.
*
* Form 'Wet/Dry Depos Flags' Comment:
* Deposition flags are consistent with Section 3.8 of the NUREG/CR-7270.
*
```

```
* WETDEP, DRYDEP, wet and dry deposition flags for each nuclide group
ISDEPFLA001    .FALSE. .FALSE.
ISDEPFLA002    .TRUE.  .TRUE.
ISDEPFLA003    .TRUE.  .TRUE.
ISDEPFLA004    .TRUE.  .TRUE.
ISDEPFLA005    .TRUE.  .TRUE.
ISDEPFLA006    .TRUE.  .TRUE.
ISDEPFLA007    .TRUE.  .TRUE.
ISDEPFLA008    .TRUE.  .TRUE.
ISDEPFLA009    .TRUE.  .TRUE.
ISDEPFLA010    .TRUE.  .TRUE.
ISDEPFLA011    .TRUE.  .TRUE.
ISDEPFLA012    .TRUE.  .TRUE.
ISDEPFLA013    .TRUE.  .TRUE.
*
* NUMSTB, number of pseudostable radionuclides, always 0
ISNUMSTB001    0
*
* Form 'Pseudostable Radionuclides' Comment:
* Psedudstable nuclides updated to be consistent with radionuclide list
*
* NUMSTB, number of pseudostable radionuclides
ISNUMSTB001    12
*
* NAMSTB, list of pseudostable radionuclides
ISNAMSTB001    I-129
ISNAMSTB002    Xe-131m
ISNAMSTB003    Xe-133m
ISNAMSTB004    Cs-135
ISNAMSTB005    Sm-147
ISNAMSTB006    U-235
ISNAMSTB007    U-236
ISNAMSTB008    Np-237
ISNAMSTB009    Rb-87
ISNAMSTB010    Zr-93
ISNAMSTB011    Nb-93m
ISNAMSTB012    Tc-99
*
* NUCNAM, IGROUP, chemical group associated with each nuclide
ISOTPGRP001    Kr-85   1
ISOTPGRP002    Kr-85m  1
ISOTPGRP003    Kr-87   1
ISOTPGRP004    Kr-88   1
ISOTPGRP005    Xe-133  1
ISOTPGRP006    Xe-135  1
ISOTPGRP007    Xe-135m 1
ISOTPGRP008    Cs-134  2
ISOTPGRP009    Cs-136  2
ISOTPGRP010    Cs-137  2
ISOTPGRP011    Rb-86   2
ISOTPGRP012    Rb-88   2
ISOTPGRP013    Ba-139  3
ISOTPGRP014    Ba-140  3
ISOTPGRP015    Sr-89   3
ISOTPGRP016    Sr-90   3
ISOTPGRP017    Sr-91   3
ISOTPGRP018    Sr-92   3
ISOTPGRP019    Ba-137m 3
ISOTPGRP020    I-131   4
ISOTPGRP021    I-132   4
ISOTPGRP022    I-133   4
ISOTPGRP023    I-134   4
ISOTPGRP024    I-135   4
ISOTPGRP025    Te-127  5
ISOTPGRP026    Te-127m 5
ISOTPGRP027    Te-129  5
```

```
ISOTPGRP028    Te-129m 5
ISOTPGRP029    Te-131m 5
ISOTPGRP030    Te-132  5
ISOTPGRP031    Te-131  5
ISOTPGRP032    Rh-105  6
ISOTPGRP033    Ru-103  6
ISOTPGRP034    Ru-105  6
ISOTPGRP035    Ru-106  6
ISOTPGRP036    Rh-103m 6
ISOTPGRP037    Rh-106  6
ISOTPGRP038    Nb-95   7
ISOTPGRP039    Co-58   7
ISOTPGRP040    Co-60   7
ISOTPGRP041    Mo-99   7
ISOTPGRP042    Tc-99m  7
ISOTPGRP043    Nb-97   7
ISOTPGRP044    Nb-97m  7
ISOTPGRP045    Ce-141  8
ISOTPGRP046    Ce-143  8
ISOTPGRP047    Ce-144  8
ISOTPGRP048    Np-239  8
ISOTPGRP049    Pu-238  8
ISOTPGRP050    Pu-239  8
ISOTPGRP051    Pu-240  8
ISOTPGRP052    Pu-241  8
ISOTPGRP053    Zr-95   8
ISOTPGRP054    Zr-97   8
ISOTPGRP055    Am-241  9
ISOTPGRP056    Cm-242  9
ISOTPGRP057    Cm-244  9
ISOTPGRP058    La-140  9
ISOTPGRP059    La-141  9
ISOTPGRP060    La-142  9
ISOTPGRP061    Nd-147  9
ISOTPGRP062    Pr-143  9
ISOTPGRP063    Y-90    9
ISOTPGRP064    Y-91    9
ISOTPGRP065    Y-92    9
ISOTPGRP066    Y-93    9
ISOTPGRP067    Y-91m   9
ISOTPGRP068    Pr-144  9
ISOTPGRP069    Pr-144m 9
ISOTPGRP070    Sb-127  11
ISOTPGRP071    Sb-129  11
ISOTPGRP072    Ag-111  12
ISOTPGRP073    As-77   11
ISOTPGRP074    Cd-115  11
ISOTPGRP075    Cd-115m 11
ISOTPGRP076    Eu-154  9
ISOTPGRP077    Eu-155  9
ISOTPGRP078    Eu-156  9
ISOTPGRP079    Ge-77   12
ISOTPGRP080    Nb-95m  7
ISOTPGRP081    Nd-149  9
ISOTPGRP082    Pd-109  6
ISOTPGRP083    Pm-147  9
ISOTPGRP084    Pm-148  9
ISOTPGRP085    Pm-148m 9
ISOTPGRP086    Pm-149  9
ISOTPGRP087    Pm-151  9
ISOTPGRP088    Pr-145  9
ISOTPGRP089    Sb-125  11
ISOTPGRP090    Sm-151  9
ISOTPGRP091    Sm-153  9
ISOTPGRP092    Sm-156  9
ISOTPGRP093    Sn-121  12
```

```
ISOTPGRP094    Sn-123  12
ISOTPGRP095    Sn-125  12
ISOTPGRP096    Sn-127  12
ISOTPGRP097    Te-125m 5
ISOTPGRP098    U-234   10
ISOTPGRP099    U-237   10
ISOTPGRP100    In-115m 12
ISOTPGRP101    In-115  12
ISOTPGRP102    Th-230  8
ISOTPGRP103    Ra-226  3
ISOTPGRP104    Rn-222  1
*
* Form 'Wet Deposition' Comment:
* Based on a median particle size of 0.736 microns derived from PSDIST.
*
* CWASH1, washout coefficient number one, linear factor (1/s)
WDCWASH1001    1.18E-05
*
* CWASH2, washout coefficient number two, exponential factor (1/s)
WDCWASH2001    0.664
*
* Form 'Particle Size Groups' Comment:
* Partical size group is consistent with Table 2.9 the NUREG/CR-7270.
*
* NPSGRP, number of particle size groups
DDNPSGRP001    10
*
* Form 'Dry Deposition' Comment:
* Deposition velocities are consistent with the NUREG/CR-7270.
*
* VDEPOS, dry deposition velocities for each particle size group (m/sec)
DDVDEPOS001    6.5205E-04
DDVDEPOS002    5.9841E-04
DDVDEPOS003    7.8397E-04
DDVDEPOS004    0.0013218
DDVDEPOS005    0.0025854
DDVDEPOS006    0.0052893
DDVDEPOS007    0.010203
DDVDEPOS008    0.01673
DDVDEPOS009    0.020715
DDVDEPOS010    0.051507
*
* Form 'Dispersion Table' Comment:
* Dispersion table is based on the Eimutis and Konicek approximation of Pasquill-Gifford
dispersion curves.
*
* NUM_DIST, number of entries in the dispersion lookup table
NUM_DIST001    50
*
* DISTANCE, SIGMA_Y_A, SIGMA_Z_A, downwind distances (m), A-stability dispersion table
A-STB/DIS01    1.      0.366   0.192
A-STB/DIS02    1.4     0.496   0.263
A-STB/DIS03    2.      0.684   0.367
A-STB/DIS04    3.      0.987   0.537
A-STB/DIS05    4.      1.28    0.703
A-STB/DIS06    6.      1.84    1.03
A-STB/DIS07    8.      2.39    1.34
A-STB/DIS08    10.     2.93    1.66
A-STB/DIS09    14.     3.97    2.27
A-STB/DIS10    20.     5.47    3.17
A-STB/DIS11    30.     7.89    4.63
A-STB/DIS12    40.     10.2    6.06
A-STB/DIS13    60.     14.8    8.86
A-STB/DIS14    80.     19.1    11.6
A-STB/DIS15    100.    23.4    14.3
A-STB/DIS16    140.    31.7    18.9
```

```
A-STB/DIS17    200.    43.8    28.6
A-STB/DIS18    300.    63.1    51.7
A-STB/DIS19    400.    81.9    83.4
A-STB/DIS20    600.    118.    172.
A-STB/DIS21    800.    153.    294.
A-STB/DIS22    1000.   187.    448.
A-STB/DIS23    1400.   254.    920.
A-STB/DIS24    2000.   350.    1950.
A-STB/DIS25    3000.   505.    4580.
A-STB/DIS26    4000.   655.    8360.
A-STB/DIS27    6000.   945.    19600.
A-STB/DIS28    8000.   1220.   35700.
A-STB/DIS29    10000.  1500.   57000.
A-STB/DIS30    14000.  2030.   1.15000E+05
A-STB/DIS31    20000.  2800.   2.44000E+05
A-STB/DIS32    30000.  4040.   5.69000E+05
A-STB/DIS33    40000.  5240.   1.040000E+06
A-STB/DIS34    60000.  7560.   2.430000E+06
A-STB/DIS35    80000.  9800.   4.440000E+06
A-STB/DIS36    1.00000E+05     12000.  7.080000E+06
A-STB/DIS37    1.40000E+05     16200.  1.43E+07
A-STB/DIS38    2.00000E+05     22400.  3.02E+07
A-STB/DIS39    3.00000E+05     32300.  7.07E+07
A-STB/DIS40    4.00000E+05     41900.  1.29E+08
A-STB/DIS41    6.00000E+05     60500.  3.02E+08
A-STB/DIS42    8.00000E+05     78400.  5.51E+08
A-STB/DIS43    1.000000E+06    95900.  8.79E+08
A-STB/DIS44    1.400000E+06    1.30000E+05     1.78E+09
A-STB/DIS45    2.000000E+06    1.79000E+05     3.75E+09
A-STB/DIS46    3.000000E+06    2.59000E+05     8.78E+09
A-STB/DIS47    4.000000E+06    3.35000E+05     1.6E+10
A-STB/DIS48    6.000000E+06    4.84000E+05     3.75E+10
A-STB/DIS49    8.000000E+06    6.27000E+05     6.84E+10
A-STB/DIS50    1.E+07  7.67000E+05     1.09E+11
*
* DISTANCE, SIGMA_Y_B, SIGMA_Z_B, downwind distances (m), B-stability dispersion table
B-STB/DIS01    1.      0.275   0.156
B-STB/DIS02    1.4     0.373   0.213
B-STB/DIS03    2.      0.514   0.296
B-STB/DIS04    3.      0.742   0.43
B-STB/DIS05    4.      0.962   0.56
B-STB/DIS06    6.      1.39    0.814
B-STB/DIS07    8.      1.8     1.06
B-STB/DIS08    10.     2.2     1.3
B-STB/DIS09    14.     2.98    1.78
B-STB/DIS10    20.     4.12    2.47
B-STB/DIS11    30.     5.94    3.59
B-STB/DIS12    40.     7.7     4.68
B-STB/DIS13    60.     11.1    6.8
B-STB/DIS14    80.     14.4    8.87
B-STB/DIS15    100.    17.6    10.9
B-STB/DIS16    140.    23.9    14.5
B-STB/DIS17    200.    32.9    20.1
B-STB/DIS18    300.    47.5    30.1
B-STB/DIS19    400.    61.6    40.6
B-STB/DIS20    600.    88.8    62.8
B-STB/DIS21    800.    115.    86.
B-STB/DIS22    1000.   141.    110.
B-STB/DIS23    1400.   191.    159.
B-STB/DIS24    2000.   263.    234.
B-STB/DIS25    3000.   380.    364.
B-STB/DIS26    4000.   493.    498.
B-STB/DIS27    6000.   710.    776.
B-STB/DIS28    8000.   921.    1060.
B-STB/DIS29    10000.  1130.   1360.
B-STB/DIS30    14000.  1530.   1960.
```

```
B-STB/DIS31    20000.  2110.   2910.
B-STB/DIS32    30000.  3040.   4530.
B-STB/DIS33    40000.  3940.   6220.
B-STB/DIS34    60000.  5680.   9700.
B-STB/DIS35    80000.  7370.   13300.
B-STB/DIS36    1.00000E+05    9020.   17000.
B-STB/DIS37    1.40000E+05    12200.  24600.
B-STB/DIS38    2.00000E+05    16900.  36400.
B-STB/DIS39    3.00000E+05    24300.  56800.
B-STB/DIS40    4.00000E+05    31500.  77900.
B-STB/DIS41    6.00000E+05    45500.  1.22000E+05
B-STB/DIS42    8.00000E+05    59000.  1.67000E+05
B-STB/DIS43    1.000000E+06   72100.  2.13000E+05
B-STB/DIS44    1.400000E+06   97700.  3.08000E+05
B-STB/DIS45    2.000000E+06   1.35000E+05    4.56000E+05
B-STB/DIS46    3.000000E+06   1.95000E+05    7.12000E+05
B-STB/DIS47    4.000000E+06   2.52000E+05    9.76000E+05
B-STB/DIS48    6.000000E+06   3.64000E+05    1.520000E+06
B-STB/DIS49    8.000000E+06   4.72000E+05    2.090000E+06
B-STB/DIS50    1.E+07  5.77000E+05    2.670000E+06
*
* DISTANCE, SIGMA_Y_C, SIGMA_Z_C, downwind distances (m), C-stability dispersion table
C-STB/DIS01    1.      0.209   0.116
C-STB/DIS02    1.4     0.283   0.157
C-STB/DIS03    2.      0.391   0.217
C-STB/DIS04    3.      0.563   0.314
C-STB/DIS05    4.      0.731   0.407
C-STB/DIS06    6.      1.05    0.587
C-STB/DIS07    8.      1.37    0.762
C-STB/DIS08    10.     1.67    0.932
C-STB/DIS09    14.     2.26    1.26
C-STB/DIS10    20.     3.13    1.75
C-STB/DIS11    30.     4.51    2.52
C-STB/DIS12    40.     5.84    3.27
C-STB/DIS13    60.     8.43    4.72
C-STB/DIS14    80.     10.9    6.12
C-STB/DIS15    100.    13.4    7.49
C-STB/DIS16    140.    18.1    10.2
C-STB/DIS17    200.    25.     14.1
C-STB/DIS18    300.    36.1    20.4
C-STB/DIS19    400.    46.8    26.5
C-STB/DIS20    600.    67.4    38.4
C-STB/DIS21    800.    87.4    49.9
C-STB/DIS22    1000.   107.    61.1
C-STB/DIS23    1400.   145.    83.
C-STB/DIS24    2000.   200.    115.
C-STB/DIS25    3000.   288.    166.
C-STB/DIS26    4000.   374.    216.
C-STB/DIS27    6000.   539.    313.
C-STB/DIS28    8000.   700.    406.
C-STB/DIS29    10000.  856.    498.
C-STB/DIS30    14000.  1160.   676.
C-STB/DIS31    20000.  1600.   936.
C-STB/DIS32    30000.  2310.   1350.
C-STB/DIS33    40000.  2990.   1760.
C-STB/DIS34    60000.  4320.   2550.
C-STB/DIS35    80000.  5600.   3310.
C-STB/DIS36    1.00000E+05    6850.   4060.
C-STB/DIS37    1.40000E+05    9280.   5510.
C-STB/DIS38    2.00000E+05    12800.  7630.
C-STB/DIS39    3.00000E+05    18500.  11000.
C-STB/DIS40    4.00000E+05    23900.  14300.
C-STB/DIS41    6.00000E+05    34500.  20700.
C-STB/DIS42    8.00000E+05    44800.  27000.
C-STB/DIS43    1.000000E+06   54800.  33000.
C-STB/DIS44    1.400000E+06   74200.  44900.
```

```
C-STB/DIS45    2.000000E+06   1.02000E+05    62100.
C-STB/DIS46    3.000000E+06   1.48000E+05    89900.
C-STB/DIS47    4.000000E+06   1.92000E+05    1.17000E+05
C-STB/DIS48    6.000000E+06   2.76000E+05    1.69000E+05
C-STB/DIS49    8.000000E+06   3.58000E+05    2.20000E+05
C-STB/DIS50    1.E+07  4.38000E+05    2.69000E+05
*
* DISTANCE, SIGMA_Y_D, SIGMA_Z_D, downwind distances (m), D-stability dispersion table
D-STB/DIS01    1.      0.147   0.079
D-STB/DIS02    1.4     0.199   0.106
D-STB/DIS03    2.      0.275   0.145
D-STB/DIS04    3.      0.397   0.208
D-STB/DIS05    4.      0.514   0.268
D-STB/DIS06    6.      0.742   0.383
D-STB/DIS07    8.      0.962   0.493
D-STB/DIS08    10.     1.18    0.601
D-STB/DIS09    14.     1.59    0.808
D-STB/DIS10    20.     2.2     1.11
D-STB/DIS11    30.     3.17    1.58
D-STB/DIS12    40.     4.12    2.04
D-STB/DIS13    60.     5.94    2.91
D-STB/DIS14    80.     7.7     3.75
D-STB/DIS15    100.    9.41    4.57
D-STB/DIS16    140.    12.8    6.29
D-STB/DIS17    200.    17.6    8.64
D-STB/DIS18    300.    25.4    12.2
D-STB/DIS19    400.    32.9    15.4
D-STB/DIS20    600.    47.5    21.2
D-STB/DIS21    800.    61.6    26.6
D-STB/DIS22    1000.   75.3    31.5
D-STB/DIS23    1400.   102.    39.9
D-STB/DIS24    2000.   141.    50.6
D-STB/DIS25    3000.   203.    65.4
D-STB/DIS26    4000.   263.    78.
D-STB/DIS27    6000.   380.    99.2
D-STB/DIS28    8000.   493.    117.
D-STB/DIS29    10000.  603.    133.
D-STB/DIS30    14000.  817.    161.
D-STB/DIS31    20000.  1130.   196.
D-STB/DIS32    30000.  1630.   244.
D-STB/DIS33    40000.  2110.   286.
D-STB/DIS34    60000.  3040.   355.
D-STB/DIS35    80000.  3940.   414.
D-STB/DIS36    1.00000E+05    4820.   466.
D-STB/DIS37    1.40000E+05    6530.   557.
D-STB/DIS38    2.00000E+05    9020.   672.
D-STB/DIS39    3.00000E+05    13000.  831.
D-STB/DIS40    4.00000E+05    16900.  967.
D-STB/DIS41    6.00000E+05    24300.  1190.
D-STB/DIS42    8.00000E+05    31500.  1390.
D-STB/DIS43    1.000000E+06   38600.  1560.
D-STB/DIS44    1.400000E+06   52300.  1860.
D-STB/DIS45    2.000000E+06   72100.  2230.
D-STB/DIS46    3.000000E+06   1.04000E+05    2760.
D-STB/DIS47    4.000000E+06   1.35000E+05    3200.
D-STB/DIS48    6.000000E+06   1.95000E+05    3950.
D-STB/DIS49    8.000000E+06   2.52000E+05    4580.
D-STB/DIS50    1.E+07  3.09000E+05    5140.
*
* DISTANCE, SIGMA_Y_E, SIGMA_Z_E, downwind distances (m), E-stability dispersion table
E-STB/DIS01    1.      0.105   0.063
E-STB/DIS02    1.4     0.142   0.0845
E-STB/DIS03    2.      0.196   0.115
E-STB/DIS04    3.      0.282   0.164
E-STB/DIS05    4.      0.366   0.211
E-STB/DIS06    6.      0.528   0.3
```

```
E-STB/DIS07    8.      0.684   0.385
E-STB/DIS08    10.     0.837   0.468
E-STB/DIS09    14.     1.13    0.628
E-STB/DIS10    20.     1.56    0.856
E-STB/DIS11    30.     2.26    1.22
E-STB/DIS12    40.     2.93    1.57
E-STB/DIS13    60.     4.22    2.23
E-STB/DIS14    80.     5.47    2.86
E-STB/DIS15    100.    6.69    3.48
E-STB/DIS16    140.    9.07    4.72
E-STB/DIS17    200.    12.5    6.36
E-STB/DIS18    300.    18.1    8.79
E-STB/DIS19    400.    23.4    11.
E-STB/DIS20    600.    33.8    14.8
E-STB/DIS21    800.    43.8    18.3
E-STB/DIS22    1000.   53.6    21.5
E-STB/DIS23    1400.   72.6    27.3
E-STB/DIS24    2000.   100.    34.4
E-STB/DIS25    3000.   144.    43.4
E-STB/DIS26    4000.   187.    50.5
E-STB/DIS27    6000.   270.    61.6
E-STB/DIS28    8000.   350.    70.3
E-STB/DIS29    10000.  428.    77.7
E-STB/DIS30    14000.  581.    89.8
E-STB/DIS31    20000.  801.    104.
E-STB/DIS32    30000.  1160.   122.
E-STB/DIS33    40000.  1500.   136.
E-STB/DIS34    60000.  2160.   159.
E-STB/DIS35    80000.  2800.   177.
E-STB/DIS36    1.00000E+05    3430.   191.
E-STB/DIS37    1.40000E+05    4650.   216.
E-STB/DIS38    2.00000E+05    6410.   245.
E-STB/DIS39    3.00000E+05    9250.   281.
E-STB/DIS40    4.00000E+05    12000.  310.
E-STB/DIS41    6.00000E+05    17300.  355.
E-STB/DIS42    8.00000E+05    22400.  391.
E-STB/DIS43    1.000000E+06   27400.  421.
E-STB/DIS44    1.400000E+06   37200.  470.
E-STB/DIS45    2.000000E+06   51300.  528.
E-STB/DIS46    3.000000E+06   74000.  602.
E-STB/DIS47    4.000000E+06   95900.  660.
E-STB/DIS48    6.000000E+06   1.38000E+05    752.
E-STB/DIS49    8.000000E+06   1.79000E+05    824.
E-STB/DIS50    1.E+07  2.19000E+05    884.
*
* DISTANCE, SIGMA_Y_F, SIGMA_Z_F, downwind distances (m), F-stability dispersion table
F-STB/DIS01    1.      0.0722  0.053
F-STB/DIS02    1.4     0.0978  0.0697
F-STB/DIS03    2.      0.135   0.0932
F-STB/DIS04    3.      0.195   0.13
F-STB/DIS05    4.      0.252   0.164
F-STB/DIS06    6.      0.364   0.228
F-STB/DIS07    8.      0.472   0.288
F-STB/DIS08    10.     0.578   0.345
F-STB/DIS09    14.     0.783   0.454
F-STB/DIS10    20.     1.08    0.607
F-STB/DIS11    30.     1.56    0.845
F-STB/DIS12    40.     2.02    1.07
F-STB/DIS13    60.     2.91    1.48
F-STB/DIS14    80.     3.78    1.88
F-STB/DIS15    100.    4.62    2.25
F-STB/DIS16    140.    6.26    2.98
F-STB/DIS17    200.    8.64    3.99
F-STB/DIS18    300.    12.5    5.51
F-STB/DIS19    400.    16.2    6.89
F-STB/DIS20    600.    23.3    9.43
```

```
F-STB/DIS21    800.    30.2    11.7
F-STB/DIS22    1000.   37.     13.9
F-STB/DIS23    1400.   50.1    17.9
F-STB/DIS24    2000.   69.1    22.3
F-STB/DIS25    3000.   99.7    27.7
F-STB/DIS26    4000.   129.    31.7
F-STB/DIS27    6000.   186.    37.8
F-STB/DIS28    8000.   242.    42.4
F-STB/DIS29    10000.  296.    46.1
F-STB/DIS30    14000.  401.    52.
F-STB/DIS31    20000.  553.    58.7
F-STB/DIS32    30000.  798.    66.8
F-STB/DIS33    40000.  1030.   73.
F-STB/DIS34    60000.  1490.   82.2
F-STB/DIS35    80000.  1930.   89.1
F-STB/DIS36    1.00000E+05    2370.   94.8
F-STB/DIS37    1.40000E+05    3210.   104.
F-STB/DIS38    2.00000E+05    4420.   114.
F-STB/DIS39    3.00000E+05    6380.   126.
F-STB/DIS40    4.00000E+05    8270.   135.
F-STB/DIS41    6.00000E+05    11900.  149.
F-STB/DIS42    8.00000E+05    15500.  160.
F-STB/DIS43    1.000000E+06   18900.  168.
F-STB/DIS44    1.400000E+06   25700.  182.
F-STB/DIS45    2.000000E+06   35400.  197.
F-STB/DIS46    3.000000E+06   51100.  216.
F-STB/DIS47    4.000000E+06   66200.  230.
F-STB/DIS48    6.000000E+06   95500.  251.
F-STB/DIS49    8.000000E+06   1.24000E+05    267.
F-STB/DIS50    1.E+07  1.51000E+05    280.
*
* Form 'Scaling Factors' Comment:
* Scaling factors are assigned consistent with Section 3.6 of the NUREG/CR-7270.
*
* YSCALE, linear scaling factor for sigma-y
DPYSCALE001    1.
*
* ZSCALE, linear scaling factor for sigma-z
DPZSCALE001    1.67
*
* DISPMD,  dispersion long-range model
DPDISPMD001    LRTIME
*
* Form 'Long-Range Parameters' Comment:
* Long range dispersion parameters are consistent with Section 3.6.2 of the NUREG/CR-7270.
*
* CYDIST, distance for switching to long-range dispersion model (m)
DPCYDIST001    30000.
*
* CYCOEF coefficient for crosswind dispersion (m/s)
DPCYCOEF001    0.5
*
* MNDMOD, plume meander model (OLD, NEW, OFF, RAF)
PMMNDMOD001    NEW
*
* Form 'US NRC Reg. Guide 1.145 Meander' Comment:
* These values are consistent with Regulatory Guide 1.145.
*
* WINSP1, wind speed where the meander factor changes from constant to decreasing(m/s)
PMWINSP1001    2.
*
* WINSP2, wind speed where the meander factor reaches one (m/s)
PMWINSP2001    6.
*
* MNDIST, distance where the effect of meander begins to diminish (m)
PMMNDIST001    800.
```

```
*
* MNDFAC, plume meander factor used to calculate sigma-y
PMMNDFAC001    1.
PMMNDFAC002    1.
PMMNDFAC003    1.
PMMNDFAC004    2.
PMMNDFAC005    3.
PMMNDFAC006    4.
*
* Form 'Plume Rise Scale Factor' Comment:
* Scaling factors are typically set to unity.
*
* SCLCRW, scaling factor for entrainment of buoyant plume
PRSCLCRW001    1.
*
* SCLADP, scaling factor for the A through D stability plume rise formula
PRSCLADP001    1.
*
* SCLEFP, scaling factor for the E through F stability plume rise formula
PRSCLEFP001    1.
*
* Form 'Building Height Data' Comment:
* Values set based on the height of the structure from which it was released.
*
* BUILDH, building height (m)
WEBUILDH001    9.15
WEBUILDH002    9.15
WEBUILDH003    9.15
WEBUILDH004    9.15
WEBUILDH005    9.15
WEBUILDH006    9.15
WEBUILDH007    9.15
WEBUILDH008    9.15
WEBUILDH009    9.15
WEBUILDH010    9.15
WEBUILDH011    9.15
WEBUILDH012    9.15
WEBUILDH013    9.15
WEBUILDH014    9.15
WEBUILDH015    9.15
WEBUILDH016    9.15
WEBUILDH017    9.15
WEBUILDH018    9.15
WEBUILDH019    9.15
WEBUILDH020    9.15
WEBUILDH021    9.15
WEBUILDH022    9.15
WEBUILDH023    9.15
WEBUILDH024    9.15
WEBUILDH025    9.15
WEBUILDH026    9.15
WEBUILDH027    9.15
WEBUILDH028    9.15
*
* ATNAM2, source term description
RDATNAM2001    'Source term from HPR MELCOR analysis of the transient overpower (TOP) scenario'
*
* Form 'Plume Parameters' Comment:
* One hour plume segments have been defined for risk significant plume segments using MelMACCS.
*
* NUMREL, number of plumes
RDNUMREL001    28
*
* Form 'Plume of Maximum Risk' Comment:
* MAXRIS usually corresponds to the first large spike in the release fraction of a key chemical
group, such as iodine.
```

```
*
* MAXRIS, index of risk-dominant plume segment
RDMAXRIS001    6
*
* REFTIM, representative time point for dispersion and radioactive decay
RDREFTIM001    0.
RDREFTIM002    0.5
RDREFTIM003    0.5
RDREFTIM004    0.5
RDREFTIM005    0.5
RDREFTIM006    0.5
RDREFTIM007    0.5
RDREFTIM008    0.5
RDREFTIM009    0.5
RDREFTIM010    0.5
RDREFTIM011    0.5
RDREFTIM012    0.5
RDREFTIM013    0.5
RDREFTIM014    0.5
RDREFTIM015    0.5
RDREFTIM016    0.5
RDREFTIM017    0.5
RDREFTIM018    0.5
RDREFTIM019    0.5
RDREFTIM020    0.5
RDREFTIM021    0.5
RDREFTIM022    0.5
RDREFTIM023    0.5
RDREFTIM024    0.5
RDREFTIM025    0.5
RDREFTIM026    0.5
RDREFTIM027    0.5
RDREFTIM028    0.5
*
* plume rise model set to DENSITY (DENSITY, HEAT)
RDPLMMOD001    DENSITY
*
* Form 'Density and Flow' Comment:
* One hour plume segments have been defined using MelMACCS.
*
* PLMFLA, mass flow rate for a plume segment (kg/s)
RDPLMFLA001    3.299E-04
RDPLMFLA002    5.1721E-04
RDPLMFLA003    2.1689E-04
RDPLMFLA004    7.0363E-04
RDPLMFLA005    3.6347E-05
RDPLMFLA006    6.6841E-04
RDPLMFLA007    1.E-06
RDPLMFLA008    6.5058E-04
RDPLMFLA009    6.3073E-04
RDPLMFLA010    6.1847E-04
RDPLMFLA011    6.1271E-04
RDPLMFLA012    6.1048E-04
RDPLMFLA013    6.1003E-04
RDPLMFLA014    6.0996E-04
RDPLMFLA015    6.0981E-04
RDPLMFLA016    6.0956E-04
RDPLMFLA017    6.091E-04
RDPLMFLA018    6.0834E-04
RDPLMFLA019    6.0742E-04
RDPLMFLA020    6.0623E-04
RDPLMFLA021    6.0503E-04
RDPLMFLA022    6.0373E-04
RDPLMFLA023    6.0243E-04
RDPLMFLA024    6.0128E-04
RDPLMFLA025    5.9986E-04
```

```
RDPLMFLA026    5.9866E-04
RDPLMFLA027    5.9753E-04
RDPLMFLA028    5.969E-04
*
* PLMDEN, average gas density for a plume segment (kg/m3)
RDPLMDEN001    1.1436
RDPLMDEN002    1.1444
RDPLMDEN003    1.1457
RDPLMDEN004    1.1456
RDPLMDEN005    1.1452
RDPLMDEN006    1.1451
RDPLMDEN007    1.1449
RDPLMDEN008    1.1447
RDPLMDEN009    1.1444
RDPLMDEN010    1.1441
RDPLMDEN011    1.1439
RDPLMDEN012    1.1436
RDPLMDEN013    1.1434
RDPLMDEN014    1.1432
RDPLMDEN015    1.143
RDPLMDEN016    1.1428
RDPLMDEN017    1.1426
RDPLMDEN018    1.1424
RDPLMDEN019    1.1422
RDPLMDEN020    1.142
RDPLMDEN021    1.1418
RDPLMDEN022    1.1417
RDPLMDEN023    1.1415
RDPLMDEN024    1.1413
RDPLMDEN025    1.1412
RDPLMDEN026    1.141
RDPLMDEN027    1.1409
RDPLMDEN028    1.1408
*
* BRGSMD, Briggs plume rise model (ORIGINAL, IMPROVED)
RDBRGSMD001    IMPROVED
*
* PLHITE, height of each plume segment at release (m)
RDPLHITE001    5.15
RDPLHITE002    9.15
RDPLHITE003    5.15
RDPLHITE004    9.15
RDPLHITE005    5.15
RDPLHITE006    9.15
RDPLHITE007    5.15
RDPLHITE008    9.15
RDPLHITE009    9.15
RDPLHITE010    9.15
RDPLHITE011    9.15
RDPLHITE012    9.15
RDPLHITE013    9.15
RDPLHITE014    9.15
RDPLHITE015    9.15
RDPLHITE016    9.15
RDPLHITE017    9.15
RDPLHITE018    9.15
RDPLHITE019    9.15
RDPLHITE020    9.15
RDPLHITE021    9.15
RDPLHITE022    9.15
RDPLHITE023    9.15
RDPLHITE024    9.15
RDPLHITE025    9.15
RDPLHITE026    9.15
RDPLHITE027    9.15
RDPLHITE028    9.15
```

```
*
* PLUDUR, duration of each plume segment (s)
RDPLUDUR001    3587.4
RDPLUDUR002    3587.4
RDPLUDUR003    3600.
RDPLUDUR004    3600.
RDPLUDUR005    3600.
RDPLUDUR006    3600.
RDPLUDUR007    480.
RDPLUDUR008    3600.
RDPLUDUR009    3600.
RDPLUDUR010    3600.
RDPLUDUR011    3600.
RDPLUDUR012    3600.
RDPLUDUR013    3600.
RDPLUDUR014    3600.
RDPLUDUR015    3600.
RDPLUDUR016    3600.
RDPLUDUR017    3600.
RDPLUDUR018    3600.
RDPLUDUR019    3600.
RDPLUDUR020    3600.
RDPLUDUR021    3600.
RDPLUDUR022    3600.
RDPLUDUR023    3600.
RDPLUDUR024    3600.
RDPLUDUR025    3600.
RDPLUDUR026    3600.
RDPLUDUR027    3600.
RDPLUDUR028    240.
*
* PDELAY, start time of each plume segment from accident initiation (s)
RDPDELAY001    3372.7
RDPDELAY002    3372.7
RDPDELAY003    6960.
RDPDELAY004    6960.
RDPDELAY005    10560.
RDPDELAY006    10560.
RDPDELAY007    14160.
RDPDELAY008    14160.
RDPDELAY009    17760.
RDPDELAY010    21360.
RDPDELAY011    24960.
RDPDELAY012    28560.
RDPDELAY013    32160.
RDPDELAY014    35760.
RDPDELAY015    39360.
RDPDELAY016    42960.
RDPDELAY017    46560.
RDPDELAY018    50160.
RDPDELAY019    53760.
RDPDELAY020    57360.
RDPDELAY021    60960.
RDPDELAY022    64560.
RDPDELAY023    68160.
RDPDELAY024    71760.
RDPDELAY025    75360.
RDPDELAY026    78960.
RDPDELAY027    82560.
RDPDELAY028    86160.
*
* Form 'Particle Size Distribution' Comment:
* Partical size distribution computed by MelMACCS.
*
* PSDIST, particle size distribution of each element group
RDPSDIST001    0.1    0.1    0.1    0.1    0.1    0.1    0.1    0.1    0.1    0.1
```

```
RDPSDIST002    1.      0.      0.      0.      0.      0.      0.      0.      0.      0.
RDPSDIST003    1.      0.      0.      0.      0.      0.      0.      0.      0.      0.
RDPSDIST004    1.      0.      0.      0.      0.      0.      0.      0.      0.      0.
RDPSDIST005    1.      0.      0.      0.      0.      0.      0.      0.      0.      0.
RDPSDIST006    1.      0.      0.      0.      0.      0.      0.      0.      0.      0.
RDPSDIST007    1.      0.      0.      0.      0.      0.      0.      0.      0.      0.
RDPSDIST008    1.      0.      0.      0.      0.      0.      0.      0.      0.      0.
RDPSDIST009    1.      0.      0.      0.      0.      0.      0.      0.      0.      0.
RDPSDIST010    1.      0.      0.      0.      0.      0.      0.      0.      0.      0.
RDPSDIST011    1.      0.      0.      0.      0.      0.      0.      0.      0.      0.
RDPSDIST012    1.      0.      0.      0.      0.      0.      0.      0.      0.      0.
RDPSDIST013    0.1     0.1     0.1     0.1     0.1     0.1     0.1     0.1     0.1     0.1
*
* CORINV, inventory of each radionuclide present at the time of accident initiation (Bq)
RDCORINV001    Kr-85   1.1691E+14
RDCORINV002    Kr-85m  1.9459E+15
RDCORINV003    Kr-87   3.8162E+15
RDCORINV004    Kr-88   5.233E+15
RDCORINV005    Xe-133  1.0411E+16
RDCORINV006    Xe-135  1.0209E+16
RDCORINV007    Xe-135m 1.8497E+15
RDCORINV008    Cs-134  1.24E+13
RDCORINV009    Cs-136  1.7619E+13
RDCORINV010    Cs-137  1.0444E+15
RDCORINV011    Rb-86   1.4908E+12
RDCORINV012    Rb-88   5.2731E+15
RDCORINV013    Ba-139  9.8213E+15
RDCORINV014    Ba-140  9.5172E+15
RDCORINV015    Sr-89   6.957E+15
RDCORINV016    Sr-90   9.6366E+14
RDCORINV017    Sr-91   8.7223E+15
RDCORINV018    Sr-92   8.9274E+15
RDCORINV019    Ba-137m 9.8928E+14
RDCORINV020    I-131   4.6425E+15
RDCORINV021    I-132   6.9743E+15
RDCORINV022    I-133   1.0362E+16
RDCORINV023    I-134   1.2067E+16
RDCORINV024    I-135   9.8654E+15
RDCORINV025    Te-127  2.9981E+14
RDCORINV026    Te-127m 4.835E+13
RDCORINV027    Te-129  9.5035E+14
RDCORINV028    Te-129m 1.6589E+14
RDCORINV029    Te-131m 6.2486E+14
RDCORINV030    Te-132  6.8953E+15
RDCORINV031    Te-131  4.1801E+15
RDCORINV032    Rh-105  1.9973E+15
RDCORINV033    Ru-103  5.2929E+15
RDCORINV034    Ru-105  2.0692E+15
RDCORINV035    Ru-106  9.743E+14
RDCORINV036    Rh-103m 5.2354E+15
RDCORINV037    Rh-106  9.7435E+14
RDCORINV038    Nb-95   9.8495E+15
RDCORINV039    Co-58   0.
RDCORINV040    Co-60   0.
RDCORINV041    Mo-99   9.4597E+15
RDCORINV042    Tc-99m  8.4709E+15
RDCORINV043    Nb-97   9.2447E+15
RDCORINV044    Nb-97m  8.7739E+15
RDCORINV045    Ce-141  8.9956E+15
RDCORINV046    Ce-143  8.9807E+15
RDCORINV047    Ce-144  8.2266E+15
RDCORINV048    Np-239  7.6711E+16
RDCORINV049    Pu-238  9.3667E+10
RDCORINV050    Pu-239  1.0932E+13
RDCORINV051    Pu-240  5.4714E+10
RDCORINV052    Pu-241  1.0737E+11
```

```
RDCORINV053    Zr-95   9.8547E+15
RDCORINV054    Zr-97   9.2281E+15
RDCORINV055    Am-241  2.1863E+08
RDCORINV056    Cm-242  3.6011E+08
RDCORINV057    Cm-244  3916.5
RDCORINV058    La-140  9.5253E+15
RDCORINV059    La-141  9.0176E+15
RDCORINV060    La-142  8.8054E+15
RDCORINV061    Nd-147  3.5134E+15
RDCORINV062    Pr-143  8.9964E+15
RDCORINV063    Y-90    9.6248E+14
RDCORINV064    Y-91    8.6985E+15
RDCORINV065    Y-92    9.0098E+15
RDCORINV066    Y-93    9.584699E+15
RDCORINV067    Y-91m   5.1321E+15
RDCORINV068    Pr-144  8.2269E+15
RDCORINV069    Pr-144m 7.8618E+13
RDCORINV070    Sb-127  2.9214E+14
RDCORINV071    Sb-129  9.9663E+14
RDCORINV072    Ag-111  5.3718E+13
RDCORINV073    As-77   1.6361E+13
RDCORINV074    Cd-115  3.5822E+13
RDCORINV075    Cd-115m 2.1272E+12
RDCORINV076    Eu-154  6.4342E+11
RDCORINV077    Eu-155  3.5986E+13
RDCORINV078    Eu-156  3.5653E+13
RDCORINV079    Ge-77   1.7524E+13
RDCORINV080    Nb-95m  1.0648E+14
RDCORINV081    Nd-149  1.7575E+15
RDCORINV082    Pd-109  1.1571E+14
RDCORINV083    Pm-147  2.5593E+15
RDCORINV084    Pm-148  7.4819E+12
RDCORINV085    Pm-148m 6.209E+12
RDCORINV086    Pm-149  1.7379E+15
RDCORINV087    Pm-151  7.114E+14
RDCORINV088    Pr-145  6.0406E+15
RDCORINV089    Sb-125  5.4589E+13
RDCORINV090    Sm-151  2.663E+13
RDCORINV091    Sm-153  2.9258E+14
RDCORINV092    Sm-156  3.5372E+13
RDCORINV093    Sn-121  3.6275E+13
RDCORINV094    Sn-123  2.7937E+12
RDCORINV095    Sn-125  2.5928E+13
RDCORINV096    Sn-127  1.7085E+14
RDCORINV097    Te-125m 1.2297E+13
RDCORINV098    U-234   1.5721E+12
RDCORINV099    U-237   6.2345E+14
RDCORINV100    In-115m 3.6243E+13
RDCORINV101    In-115  0.28884
RDCORINV102    Th-230  7.2342E+07
RDCORINV103    Ra-226  78329.
RDCORINV104    Rn-222  77857.
*
* Form 'Inventory Scale Factor' Comment:
* Core inventory scaling factor is set to unity because a facility specific core inventory is
defined.
*
* CORSCA, scaling factor to adjust the core inventory
RDCORSCA001    1.
*
* Form 'Daughter Ingrowth Flag' Comment:
* Choosing PARENT means each decay product is released at the same release fraction as the
chemical group of the parent radionuclide choice and is consistent with the MELCOR and MAAP codes
that are often used to construct source terms
*
```

```
* APLFRC, Specifies how release fractions are applied to daughter ingrowth products (PARENT,
PROGENY)
RDAPLFRC001    PARENT
*
* Form 'Release Fractions' Comment:
* One hour plume segments have been defined using MelMACCS.
*
* RELFRC, release fractions for each of the plume segments for each chemical group
RDRELFRC001    2.1958E-07     1.8745E-07     3.2965E-11     7.741E-08      3.061E-08
       7.3153E-11     5.7105E-08     9.0462E-15     7.9863E-15     2.253E-11      1.1371E-08
       3.4594E-08     0.
RDRELFRC002    1.7174E-06     1.4513E-06     2.2644E-10     5.5901E-07     1.7622E-07
       4.7216E-10     4.4513E-07     7.1094E-14     6.4179E-14     1.8182E-10     8.1583E-08
       2.7258E-07     0.
RDRELFRC003    1.958E-06      1.6297E-06     2.3635E-10     5.9527E-07     1.7753E-07
       5.2485E-10     5.0348E-07     8.1231E-14     7.369E-14      2.1267E-10     8.5892E-08
       3.0943E-07     0.
RDRELFRC004    6.4796E-06     5.3694E-06     7.6682E-10     1.9378E-06     5.7597E-07
       1.7409E-09     1.6617E-06     2.6891E-13     2.4404E-13     7.0791E-10     2.7866E-07
       1.0218E-06     0.
RDRELFRC005    3.7838E-07     3.055E-07      3.9632E-11     1.0238E-07     2.9766E-08
       1.0302E-10     9.5514E-08     1.5735E-14     1.431E-14      4.272E-11      1.44E-08
       5.8926E-08     0.
RDRELFRC006    6.9683E-06     5.6244E-06     7.288E-10      1.8832E-06     5.4737E-07
       1.8975E-09     1.7586E-06     2.8979E-13     2.6355E-13     7.8703E-10     2.648E-07
       1.085E-06      0.
RDRELFRC007    8.2218E-10     6.6302E-10     8.582E-14      2.2186E-10     6.4446E-11
       2.2382E-13     2.0736E-10     3.4179E-17     3.109E-17      9.287E-14      3.1186E-11
       1.2793E-10     0.
RDRELFRC008    6.8E-06 5.4844E-06     7.0929E-10     1.834E-06      5.3272E-07     1.8521E-09
       1.7151E-06     2.828E-13      2.572E-13      7.6852E-10     2.5771E-07     1.0582E-06
       0.
RDRELFRC009    6.6098E-06     5.3249E-06     6.8753E-10     1.7791E-06     5.1638E-07
       1.8009E-09     1.6654E-06     2.749E-13      2.5003E-13     7.4755E-10     2.498E-07
       1.0276E-06     0.
RDRELFRC010    6.4977E-06     5.2277E-06     6.7403E-10     1.7455E-06     5.0625E-07
       1.7708E-09     1.6352E-06     2.7024E-13     2.458E-13      7.3535E-10     2.449E-07
       1.009E-06      0.
RDRELFRC011    6.4495E-06     5.1829E-06     6.676E-10      1.73E-06       5.0142E-07
       1.7581E-09     1.6212E-06     2.6825E-13     2.4399E-13     7.3029E-10     2.4256E-07
       1.0004E-06     0.
RDRELFRC012    6.4356E-06     5.1665E-06     6.6502E-10     1.7242E-06     4.9949E-07
       1.7546E-09     1.6161E-06     2.6767E-13     2.4348E-13     7.2901E-10     2.4162E-07
       9.9734E-07     0.
RDRELFRC013    6.4388E-06     5.1642E-06     6.6438E-10     1.7233E-06     4.99E-07
       1.7558E-09     1.6154E-06     2.6781E-13     2.4361E-13     7.2964E-10     2.4139E-07
       9.9697E-07     0.
RDRELFRC014    6.445E-06      5.1647E-06     6.6414E-10     1.7234E-06     4.9883E-07
       1.7577E-09     1.6156E-06     2.6807E-13     2.4385E-13     7.3057E-10     2.413E-07
       9.9711E-07     0.
RDRELFRC015    6.4491E-06     5.1638E-06     6.6381E-10     1.7232E-06     4.9858E-07     1.759E-
09      1.6153E-06     2.6825E-13     2.4401E-13     7.3124E-10     2.4118E-07     9.97E-07
       0.
RDRELFRC016    6.4513E-06     5.1619E-06     6.6338E-10     1.7226E-06     4.9826E-07
       1.7598E-09     1.6147E-06     2.6834E-13     2.441E-13      7.3166E-10     2.4103E-07
       9.9667E-07     0.
RDRELFRC017    6.4507E-06     5.1579E-06     6.6271E-10     1.7214E-06     4.9775E-07
       1.7598E-09     1.6134E-06     2.6832E-13     2.4409E-13     7.3176E-10     2.4078E-07
       9.9594E-07     0.
RDRELFRC018    6.4462E-06     5.1511E-06     6.617E-10      1.7193E-06     4.97E-07
       1.7587E-09     1.6113E-06     2.6813E-13     2.4392E-13     7.3139E-10     2.4042E-07
       9.9466E-07     0.
RDRELFRC019    6.4397E-06     5.1428E-06     6.6053E-10     1.7167E-06     4.9612E-07
       1.7571E-09     1.6087E-06     2.6786E-13     2.4368E-13     7.3078E-10     2.3999E-07
       9.931E-07      0.
```

```
RDRELFRC020    6.4305E-06     5.1323E-06     6.5906E-10     1.7134E-06     4.9502E-07
       1.7547E-09     1.6053E-06     2.6749E-13     2.4333E-13     7.2988E-10     2.3946E-07
       9.911E-07      0.
RDRELFRC021    6.4208E-06     5.1214E-06     6.5757E-10     1.71E-06       4.939E-07
       1.7522E-09     1.6019E-06     2.6708E-13     2.4297E-13     7.2891E-10     2.3891E-07
       9.8904E-07     0.
RDRELFRC022    6.41E-06       5.1098E-06     6.5598E-10     1.7064E-06     4.9272E-07
       1.7494E-09     1.5982E-06     2.6664E-13     2.4257E-13     7.2782E-10     2.3834E-07
       9.868201E-07   0.
RDRELFRC023    6.3985E-06     5.0979E-06     6.5439E-10     1.7027E-06     4.9152E-07
       1.7464E-09     1.5945E-06     2.6616E-13     2.4214E-13     7.2662E-10     2.3776E-07
       9.8456E-07     0.
RDRELFRC024    6.3878E-06     5.0871E-06     6.5294E-10     1.6993E-06     4.9043E-07
       1.7435E-09     1.5911E-06     2.6572E-13     2.4174E-13     7.255E-10      2.3723E-07
       9.825E-07      0.
RDRELFRC025    6.3743E-06     5.074E-06      6.512E-10      1.6952E-06     4.8913E-07     1.74E-
09     1.587E-06      2.6516E-13     2.4123E-13     7.2407E-10     2.366E-07      9.8E-07 0.
RDRELFRC026    6.3638E-06     5.0629E-06     6.4972E-10     1.6918E-06     4.8801E-07
       1.7372E-09     1.5835E-06     2.6472E-13     2.4084E-13     7.2299E-10     2.3606E-07
       9.7789E-07     0.
RDRELFRC027    6.3536E-06     5.0523E-06     6.483E-10      1.6886E-06     4.8695E-07
       1.7345E-09     1.5801E-06     2.643E-13      2.4045E-13     7.2193E-10     2.3555E-07
       9.7587E-07     0.
RDRELFRC028    4.2317E-07     3.3643E-07     4.3169E-11     1.1245E-07     3.2424E-08
       1.1553E-10     1.0522E-07     1.7604E-14     1.6015E-14     4.8088E-11     1.5684E-08
       6.4983E-08     0.
*
* NUCSCA, fraction scale factor to be applied to RELFRC (Columns: NUCNAM, IGROUP, NUCSCA)
RDNUCSCA001    Kr-85   1       1.
RDNUCSCA002    Kr-85m  1       1.
RDNUCSCA003    Kr-87   1       1.
RDNUCSCA004    Kr-88   1       1.
RDNUCSCA005    Xe-133  1       1.
RDNUCSCA006    Xe-135  1       1.
RDNUCSCA007    Xe-135m 1       1.
RDNUCSCA008    Cs-134  2       1.
RDNUCSCA009    Cs-136  2       1.
RDNUCSCA010    Cs-137  2       1.
RDNUCSCA011    Rb-86   2       1.
RDNUCSCA012    Rb-88   2       1.
RDNUCSCA013    Ba-139  3       1.
RDNUCSCA014    Ba-140  3       1.
RDNUCSCA015    Sr-89   3       1.
RDNUCSCA016    Sr-90   3       1.
RDNUCSCA017    Sr-91   3       1.
RDNUCSCA018    Sr-92   3       1.
RDNUCSCA019    Ba-137m 3       1.
RDNUCSCA020    I-131   4       1.
RDNUCSCA021    I-132   4       1.
RDNUCSCA022    I-133   4       1.
RDNUCSCA023    I-134   4       1.
RDNUCSCA024    I-135   4       1.
RDNUCSCA025    Te-127  5       1.
RDNUCSCA026    Te-127m 5       1.
RDNUCSCA027    Te-129  5       1.
RDNUCSCA028    Te-129m 5       1.
RDNUCSCA029    Te-131m 5       1.
RDNUCSCA030    Te-132  5       1.
RDNUCSCA031    Te-131  5       1.
RDNUCSCA032    Rh-105  6       1.
RDNUCSCA033    Ru-103  6       1.
RDNUCSCA034    Ru-105  6       1.
RDNUCSCA035    Ru-106  6       1.
RDNUCSCA036    Rh-103m 6       1.
RDNUCSCA037    Rh-106  6       1.
RDNUCSCA038    Nb-95   7       1.
```

```
RDNUCSCA039    Co-58   7       1.
RDNUCSCA040    Co-60   7       1.
RDNUCSCA041    Mo-99   7       1.
RDNUCSCA042    Tc-99m  7       1.
RDNUCSCA043    Nb-97   7       1.
RDNUCSCA044    Nb-97m  7       1.
RDNUCSCA045    Ce-141  8       1.
RDNUCSCA046    Ce-143  8       1.
RDNUCSCA047    Ce-144  8       1.
RDNUCSCA048    Np-239  8       1.
RDNUCSCA049    Pu-238  8       1.
RDNUCSCA050    Pu-239  8       1.
RDNUCSCA051    Pu-240  8       1.
RDNUCSCA052    Pu-241  8       1.
RDNUCSCA053    Zr-95   8       1.
RDNUCSCA054    Zr-97   8       1.
RDNUCSCA055    Am-241  9       1.
RDNUCSCA056    Cm-242  9       1.
RDNUCSCA057    Cm-244  9       1.
RDNUCSCA058    La-140  9       1.
RDNUCSCA059    La-141  9       1.
RDNUCSCA060    La-142  9       1.
RDNUCSCA061    Nd-147  9       1.
RDNUCSCA062    Pr-143  9       1.
RDNUCSCA063    Y-90    9       1.
RDNUCSCA064    Y-91    9       1.
RDNUCSCA065    Y-92    9       1.
RDNUCSCA066    Y-93    9       1.
RDNUCSCA067    Y-91m   9       1.
RDNUCSCA068    Pr-144  9       1.
RDNUCSCA069    Pr-144m 9       1.
RDNUCSCA070    Sb-127  11      1.
RDNUCSCA071    Sb-129  11      1.
RDNUCSCA072    Ag-111  12      1.
RDNUCSCA073    As-77   11      1.
RDNUCSCA074    Cd-115  11      1.
RDNUCSCA075    Cd-115m 11      1.
RDNUCSCA076    Eu-154  9       1.
RDNUCSCA077    Eu-155  9       1.
RDNUCSCA078    Eu-156  9       1.
RDNUCSCA079    Ge-77   12      1.
RDNUCSCA080    Nb-95m  7       1.
RDNUCSCA081    Nd-149  9       1.
RDNUCSCA082    Pd-109  6       1.
RDNUCSCA083    Pm-147  9       1.
RDNUCSCA084    Pm-148  9       1.
RDNUCSCA085    Pm-148m 9       1.
RDNUCSCA086    Pm-149  9       1.
RDNUCSCA087    Pm-151  9       1.
RDNUCSCA088    Pr-145  9       1.
RDNUCSCA089    Sb-125  11      1.
RDNUCSCA090    Sm-151  9       1.
RDNUCSCA091    Sm-153  9       1.
RDNUCSCA092    Sm-156  9       1.
RDNUCSCA093    Sn-121  12      1.
RDNUCSCA094    Sn-123  12      1.
RDNUCSCA095    Sn-125  12      1.
RDNUCSCA096    Sn-127  12      1.
RDNUCSCA097    Te-125m 5       1.
RDNUCSCA098    U-234   10      1.
RDNUCSCA099    U-237   10      1.
RDNUCSCA100    In-115m 12      1.
RDNUCSCA101    In-115  12      1.
RDNUCSCA102    Th-230  8       1.
RDNUCSCA103    Ra-226  3       1.
RDNUCSCA104    Rn-222  1       1.
```

```
*
* ENDAT1, set to TRUE if only running ATMOS
OCENDAT1001    .FALSE.
*
* Form 'Output Control' Comment:
* No debugging information is requested for this problem. Cs-137 is used as a representative
slowly decaying radionuclide for output data.
*
* IDEBUG, specifies set of debug results to report
OCIDEBUG001    0
*
* NUCOUT, name of the nuclide to be listed on the dispersion listings
OCNUCOUT001    Cs-137
*
* ATDMODL, atmospheric transport model
ISATDMODL01    GAUSSIAN
*
* METCOD, meteorological sampling model (1, 2, 3, 4, or 5)
M1METCOD001    2
*
* Form 'Boundary Limit' Comment:
* It is recommended to assign LIMSPA equal to the index of last spatial interval to avoid use of
constant weather conditions if observed data from a meteorological file are available, unless a
very long distance (>500 mi) calculation is being performed, in which case LIMSPA may be chosen
to correspond to the interval ending at approximately 500 mi.
*
* LIMSPA, last spatial interval for recorded weather, beyond use boundary weather
M2LIMSPA001    30
*
* Form 'Constant or Boundary Conditions' Comment:
* Boundary weather is used beyond the radius denoted by LIMSPA.
*
* BNDMXH, boundary weather mixing layer height (m)
M2BNDMXH001    966.
*
* IBDSTB, boundary weather stability class index
M2IBDSTB001    4
*
* BNDRAN, boundary weather rain rate (mm/hr)
M2BNDRAN001    5.
*
* BNDWND, boundary weather wind speed (m/sec)
M2BNDWND001    5.
*
* MAXHGT, determines mixing height model
M1MAXHGT001    DAY_AND_NIGHT
*
* Form 'Site Location' Comment:
* This value should be consistent with the site file and is used to determine the time of the
sunrise and sunset for estimating the mixing height
*
* LATITUDE, indicates degrees of site latitude (deg)
M1LATITUD01    35.22666
*
* LONGITUDE, indicates degrees of site longitude (deg)
M1LONGITU01    -8.50912E+01
*
* Form 'Rain Distances' Comment:
* Updated to be consistent with the radial intervals
*
* NRNINT, number of rain distance intervals for binning
M4NRNINT001    5
*
* RNDSTS, endpoints of the rain distance intervals (km)
M4RNDSTS001    2.
M4RNDSTS002    5.
```

```
M4RNDSTS003    10.
M4RNDSTS004    20.
M4RNDSTS005    30.
*
* Form 'Rain Intensities' Comment:
* Consistent with NUREG/CR-7245.
*
* NRINTN, number of rain intensity breakpoints
M4NRINTN001    3
*
* RNRATE, rain intensity breakpoints for weather binning (mm/hr)
M4RNRATE001    2.
M4RNRATE002    4.
M4RNRATE003    6.
*
* Form 'Seed' Comment:
* The MACCS variable IRSEED is used to ensure that the random number generator produces a
consistent set of weather trials among different MACCS runs. Any value between 1 and 255 may be
used.
*
* IRSEED, initial seed for random number generator
M4IRSEED001    79
*
* Form 'Bins' Comment:
* These values are consistent with the weather data documented in NUREG/CR-7245. The values of
INWGHT are set to use 10 percent of the available sequences in each bin, with a minimum value of
either 12 or all available samples in the bin.
*
* NSBINS, number of bins to be sampled when NSMPLS = 0
M4NSBINS001    36
*
* INDXBN, INWGHT, number of weather sequences to be selected from specific weather bins
M4SMPLDF001    1       12
M4SMPLDF002    2       12
M4SMPLDF003    3       23
M4SMPLDF004    4       145
M4SMPLDF005    5       117
M4SMPLDF006    6       64
M4SMPLDF007    7       12
M4SMPLDF008    8       0
M4SMPLDF009    9       97
M4SMPLDF010    10      117
M4SMPLDF011    11      25
M4SMPLDF012    12      12
M4SMPLDF013    13      83
M4SMPLDF014    14      43
M4SMPLDF015    15      12
M4SMPLDF016    16      0
M4SMPLDF017    17      42
M4SMPLDF018    18      15
M4SMPLDF019    19      18
M4SMPLDF020    20      17
M4SMPLDF021    21      15
M4SMPLDF022    22      12
M4SMPLDF023    23      12
M4SMPLDF024    24      12
M4SMPLDF025    25      12
M4SMPLDF026    26      12
M4SMPLDF027    27      12
M4SMPLDF028    28      7
M4SMPLDF029    29      12
M4SMPLDF030    30      7
M4SMPLDF031    31      7
M4SMPLDF032    32      12
M4SMPLDF033    33      8
M4SMPLDF034    34      11
```

```
M4SMPLDF035    35      7
M4SMPLDF036    36      7
*
* NUM0,  used for no input, always 0
TYPE0NUMBER    0
*
* Form 'Plume and Spatial Intervals' Comment:
* These values maybe used for atmospheric dispersion results
*
* NUM0, number of results
TYPE0NUMBER    31
*
* INDREL, INDRAD, CCDF, ATMOS release and spatial interval
TYPE0OUT001    7       1       NONE
TYPE0OUT002    7       2       NONE
TYPE0OUT003    7       3       NONE
TYPE0OUT004    7       4       NONE
TYPE0OUT005    7       5       NONE
TYPE0OUT006    7       6       NONE
TYPE0OUT007    7       7       NONE
TYPE0OUT008    7       8       NONE
TYPE0OUT009    7       9       NONE
TYPE0OUT010    7       10      NONE
TYPE0OUT011    7       11      NONE
TYPE0OUT012    7       12      NONE
TYPE0OUT013    7       13      NONE
TYPE0OUT014    7       14      NONE
TYPE0OUT015    7       15      NONE
TYPE0OUT016    7       16      NONE
TYPE0OUT017    7       17      NONE
TYPE0OUT018    7       18      NONE
TYPE0OUT019    7       19      NONE
TYPE0OUT020    7       20      NONE
TYPE0OUT021    7       21      NONE
TYPE0OUT022    7       22      NONE
TYPE0OUT023    7       23      NONE
TYPE0OUT024    7       24      NONE
TYPE0OUT025    7       25      NONE
TYPE0OUT026    7       26      NONE
TYPE0OUT027    7       27      NONE
TYPE0OUT028    7       28      NONE
TYPE0OUT029    7       29      NONE
TYPE0OUT030    7       30      NONE
TYPE0OUT031    7       31      NONE
*
* NUM0_HY, used for no input, always 0
TYPE0_HYNUM    0
*
* NSMPLS,  used for no input, always 0
M4NSMPLS001    0
*
* SRCMOD, Plume Source model set to PNT (PNT, AREA, AUTO)
RDSRCMOD001    PNT
*
* TDWMOD, Plume Trapping model set to BRGFLX (BRGBLD, BRGFLX, PRIME)
RDTDWMOD001    BRGBLD
*
* Form 'Additional Building Data' Comment:
* Values set based on the height of the structure from which it was released.
*
* BUILDW, building width (m)
WEBUILDW001    21.55
WEBUILDW002    21.55
WEBUILDW003    21.55
WEBUILDW004    21.55
WEBUILDW005    21.55
```

```
WEBUILDW006    21.55
WEBUILDW007    21.55
WEBUILDW008    21.55
WEBUILDW009    21.55
WEBUILDW010    21.55
WEBUILDW011    21.55
WEBUILDW012    21.55
WEBUILDW013    21.55
WEBUILDW014    21.55
WEBUILDW015    21.55
WEBUILDW016    21.55
WEBUILDW017    21.55
WEBUILDW018    21.55
WEBUILDW019    21.55
WEBUILDW020    21.55
WEBUILDW021    21.55
WEBUILDW022    21.55
WEBUILDW023    21.55
WEBUILDW024    21.55
WEBUILDW025    21.55
WEBUILDW026    21.55
WEBUILDW027    21.55
WEBUILDW028    21.55
*
* BUILDL, building length (m)
WEBUILDL001    21.55
WEBUILDL002    21.55
WEBUILDL003    21.55
WEBUILDL004    21.55
WEBUILDL005    21.55
WEBUILDL006    21.55
WEBUILDL007    21.55
WEBUILDL008    21.55
WEBUILDL009    21.55
WEBUILDL010    21.55
WEBUILDL011    21.55
WEBUILDL012    21.55
WEBUILDL013    21.55
WEBUILDL014    21.55
WEBUILDL015    21.55
WEBUILDL016    21.55
WEBUILDL017    21.55
WEBUILDL018    21.55
WEBUILDL019    21.55
WEBUILDL020    21.55
WEBUILDL021    21.55
WEBUILDL022    21.55
WEBUILDL023    21.55
WEBUILDL024    21.55
WEBUILDL025    21.55
WEBUILDL026    21.55
WEBUILDL027    21.55
WEBUILDL028    21.55
*
* BUILDA, angle from north for width dimension (degrees)
WEBUILDA001    0.
WEBUILDA002    0.
WEBUILDA003    0.
WEBUILDA004    0.
WEBUILDA005    0.
WEBUILDA006    0.
WEBUILDA007    0.
WEBUILDA008    0.
WEBUILDA009    0.
WEBUILDA010    0.
WEBUILDA011    0.
```

```
WEBUILDA012    0.
WEBUILDA013    0.
WEBUILDA014    0.
WEBUILDA015    0.
WEBUILDA016    0.
WEBUILDA017    0.
WEBUILDA018    0.
WEBUILDA019    0.
WEBUILDA020    0.
WEBUILDA021    0.
WEBUILDA022    0.
WEBUILDA023    0.
WEBUILDA024    0.
WEBUILDA025    0.
WEBUILDA026    0.
WEBUILDA027    0.
WEBUILDA028    0.
*
* TDWAUTO, Specifies if automatically calculating the trapped/downwashed release height.
RDTDWAUTO01    .TRUE.
*
* Form 'US NRC Regulatory Guide 1.145 Point Source Meander' Comment:
* The values are consistent with Regulatory Guide 1.145
*
* PSMEQ1C, Point Source Model Equation 1 Coefficient
PMPSMEQ1C01    0.5
*
* PSMEQ2C, Point Source Model Equation 2 Coefficient
PMPSMEQ2C01    3.
.
```

A.2 EARLY.inp

```
* File created using WinMACCS version 4.1.0 SVN:8280 8/23/2022 12:47:52 PM
*
* Form 'Dose Conversion Factor File' Comment:
* Cosistent with DCF file used in NUREG/CR-7245
* Form 'Organs of Risk' Comment:
* All organs selected.
*
* DCF_FILE,  identifies the DCF file to be used for the MACCS calculation
DCF_FILE001    'C:\Users\AJN1\MACCS Code Suite\WinMACCS Project Files\INL Design A, TOP scenario
(HPR stz, HPR nuclides, 1.145 area)\Data\FGR13GyEquiv_RevA.inp'
*
* Form 'Early Description' Comment:
* The intent of this project is to model a single, non-evacuating cohort of a phantom population.
Because WinMACCS requires an evacuating cohort to be able to report Type 14, 2 cohorts are used,
with a weight fraction of 0 for the evacuating cohort.
*
* EANAM1, identifies the EARLY calculation
MIEANAM1001    'EARLY file'
*
* Form 'Property Form Parameters' Comment:
* Property form parameters are defined in the properties box and cannot be changed in this form.
They are reproduced here for the user A-24vacuationA-24.
*
* ENDAT2, set to TRUE if only running ATMOS and EARLY
MIENDAT2001    .FALSE.
*
* Form 'Property Form Parameters' Comment:
* Property form parameters are defined in the properties box and cannot be changed in this form.
They are reproduced here for the user A-24vacuationA-24.
*
* IPLUME, dispersion code determines wind shift and rotation flags
```

```
MIIPLUME001    3
*
* Form 'Grid Subdivisions' Comment:
* Maximum number of fine grids is recommended
*
* NUMFIN, number of fine-grid subdivisions used by model
MINUMFIN001    7
*
* Form 'Debug Options' Comment:
* No debug requested.
*
* IPRINT, amount of detail of output reported. Zero is used for standard reporting.
MIIPRINT001    0
*
* POPFLG,  if set to FILE, population is defined in a site data file. UNIFORM indicates a user
defined uniform distribution.
PDPOPFLG001    UNIFORM
*
* Form 'Uniform Site Data' Comment:
* the project assumed a uniform population density and uniform economic data based on average
values over 50-mile area around the Sequoyah Nuclear Power Plant in Tennessee
*
* IBEGIN, spatial interval at which population is considered to be non-zero
PDIBEGIN001    1
*
* POPDEN, uniform population density of the region
PDPOPDEN001    40.
*
* NORGANS_SEL, number of organs selected by user
MINUMORG001    34
*
* ORGANS_SEL, list of organs selected by user, first organ is always A-SKIN
MIORGNAM001    A-SKIN
MIORGNAM002    A-STOMACH
MIORGNAM003    'A-SMALL IN'
MIORGNAM004    'A-LOWER LI'
MIORGNAM005    'A-RED MARR'
MIORGNAM006    A-THYROID
MIORGNAM007    A-LUNGS
MIORGNAM008    L-ADRENALS
MIORGNAM009    'L-BONE SUR'
MIORGNAM010    L-BRAIN
MIORGNAM011    L-BREAST
MIORGNAM012    L-STOMACH
MIORGNAM013    'L-BLAD WAL'
MIORGNAM014    'L-SMALL IN'
MIORGNAM015    L-ULI_WALL
MIORGNAM016    'L-LOWER LI'
MIORGNAM017    L-KIDNEYS
MIORGNAM018    L-LIVER
MIORGNAM019    L-MUSCLE
MIORGNAM020    L-OVARIES
MIORGNAM021    L-PANCREAS
MIORGNAM022    'L-RED MARR'
MIORGNAM023    L-SKIN
MIORGNAM024    L-SPLEEN
MIORGNAM025    L-TESTES
MIORGNAM026    L-THYMUS
MIORGNAM027    L-THYROID
MIORGNAM028    L-UTERUS
MIORGNAM029    L-ESOPHAGUS
MIORGNAM030    L-LUNGS
MIORGNAM031    L-GONADS
MIORGNAM032    L-COLON
MIORGNAM033    L-REMAINDER
MIORGNAM034    L-ICRP60ED
```

```
*
* RISCAT, flag set to true if relative contribution of each weather category bins is to be
included in output
MIRISCAT001    .FALSE.
*
* OVRRID, flag set to FALSE if wind rose is calculated from the weather file. TRUE indicates user
will supply values.
MIOVRRID001    .FALSE.
*
* Form 'Shielding and Exposure' Comment:
* No shielding protection for phantom cohort
*
* CSFACT, cloudshine shielding factor
SECSFACT001    0.95
SECSFACT002    0.75
SECSFACT003    0.6
*
* PROTIN, inhalation protection factor
SEPROTIN001    0.98
SEPROTIN002    0.46
SEPROTIN003    0.25
*
* BRRATE, breathing rate (m3/s)
SEBRRATE001    2.66E-04
SEBRRATE002    2.66E-04
SEBRRATE003    2.66E-04
*
* SKPFAC, skin protection factors
SESKPFAC001    0.98
SESKPFAC002    0.46
SESKPFAC003    0.25
*
* GSHFAC, groundshine shielding factors
SEGSHFAC001    0.52
SEGSHFAC002    0.34
SEGSHFAC003    0.19
*
* Form 'Emergency Phase Resuspension' Comment:
* The recommended resuspension half-life for early phase resuspension is based on the value used
in NUREG/CR-4551 Vol 2  Part 7 Rev. 1
*
* RESCON, initial value for emergency-phase resuspension concentration factor (s/m)
SERESCON001    1.E-04
*
* RESHAF, emergency-phase resuspension concentration coefficient weathering half-life (s)
SERESHAF001    1.82000E+05
*
* Form 'Basic Parameters' Comment:
* Empty cohort
*
* EANAM2, identifier of emergency response cohort
EZEANAM2001    'Empty Cohort'
*
* WTNAME, type of weighting factor to be used in generating weighted sum of results
EZWTNAME001    PEOPLE
*
* Form 'Cohort Fraction' Comment:
* Not used in the sample problem.
*
* WTFRAC, weighting fraction applied to results of emergency response cohort when WTNAME = PEOPLE
or TIME
EZWTFRAC001    0.
*
* EVATYP, indicates if evacuation model is radial or network
EZEVATYP001    RADIAL
*
```

```
* TRAVELPOINT, determines whether boundary or centerpoint of destination is evacuee objective
TRAVELPOINT    CENTERPOINT
*
* ESPEED, evacuee travel speed during the three phases of evacuation (m/s)
EZESPEED001    6.06
EZESPEED002    6.06
EZESPEED003    13.3
*
* ESPMUL, multiplicative factor that affects ESPEED, applied during times of precipitation
EZESPMUL001    0.7
EZESPMUL002    0.7
EZESPMUL003    0.7
*
* REFPNT, defines reference time point for actions in evacuation and sheltering zone
EZREFPNT001    ALARM
*
* DURBEG, duration of initial phase (when first individual begins to evacuate)  of evacuation (s)
EZDURBEG001    1832.
*
* DURMID, duration of middle phase of evacuation (s)
EZDURMID001    808.
*
* NUMEVA, outer boundary of the sheltering and evacuation region
EZNUMEVA001    22
*
* OALARM, time after accident initiation that off-site alarm is initiated (s)
EZOALARM001    9900.
*
* DLTSHL, the delay from the time represented by REFPNT to the start of sheltering (s)
EZDLTSHL001    0.
EZDLTSHL002    0.
EZDLTSHL003    0.
EZDLTSHL004    0.
EZDLTSHL005    0.
EZDLTSHL006    0.
EZDLTSHL007    0.
EZDLTSHL008    0.
EZDLTSHL009    0.
EZDLTSHL010    0.
EZDLTSHL011    0.
EZDLTSHL012    0.
EZDLTSHL013    0.
EZDLTSHL014    0.
EZDLTSHL015    0.
EZDLTSHL016    0.
EZDLTSHL017    0.
EZDLTSHL018    0.
EZDLTSHL019    0.
EZDLTSHL020    0.
EZDLTSHL021    0.
EZDLTSHL022    0.
*
* DLTEVA, the delay from the beginning of the sheltering period to the beginning of evacuation
EZDLTEVA001    0.
EZDLTEVA002    0.
EZDLTEVA003    0.
EZDLTEVA004    0.
EZDLTEVA005    0.
EZDLTEVA006    0.
EZDLTEVA007    0.
EZDLTEVA008    0.
EZDLTEVA009    0.
EZDLTEVA010    0.
EZDLTEVA011    0.
EZDLTEVA012    0.
EZDLTEVA013    0.
```

```
EZDLTEVA014    0.
EZDLTEVA015    0.
EZDLTEVA016    0.
EZDLTEVA017    0.
EZDLTEVA018    0.
EZDLTEVA019    0.
EZDLTEVA020    0.
EZDLTEVA021    0.
EZDLTEVA022    0.
*
* LASMOV, outermost spatial interval of the evacuation movement zone
EZLASMOV001    22
*
* Form 'Duration of Early Phase' Comment:
* Project varies ENDEMP for dose sensitivity
*
* ENDEMP, duration of the emergency-phase period (s)
SRENDEMP001    6.04800E+05
*
* CRIORG, critical organ for relocation decisions during emergency-phase period
SRCRIORG001    L-ICRP60ED
*
* Form 'Hot Spot Relocation' Comment:
* dose levels for emergency phase relocation were increased to artificially high levels so they
are not triggered in the scenario
*
* TIMHOT, hot-spot relocation action time (individuals residing outside the emergency-planning
zone) after plume arrival (s)
SRTIMHOT001    0.
*
* Form 'Normal Relocation' Comment:
* dose levels for emergency phase relocation were increased to artificially high levels so they
are not triggered in the scenario
*
* TIMNRM - normal relocation action time  (individuals residing outside the emergency-planning
zone) after plume arrival (s)
SRTIMNRM001    0.
*
* Form 'Dose Projection' Comment:
* 96 hours, or 4 days, consistent with the parameter guide and the Sequoyah analysis
*
* DPPEMP, dose projection period for the emergency phase (s)
SRDPPEMP001    0.
*
* DOSHOT, defines the hot-spot relocation dose threshold (Sv)
SRDOSHOT001    1.E+10
*
* DOSNRM, defines the normal relocation dose threshold (Sv)
SRDOSNRM001    1.E+10
*
* Form 'Early Fatality Parameters' Comment:
* Based on NUREG/CR-6545  and  NUREG/CR-7161
*
* NUMEFA, number of Early Fatality Effects
EFNUMEFA001    3
*
* ORGNAM2, EFFACA, EFFACB, EFFTHR, early fatality effect settings.  Columns are target organ,
alpha factor (Sv) and beta factor for hazard function, and threshold dose (Sv)
EFATAGRP001    'A-RED MARR'   5.6     6.1     2.3
EFATAGRP002    A-LUNGS 24.    9.6     14.
EFATAGRP003    A-STOMACH      12.     9.3     6.5
*
* ANIM_MOVE, flag to create animation file describing plume movement
VIANIPLM001    .FALSE.
*
* ANIM_CONC, flag to create animation file containing ground and air concentrations
```

```
VIANIGAC001    .FALSE.
*
* Form 'Early Injury Parameters' Comment:
* Based on NUREG/CR-6545 and NUREG/CR-4214 part I Rev 2
*
* NUMEIN, number of Early Injury Effects
EINUMEIN001    7
*
* EINAME, ORGNAM3, EISUSC, EITHRE, EIFACA, EIFACB,  early injury effect settings.  Columns are
injury, target organ, population fraction, threshold dose (Sv), alpha factor, and beta factor.
EINJUGRP001    'PRODROMAL VOMIT'      A-STOMACH      1.      0.5     2.      3.
EINJUGRP002    DIARRHEA       A-STOMACH      1.      1.      3.      2.5
EINJUGRP003    PNEUMONITIS    A-LUNGS 1.      9.2     16.6    7.3
EINJUGRP004    'SKIN ERYTHEMA'        A-SKIN  1.      3.      6.      5.
EINJUGRP005    TRANSEPIDERMAL A-SKIN  1.      10.     20.     5.
EINJUGRP006    THYROIDITIS    A-THYROID      1.      40.     240.    2.
EINJUGRP007    HYPOTHYROIDISM A-THYROID      1.      2.      60.     1.3
*
* Form 'Latent Cancer Parameters' Comment:
* CFRISK values derived from Table 7.3 of FGR 13 and CIRISK values derived from Table 7.6 of FGR
13
*
* NUMACA, number of latent cancer effects
LCNUMACA001    14
*
* ACTHRE, used for non quadratic model, always 0
LCACTHRE001    0.
*
* DDTHRE, dose threshold for applying dose-dependent reduction factor, DDREFA (Sv)
LCDDTHRE001    0.2
*
* ACNAME, ORGNAM4, ACSUSC , DOSEFA =1 , DOSEFB = 0, CFRISK, CIRISK, DDREFA, latent cancer, organ,
population fraction, alpha factor, beta factor, risk for death (1/Sv),  risk for cancer (1/Sv),
reduction factor
LCANCERS001    Leukemia       'L-RED MARR'   1.      1.      0.      0.0111  0.0113  2.
LCANCERS002    Bone    'L-BONE SUR'   1.      1.      0.      1.9E-04 2.72E-04        2.
LCANCERS003    Breast  L-BREAST       1.      1.      0.      0.00506 0.0101  1.
LCANCERS004    Lung    L-LUNGS 1.      1.      0.      0.0198  0.0208  2.
LCANCERS005    Thyroid L-THYROID      1.      1.      0.      6.48E-04        0.00648 2.
LCANCERS006    Liver   L-LIVER 1.      1.      0.      0.003   0.00316 2.
LCANCERS007    Colon   L-COLON 1.      1.      0.      0.0208  0.0378  2.
LCANCERS008    Residual       L-REMAINDER    1.      1.      0.      0.0298  0.0422  2.
LCANCERS009    Esophagus      L-ESOPHAGUS    1.      1.      0.      0.00234 0.00246 2.
LCANCERS010    Stomach L-STOMACH      1.      1.      0.      0.00814 0.00906 2.
LCANCERS011    Skin    L-SKIN  1.      1.      0.      2.E-04  2.E-04  2.
LCANCERS012    Ovaries L-OVARIES      1.      1.      0.      0.00298 0.00426 2.
LCANCERS013    'Blad Wall'    'L-BLAD WAL'   1.      1.      0.      0.00476 0.00952 2.
LCANCERS014    Kidney  L-KIDNEYS      1.      1.      0.      0.00103 0.0016  2.
*
* NUM1, used for no input, always 0
TYPE1NUMBER    0
*
* NUM1, number of type 1 results
TYPE1NUMBER    32
*
* NAME1, I1DIS1, I2DIS1, CCDF1, heath risk name to count heath effect cases, inner spatial
interval, outer spatial interval, CCDF report indicator flag
TYPE1OUT001    'ERL FAT/TOTAL'        1       14      NONE
TYPE1OUT002    'ERL FAT/TOTAL'        1       22      NONE
TYPE1OUT003    'ERL FAT/TOTAL'        1       31      NONE
TYPE1OUT004    'CAN INJ/TOTAL'        1       14      NONE
TYPE1OUT005    'CAN INJ/TOTAL'        1       17      NONE
TYPE1OUT006    'CAN INJ/TOTAL'        1       22      NONE
TYPE1OUT007    'CAN INJ/TOTAL'        1       25      NONE
TYPE1OUT008    'CAN INJ/TOTAL'        1       28      NONE
TYPE1OUT009    'CAN INJ/TOTAL'        1       31      NONE
```

```
TYPE1OUT010    'CAN FAT/TOTAL'       1       14      NONE
TYPE1OUT011    'CAN FAT/TOTAL'       1       17      NONE
TYPE1OUT012    'CAN FAT/TOTAL'       1       22      NONE
TYPE1OUT013    'CAN FAT/TOTAL'       1       25      NONE
TYPE1OUT014    'CAN FAT/TOTAL'       1       28      NONE
TYPE1OUT015    'CAN FAT/TOTAL'       1       31      NONE
TYPE1OUT016    'CAN FAT/Thyroid'     1       14      NONE
TYPE1OUT017    'CAN FAT/Thyroid'     1       22      NONE
TYPE1OUT018    'CAN FAT/Thyroid'     1       25      NONE
TYPE1OUT019    'CAN FAT/Thyroid'     1       31      NONE
TYPE1OUT020    'CAN FAT/Breast'      1       14      NONE
TYPE1OUT021    'CAN FAT/Breast'      1       22      NONE
TYPE1OUT022    'CAN FAT/Breast'      1       25      NONE
TYPE1OUT023    'CAN FAT/Breast'      1       31      NONE
TYPE1OUT024    'CAN FAT/Lung' 1      14      NONE
TYPE1OUT025    'CAN FAT/Lung' 1      22      NONE
TYPE1OUT026    'CAN FAT/Lung' 1      25      NONE
TYPE1OUT027    'CAN FAT/Lung' 1      31      NONE
TYPE1OUT028    'CAN FAT/Leukemia'    1       31      NONE
TYPE1OUT029    'CAN FAT/Bone' 1      31      NONE
TYPE1OUT030    'CAN FAT/Liver'       1       31      NONE
TYPE1OUT031    'CAN FAT/Colon'       1       31      NONE
TYPE1OUT032    'CAN FAT/Residual'    1       31      NONE
*
* NUM2, used for no input, always 0
TYPE2NUMBER    0
*
* Form 'Early-Fatality Radius' Comment:
* Results provide max distance at which early fatality may occur.
*
* NUM2, number of type 2 results
TYPE2NUMBER    1
*
* RISTHR, CCDF2 , fatality risk threshold to calculate distance, CCDF report indicator flag
TYPE2OUT001    0.     NONE
*
* NUM3,  used for no input, always 0
TYPE3NUMBER    0
*
* Form 'Population Exceeding Threshold' Comment:
* Results provide the size of population exceeding the low dose.
* Results provide the size of population exceeding early fatality threshold.
*
*
* NUM3, number of type 3 results
TYPE3NUMBER    6
*
* NAME3, DOSTH3, CCDF3 -  organ name, dose threshold (Sv) for population count, CCDF report
indicator flag
TYPE3OUT001    L-ICRP60ED     0.      NONE
TYPE3OUT002    L-ICRP60ED     0.01    NONE
TYPE3OUT003    L-ICRP60ED     0.1     NONE
TYPE3OUT004    L-ICRP60ED     1.      NONE
TYPE3OUT005    'A-RED MARR'   1.      NONE
TYPE3OUT006    'A-RED MARR'   2.32    NONE
*
* NUM4, used for no input, always 0
TYPE4NUMBER    0
*
* NUM5,  used for no input, always 0
TYPE5NUMBER    0
*
* NUM5, number of type 5 results
TYPE5NUMBER    6
*
```

```
* NAME5, I1DIS5, I2DIS5, CCDF5, organ name to calculate population dose, inner spatial interval,
outer spatial interval,  CCDF report indicator flag
TYPE5OUT001    L-ICRP60ED     1       14      NONE
TYPE5OUT002    L-ICRP60ED     1       17      NONE
TYPE5OUT003    L-ICRP60ED     1       22      NONE
TYPE5OUT004    L-ICRP60ED     1       25      NONE
TYPE5OUT005    L-ICRP60ED     1       28      NONE
TYPE5OUT006    L-ICRP60ED     1       31      NONE
*
* NUM6,  used for no input, always 0
TYPE6NUMBER    0
*
* NUM7,  used for no input, always 0
TYPE7NUMBER    0
*
* NUM8,  used for no input, always 0
TYPE8NUMBER    0
*
* NUM8, number of type 8 results
TYPE8NUMBER    11
*
* NAME8, I1DIS8, I2DIS8, CCDF8, health risk name to calculate population-weighted Risk,  inner
spatial interval, outer spatial interval, CCDF report indicator flag
TYPE8OUT001    'CAN FAT/TOTAL'        1       14      NONE
TYPE8OUT002    'CAN FAT/TOTAL'        1       17      NONE
TYPE8OUT003    'CAN FAT/TOTAL'        1       22      NONE
TYPE8OUT004    'CAN FAT/TOTAL'        1       25      NONE
TYPE8OUT005    'CAN FAT/TOTAL'        1       28      NONE
TYPE8OUT006    'CAN FAT/TOTAL'        1       31      NONE
TYPE8OUT007    'CAN FAT/TOTAL'        15      17      NONE
TYPE8OUT008    'CAN FAT/TOTAL'        18      22      NONE
TYPE8OUT009    'CAN FAT/TOTAL'        23      25      NONE
TYPE8OUT010    'CAN FAT/TOTAL'        26      28      NONE
TYPE8OUT011    'CAN FAT/TOTAL'        29      31      NONE
*
* NUMA,  used for no input, always 0
TYPEANUMBER    0
*
* NUMA, number of type A results
TYPEANUMBER    1
*
* NAMEA, I1DISA, I2DISA, CCDFA, organ name to calculate peak dose vs distance, inner spatial
interval, outer spatial interval, CCDF report indicator flag
TYPEAOUT001    L-ICRP60ED     1       31      NONE
*
* NUMB,  used for no input, always 0
TYPEBNUMBER    0
*
* NUMC,  used for no input, always 0
TYPECNUMBER    0
*
* NUMC,  number of typeC output
TYPECNUMBER    1
*
* ORGNAM8, ELEVDOSE, PRINT_FLAG_C, CCDFC - organ name to calculate land area, dose threshold
(Sv), true indicates extended output by grid element
TYPECOUT001    L-ICRP60ED     0.05    .TRUE.  NONE
*
* NUMD,  used for no input, always 0
TYPEDNUMBER    0
*
* NUMD, number of A-31vacu output
TYPEDNUMBER    20
*
```

```
* I1DISD, NUCLIDED, ELEVCONC, PRINT_FLAG_D, CCDFD – outer spatial interval (inner starts at
0),nuclides for which ground and air concentrations are calculated if above threshold, threshold
(Bq/m2), true indicates extended output by grid element
TYPEDOUT001    14      Cs-137  37000.  .TRUE.  NONE
TYPEDOUT002    14      Cs-137  1.85000E+05    .FALSE. NONE
TYPEDOUT003    14      Cs-137  5.55000E+05    .FALSE. NONE
TYPEDOUT004    14      Cs-137  1.480000E+06   .FALSE. NONE
TYPEDOUT005    22      Cs-137  37000.  .FALSE. NONE
TYPEDOUT006    22      Cs-137  1.85000E+05    .FALSE. NONE
TYPEDOUT007    22      Cs-137  5.55000E+05    .FALSE. NONE
TYPEDOUT008    22      Cs-137  1.480000E+06   .FALSE. NONE
TYPEDOUT009    25      Cs-137  37000.  .FALSE. NONE
TYPEDOUT010    25      Cs-137  1.85000E+05    .FALSE. NONE
TYPEDOUT011    25      Cs-137  5.55000E+05    .FALSE. NONE
TYPEDOUT012    25      Cs-137  1.480000E+06   .FALSE. NONE
TYPEDOUT013    28      Cs-137  37000.  .FALSE. NONE
TYPEDOUT014    28      Cs-137  1.85000E+05    .FALSE. NONE
TYPEDOUT015    28      Cs-137  5.55000E+05    .FALSE. NONE
TYPEDOUT016    28      Cs-137  1.480000E+06   .FALSE. NONE
TYPEDOUT017    31      Cs-137  37000.  .FALSE. NONE
TYPEDOUT018    31      Cs-137  1.85000E+05    .FALSE. NONE
TYPEDOUT019    31      Cs-137  5.55000E+05    .FALSE. NONE
TYPEDOUT020    31      Cs-137  1.480000E+06   .FALSE. NONE
*
* DOSMOD, indicates dose model (LNT, AT or PL)
LCDOSMOD001    LNT
*
* KIMODL, KI model (KI or NOKI)
EZKIMODL001    NOKI
*
* Form 'KI Ingestion Linear No Threshold' Comment:
* Model is not used in the sample problem.
*
* EFFACY,  lower bound of efficacy factor for KI model when using the LNT dose model
EZEFFACY001    0.
*
* POPFRAC, lower bound of the fraction of the population that ingests KI when using the LNT dose
model.
EZPOPFRC001    0.
*
* FRACLD, fraction of site covered by land
STFRACLD001    1.
*
* NUME,  used for no input, always 0
TYPEENUMBER    0
*
* EVAKEY, evacuation model (CIRCULAR, KEYHOLE, NONE)
EZEVAKEY001    CIRCULAR
*
* NUMF,  used for no input, always 0
TYPEFNUMBER    0
.
*
* Form 'Shielding and Exposure' Comment:
* Inputs are generic values.
*
* CSFACT, cloudshine shielding factor
SECSFACT001    1.
SECSFACT002    0.
SECSFACT003    0.
*
* PROTIN, inhalation protection factor
SEPROTIN001    1.
SEPROTIN002    0.
SEPROTIN003    0.
*
```

```
* BRRATE, breathing rate (m3/s)
SEBRRATE001    2.66E-04
SEBRRATE002    2.66E-04
SEBRRATE003    2.66E-04
*
* SKPFAC, skin protection factors
SESKPFAC001    1.
SESKPFAC002    0.
SESKPFAC003    0.
*
* GSHFAC, groundshine shielding factors
SEGSHFAC001    1.
SEGSHFAC002    0.
SEGSHFAC003    0.
*
* Form 'Basic Parameters' Comment:
* Non-evacuating, phantom cohort
*
* EANAM2, identifier of emergency response cohort
EZEANAM2001    'Phantom cohort'
*
* Form 'Cohort Fraction' Comment:
* Not used in the sample problem.
*
* WTFRAC, weighting fraction applied to results of emergency response cohort when WTNAME = PEOPLE
or TIME
EZWTFRAC001    1.
*
* Form 'Phase Durations and Speeds' Comment:
* Evacuation speed based on ETE for a  generic medium population site as documented in NUREG/CR-
7269
*
* TRAVELPOINT, determines whether boundary or centerpoint of destination is evacuee objective
TRAVELPOINT    CENTERPOINT
*
* ESPEED, evacuee travel speed during the three phases of evacuation (m/s)
EZESPEED001    6.06
EZESPEED002    6.06
EZESPEED003    13.3
*
* ESPMUL, multiplicative factor that affects ESPEED, applied during times of precipitation
EZESPMUL001    0.7
EZESPMUL002    0.7
EZESPMUL003    0.7
*
* REFPNT, defines reference time point for actions in evacuation and sheltering zone
EZREFPNT001    ALARM
*
* DURBEG, duration of initial phase (when first individual begins to evacuate)  of evacuation (s)
EZDURBEG001    1832.
*
* DURMID, duration of middle phase of evacuation (s)
EZDURMID001    808.
*
* Form 'Sheltering and Evacuation Boundary' Comment:
* Evacuation zone is 10 miles (ring 12)
* Evacuation movement zone is 50 miles (ring 19)
*
*
* NUMEVA, outer boundary of the sheltering and evacuation region
EZNUMEVA001    22
*
* Form 'Notification Delay' Comment:
* GE siren assumed at 2.75 hours. See NUREG/CR-7245. This value should be adjusted based on the
accident sequence analyzed.
*
```

```
* OALARM, time after accident initiation that off-site alarm is initiated (s)
EZOALARM001    3600.
*
* Form 'Response Delays' Comment:
* Evacuation is the same for all intervals within the evacuation zone.
*
* DLTSHL, the delay from the time represented by REFPNT to the start of sheltering (s)
EZDLTSHL001    0.
EZDLTSHL002    0.
EZDLTSHL003    0.
EZDLTSHL004    0.
EZDLTSHL005    0.
EZDLTSHL006    0.
EZDLTSHL007    0.
EZDLTSHL008    0.
EZDLTSHL009    0.
EZDLTSHL010    0.
EZDLTSHL011    0.
EZDLTSHL012    0.
EZDLTSHL013    0.
EZDLTSHL014    0.
EZDLTSHL015    0.
EZDLTSHL016    0.
EZDLTSHL017    0.
EZDLTSHL018    0.
EZDLTSHL019    0.
EZDLTSHL020    0.
EZDLTSHL021    0.
EZDLTSHL022    0.
*
* DLTEVA, the delay from the beginning of the sheltering period to the beginning of evacuation
EZDLTEVA001    0.
EZDLTEVA002    0.
EZDLTEVA003    0.
EZDLTEVA004    0.
EZDLTEVA005    0.
EZDLTEVA006    0.
EZDLTEVA007    0.
EZDLTEVA008    0.
EZDLTEVA009    0.
EZDLTEVA010    0.
EZDLTEVA011    0.
EZDLTEVA012    0.
EZDLTEVA013    0.
EZDLTEVA014    0.
EZDLTEVA015    0.
EZDLTEVA016    0.
EZDLTEVA017    0.
EZDLTEVA018    0.
EZDLTEVA019    0.
EZDLTEVA020    0.
EZDLTEVA021    0.
EZDLTEVA022    0.
*
* LASMOV, outermost spatial interval of the evacuation movement zone
EZLASMOV001    22
*
* Form 'Critical Organ' Comment:
* Evacuation decision based on total effective dose.
*
* CRIORG, critical organ for relocation decisions during emergency-phase period
SRCRIORG001    L-ICRP60ED
*
* EVAKEY, evacuation model (CIRCULAR, KEYHOLE, NONE)
EZEVAKEY001    CIRCULAR
.
```

A.3 CHRONC.inp

```
* File created using WinMACCS version 4.1.0 SVN:8280 8/23/2022 12:47:53 PM
*
* Form 'Chronc Description' Comment:
* The project models uniform economic information from the Sequoyah NPP region derived from
SecPop v4.3
*
* CHNAME, late consequences description
CHCHNAME001    'CHRONC file'
*
* Form 'Compensation Costs' Comment:
* Generic values based on the discussions in sections 4.3.4 and 4.4.3 of NUREG/CR 7270.
*
* EVACST, daily cost compensation for evacuees and short-term relocation($/person-d)
CHEVACST001    230.
*
* RELCST, daily cost of compensation for individuals due to intermediate-phase relocation
($/person-d)
CHRELCST001    162.
*
* Form 'Long Term Exposure Period' Comment:
* Values are consistent with the recommendations of section 4.4.1 of NUREG CR-7270
*
* DUR_INTPHAS, duration of the intermediate-phase period (s)
DUR_INTPHAS    3.1536E+07
*
* TMPACT, long term dose projection period (s)
CHTMPACT001    3.1536E+07
*
* Form 'Long Term Dose Criterion' Comment:
* Values are consistent with the recommendations of section 4.4.2 of NUREG CR-7270
*
* DSCRTI, maximum allowable direct-exposure dose commitment in the intermediate phase period (Sv)
CHDSCRTI001    0.02
*
* DSCRLT, maximum allowable direct-exposure dose commitment in the long term phase period (Sv)
CHDSCRLT001    0.005
*
* EXPTIM, long term phase period (s)
CHEXPTIM001    1.5768E+09
*
* CRTOCR, long term phase critical organ
CHCRTOCR001    L-ICRP60ED
*
* Form 'Number of Plan Levels' Comment:
* Values are consistent with the recommendations of section 4.4.4 of NUREG CR-7270
*
* LVLDEC, number of decontamination levels (1, 2 or 3)
CHLVLDEC001    3
*
* Form 'Plan Definition' Comment:
* Values are consistent with the recommendations of section 4.4.4 of NUREG CR-7270
*
* TIMDEC, time required for completion of each level of decontamination (s)
CHTIMDEC001    3.1536E+07
CHTIMDEC002    3.1536E+07
CHTIMDEC003    3.1536E+07
*
* DSRFCT, effectiveness of the various decontamination levels in reducing dose
CHDSRFCT001    2.
CHDSRFCT002    4.
CHDSRFCT003    8.
```

```
*
* Form 'Farmland Costs' Comment:
* Values are consistent with the recommendations of section 4.4.4 of NUREG CR-7270. These values
can be adjusted to be site specific if needed.
*
* CDFRM, farmland decontamination cost ($/ha)
CHCDFRM0001    3700.
CHCDFRM0002    38000.
CHCDFRM0003    38000.
*
* Form 'NonFarmland Costs' Comment:
* Values are consistent with the recommendations of section 4.4.4 of NUREG CR-7270. These values
can be adjusted to be site specific if needed.
*
* CDNFRM, nonfarmland decontamination cost ($/person)
CHCDNFRM001    78000.
CHCDNFRM002    1.80000E+05
CHCDNFRM003    2.70000E+05
*
* FRFDL, fraction farmland decontamination cost due labor
CHFRFDL0001    0.35
CHFRFDL0002    0.35
CHFRFDL0003    0.35
*
* FRNFDL, fraction nonfarmland decontamination cost due labor
CHFRNFDL001    0.35
CHFRNFDL002    0.35
CHFRNFDL003    0.35
*
* TFWKF , fraction of the decontamination period that a farmland  worker spends in  the
contaminated area
CHTFWKF0001    0.15
CHTFWKF0002    0.15
CHTFWKF0003    0.15
*
* TFWKNF, fraction of the decontamination period that a nonfarmland worker spends in  the
contaminated area
CHTFWKNF001    0.15
CHTFWKNF002    0.15
CHTFWKNF003    0.15
*
* DLBCST, labor cost decontamination worker ($/man-y)
CHDLBCST001    76000.
*
* Form 'Interdiction Costs' Comment:
* Values are consistent with the recommendations of section 4.4.3 of NUREG CR-7270.
*
* DPRATE, depreciation rate applies to improvements (1/y)
CHDPRATE001    0.2
*
* DSRATE, rate of return from land, buildings, equipment (1/y)
CHDSRATE001    0.07
*
* POPCST, per capita removal cost for temporary or permanent relocation of population and
businesses ($/person)
CHPOPCST001    7750.
*
* Form 'Groundshine Weathering Terms' Comment:
* Values are consistent with the recommendations of section 4.2.3 of NUREG CR-7270.
*
* NGWTRM, number of terms in the groundshine weathering relationship (1 or 2)
CHNGWTRM001    2
*
* Form 'Groundshine Weathering Coef' Comment:
* Values are consistent with the recommendations of section 4.2.3 of NUREG CR-7270.
*
```

```
* GWCOEF, groundshine weathering equation coefficient
CHGWCOEF001    0.4
CHGWCOEF002    0.6
*
* TGWHLF, groundshine weathering equation half-lives (s)
CHTGWHLF001    4.7E+07
CHTGWHLF002    1.58E+09
*
* Form 'Resuspension Weathering Terms' Comment:
* Values are consistent with the recommendations of section 4.2.2 of NUREG CR-7270.
*
* NRWTRM, number resuspension terms (1, 2 or 3)
CHNRWTRM001    3
*
* Form 'Resuspension Weathering Coef' Comment:
* Values are consistent with the recommendations of section 4.2.2 of NUREG CR-7270.
*
* RWCOEF, resuspension weathering equation coefficient (1/m)
CHRWCOEF001    1.E-05
CHRWCOEF002    7.E-09
CHRWCOEF003    1.E-09
*
* TRWHLF, resuspension weathering equation half lives (s)
CHTRWHLF001    8.56000E+05
CHTRWHLF002    2.99E+07
CHTRWHLF003    1.E+12
*
* Form 'Dose Projection' Comment:
* One year intermediate phase is assumed consistent with section 4.4.1 of NUREG/CR 7270.
*
* DPP_INTERPHAS, dose projection period for the intermediate phase (s)
DPP_INTPHAS    3.15576E+07
*
* Form 'Land Usage' Comment:
* Values derived from SecPop for Sequoyah NPP region.
*
* FRCFRM, average fraction of land devoted to farm production
CHFRCFRM001    0.2678
*
* FRMPRD – average annual farm production (gross sales)  ($/ha)
CHFRMPRD001    2685.
*
* DPFRCT – fraction of annual farm production (gross sales) in the region resulting from dairy
production.
CHDPFRCT001    0.0322
*
* Form 'Property Values' Comment:
* Values derived from SecPop for Sequoyah NPP region.
*
* VALWF – value of farm wealth ($/ha)
CHVALWF0001    14587.
*
* Form 'Property Improvements' Comment:
* Values are consistent with the recommendations of section 4.4.3 of NUREG CR-7270.
*
* FRFIM, fraction of farm wealth due improvements
CHFRFIM0001    0.18
*
* VALWNF, value of nonfarm wealth ($/person)
CHVALWNF001    4.10997E+05
*
* FRNFIM, fraction nonfarm wealth due improvements
CHFRNFIM001    0.72
*
* Form 'Property Form Parameters' Comment:
```

```
* Property form parameters are defined in the properties box and cannot be changed in this form.
They are reproduced here for the user A-38vacuationA-38.
*
* FDPATH, food model (OLD, NEW or OFF)
CHFDPATH001    NEW
*
* Form 'COMIDA2 File' Comment:
* Name of COMIDA2 food chain file. The COMIDA2 file should be consistent with the DCF file.
*
* COMIDA2_INP, COMIDA2 input file
BIN_FILE001    'C:\Users\AJN1\MACCS Code Suite\WinMACCS Project Files\INL Design A, TOP scenario
(HPR stz, HPR nuclides, 1.145 area)\Data\comida2_2.0.0.2_FGR13GyEquiv_RevA.bin'
*
* Form 'Maximum Food Ingestion Dose' Comment:
* Values are consistent with the recommendations of section 4.4.5 of NUREG CR-7270.
*
* DOSEMILK, maximum allowable food ingestion dose from milk crops during the year of the accident
(Sv)
DOSEMILK001    0.0025
DOSEMILK002    0.025
*
* DOSEOTHR, maximum allowable food ingestion dose from non-milk crops during the year of the
accident (Sv)
DOSEOTHR001    0.0025
DOSEOTHR002    0.025
*
* DOSELONG, maximum allowable long-term annual dose to an individual from ingestion of milk and
non-milk crops (Sv)
DOSELONG001    0.005
DOSELONG002    0.05
*
* Form 'Water Ingestion Radionuclides' Comment:
* Values are consistent with the recommendations of section 4.4.6 of NUREG CR-7270.
*
* NUMWPI, number of water ingestion radionuclides
CHNUMWPI001    4
*
* Form 'Water Washoff Fraction' Comment:
* Values are consistent with the recommendations of section 4.4.6 of NUREG CR-7270.
* Form 'Water Ingestion Factor' Comment:
* Values are read from the site file in the sample problem.
*
* NAMWPI, WSHFRI, WSHRTA, WINGF, radionuclide, washout fraction, annual washout rate (1/y), water
ingestion factor
CHWTRISO001    Sr-89   0.01    0.004   5.E-06
CHWTRISO002    Sr-90   0.01    0.004   5.E-06
CHWTRISO003    Cs-134  0.005   0.001   5.E-06
CHWTRISO004    Cs-137  0.005   0.001   5.E-06
*
* Form 'Debug Flag' Comment:
* No debugging output request for the sample problem.
*
* KSWTCH, output diagnostic flag (0 or 1)
CHKSWTCH001    0
*
* ECON_MODL,  economic model (Original, RDEIM)
CHECONMODL1    Original
*
* CM2THY, Comida2 thyroid organ
CHCM2THY001    L-THYROID
*
* CM2EFF, effective organ
CHCM2EFF001    L-ICRP60ED
*
* Form 'Shielding and Exposure' Comment:
* No shielding protection for phantom cohort
```

```
*
* LPROTIN, inhalation protection factor (0 means complete protection)
CHLPROTIN01    1.
*
* LBRRATE, breathing rate for longterm calculation (m3/s)
CHLBRRATE01    2.66E-04
*
* LGSHFAC, longterm groundshine shielding factor  (0 means complete protection)
CHLGSHFAC01    1.
*
* NXUM9,  used for no input, always 0
TYPE9NUMBER    0
*
* NXUM9, number of type9 results
TYPE9NUMBER    6
*
* ORGNAM7, IX1DS9, IX2DS9, CCDF9, organ name to report population dose,  inner spatial interval,
outer spatial interval, CCDF report indicator flag
TYPE9OUT001    L-ICRP60ED     1       14      NONE
TYPE9OUT002    L-ICRP60ED     1       17      NONE
TYPE9OUT003    L-ICRP60ED     1       22      NONE
TYPE9OUT004    L-ICRP60ED     1       25      NONE
TYPE9OUT005    L-ICRP60ED     1       28      NONE
TYPE9OUT006    L-ICRP60ED     1       31      NONE
*
* NXUM10,  used for no input, always 0
TYP10NUMBER    0
*
* NXUM10, number of type10 results
TYP10NUMBER    6
*
*  I1DS10, I2DS10, CCDF10, FLAG10 - inner spatial interval used in economic cost calculation,
outer spatial interval,  CCDF report indicator flag, output detail flag (True for extended)
TYP10OUT001    1       14      NONE    .TRUE.
TYP10OUT002    1       17      NONE    .TRUE.
TYP10OUT003    1       22      NONE    .TRUE.
TYP10OUT004    1       25      NONE    .TRUE.
TYP10OUT005    1       28      NONE    .TRUE.
TYP10OUT006    1       31      NONE    .TRUE.
*
* FLAG11, True if reporting maximum action distance for decontamination or interdiction
TYP11FLAG11    .TRUE.  NONE
*
* NUM12,  used for no input, always 0
TYP12NUMBER    0
*
* NUM12, number of type 12 results
TYP12NUMBER    6
*
* I1DS12, I2DS12, inner spatial interval for reporting impacted area population results, outer
spatial interval
TYP12OUT001    1       14      NONE
TYP12OUT002    1       17      NONE
TYP12OUT003    1       22      NONE
TYP12OUT004    1       25      NONE
TYP12OUT005    1       28      NONE
TYP12OUT006    1       31      NONE
*
* NUM13,  used for no input, always 0
TYP13NUMBER    0
*
* NUM13, number of type 13 results
TYP13NUMBER    13
*
* IRAD13, ORGN13, spatial interval for the report of maximum food ingestion dose, organ name
TYP13OUT001    2       EFFECTIVE       NONE
```

```
TYP13OUT002    14      EFFECTIVE      NONE
TYP13OUT003    17      EFFECTIVE      NONE
TYP13OUT004    22      EFFECTIVE      NONE
TYP13OUT005    25      EFFECTIVE      NONE
TYP13OUT006    28      EFFECTIVE      NONE
TYP13OUT007    31      EFFECTIVE      NONE
TYP13OUT008    14      THYROID NONE
TYP13OUT009    17      THYROID NONE
TYP13OUT010    22      THYROID NONE
TYP13OUT011    25      THYROID NONE
TYP13OUT012    28      THYROID NONE
TYP13OUT013    31      THYROID NONE
*
* NUM14,  used for no input, always 0
TYP14NUMBER    0
*
* NUM14, number of type 14 results
TYP14NUMBER    6
*
* I1DS14, I2DS14, CCDF14 , inner spatial interval in calculated population count in impacted
areas, outer spatial interval,  CCDF report indicator flag
TYP14OUT001    1       14      NONE
TYP14OUT002    1       17      NONE
TYP14OUT003    1       22      NONE
TYP14OUT004    1       25      NONE
TYP14OUT005    1       28      NONE
TYP14OUT006    1       31      NONE
.
```

APPENDIX B
MACCS SETTINGS—DOSE EXPOSURE PERIOD PATCH FILES

This appendix documents the patch files representing the MACCS settings used in the dose exposure period sensitivity analysis. For exposure periods between 2 hours and 30 days, the results are the peak dose in the early phase. In the analysis for a 2-hour exposure period, since MACCS does not allow an early phase period of 2 hours, the analysis defined a cohort with a 2-hour exposure and perfect protection during evacuation.

For the 51-year exposure period, the results are the peak dose from the combined early and late phases. In this last analysis (not shown), the protective action dose limits in the intermediate and long-term phase were artificially increased so they would not interfere with the dose projection.

B.1 Exposure = 30 Days patch.inp

```
*
* ENDEMP, duration of the emergency-phase period (s)
* SRENDEMP001  7200           *2 hours
* SRENDEMP001  86400          *24 hours
* SRENDEMP001  345600         *96 hours
SRENDEMP001    2592000        *30 days
*
```

B.2 Exposure = 4 Days patch.inp

```
*
* ENDEMP, duration of the emergency-phase period (s)
* SRENDEMP001  7200           *2 hours
* SRENDEMP001  86400          *24 hours
SRENDEMP001    345600         *96 hours
* SRENDEMP001  2592000        *30 days
*
```

B.3 Exposure = 1 Day patch.inp

```
*
* ENDEMP, duration of the emergency-phase period (s)
* SRENDEMP001  7200           *2 hours
SRENDEMP001    86400          *24 hours
* SRENDEMP001  345600         *96 hours
* SRENDEMP001  2592000        *30 days
*
```

B.4 Exposure = 2 Hours patch.inp

```
*
* ENDEMP, duration of the emergency-phase period (s)
* SRENDEMP001  7200           *2 hours
* SRENDEMP001  86400          *24 hours
* SRENDEMP001  345600         *96 hours
* SRENDEMP001  2592000        *30 days
*
* A value of ENDEMP=2hrs is not allowed. To simulate a 2 hour dose, cohort 2 is given a 2 hour
evacuation with perfect sheilding during evacuation.
*
*
*******************************
*       START OF COHORT 1
*******************************
*
```

```
* WTFRAC, weighting fraction applied to results of emergency response cohort when WTNAME = PEOPLE
or TIME
EZWTFRAC001    0.
*
* EVATYP, indicates if evacuation model is radial or network
EZEVATYP001    RADIAL
*
* LASMOV , outermost spatial interval of the evacuation movement zone, zero indicates no
evaucation
EZLASMOV001    22
*
* NUMEVA, outer boundary of the sheltering and evacuation region
EZNUMEVA001    22
*
* EVAKEY, evacuation model (CIRCULAR, KEYHOLE, NONE)
EZEVAKEY001    CIRCULAR
*
* DLTSHL, the delay from the time represented by REFPNT to the start of sheltering (s)
EZDLTSHL001    0.
EZDLTSHL002    0.
EZDLTSHL003    0.
EZDLTSHL004    0.
EZDLTSHL005    0.
EZDLTSHL006    0.
EZDLTSHL007    0.
EZDLTSHL008    0.
EZDLTSHL009    0.
EZDLTSHL010    0.
EZDLTSHL011    0.
EZDLTSHL012    0.
EZDLTSHL013    0.
EZDLTSHL014    0.
EZDLTSHL015    0.
EZDLTSHL016    0.
EZDLTSHL017    0.
EZDLTSHL018    0.
EZDLTSHL019    0.
EZDLTSHL020    0.
EZDLTSHL021    0.
EZDLTSHL022    0.
*
* DLTEVA, the delay from the beginning of the sheltering period to the beginning of evacuation
EZDLTEVA001    0.
EZDLTEVA002    0.
EZDLTEVA003    0.
EZDLTEVA004    0.
EZDLTEVA005    0.
EZDLTEVA006    0.
EZDLTEVA007    0.
EZDLTEVA008    0.
EZDLTEVA009    0.
EZDLTEVA010    0.
EZDLTEVA011    0.
EZDLTEVA012    0.
EZDLTEVA013    0.
EZDLTEVA014    0.
EZDLTEVA015    0.
EZDLTEVA016    0.
EZDLTEVA017    0.
EZDLTEVA018    0.
EZDLTEVA019    0.
EZDLTEVA020    0.
EZDLTEVA021    0.
EZDLTEVA022    0.
*
*
**********************************
.           * END OF COHORT 1
**********************************
*
**********************************
```

```
*            START OF COHORT 2
**********************************
*
* WTFRAC, weighting fraction applied to results of emergency response cohort when WTNAME = PEOPLE
or TIME
EZWTFRAC001    1.
*
* EVATYP, indicates if evacuation model is radial or network
EZEVATYP001    RADIAL
*
* EVAKEY, evacuation model (CIRCULAR, KEYHOLE, NONE)
EZEVAKEY001    CIRCULAR
*
* CSFACT, cloudshine shielding factor
SECSFACT001    1
SECSFACT002    0
SECSFACT003    0
*
* PROTIN, inhalation protection factor
SEPROTIN001    1
SEPROTIN002    0
SEPROTIN003    0
*
* BRRATE, breathing rate (m3/s)
SEBRRATE001    2.66E-04
SEBRRATE002    2.66E-04
SEBRRATE003    2.66E-04
*
* SKPFAC, skin protection factors
SESKPFAC001    1
SESKPFAC002    0
SESKPFAC003    0
*
* GSHFAC, groundshine shielding factors
SEGSHFAC001    1
SEGSHFAC002    0
SEGSHFAC003    0
*
* TRAVELPOINT, determines whether boundary or centerpoint of destination is evacuee objective
TRAVELPOINT    CENTERPOINT
*
* ESPEED, evacuee travel speed during the three phases of evacuation (m/s)
EZESPEED001    6.06
EZESPEED002    6.06
EZESPEED003    13.3
*
* ESPMUL, multiplicative factor that affects ESPEED, applied during times of precipitation
EZESPMUL001    0.7
EZESPMUL002    0.7
EZESPMUL003    0.7
*
* REFPNT, defines reference time point for actions in evacuation and sheltering zone
EZREFPNT001    ALARM
*
* DURBEG, duration of initial phase (when first individual begins to evacuate)  of evacuation (s)
EZDURBEG001    1832.
*
* DURMID, duration of middle phase of evacuation (s)
EZDURMID001    808.
*
* NUMEVA, outer boundary of the sheltering and evacuation region
EZNUMEVA001    22
*
* LASMOV, outermost spatial interval of the evacuation movement zone
EZLASMOV001    22
*
* OALARM, time after accident initiation that off-site alarm is initiated (s)
EZOALARM001    3600.
*
* DLTSHL, the delay from the time represented by REFPNT to the start of sheltering (s)
EZDLTSHL001    0.
```

```
EZDLTSHL002    0.
EZDLTSHL003    0.
EZDLTSHL004    0.
EZDLTSHL005    0.
EZDLTSHL006    0.
EZDLTSHL007    0.
EZDLTSHL008    0.
EZDLTSHL009    0.
EZDLTSHL010    0.
EZDLTSHL011    0.
EZDLTSHL012    0.
EZDLTSHL013    0.
EZDLTSHL014    0.
EZDLTSHL015    0.
EZDLTSHL016    0.
EZDLTSHL017    0.
EZDLTSHL018    0.
EZDLTSHL019    0.
EZDLTSHL020    0.
EZDLTSHL021    0.
EZDLTSHL022    0.
*
* DLTEVA, the delay from the beginning of the sheltering period to the beginning of evacuation
EZDLTEVA001    0.
EZDLTEVA002    0.
EZDLTEVA003    0.
EZDLTEVA004    0.
EZDLTEVA005    0.
EZDLTEVA006    0.
EZDLTEVA007    0.
EZDLTEVA008    0.
EZDLTEVA009    0.
EZDLTEVA010    0.
EZDLTEVA011    0.
EZDLTEVA012    0.
EZDLTEVA013    0.
EZDLTEVA014    0.
EZDLTEVA015    0.
EZDLTEVA016    0.
EZDLTEVA017    0.
EZDLTEVA018    0.
EZDLTEVA019    0.
EZDLTEVA020    0.
EZDLTEVA021    0.
EZDLTEVA022    0.
*
*
**********************************
.           * END OF COHORT 2
**********************************
*
*
```

APPENDIX C
MACCS SETTINGS—INVENTORY PATCH FILES

This appendix documents the settings contained in two patch files, “HPR - original nuclide list import.inp” and “HPR - new nuclide list import.inp.” The first contains the heat pipe reactor (HPR) core inventory using a new list of 104 radionuclides as recommended by the HPR radionuclide screening evaluation [20]. The second contains the HPR core inventory using the original list of 71 radionuclides as recommended in NUREG/CR-7270, “Technical Bases for Consequence Analysis Using MACCS (MELCOR Accident Consequence Code System),” issued October 2022. Both files are identical for the first 71 radionuclides and contain data from the HPR SCALE depletion calculation [4], but the first file extends the radionuclide list based on the HPR advanced reactor radionuclide screening analysis and updates the pseudostable isotopes to be consistent with the new list.

C.1 HPR nuclide list patch.inp

```
* This is a MACCS import file of the HPR inventory based on SCALE depletion calculations of the
INL Design A HPR reactor. The file assumes 99 radionuclides as recommended in the HPR
radionuclide screening assessment, plus 5 additional daughter products and an update to the
pseudostable isotope list.
*
*
* NUMSTB, number of pseudostable radionuclides
ISNUMSTB001    12
*
* NAMSTB, list of pseudostable radionuclides
ISNAMSTB001    I-129
ISNAMSTB002    Xe-131m
ISNAMSTB003    Xe-133m
ISNAMSTB004    Cs-135
ISNAMSTB005    Sm-147
ISNAMSTB006    U-235
ISNAMSTB007    U-236
ISNAMSTB008    Np-237
ISNAMSTB009    Rb-87
ISNAMSTB010    Zr-93
ISNAMSTB011    Nb-93m
ISNAMSTB012    Tc-99
*
* NUMISO, number of nuclides
ISNUMISO001    104
*
* NUCNAM, IGROUP, chemical group associated with each nuclide
ISOTPGRP001    Kr-85   1
ISOTPGRP002    Kr-85m  1
ISOTPGRP003    Kr-87   1
ISOTPGRP004    Kr-88   1
ISOTPGRP005    Xe-133  1
ISOTPGRP006    Xe-135  1
ISOTPGRP007    Xe-135m 1
ISOTPGRP008    Cs-134  2
ISOTPGRP009    Cs-136  2
ISOTPGRP010    Cs-137  2
ISOTPGRP011    Rb-86   2
ISOTPGRP012    Rb-88   2
ISOTPGRP013    Ba-139  3
ISOTPGRP014    Ba-140  3
ISOTPGRP015    Sr-89   3
ISOTPGRP016    Sr-90   3
ISOTPGRP017    Sr-91   3
ISOTPGRP018    Sr-92   3
ISOTPGRP019    Ba-137m 3
ISOTPGRP020    I-131   4
```

```
ISOTPGRP021    I-132   4
ISOTPGRP022    I-133   4
ISOTPGRP023    I-134   4
ISOTPGRP024    I-135   4
ISOTPGRP025    Te-127  5
ISOTPGRP026    Te-127m 5
ISOTPGRP027    Te-129  5
ISOTPGRP028    Te-129m 5
ISOTPGRP029    Te-131m 5
ISOTPGRP030    Te-132  5
ISOTPGRP031    Te-131  5
ISOTPGRP032    Rh-105  6
ISOTPGRP033    Ru-103  6
ISOTPGRP034    Ru-105  6
ISOTPGRP035    Ru-106  6
ISOTPGRP036    Rh-103m 6
ISOTPGRP037    Rh-106  6
ISOTPGRP038    Nb-95   7
ISOTPGRP039    Co-58   7
ISOTPGRP040    Co-60   7
ISOTPGRP041    Mo-99   7
ISOTPGRP042    Tc-99m  7
ISOTPGRP043    Nb-97   7
ISOTPGRP044    Nb-97m  7
ISOTPGRP045    Ce-141  8
ISOTPGRP046    Ce-143  8
ISOTPGRP047    Ce-144  8
ISOTPGRP048    Np-239  8
ISOTPGRP049    Pu-238  8
ISOTPGRP050    Pu-239  8
ISOTPGRP051    Pu-240  8
ISOTPGRP052    Pu-241  8
ISOTPGRP053    Zr-95   8
ISOTPGRP054    Zr-97   8
ISOTPGRP055    Am-241  9
ISOTPGRP056    Cm-242  9
ISOTPGRP057    Cm-244  9
ISOTPGRP058    La-140  9
ISOTPGRP059    La-141  9
ISOTPGRP060    La-142  9
ISOTPGRP061    Nd-147  9
ISOTPGRP062    Pr-143  9
ISOTPGRP063    Y-90    9
ISOTPGRP064    Y-91    9
ISOTPGRP065    Y-92    9
ISOTPGRP066    Y-93    9
ISOTPGRP067    Y-91m   9
ISOTPGRP068    Pr-144  9
ISOTPGRP069    Pr-144m 9
ISOTPGRP070    Sb-127  11
ISOTPGRP071    Sb-129  11
ISOTPGRP072    Ag-111  12
ISOTPGRP073    As-77   11
ISOTPGRP074    Cd-115  11
ISOTPGRP075    Cd-115m 11
ISOTPGRP076    Eu-154  9
ISOTPGRP077    Eu-155  9
ISOTPGRP078    Eu-156  9
ISOTPGRP079    Ge-77   12
ISOTPGRP080    Nb-95m  7
ISOTPGRP081    Nd-149  9
ISOTPGRP082    Pd-109  6
ISOTPGRP083    Pm-147  9
ISOTPGRP084    Pm-148  9
ISOTPGRP085    Pm-148m 9
ISOTPGRP086    Pm-149  9
ISOTPGRP087    Pm-151  9
ISOTPGRP088    Pr-145  9
ISOTPGRP089    Sb-125  11
ISOTPGRP090    Sm-151  9
ISOTPGRP091    Sm-153  9
```

```
ISOTPGRP092    Sm-156  9
ISOTPGRP093    Sn-121  12
ISOTPGRP094    Sn-123  12
ISOTPGRP095    Sn-125  12
ISOTPGRP096    Sn-127  12
ISOTPGRP097    Te-125m 5
ISOTPGRP098    U-234   10
ISOTPGRP099    U-237   10
ISOTPGRP100    In-115m 12
ISOTPGRP101    In-115  12
ISOTPGRP102    Th-230  8
ISOTPGRP103    Ra-226  3
ISOTPGRP104    Rn-222  1
*
* NUCSCA, fraction scale factor to be applied to RELFRC (Columns: NUCNAM, IGROUP, NUCSCA)
RDNUCSCA001    Kr-85   1       1.
RDNUCSCA002    Kr-85m  1       1.
RDNUCSCA003    Kr-87   1       1.
RDNUCSCA004    Kr-88   1       1.
RDNUCSCA005    Xe-133  1       1.
RDNUCSCA006    Xe-135  1       1.
RDNUCSCA007    Xe-135m 1       1.
RDNUCSCA008    Cs-134  2       1.
RDNUCSCA009    Cs-136  2       1.
RDNUCSCA010    Cs-137  2       1.
RDNUCSCA011    Rb-86   2       1.
RDNUCSCA012    Rb-88   2       1.
RDNUCSCA013    Ba-139  3       1.
RDNUCSCA014    Ba-140  3       1.
RDNUCSCA015    Sr-89   3       1.
RDNUCSCA016    Sr-90   3       1.
RDNUCSCA017    Sr-91   3       1.
RDNUCSCA018    Sr-92   3       1.
RDNUCSCA019    Ba-137m 3       1.
RDNUCSCA020    I-131   4       1.
RDNUCSCA021    I-132   4       1.
RDNUCSCA022    I-133   4       1.
RDNUCSCA023    I-134   4       1.
RDNUCSCA024    I-135   4       1.
RDNUCSCA025    Te-127  5       1.
RDNUCSCA026    Te-127m 5       1.
RDNUCSCA027    Te-129  5       1.
RDNUCSCA028    Te-129m 5       1.
RDNUCSCA029    Te-131m 5       1.
RDNUCSCA030    Te-132  5       1.
RDNUCSCA031    Te-131  5       1.
RDNUCSCA032    Rh-105  6       1.
RDNUCSCA033    Ru-103  6       1.
RDNUCSCA034    Ru-105  6       1.
RDNUCSCA035    Ru-106  6       1.
RDNUCSCA036    Rh-103m 6       1.
RDNUCSCA037    Rh-106  6       1.
RDNUCSCA038    Nb-95   7       1.
RDNUCSCA039    Co-58   7       1.
RDNUCSCA040    Co-60   7       1.
RDNUCSCA041    Mo-99   7       1.
RDNUCSCA042    Tc-99m  7       1.
RDNUCSCA043    Nb-97   7       1.
RDNUCSCA044    Nb-97m  7       1.
RDNUCSCA045    Ce-141  8       1.
RDNUCSCA046    Ce-143  8       1.
RDNUCSCA047    Ce-144  8       1.
RDNUCSCA048    Np-239  8       1.
RDNUCSCA049    Pu-238  8       1.
RDNUCSCA050    Pu-239  8       1.
RDNUCSCA051    Pu-240  8       1.
RDNUCSCA052    Pu-241  8       1.
RDNUCSCA053    Zr-95   8       1.
RDNUCSCA054    Zr-97   8       1.
RDNUCSCA055    Am-241  9       1.
RDNUCSCA056    Cm-242  9       1.
```

```
RDNUCSCA057    Cm-244  9       1.
RDNUCSCA058    La-140  9       1.
RDNUCSCA059    La-141  9       1.
RDNUCSCA060    La-142  9       1.
RDNUCSCA061    Nd-147  9       1.
RDNUCSCA062    Pr-143  9       1.
RDNUCSCA063    Y-90    9       1.
RDNUCSCA064    Y-91    9       1.
RDNUCSCA065    Y-92    9       1.
RDNUCSCA066    Y-93    9       1.
RDNUCSCA067    Y-91m   9       1.
RDNUCSCA068    Pr-144  9       1.
RDNUCSCA069    Pr-144m 9       1.
RDNUCSCA070    Sb-127  11      1.
RDNUCSCA071    Sb-129  11      1.
RDNUCSCA072    Ag-111  12      1.
RDNUCSCA073    As-77   11      1.
RDNUCSCA074    Cd-115  11      1.
RDNUCSCA075    Cd-115m 11      1.
RDNUCSCA076    Eu-154  9       1.
RDNUCSCA077    Eu-155  9       1.
RDNUCSCA078    Eu-156  9       1.
RDNUCSCA079    Ge-77   12      1.
RDNUCSCA080    Nb-95m  7       1.
RDNUCSCA081    Nd-149  9       1.
RDNUCSCA082    Pd-109  6       1.
RDNUCSCA083    Pm-147  9       1.
RDNUCSCA084    Pm-148  9       1.
RDNUCSCA085    Pm-148m 9       1.
RDNUCSCA086    Pm-149  9       1.
RDNUCSCA087    Pm-151  9       1.
RDNUCSCA088    Pr-145  9       1.
RDNUCSCA089    Sb-125  11      1.
RDNUCSCA090    Sm-151  9       1.
RDNUCSCA091    Sm-153  9       1.
RDNUCSCA092    Sm-156  9       1.
RDNUCSCA093    Sn-121  12      1.
RDNUCSCA094    Sn-123  12      1.
RDNUCSCA095    Sn-125  12      1.
RDNUCSCA096    Sn-127  12      1.
RDNUCSCA097    Te-125m 5       1.
RDNUCSCA098    U-234   10      1.
RDNUCSCA099    U-237   10      1.
RDNUCSCA100    In-115m 12      1.
RDNUCSCA101    In-115  12      1.
RDNUCSCA102    Th-230  8       1.
RDNUCSCA103    Ra-226  3       1.
RDNUCSCA104    Rn-222  1       1.
*
*
* CORINV, inventory of each radionuclide present at the time of accident initiation (Bq)
RDCORINV001    Kr-85   1.1691E+14
RDCORINV002    Kr-85m  1.9459E+15
RDCORINV003    Kr-87   3.8162E+15
RDCORINV004    Kr-88   5.2330E+15
RDCORINV005    Xe-133  1.0411E+16
RDCORINV006    Xe-135  1.0209E+16
RDCORINV007    Xe-135m 1.8497E+15
RDCORINV008    Cs-134  1.2400E+13
RDCORINV009    Cs-136  1.7619E+13
RDCORINV010    Cs-137  1.0444E+15
RDCORINV011    Rb-86   1.4908E+12
RDCORINV012    Rb-88   5.2731E+15
RDCORINV013    Ba-139  9.8213E+15
RDCORINV014    Ba-140  9.5172E+15
RDCORINV015    Sr-89   6.9570E+15
RDCORINV016    Sr-90   9.6366E+14
RDCORINV017    Sr-91   8.7223E+15
RDCORINV018    Sr-92   8.9274E+15
RDCORINV019    Ba-137m 9.8928E+14
RDCORINV020    I-131   4.6425E+15
```

```
RDCORINV021    I-132   6.9743E+15
RDCORINV022    I-133   1.0362E+16
RDCORINV023    I-134   1.2067E+16
RDCORINV024    I-135   9.8654E+15
RDCORINV025    Te-127  2.9981E+14
RDCORINV026    Te-127m 4.8350E+13
RDCORINV027    Te-129  9.5035E+14
RDCORINV028    Te-129m 1.6589E+14
RDCORINV029    Te-131m 6.2486E+14
RDCORINV030    Te-132  6.8953E+15
RDCORINV031    Te-131  4.1801E+15
RDCORINV032    Rh-105  1.9973E+15
RDCORINV033    Ru-103  5.2929E+15
RDCORINV034    Ru-105  2.0692E+15
RDCORINV035    Ru-106  9.7430E+14
RDCORINV036    Rh-103m 5.2354E+15
RDCORINV037    Rh-106  9.7435E+14
RDCORINV038    Nb-95   9.8495E+15
RDCORINV039    Co-58   0
RDCORINV040    Co-60   0
RDCORINV041    Mo-99   9.4597E+15
RDCORINV042    Tc-99m  8.4709E+15
RDCORINV043    Nb-97   9.2447E+15
RDCORINV044    Nb-97m  8.7739E+15
RDCORINV045    Ce-141  8.9956E+15
RDCORINV046    Ce-143  8.9807E+15
RDCORINV047    Ce-144  8.2266E+15
RDCORINV048    Np-239  7.6711E+16
RDCORINV049    Pu-238  9.3667E+10
RDCORINV050    Pu-239  1.0932E+13
RDCORINV051    Pu-240  5.4714E+10
RDCORINV052    Pu-241  1.0737E+11
RDCORINV053    Zr-95   9.8547E+15
RDCORINV054    Zr-97   9.2281E+15
RDCORINV055    Am-241  2.1863E+08
RDCORINV056    Cm-242  3.6011E+08
RDCORINV057    Cm-244  3.9165E+03
RDCORINV058    La-140  9.5253E+15
RDCORINV059    La-141  9.0176E+15
RDCORINV060    La-142  8.8054E+15
RDCORINV061    Nd-147  3.5134E+15
RDCORINV062    Pr-143  8.9964E+15
RDCORINV063    Y-90    9.6248E+14
RDCORINV064    Y-91    8.6985E+15
RDCORINV065    Y-92    9.0098E+15
RDCORINV066    Y-93    9.5847E+15
RDCORINV067    Y-91m   5.1321E+15
RDCORINV068    Pr-144  8.2269E+15
RDCORINV069    Pr-144m 7.8618E+13
RDCORINV070    Sb-127  2.9214E+14
RDCORINV071    Sb-129  9.9663E+14
RDCORINV072    Ag-111  5.3718E+13
RDCORINV073    As-77   1.6361E+13
RDCORINV074    Cd-115  3.5822E+13
RDCORINV075    Cd-115m 2.1272E+12
RDCORINV076    Eu-154  6.4342E+11
RDCORINV077    Eu-155  3.5986E+13
RDCORINV078    Eu-156  3.5653E+13
RDCORINV079    Ge-77   1.7524E+13
RDCORINV080    Nb-95m  1.0648E+14
RDCORINV081    Nd-149  1.7575E+15
RDCORINV082    Pd-109  1.1571E+14
RDCORINV083    Pm-147  2.5593E+15
RDCORINV084    Pm-148  7.4819E+12
RDCORINV085    Pm-148m 6.2090E+12
RDCORINV086    Pm-149  1.7379E+15
RDCORINV087    Pm-151  7.1140E+14
RDCORINV088    Pr-145  6.0406E+15
RDCORINV089    Sb-125  5.4589E+13
RDCORINV090    Sm-151  2.6630E+13
RDCORINV091    Sm-153  2.9258E+14
```

```
RDCORINV092    Sm-156  3.5372E+13
RDCORINV093    Sn-121  3.6275E+13
RDCORINV094    Sn-123  2.7937E+12
RDCORINV095    Sn-125  2.5928E+13
RDCORINV096    Sn-127  1.7085E+14
RDCORINV097    Te-125m 1.2297E+13
RDCORINV098    U-234   1.5721E+12
RDCORINV099    U-237   6.2345E+14
RDCORINV100    In-115m 3.6243E+13
RDCORINV101    In-115  2.8884E-01
RDCORINV102    Th-230  7.2342E+07
RDCORINV103    Ra-226  7.8329E+04
RDCORINV104    Rn-222  7.7857E+04
*
*
```

C.2 LWR nuclide list patch.inp

```
* This is a MACCS import file of the HPR inventory based on SCALE depletion calculations of the
INL Design A HPR reactor. The file assumes 71 radionuclides as recommended in NUREG/CR-7270.*
*
*
* Number of Pseudostable Radionuclides
ISNUMSTB001 16
*
* List of Pseudostable Radionuclides
ISNAMSTB001 I-129
ISNAMSTB002 Xe-131m
ISNAMSTB003 Xe-133m
ISNAMSTB004 Cs-135
ISNAMSTB005 Sm-147
ISNAMSTB006 U-234
ISNAMSTB007 U-235
ISNAMSTB008 U-236
ISNAMSTB009 U-237
ISNAMSTB010 Np-237
ISNAMSTB011 Rb-87
ISNAMSTB012 Zr-93
ISNAMSTB013 Nb-93m
ISNAMSTB014 Nb-95m
ISNAMSTB015 Tc-99
ISNAMSTB016 Pm-147
*
* NUMISO, number of nuclides
ISNUMISO001    71
*
* NUCNAM, IGROUP, chemical group associated with each nuclide
ISOTPGRP001    Kr-85   1
ISOTPGRP002    Kr-85m  1
ISOTPGRP003    Kr-87   1
ISOTPGRP004    Kr-88   1
ISOTPGRP005    Xe-133  1
ISOTPGRP006    Xe-135  1
ISOTPGRP007    Xe-135m 1
ISOTPGRP008    Cs-134  2
ISOTPGRP009    Cs-136  2
ISOTPGRP010    Cs-137  2
ISOTPGRP011    Rb-86   2
ISOTPGRP012    Rb-88   2
ISOTPGRP013    Ba-139  3
ISOTPGRP014    Ba-140  3
ISOTPGRP015    Sr-89   3
ISOTPGRP016    Sr-90   3
ISOTPGRP017    Sr-91   3
ISOTPGRP018    Sr-92   3
ISOTPGRP019    Ba-137m 3
ISOTPGRP020    I-131   4
ISOTPGRP021    I-132   4
ISOTPGRP022    I-133   4
ISOTPGRP023    I-134   4
```

```
ISOTPGRP024    I-135   4
ISOTPGRP025    Te-127  5
ISOTPGRP026    Te-127m 5
ISOTPGRP027    Te-129  5
ISOTPGRP028    Te-129m 5
ISOTPGRP029    Te-131m 5
ISOTPGRP030    Te-132  5
ISOTPGRP031    Te-131  5
ISOTPGRP032    Rh-105  6
ISOTPGRP033    Ru-103  6
ISOTPGRP034    Ru-105  6
ISOTPGRP035    Ru-106  6
ISOTPGRP036    Rh-103m 6
ISOTPGRP037    Rh-106  6
ISOTPGRP038    Nb-95   7
ISOTPGRP039    Co-58   7
ISOTPGRP040    Co-60   7
ISOTPGRP041    Mo-99   7
ISOTPGRP042    Tc-99m  7
ISOTPGRP043    Nb-97   7
ISOTPGRP044    Nb-97m  7
ISOTPGRP045    Ce-141  8
ISOTPGRP046    Ce-143  8
ISOTPGRP047    Ce-144  8
ISOTPGRP048    Np-239  8
ISOTPGRP049    Pu-238  8
ISOTPGRP050    Pu-239  8
ISOTPGRP051    Pu-240  8
ISOTPGRP052    Pu-241  8
ISOTPGRP053    Zr-95   8
ISOTPGRP054    Zr-97   8
ISOTPGRP055    Am-241  9
ISOTPGRP056    Cm-242  9
ISOTPGRP057    Cm-244  9
ISOTPGRP058    La-140  9
ISOTPGRP059    La-141  9
ISOTPGRP060    La-142  9
ISOTPGRP061    Nd-147  9
ISOTPGRP062    Pr-143  9
ISOTPGRP063    Y-90    9
ISOTPGRP064    Y-91    9
ISOTPGRP065    Y-92    9
ISOTPGRP066    Y-93    9
ISOTPGRP067    Y-91m   9
ISOTPGRP068    Pr-144  9
ISOTPGRP069    Pr-144m 9
ISOTPGRP070    Sb-127  11
ISOTPGRP071    Sb-129  11
*
* NUCSCA, fraction scale factor to be applied to RELFRC (Columns: NUCNAM, IGROUP, NUCSCA)
RDNUCSCA001    Kr-85   1       1.
RDNUCSCA002    Kr-85m  1       1.
RDNUCSCA003    Kr-87   1       1.
RDNUCSCA004    Kr-88   1       1.
RDNUCSCA005    Xe-133  1       1.
RDNUCSCA006    Xe-135  1       1.
RDNUCSCA007    Xe-135m 1       1.
RDNUCSCA008    Cs-134  2       1.
RDNUCSCA009    Cs-136  2       1.
RDNUCSCA010    Cs-137  2       1.
RDNUCSCA011    Rb-86   2       1.
RDNUCSCA012    Rb-88   2       1.
RDNUCSCA013    Ba-139  3       1.
RDNUCSCA014    Ba-140  3       1.
RDNUCSCA015    Sr-89   3       1.
RDNUCSCA016    Sr-90   3       1.
RDNUCSCA017    Sr-91   3       1.
RDNUCSCA018    Sr-92   3       1.
RDNUCSCA019    Ba-137m 3       1.
RDNUCSCA020    I-131   4       1.
RDNUCSCA021    I-132   4       1.
```

```
RDNUCSCA022    I-133   4       1.
RDNUCSCA023    I-134   4       1.
RDNUCSCA024    I-135   4       1.
RDNUCSCA025    Te-127  5       1.
RDNUCSCA026    Te-127m 5       1.
RDNUCSCA027    Te-129  5       1.
RDNUCSCA028    Te-129m 5       1.
RDNUCSCA029    Te-131m 5       1.
RDNUCSCA030    Te-132  5       1.
RDNUCSCA031    Te-131  5       1.
RDNUCSCA032    Rh-105  6       1.
RDNUCSCA033    Ru-103  6       1.
RDNUCSCA034    Ru-105  6       1.
RDNUCSCA035    Ru-106  6       1.
RDNUCSCA036    Rh-103m 6       1.
RDNUCSCA037    Rh-106  6       1.
RDNUCSCA038    Nb-95   7       1.
RDNUCSCA039    Co-58   7       1.
RDNUCSCA040    Co-60   7       1.
RDNUCSCA041    Mo-99   7       1.
RDNUCSCA042    Tc-99m  7       1.
RDNUCSCA043    Nb-97   7       1.
RDNUCSCA044    Nb-97m  7       1.
RDNUCSCA045    Ce-141  8       1.
RDNUCSCA046    Ce-143  8       1.
RDNUCSCA047    Ce-144  8       1.
RDNUCSCA048    Np-239  8       1.
RDNUCSCA049    Pu-238  8       1.
RDNUCSCA050    Pu-239  8       1.
RDNUCSCA051    Pu-240  8       1.
RDNUCSCA052    Pu-241  8       1.
RDNUCSCA053    Zr-95   8       1.
RDNUCSCA054    Zr-97   8       1.
RDNUCSCA055    Am-241  9       1.
RDNUCSCA056    Cm-242  9       1.
RDNUCSCA057    Cm-244  9       1.
RDNUCSCA058    La-140  9       1.
RDNUCSCA059    La-141  9       1.
RDNUCSCA060    La-142  9       1.
RDNUCSCA061    Nd-147  9       1.
RDNUCSCA062    Pr-143  9       1.
RDNUCSCA063    Y-90    9       1.
RDNUCSCA064    Y-91    9       1.
RDNUCSCA065    Y-92    9       1.
RDNUCSCA066    Y-93    9       1.
RDNUCSCA067    Y-91m   9       1.
RDNUCSCA068    Pr-144  9       1.
RDNUCSCA069    Pr-144m 9       1.
RDNUCSCA070    Sb-127  11      1.
RDNUCSCA071    Sb-129  11      1.
*
* CORINV, inventory of each radionuclide present at the time of accident initiation (Bq)
RDCORINV001    Kr-85   1.1691E+14
RDCORINV002    Kr-85m  1.9459E+15
RDCORINV003    Kr-87   3.8162E+15
RDCORINV004    Kr-88   5.2330E+15
RDCORINV005    Xe-133  1.0411E+16
RDCORINV006    Xe-135  1.0209E+16
RDCORINV007    Xe-135m 1.8497E+15
RDCORINV008    Cs-134  1.2400E+13
RDCORINV009    Cs-136  1.7619E+13
RDCORINV010    Cs-137  1.0444E+15
RDCORINV011    Rb-86   1.4908E+12
RDCORINV012    Rb-88   5.2731E+15
RDCORINV013    Ba-139  9.8213E+15
RDCORINV014    Ba-140  9.5172E+15
RDCORINV015    Sr-89   6.9570E+15
RDCORINV016    Sr-90   9.6366E+14
RDCORINV017    Sr-91   8.7223E+15
RDCORINV018    Sr-92   8.9274E+15
RDCORINV019    Ba-137m 9.8928E+14
```

```
RDCORINV020    I-131   4.6425E+15
RDCORINV021    I-132   6.9743E+15
RDCORINV022    I-133   1.0362E+16
RDCORINV023    I-134   1.2067E+16
RDCORINV024    I-135   9.8654E+15
RDCORINV025    Te-127  2.9981E+14
RDCORINV026    Te-127m 4.8350E+13
RDCORINV027    Te-129  9.5035E+14
RDCORINV028    Te-129m 1.6589E+14
RDCORINV029    Te-131m 6.2486E+14
RDCORINV030    Te-132  6.8953E+15
RDCORINV031    Te-131  4.1801E+15
RDCORINV032    Rh-105  1.9973E+15
RDCORINV033    Ru-103  5.2929E+15
RDCORINV034    Ru-105  2.0692E+15
RDCORINV035    Ru-106  9.7430E+14
RDCORINV036    Rh-103m 5.2354E+15
RDCORINV037    Rh-106  9.7435E+14
RDCORINV038    Nb-95   9.8495E+15
RDCORINV039    Co-58   0
RDCORINV040    Co-60   0
RDCORINV041    Mo-99   9.4597E+15
RDCORINV042    Tc-99m  8.4709E+15
RDCORINV043    Nb-97   9.2447E+15
RDCORINV044    Nb-97m  8.7739E+15
RDCORINV045    Ce-141  8.9956E+15
RDCORINV046    Ce-143  8.9807E+15
RDCORINV047    Ce-144  8.2266E+15
RDCORINV048    Np-239  7.6711E+16
RDCORINV049    Pu-238  9.3667E+10
RDCORINV050    Pu-239  1.0932E+13
RDCORINV051    Pu-240  5.4714E+10
RDCORINV052    Pu-241  1.0737E+11
RDCORINV053    Zr-95   9.8547E+15
RDCORINV054    Zr-97   9.2281E+15
RDCORINV055    Am-241  2.1863E+08
RDCORINV056    Cm-242  3.6011E+08
RDCORINV057    Cm-244  3.9165E+03
RDCORINV058    La-140  9.5253E+15
RDCORINV059    La-141  9.0176E+15
RDCORINV060    La-142  8.8054E+15
RDCORINV061    Nd-147  3.5134E+15
RDCORINV062    Pr-143  8.9964E+15
RDCORINV063    Y-90    9.6248E+14
RDCORINV064    Y-91    8.6985E+15
RDCORINV065    Y-92    9.0098E+15
RDCORINV066    Y-93    9.5847E+15
RDCORINV067    Y-91m   5.1321E+15
RDCORINV068    Pr-144  8.2269E+15
RDCORINV069    Pr-144m 7.8618E+13
RDCORINV070    Sb-127  2.9214E+14
RDCORINV071    Sb-129  9.9663E+14
*
*
```

APPENDIX D
MACCS SETTINGS—NEARFIELD MODELING PATCH FILES

This appendix presents the settings for the MACCS nearfield modeling approaches.

D.1 Nearfield—Ramsdell and Fosmire patch.inp

```
*
* MNDMOD, plume meander model (OLD, NEW, OFF, RAF)
PMMNDMOD001 RAF
*
* SRCMOD, Plume Source model set to PNT (PNT, AREA, AUTO)
RDSRCMOD001 PNT
*
* RAFDIST, Distance to stop using Ramsdell and Fosmire meander model
PMRAFDIST01 1200.
*
* TIMSCLY1, Ramsdell and Fosmire meander model low speed y timescale parameter
PMTIMSCLY11 1000.
*
* TIMSCLZ1, Ramsdell and Fosmire meander model low speed z timescale parameter
PMTIMSCLZ11 100.
*
* TIMSCLY2, Ramsdell and Fosmire meander model high speed y timescale coefficient
PMTIMSCLY21 10.
*
* TIMSCLZ2, Ramsdell and Fosmire meander model high speed z timescale coefficient
PMTIMSCLZ21 10.
*
* BKGTRBV, Ramsdell and Fosmire meander model background v turbulence
PMBKGTRBV01 0.655
*
* BKGTRBW, Ramsdell and Fosmire meander model background w turbulence
PMBKGTRBW01 0.584
*
* TRBINCV1, Ramsdell and Fosmire meander model low speed v turbulent increment
PMTRBINCV11 0.835
*
* TRBINCW1, Ramsdell and Fosmire meander model low speed w turbulent increment
PMTRBINCW11 0.239
*
* TRBINCV2, Ramsdell and Fosmire meander model high speed v turbulent coefficient
PMTRBINCV21 0.02
*
* TRBINCW2, Ramsdell and Fosmire meander model high speed w turbulent coefficient
PMTRBINCW21 0.01
```

D.2 Nearfield—RG 1.145 point source patch.inp

```
*
* MNDMOD, plume meander model (OLD, NEW, OFF, RAF)
PMMNDMOD001 NEW
*
* WINSP1, wind speed where the meander factor changes from constant to decreasing(m/s)
PMWINSP1001 2.
*
* WINSP2, wind speed where the meander factor reaches one (m/s)
PMWINSP2001 6.
*
* MNDIST, distance where the effect of meander begins to diminish (m)
PMMNDIST001 800.
*
* MNDFAC, plume meander factor used to calculate sigma-y
PMMNDFAC001 1.
```

```
PMMNDFAC002 1.
PMMNDFAC003 1.
PMMNDFAC004 2.
PMMNDFAC005 3.
PMMNDFAC006 4.
*
* SRCMOD, Plume Source model set to PNT (PNT, AREA, AUTO)
RDSRCMOD001 PNT
*
* PSMEQ1C, Point Source Model Equation 1 Coefficient
PMPSMEQ1C01 0.5
*
* PSMEQ2C, Point Source Model Equation 2 Coefficient
PMPSMEQ2C01 3.
```

D.3 Nearfield—RG 1.145 area source patch.inp

```
*
* MNDMOD, plume meander model (OLD, NEW, OFF, RAF)
PMMNDMOD001 NEW
*
* WINSP1, wind speed where the meander factor changes from constant to decreasing(m/s)
PMWINSP1001 2.
*
* WINSP2, wind speed where the meander factor reaches one (m/s)
PMWINSP2001 6.
*
* MNDIST, distance where the effect of meander begins to diminish (m)
PMMNDIST001 800.
*
* MNDFAC, plume meander factor used to calculate sigma-y
PMMNDFAC001 1.
PMMNDFAC002 1.
PMMNDFAC003 1.
PMMNDFAC004 2.
PMMNDFAC005 3.
PMMNDFAC006 4.
*
* SRCMOD, Plume Source model set to PNT (PNT, AREA, AUTO)
RDSRCMOD001 AREA
*
* SIGYINIT, initial value of sigma-y for each of the plumes (m)
* SIGYINIT001 5.0116E+00   * given by MelMACCS file

*
* SIGZINIT, initial value of sigma-z for each of the plumes (m)
* SIGZINIT001 4.2558E+00   * given by MelMACCS file
```

APPENDIX E
MACCS SETTINGS—RELEASE TIMING PATCH FILES

This appendix shows the settings used for the release timing sensitivity analysis. The sensitivity analysis considered changes in the release of -0.94 (immediate release), 0 (base case), 1, 2, 4, 8, 24, and 96 hours. To avoid redundancy, the input for just one realization is shown below. However, the inputs for all the realizations are available in the commented lines and can be run by switching the comment fields.

```
*
*
* Start Time of Release
RDPDELAY001 0.00E+00 0.00E+00 3.59E+03 3.59E+03 7.19E+03 7.19E+03 1.08E+04 1.08E+04 1.44E+04
1.80E+04 2.16E+04 2.52E+04 2.88E+04 3.24E+04 3.60E+04 3.96E+04 4.32E+04 4.68E+04 5.04E+04
5.40E+04 5.76E+04 6.12E+04 6.48E+04 6.84E+04 7.20E+04 7.56E+04 7.92E+04 8.28E+04      *Immediate
Release (-0.94 hours)
* RDPDELAY001 3.37E+03 3.37E+03 6.96E+03 6.96E+03 1.06E+04 1.06E+04 1.42E+04 1.42E+04 1.78E+04
2.14E+04 2.50E+04 2.86E+04 3.22E+04 3.58E+04 3.94E+04 4.30E+04 4.66E+04 5.02E+04 5.38E+04
5.74E+04 6.10E+04 6.46E+04 6.82E+04 7.18E+04 7.54E+04 7.90E+04 8.26E+04 8.62E+04      *Base Case
(0 delay)
* RDPDELAY001 6.97E+03 6.97E+03 1.06E+04 1.06E+04 1.42E+04 1.42E+04 1.78E+04 1.78E+04 2.14E+04
2.50E+04 2.86E+04 3.22E+04 3.58E+04 3.94E+04 4.30E+04 4.66E+04 5.02E+04 5.38E+04 5.74E+04
6.10E+04 6.46E+04 6.82E+04 7.18E+04 7.54E+04 7.90E+04 8.26E+04 8.62E+04 8.98E+04      *1 hour
delay
* RDPDELAY001 1.06E+04 1.06E+04 1.42E+04 1.42E+04 1.78E+04 1.78E+04 2.14E+04 2.14E+04 2.50E+04
2.86E+04 3.22E+04 3.58E+04 3.94E+04 4.30E+04 4.66E+04 5.02E+04 5.38E+04 5.74E+04 6.10E+04
6.46E+04 6.82E+04 7.18E+04 7.54E+04 7.90E+04 8.26E+04 8.62E+04 8.98E+04 9.34E+04      *2 hour
delay
* RDPDELAY001 1.42E+04 1.42E+04 1.78E+04 1.78E+04 2.14E+04 2.14E+04 2.50E+04 2.50E+04 2.86E+04
3.22E+04 3.58E+04 3.94E+04 4.30E+04 4.66E+04 5.02E+04 5.38E+04 5.74E+04 6.10E+04 6.46E+04
6.82E+04 7.18E+04 7.54E+04 7.90E+04 8.26E+04 8.62E+04 8.98E+04 9.34E+04 9.70E+04      *4 hour
delay
* RDPDELAY001 1.78E+04 1.78E+04 2.14E+04 2.14E+04 2.50E+04 2.50E+04 2.86E+04 2.86E+04 3.22E+04
3.58E+04 3.94E+04 4.30E+04 4.66E+04 5.02E+04 5.38E+04 5.74E+04 6.10E+04 6.46E+04 6.82E+04
7.18E+04 7.54E+04 7.90E+04 8.26E+04 8.62E+04 8.98E+04 9.34E+04 9.70E+04 1.01E+05      *8 hour
delay
* RDPDELAY001 2.14E+04 2.14E+04 2.50E+04 2.50E+04 2.86E+04 2.86E+04 3.22E+04 3.22E+04 3.58E+04
3.94E+04 4.30E+04 4.66E+04 5.02E+04 5.38E+04 5.74E+04 6.10E+04 6.46E+04 6.82E+04 7.18E+04
7.54E+04 7.90E+04 8.26E+04 8.62E+04 8.98E+04 9.34E+04 9.70E+04 1.01E+05 1.04E+05      *24 hour
delay
* RDPDELAY001 2.50E+04 2.50E+04 2.86E+04 2.86E+04 3.22E+04 3.22E+04 3.58E+04 3.58E+04 3.94E+04
4.30E+04 4.66E+04 5.02E+04 5.38E+04 5.74E+04 6.10E+04 6.46E+04 6.82E+04 7.18E+04 7.54E+04
7.90E+04 8.26E+04 8.62E+04 8.98E+04 9.34E+04 9.70E+04 1.01E+05 1.04E+05 1.08E+05      *96 hour
delay

* End of the Early Phase
ENDEMP 601427 * 7 days - 0.94 hours
* ENDEMP 604800 * 7 days
* ENDEMP 608400 * 7 days + 1 hour
* ENDEMP 612000 * 7 days + 2 hours
* ENDEMP 619200 * 7 days + 4 hours
* ENDEMP 633600 * 7 days + 8 hours
* ENDEMP 691200 * 8 days
* ENDEMP 950400 * 11 days
```

APPENDIX F
MACCS SETTINGS—HEAT PIPE REACTOR GENERAL SETTINGS

This appendix documents the contents of “HPR - Advanced Reactor import.inp.” This file contains the general settings imported into the MACCS project for the heat pipe reactor advanced reactor demonstration project.

```
* This an import file for the HPR advanced reactor demonstration project. Starting with the AAB
sample problem created using NUREG/CR-7270, this file provides documentation of the general
settings used for this project. Before this file was imported, the project reset two optional
forms for the Type E output (population movement) and for CORSCA (Release Fraction Scale Factors)
to their default settings.
*
*
*
********************************
* ATMOS inputs
********************************
*
* Comment:
* WinMACCS v4.1 does not recognize the variables TDWMOD and TDWAUTO. These settings are manually
entered in the project properties window.
*
* TDWMOD, Plume Trapping model set to BRGFLX (BRGBLD, BRGFLX, PRIME)
RDTDWMOD001 BRGBLD
*
* TDWAUTO, Specifies if automatically calculating the trapped/downwashed release height.
RDTDWAUTO01 .TRUE.
*
** NUMRAD, number of radial spatial elements
GENUMRAD001 31
*
* SPAEND, spatial endpoint distances (km)
GESPAEND001    0.1
GESPAEND002    0.2
GESPAEND003    0.3
GESPAEND004    0.4
GESPAEND005    0.5
GESPAEND006    0.6
GESPAEND007    0.7
GESPAEND008    0.8
GESPAEND009    0.9
GESPAEND010    1.
GESPAEND011    2.
GESPAEND012    5.
GESPAEND013    10.
GESPAEND014    16.09
GESPAEND015    20.
GESPAEND016    30.
GESPAEND017    32.18
GESPAEND018    40.
GESPAEND019    50.
GESPAEND020    60.
GESPAEND021    70.
GESPAEND022    80.45
GESPAEND023    90.
GESPAEND024    100.
GESPAEND025    160.9
GESPAEND026    200.
GESPAEND027    500.
GESPAEND028    804.5
GESPAEND029    1000.
GESPAEND030    1500.
GESPAEND031    1609.
*
* LIMSPA, last spatial interval for recorded weather, beyond use boundary weather
M2LIMSPA001    30
```

```
*
* LATITUDE, indicates degrees of site latitude (deg)
M1LATITUD01    35.226657
*
* LONGITUDE, indicates degrees of site longitude (deg)
M1LONGITU01    -85.091203
*
* RNDSTS, endpoints of the rain distance intervals (km)
M4RNDSTS001    2.
M4RNDSTS002    5.
M4RNDSTS003    10.
M4RNDSTS004    20.
M4RNDSTS005    30.
*
* NUM0, number of results
TYPE0NUMBER 31
*
* INDREL, INDRAD, CCDF, ATMOS release and spatial interval
TYPE0OUT001 7 1 NONE
TYPE0OUT002 7 2 NONE
TYPE0OUT003 7 3 NONE
TYPE0OUT004 7 4 NONE
TYPE0OUT005 7 5 NONE
TYPE0OUT006 7 6 NONE
TYPE0OUT007 7 7 NONE
TYPE0OUT008 7 8 NONE
TYPE0OUT009 7 9 NONE
TYPE0OUT010 7 10 NONE
TYPE0OUT011 7 11 NONE
TYPE0OUT012 7 12 NONE
TYPE0OUT013 7 13 NONE
TYPE0OUT014 7 14 NONE
TYPE0OUT015 7 15 NONE
TYPE0OUT016 7 16 NONE
TYPE0OUT017 7 17 NONE
TYPE0OUT018 7 18 NONE
TYPE0OUT019 7 19 NONE
TYPE0OUT020 7 20 NONE
TYPE0OUT021 7 21 NONE
TYPE0OUT022 7 22 NONE
TYPE0OUT023 7 23 NONE
TYPE0OUT024 7 24 NONE
TYPE0OUT025 7 25 NONE
TYPE0OUT026 7 26 NONE
TYPE0OUT027 7 27 NONE
TYPE0OUT028 7 28 NONE
TYPE0OUT029 7 29 NONE
TYPE0OUT030 7 30 NONE
TYPE0OUT031 7 31 NONE
*
****************************************
* EARLY inputs (not cohort related)
****************************************
*
* POPFLG,  if set to FILE, population is defined in a site data file. UNIFORM indicates a user
defined uniform distribution.
PDPOPFLG001    UNIFORM
*
* FRACLD, fraction of site covered by land
STFRACLD001    1.
*
* IBEGIN, spatial interval at which population is considered to be non-zero
PDIBEGIN001    1
*
* POPDEN, uniform population density of the region
PDPOPDEN001    40.
*
* DPPEMP, dose projection period for the emergency phase (s)
SRDPPEMP001    0
*
* DOSHOT, defines the hot-spot relocation dose threshold (Sv)
```

```
SRDOSHOT001    1.E+10
*
* DOSNRM, defines the normal relocation dose threshold (Sv)
SRDOSNRM001    1.E+10
*
* TIMHOT, hot-spot relocation action time (individuals residing outside the emergency-planning
zone) after plume arrival (s)
SRTIMHOT001    0
*
* TIMNRM - normal relocation action time  (individuals residing outside the emergency-planning
zone) after plume arrival (s)
SRTIMNRM001    0
*
* WTNAME, type of weighting factor to be used in generating weighted sum of results
EZWTNAME001    PEOPLE
*
****************************
* CHRONC inputs
****************************
*
* LPROTIN, inhalation protection factor (0 means complete protection)
CHLPROTIN01    1
*
* LBRRATE, breathing rate for longterm calculation (m3/s)
CHLBRRATE01    2.66E-04
*
* LGSHFAC, longterm groundshine shielding factor  (0 means complete protection)
CHLGSHFAC01    1
*
* FRCFRM, average fraction of land devoted to farm production
CHFRCFRM001    0.2678
*
* FRMPRD - average annual farm production (gross sales)  ($/ha)
CHFRMPRD001    2685.
*
* DPFRCT - fraction of annual farm production (gross sales) in the region resulting from dairy
production.
CHDPFRCT001    0.0322
*
* VALWF - value of farm wealth ($/ha)
CHVALWF0001    14587.
*
* VALWNF, value of nonfarm wealth ($/person)
CHVALWNF001    4.10997E+05
*
* NAMWPI, WSHFRI, WSHRTA, WINGF, radionuclide, washout fraction, annual washout rate (1/y), water
ingestion factor
CHWTRISO001    Sr-89   0.01    0.004   5.E-06
CHWTRISO002    Sr-90   0.01    0.004   5.E-06
CHWTRISO003    Cs-134  0.005   0.001   5.E-06
CHWTRISO004    Cs-137  0.005   0.001   5.E-06
*
* NUM1, number of type 1 results
TYPE1NUMBER 32
*
* NAME1, I1DIS1, I2DIS1, CCDF1, heath risk name to count heath effect cases, inner spatial
interval, outer spatial interval, CCDF report indicator flag

TYPE1OUT001    'ERL FAT/TOTAL'        1       14      REPORT
TYPE1OUT002    'ERL FAT/TOTAL'        1       22      REPORT
TYPE1OUT003    'ERL FAT/TOTAL'        1       31      REPORT
TYPE1OUT004    'CAN INJ/TOTAL'        1       14      NONE
TYPE1OUT005    'CAN INJ/TOTAL'        1       17      NONE
TYPE1OUT006    'CAN INJ/TOTAL'        1       22      NONE
TYPE1OUT007    'CAN INJ/TOTAL'        1       25      NONE
TYPE1OUT008    'CAN INJ/TOTAL'        1       28      NONE
TYPE1OUT009    'CAN INJ/TOTAL'        1       31      NONE
TYPE1OUT010    'CAN FAT/TOTAL'        1       14      REPORT
TYPE1OUT011    'CAN FAT/TOTAL'        1       17      REPORT
TYPE1OUT012    'CAN FAT/TOTAL'        1       22      REPORT
TYPE1OUT013    'CAN FAT/TOTAL'        1       25      REPORT
```

```
TYPE1OUT014    'CAN FAT/TOTAL'        1       28      REPORT
TYPE1OUT015    'CAN FAT/TOTAL'        1       31      REPORT
TYPE1OUT016    'CAN FAT/Thyroid'      1       14      NONE
TYPE1OUT017    'CAN FAT/Thyroid'      1       22      NONE
TYPE1OUT018    'CAN FAT/Thyroid'      1       25      NONE
TYPE1OUT019    'CAN FAT/Thyroid'      1       31      NONE
TYPE1OUT020    'CAN FAT/Breast'       1       14      NONE
TYPE1OUT021    'CAN FAT/Breast'       1       22      NONE
TYPE1OUT022    'CAN FAT/Breast'       1       25      NONE
TYPE1OUT023    'CAN FAT/Breast'       1       31      NONE
TYPE1OUT024    'CAN FAT/Lung' 1       14      NONE
TYPE1OUT025    'CAN FAT/Lung' 1       22      NONE
TYPE1OUT026    'CAN FAT/Lung' 1       25      NONE
TYPE1OUT027    'CAN FAT/Lung' 1       31      NONE
TYPE1OUT028    'CAN FAT/Leukemia'     1       31      NONE
TYPE1OUT029    'CAN FAT/Bone' 1       31      NONE
TYPE1OUT030    'CAN FAT/Liver'        1       31      NONE
TYPE1OUT031    'CAN FAT/Colon'        1       31      NONE
TYPE1OUT032    'CAN FAT/Residual'     1       31      NONE
*
* NUM2, used for no input, always 0
TYPE2NUMBER 0
*
* NUM2, number of type 2 results
TYPE2NUMBER 1
*
* RISTHR, CCDF2 , fatality risk threshold to calculate distance, CCDF report indicator flag

TYPE2OUT001 0. NONE
*
* NUM4, used for no input, always 0
TYPE4NUMBER 0
*
* NUM5,  used for no input, always 0
TYPE5NUMBER 0
*
* NUM5, number of type 5 results
TYPE5NUMBER 6
*
* NAME5, I1DIS5, I2DIS5, CCDF5, organ name to calculate population dose, inner spatial interval,
outer spatial interval,  CCDF report indicator flag
TYPE5OUT001    L-ICRP60ED     1       14      REPORT
TYPE5OUT002    L-ICRP60ED     1       17      REPORT
TYPE5OUT003    L-ICRP60ED     1       22      REPORT
TYPE5OUT004    L-ICRP60ED     1       25      REPORT
TYPE5OUT005    L-ICRP60ED     1       28      REPORT
TYPE5OUT006    L-ICRP60ED     1       31      REPORT
*
* NUM6,  used for no input, always 0
TYPE6NUMBER 0
*
* NUM7,  used for no input, always 0
TYPE7NUMBER 0
*
* NUM8,  used for no input, always 0
TYPE8NUMBER 0
*
* NUM8, number of type 8 results
TYPE8NUMBER 11
*
* NAME8, I1DIS8, I2DIS8, CCDF8, health risk name to calculate population-weighted Risk,  inner
spatial interval, outer spatial interval, CCDF report indicator flag

TYPE8OUT001    'CAN FAT/TOTAL'        1       14      REPORT
TYPE8OUT002    'CAN FAT/TOTAL'        1       17      NONE
TYPE8OUT003    'CAN FAT/TOTAL'        1       22      NONE
TYPE8OUT004    'CAN FAT/TOTAL'        1       25      NONE
TYPE8OUT005    'CAN FAT/TOTAL'        1       28      NONE
TYPE8OUT006    'CAN FAT/TOTAL'        1       31      NONE
TYPE8OUT007    'CAN FAT/TOTAL'        15      17      REPORT
TYPE8OUT008    'CAN FAT/TOTAL'        18      22      REPORT
```

```
TYPE8OUT009    'CAN FAT/TOTAL'       23     25     REPORT
TYPE8OUT010    'CAN FAT/TOTAL'       26     28     REPORT
TYPE8OUT011    'CAN FAT/TOTAL'       29     31     REPORT
*
* NUMA,  used for no input, always 0
TYPEANUMBER 0
*
* NUMA, number of type A results
TYPEANUMBER 1
*
* NAMEA, I1DISA, I2DISA, CCDFA, organ name to calculate peak dose vs distance, inner spatial
interval, outer spatial interval, CCDF report indicator flag

TYPEAOUT001 L-ICRP60ED 1 31 REPORT
*
* NUMB,  used for no input, always 0
TYPEBNUMBER 0
*
* NUMC,  number of typeC output
TYPECNUMBER    1
*
* ORGNAM8, ELEVDOSE, PRINT_FLAG_C, CCDFC - organ name to calculate land area, dose threshold
(Sv), true indicates extended output by grid element
TYPECOUT001    L-ICRP60ED     0.05    .TRUE.  NONE
*
* NUMD, number of typeD output
TYPEDNUMBER 20
*
* I1DISD, NUCLIDED, ELEVCONC, PRINT_FLAG_D, CCDFD - outer spatial interval (inner starts at
0),nuclides for which ground and air concentrations are calculated if above threshold, threshold
(Bq/m2), true indicates extended output by grid element

TYPEDOUT001    14      Cs-137  37000   .TRUE.  NONE
TYPEDOUT002    14      Cs-137  1.85E+05        .FALSE. NONE
TYPEDOUT003    14      Cs-137  5.55E+05        .FALSE. NONE
TYPEDOUT004    14      Cs-137  1.48E+06        .FALSE. NONE
TYPEDOUT005    22      Cs-137  37000   .FALSE. NONE
TYPEDOUT006    22      Cs-137  1.85E+05        .FALSE. NONE
TYPEDOUT007    22      Cs-137  5.55E+05        .FALSE. NONE
TYPEDOUT008    22      Cs-137  1.48E+06        .FALSE. NONE
TYPEDOUT009    25      Cs-137  37000   .FALSE. NONE
TYPEDOUT010    25      Cs-137  1.85E+05        .FALSE. NONE
TYPEDOUT011    25      Cs-137  5.55E+05        .FALSE. NONE
TYPEDOUT012    25      Cs-137  1.48E+06        .FALSE. NONE
TYPEDOUT013    28      Cs-137  37000   .FALSE. NONE
TYPEDOUT014    28      Cs-137  1.85E+05        .FALSE. NONE
TYPEDOUT015    28      Cs-137  5.55E+05        .FALSE. NONE
TYPEDOUT016    28      Cs-137  1.48E+06        .FALSE. NONE
TYPEDOUT017    31      Cs-137  37000   .FALSE. NONE
TYPEDOUT018    31      Cs-137  1.85E+05        .FALSE. NONE
TYPEDOUT019    31      Cs-137  5.55E+05        .FALSE. NONE
TYPEDOUT020    31      Cs-137  1.48E+06        .FALSE. NONE
*
* NUME,  used for no input, always 0
TYPEENUMBER    0
*
* NXUM9, number of type9 results
TYPE9NUMBER 6
*
* ORGNAM7, IX1DS9, IX2DS9, CCDF9, organ name to report population dose,  inner spatial interval,
outer spatial interval, CCDF report indicator flag
TYPE9OUT001    L-ICRP60ED     1       14      REPORT
TYPE9OUT002    L-ICRP60ED     1       17      REPORT
TYPE9OUT003    L-ICRP60ED     1       22      REPORT
TYPE9OUT004    L-ICRP60ED     1       25      REPORT
TYPE9OUT005    L-ICRP60ED     1       28      REPORT
TYPE9OUT006    L-ICRP60ED     1       31      REPORT
*
* NXUM10,  used for no input, always 0
TYP10NUMBER 0
*
```

```
* NXUM10, number of type10 results
TYP10NUMBER 6
*
*  I1DS10, I2DS10, CCDF10, FLAG10 - inner spatial interval used in economic cost calculation,
outer spatial interval,  CCDF report indicator flag, output detail flag (True for extended)

TYP10OUT001    1       14      REPORT  .TRUE.
TYP10OUT002    1       17      REPORT  .TRUE.
TYP10OUT003    1       22      REPORT  .TRUE.
TYP10OUT004    1       25      REPORT  .TRUE.
TYP10OUT005    1       28      REPORT  .TRUE.
TYP10OUT006    1       31      REPORT  .TRUE.
*
* FLAG11, True if reporting maximum action distance for decontamination or interdiction

TYP11FLAG11 .TRUE. NONE
*
* NUM12,  used for no input, always 0
TYP12NUMBER 0
*
* NUM12, number of type 12 results
TYP12NUMBER 6
*
* I1DS12, I2DS12, inner spatial interval for reporting impacted area population results, outer
spatial interval
TYP12OUT001    1       14      REPORT
TYP12OUT002    1       17      REPORT
TYP12OUT003    1       22      REPORT
TYP12OUT004    1       25      REPORT
TYP12OUT005    1       28      REPORT
TYP12OUT006    1       31      REPORT
*
* NUM13,  used for no input, always 0
TYP13NUMBER 0
*
* NUM13, number of type 13 results
TYP13NUMBER 13
*
* IRAD13, ORGN13, spatial interval for the report of maximum food ingestion dose, organ name

TYP13OUT001    2       EFFECTIVE       NONE
TYP13OUT002    14      EFFECTIVE       NONE
TYP13OUT003    17      EFFECTIVE       NONE
TYP13OUT004    22      EFFECTIVE       NONE
TYP13OUT005    25      EFFECTIVE       NONE
TYP13OUT006    28      EFFECTIVE       NONE
TYP13OUT007    31      EFFECTIVE       NONE
TYP13OUT008    14      THYROID NONE
TYP13OUT009    17      THYROID NONE
TYP13OUT010    22      THYROID NONE
TYP13OUT011    25      THYROID NONE
TYP13OUT012    28      THYROID NONE
TYP13OUT013    31      THYROID NONE
*
* NUM14, number of type 14 results
TYP14NUMBER 6
*
* I1DS14, I2DS14, CCDF14 , inner spatial interval in calculated population count in impacted
areas, outer spatial interval,  CCDF report indicator flag

TYP14OUT001    1       14      REPORT
TYP14OUT002    1       17      REPORT
TYP14OUT003    1       22      REPORT
TYP14OUT004    1       25      REPORT
TYP14OUT005    1       28      REPORT
TYP14OUT006    1       31      REPORT
*
*******************************
*       START OF COHORT 1
*******************************
*
```

```
* WTFRAC, weighting fraction applied to results of emergency response cohort when WTNAME = PEOPLE
or TIME
EZWTFRAC001    0.
*
* EVATYP, indicates if evacuation model is radial or network
EZEVATYP001    RADIAL
*
* LASMOV , outermost spatial interval of the evacuation movement zone, zero indicates no
evaucation
EZLASMOV001    1
*
* EVAKEY, evacuation model (CIRCULAR, KEYHOLE, NONE)
EZEVAKEY001    CIRCULAR
*
* NUMEVA, outer boundary of the sheltering and evacuation region
EZNUMEVA001    1
*
* DLTSHL, the delay from the time represented by REFPNT to the start of sheltering (s)
EZDLTSHL001    900.
*
* DLTEVA, the delay from the beginning of the sheltering period to the beginning of evacuation
EZDLTEVA001    2460.
*
*
**********************************
.           * END OF COHORT 1
**********************************
*
**********************************
*            START OF COHORT 2
**********************************
*
* WTFRAC, weighting fraction applied to results of emergency response cohort when WTNAME = PEOPLE
or TIME
EZWTFRAC001    1.
*
* EVATYP, indicates if evacuation model is radial or network
EZEVATYP001    NONE
*
* LASMOV , outermost spatial interval of the evacuation movement zone, zero indicates no
evaucation
EZLASMOV001    0
*
* EVAKEY, evacuation model (CIRCULAR, KEYHOLE, NONE)
EZEVAKEY001    NONE
*
* CSFACT, cloudshine shielding factor
SECSFACT001    1
SECSFACT002    1
SECSFACT003    1
*
* PROTIN, inhalation protection factor
SEPROTIN001    1
SEPROTIN002    1
SEPROTIN003    1
*
* BRRATE, breathing rate (m3/s)
SEBRRATE001    2.66E-04
SEBRRATE002    2.66E-04
SEBRRATE003    2.66E-04
*
* SKPFAC, skin protection factors
SESKPFAC001    1
SESKPFAC002    1
SESKPFAC003    1
*
* GSHFAC, groundshine shielding factors
SEGSHFAC001    1
SEGSHFAC002    1
SEGSHFAC003    1
*
```

```
**********************************
.            * END OF COHORT 2
**********************************
*
*
```

APPENDIX G
MELMACCS SOURCE TERM FILE OF HEAT PIPE REACTOR TRANSIENT OVERPOWER

```
* RIMELMAC lines are constructed for ease of software parsing
* The data on each line starts and ends with the MACCS string delimiter '
* The delimited data contains an optional comment followed by a space, followed by a capitalized
keyword (no spaces)
* The first colon on the line will follow this keyword followed by a single space
* Value of that keyword will be all characters following in the line
*
* Quality assurance information
RIMELMAC001 'MelMACCS generated MACCS_FILE: C:\Users\AJN1\OneDrive - U.S. NRC\Work Files\Advanced
reactor demo project\MELMACCS HPR source term\Zhe HPR update 2\HPR - TOP source term Zhe.inp'
RIMELMAC002 'MACCS input cards generated by MelMACCS_VERSION: 4.0.0-beta Git SHA:
4b46fd5eb84411b0bc395b2e9f24dd5d203ff102 Build date: 2022-03-14'
RIMELMAC003 'File CREATION_DATE: 8/17/2022 3:21:01 PM'
RIMELMAC004 'MelMACCS PROJECT_NAME: C:\Users\AJN1\OneDrive - U.S. NRC\Work Files\Advanced reactor
demo project\MELMACCS HPR source term\Zhe HPR update 2\HPR - TOP source term.mel'
RIMELMAC005 'MELCOR PTF_FILE: C:\Users\AJN1\OneDrive - U.S. NRC\Work Files\Advanced reactor demo
project\MELMACCS HPR source term\Zhe HPR update 2\rlz_base.ptf'
RIMELMAC006 'MELCOR plot file modification date PTF_DATE: 8/17/2022 2:19:00 PM'
RIMELMAC007 'MELCOR plot file title PTF_TITLE: PVHPEFQ  / 8/16/22 /15:47:30 /heat pipe reactor'
RIMELMAC008 'MELCOR_VERSION: 2.2,build21402'
RIMELMAC009 'RING_NUMBER: 1'
RIMELMAC010 'RING_DESCRIPTION: Core Inventory'
*
* C:\MACCS Code Suite\MelMACCS 4.0.0-beta\MelMACCS.ini modification date: 11/24/2021 4:07:18 PM
* Inventory file:C:\Users\AJN1\Documents\MelMACCS_Docs/Inventories\HPR INL-A inventories.inv
modification date: 6/13/2022 4:49:05 PM
* Inventory used to calculate core inventory: HPR_EOC
*
* Mass threshold fraction for path: 0
* Mass threshold fraction for plume segment: 0
*
* MELCOR compound chemical groups counted in MACCS chemical groups using the following fractions:
* Mass of I in CSI moved to chemical group I using mass fraction: 0.488444
* Mass of Cs in CSI moved to chemical group Cs using mass fraction: 0.511556
* Mass of Cs in CSM moved to chemical group Cs using mass fraction: 0.7347892
* Mass of Mo in CSM moved to chemical group Mo using mass fraction: 0.2652108
*
* Number of Chemical classes
ISMAXGRP001 13
*
* Chemical names as exported from MELCOR file
ISGRPNAM001 Xe
ISGRPNAM002 Cs
ISGRPNAM003 Ba
ISGRPNAM004 I
ISGRPNAM005 Te
ISGRPNAM006 Ru
ISGRPNAM007 Mo
ISGRPNAM008 Ce
ISGRPNAM009 La
ISGRPNAM010 U
ISGRPNAM011 Cd
ISGRPNAM012 Sn
ISGRPNAM013 B
*
* Particle size diameters equal or greater than 20 microns use gravitational deposition velocity
calculation
*
* Expert deposition velocities based on linear regression of expert elicited data
* NUREG/CR-7161, N. E.Bixler, E. Clauss and C. W. Morrow
* See MELMACCS Models Document for detail.
```

```
* The following model parameters were used:
*      Surface roughness: 0.1(m)
*      Wind speed: 5(m/s)
*      MELCOR aerosol density : 1000(kg/m**3)
*      Quantile: 0.5
*      Regression coefficients a, b, c, d, e, f, g:
* -2.964       0.992   0.19    -0.072  1.061   0       0.169
*
* Gravitational deposition velocities calculated using particle sizes from MELCOR
*      MELCOR aerosol density : 1000, slip factor of 1.257
*      Assume Mean free path of air at 298 K, .069E-6 m
*      Assume viscosity of air at 298 K, 1.8 E-5 N-s/m**2
*
* PSize: MELCOR (physical) diameter (micrometers); d_p: aerodynamic diameter used (micrometers)
*      PSize(1): 0.15332297   d_p(1): 0.15332297     Expert elicitation
*      PSize(2): 0.28543303   d_p(2): 0.28543303     Expert elicitation
*      PSize(3): 0.53137513   d_p(3): 0.53137513     Expert elicitation
*      PSize(4): 0.98923215   d_p(4): 0.98923215     Expert elicitation
*      PSize(5): 1.8415997    d_p(5): 1.8415997      Expert elicitation
*      PSize(6): 3.4284058    d_p(6): 3.4284058      Expert elicitation
*      PSize(7): 6.3824765    d_p(7): 6.3824765      Expert elicitation
*      PSize(8): 11.881909    d_p(8): 11.881909      Expert elicitation
*      PSize(9): 22.119903    d_p(9): 20     Expert elicitation
*      PSize(10): 41.17942    d_p(10): 41.17942      Gravitational deposition velocity
* Dry Deposition Velocity
DDVDEPOS001 6.5205E-04
DDVDEPOS002 5.9841E-04
DDVDEPOS003 7.8397E-04
DDVDEPOS004 1.3218E-03
DDVDEPOS005 2.5854E-03
DDVDEPOS006 5.2893E-03
DDVDEPOS007 1.0203E-02
DDVDEPOS008 1.673E-02
DDVDEPOS009 2.0715E-02
DDVDEPOS010 5.1507E-02
*
* Number of particle size groups
DDNPSGRP001 10
*
* Particle size distribution
RDPSDIST001 1.0E-01 1.0E-01 1.0E-01 1.0E-01 1.0E-01 1.0E-01 1.0E-01 1.0E-01 1.0E-01 1.0E-01
RDPSDIST002 1.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
RDPSDIST003 1.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
RDPSDIST004 1.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
RDPSDIST005 1.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
RDPSDIST006 1.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
RDPSDIST007 1.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
RDPSDIST008 1.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
RDPSDIST009 1.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
RDPSDIST010 1.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
RDPSDIST011 1.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
RDPSDIST012 1.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00 0.0E+00
RDPSDIST013 1.0E-01 1.0E-01 1.0E-01 1.0E-01 1.0E-01 1.0E-01 1.0E-01 1.0E-01 1.0E-01 1.0E-01
*
* WETDEP, DRYDEP, wet and dry deposition flags for each nuclide group
ISDEPFLA001 .FALSE. .FALSE.
ISDEPFLA002 .TRUE. .TRUE.
ISDEPFLA003 .TRUE. .TRUE.
ISDEPFLA004 .TRUE. .TRUE.
ISDEPFLA005 .TRUE. .TRUE.
ISDEPFLA006 .TRUE. .TRUE.
ISDEPFLA007 .TRUE. .TRUE.
ISDEPFLA008 .TRUE. .TRUE.
ISDEPFLA009 .TRUE. .TRUE.
ISDEPFLA010 .TRUE. .TRUE.
ISDEPFLA011 .TRUE. .TRUE.
ISDEPFLA012 .TRUE. .TRUE.
ISDEPFLA013 .TRUE. .TRUE.
*
* Number of Pseudostable Radionuclides
ISNUMSTB001 16
```

```
*
* List of Pseudostable Radionuclides
ISNAMSTB001 I-129
ISNAMSTB002 Xe-131m
ISNAMSTB003 Xe-133m
ISNAMSTB004 Cs-135
ISNAMSTB005 Sm-147
ISNAMSTB006 U-234
ISNAMSTB007 U-235
ISNAMSTB008 U-236
ISNAMSTB009 U-237
ISNAMSTB010 Np-237
ISNAMSTB011 Rb-87
ISNAMSTB012 Zr-93
ISNAMSTB013 Nb-93m
ISNAMSTB014 Nb-95m
ISNAMSTB015 Tc-99
ISNAMSTB016 Pm-147
*
* Number of releases as selected by user
RDNUMREL001 28
*
* Height of the facility building (m)
WEBUILDH001 9.15E+00
WEBUILDH002 9.15E+00
WEBUILDH003 9.15E+00
WEBUILDH004 9.15E+00
WEBUILDH005 9.15E+00
WEBUILDH006 9.15E+00
WEBUILDH007 9.15E+00
WEBUILDH008 9.15E+00
WEBUILDH009 9.15E+00
WEBUILDH010 9.15E+00
WEBUILDH011 9.15E+00
WEBUILDH012 9.15E+00
WEBUILDH013 9.15E+00
WEBUILDH014 9.15E+00
WEBUILDH015 9.15E+00
WEBUILDH016 9.15E+00
WEBUILDH017 9.15E+00
WEBUILDH018 9.15E+00
WEBUILDH019 9.15E+00
WEBUILDH020 9.15E+00
WEBUILDH021 9.15E+00
WEBUILDH022 9.15E+00
WEBUILDH023 9.15E+00
WEBUILDH024 9.15E+00
WEBUILDH025 9.15E+00
WEBUILDH026 9.15E+00
WEBUILDH027 9.15E+00
WEBUILDH028 9.15E+00
*
* Width of the facility building (m)
WEBUILDW001 2.155E+01
WEBUILDW002 2.155E+01
WEBUILDW003 2.155E+01
WEBUILDW004 2.155E+01
WEBUILDW005 2.155E+01
WEBUILDW006 2.155E+01
WEBUILDW007 2.155E+01
WEBUILDW008 2.155E+01
WEBUILDW009 2.155E+01
WEBUILDW010 2.155E+01
WEBUILDW011 2.155E+01
WEBUILDW012 2.155E+01
WEBUILDW013 2.155E+01
WEBUILDW014 2.155E+01
WEBUILDW015 2.155E+01
WEBUILDW016 2.155E+01
WEBUILDW017 2.155E+01
WEBUILDW018 2.155E+01
```

```
WEBUILDW019 2.155E+01
WEBUILDW020 2.155E+01
WEBUILDW021 2.155E+01
WEBUILDW022 2.155E+01
WEBUILDW023 2.155E+01
WEBUILDW024 2.155E+01
WEBUILDW025 2.155E+01
WEBUILDW026 2.155E+01
WEBUILDW027 2.155E+01
WEBUILDW028 2.155E+01
*
* Length of the facility building (m)
WEBUILDL001 2.155E+01
WEBUILDL002 2.155E+01
WEBUILDL003 2.155E+01
WEBUILDL004 2.155E+01
WEBUILDL005 2.155E+01
WEBUILDL006 2.155E+01
WEBUILDL007 2.155E+01
WEBUILDL008 2.155E+01
WEBUILDL009 2.155E+01
WEBUILDL010 2.155E+01
WEBUILDL011 2.155E+01
WEBUILDL012 2.155E+01
WEBUILDL013 2.155E+01
WEBUILDL014 2.155E+01
WEBUILDL015 2.155E+01
WEBUILDL016 2.155E+01
WEBUILDL017 2.155E+01
WEBUILDL018 2.155E+01
WEBUILDL019 2.155E+01
WEBUILDL020 2.155E+01
WEBUILDL021 2.155E+01
WEBUILDL022 2.155E+01
WEBUILDL023 2.155E+01
WEBUILDL024 2.155E+01
WEBUILDL025 2.155E+01
WEBUILDL026 2.155E+01
WEBUILDL027 2.155E+01
WEBUILDL028 2.155E+01
*
* Angle, degrees from N to facility building width (degrees)
WEBUILDA001 0.0E+00
WEBUILDA002 0.0E+00
WEBUILDA003 0.0E+00
WEBUILDA004 0.0E+00
WEBUILDA005 0.0E+00
WEBUILDA006 0.0E+00
WEBUILDA007 0.0E+00
WEBUILDA008 0.0E+00
WEBUILDA009 0.0E+00
WEBUILDA010 0.0E+00
WEBUILDA011 0.0E+00
WEBUILDA012 0.0E+00
WEBUILDA013 0.0E+00
WEBUILDA014 0.0E+00
WEBUILDA015 0.0E+00
WEBUILDA016 0.0E+00
WEBUILDA017 0.0E+00
WEBUILDA018 0.0E+00
WEBUILDA019 0.0E+00
WEBUILDA020 0.0E+00
WEBUILDA021 0.0E+00
WEBUILDA022 0.0E+00
WEBUILDA023 0.0E+00
WEBUILDA024 0.0E+00
WEBUILDA025 0.0E+00
WEBUILDA026 0.0E+00
WEBUILDA027 0.0E+00
WEBUILDA028 0.0E+00
*
```

```
* Trapped plume release height (m)
RDPHTRAP001 0.0E+00
RDPHTRAP002 0.0E+00
RDPHTRAP003 0.0E+00
RDPHTRAP004 0.0E+00
RDPHTRAP005 0.0E+00
RDPHTRAP006 0.0E+00
RDPHTRAP007 0.0E+00
RDPHTRAP008 0.0E+00
RDPHTRAP009 0.0E+00
RDPHTRAP010 0.0E+00
RDPHTRAP011 0.0E+00
RDPHTRAP012 0.0E+00
RDPHTRAP013 0.0E+00
RDPHTRAP014 0.0E+00
RDPHTRAP015 0.0E+00
RDPHTRAP016 0.0E+00
RDPHTRAP017 0.0E+00
RDPHTRAP018 0.0E+00
RDPHTRAP019 0.0E+00
RDPHTRAP020 0.0E+00
RDPHTRAP021 0.0E+00
RDPHTRAP022 0.0E+00
RDPHTRAP023 0.0E+00
RDPHTRAP024 0.0E+00
RDPHTRAP025 0.0E+00
RDPHTRAP026 0.0E+00
RDPHTRAP027 0.0E+00
RDPHTRAP028 0.0E+00
*
* Initial Sigma-Y width of plume segment (m)
SIGYINIT001 5.0116E+00
SIGYINIT002 5.0116E+00
SIGYINIT003 5.0116E+00
SIGYINIT004 5.0116E+00
SIGYINIT005 5.0116E+00
SIGYINIT006 5.0116E+00
SIGYINIT007 5.0116E+00
SIGYINIT008 5.0116E+00
SIGYINIT009 5.0116E+00
SIGYINIT010 5.0116E+00
SIGYINIT011 5.0116E+00
SIGYINIT012 5.0116E+00
SIGYINIT013 5.0116E+00
SIGYINIT014 5.0116E+00
SIGYINIT015 5.0116E+00
SIGYINIT016 5.0116E+00
SIGYINIT017 5.0116E+00
SIGYINIT018 5.0116E+00
SIGYINIT019 5.0116E+00
SIGYINIT020 5.0116E+00
SIGYINIT021 5.0116E+00
SIGYINIT022 5.0116E+00
SIGYINIT023 5.0116E+00
SIGYINIT024 5.0116E+00
SIGYINIT025 5.0116E+00
SIGYINIT026 5.0116E+00
SIGYINIT027 5.0116E+00
SIGYINIT028 5.0116E+00
*
* Initial Sigma-Z height of plume segment (m)
SIGZINIT001 4.2558E+00
SIGZINIT002 4.2558E+00
SIGZINIT003 4.2558E+00
SIGZINIT004 4.2558E+00
SIGZINIT005 4.2558E+00
SIGZINIT006 4.2558E+00
SIGZINIT007 4.2558E+00
SIGZINIT008 4.2558E+00
SIGZINIT009 4.2558E+00
SIGZINIT010 4.2558E+00
```

```
SIGZINIT011 4.2558E+00
SIGZINIT012 4.2558E+00
SIGZINIT013 4.2558E+00
SIGZINIT014 4.2558E+00
SIGZINIT015 4.2558E+00
SIGZINIT016 4.2558E+00
SIGZINIT017 4.2558E+00
SIGZINIT018 4.2558E+00
SIGZINIT019 4.2558E+00
SIGZINIT020 4.2558E+00
SIGZINIT021 4.2558E+00
SIGZINIT022 4.2558E+00
SIGZINIT023 4.2558E+00
SIGZINIT024 4.2558E+00
SIGZINIT025 4.2558E+00
SIGZINIT026 4.2558E+00
SIGZINIT027 4.2558E+00
SIGZINIT028 4.2558E+00
*
* Representative location of plume segment.0. = leading edge, .5 = midpoint, 1. = trailing edge
RDREFTIM001 0.
RDREFTIM002 0.5
RDREFTIM003 0.5
RDREFTIM004 0.5
RDREFTIM005 0.5
RDREFTIM006 0.5
RDREFTIM007 0.5
RDREFTIM008 0.5
RDREFTIM009 0.5
RDREFTIM010 0.5
RDREFTIM011 0.5
RDREFTIM012 0.5
RDREFTIM013 0.5
RDREFTIM014 0.5
RDREFTIM015 0.5
RDREFTIM016 0.5
RDREFTIM017 0.5
RDREFTIM018 0.5
RDREFTIM019 0.5
RDREFTIM020 0.5
RDREFTIM021 0.5
RDREFTIM022 0.5
RDREFTIM023 0.5
RDREFTIM024 0.5
RDREFTIM025 0.5
RDREFTIM026 0.5
RDREFTIM027 0.5
RDREFTIM028 0.5
*
* plume segment duration
RDPLUDUR001 3.5874E+03
RDPLUDUR002 3.5874E+03
RDPLUDUR003 3.6E+03
RDPLUDUR004 3.6E+03
RDPLUDUR005 3.6E+03
RDPLUDUR006 3.6E+03
RDPLUDUR007 4.8E+02
RDPLUDUR008 3.6E+03
RDPLUDUR009 3.6E+03
RDPLUDUR010 3.6E+03
RDPLUDUR011 3.6E+03
RDPLUDUR012 3.6E+03
RDPLUDUR013 3.6E+03
RDPLUDUR014 3.6E+03
RDPLUDUR015 3.6E+03
RDPLUDUR016 3.6E+03
RDPLUDUR017 3.6E+03
RDPLUDUR018 3.6E+03
RDPLUDUR019 3.6E+03
RDPLUDUR020 3.6E+03
RDPLUDUR021 3.6E+03
```

```
RDPLUDUR022 3.6E+03
RDPLUDUR023 3.6E+03
RDPLUDUR024 3.6E+03
RDPLUDUR025 3.6E+03
RDPLUDUR026 3.6E+03
RDPLUDUR027 3.6E+03
RDPLUDUR028 2.4E+02
*
* MELCOR Time associated with reference time for inventory: 0 (s)
* Plume Segment 1 is associated with release path 1 at MELCOR time 3372.65 s
* Plume Segment 2 is associated with release path 2 at MELCOR time 3372.65 s
* Plume Segment 3 is associated with release path 1 at MELCOR time 6960.025 s
* Plume Segment 4 is associated with release path 2 at MELCOR time 6960.025 s
* Plume Segment 5 is associated with release path 1 at MELCOR time 10560.03 s
* Plume Segment 6 is associated with release path 2 at MELCOR time 10560.03 s
* Plume Segment 7 is associated with release path 1 at MELCOR time 14160.03 s
* Plume Segment 8 is associated with release path 2 at MELCOR time 14160.03 s
* Plume Segment 9 is associated with release path 2 at MELCOR time 17760.03 s
* Plume Segment 10 is associated with release path 2 at MELCOR time 21360.03 s
* Plume Segment 11 is associated with release path 2 at MELCOR time 24960.03 s
* Plume Segment 12 is associated with release path 2 at MELCOR time 28560.03 s
* Plume Segment 13 is associated with release path 2 at MELCOR time 32160.03 s
* Plume Segment 14 is associated with release path 2 at MELCOR time 35760.03 s
* Plume Segment 15 is associated with release path 2 at MELCOR time 39360.03 s
* Plume Segment 16 is associated with release path 2 at MELCOR time 42960.03 s
* Plume Segment 17 is associated with release path 2 at MELCOR time 46560.03 s
* Plume Segment 18 is associated with release path 2 at MELCOR time 50160.03 s
* Plume Segment 19 is associated with release path 2 at MELCOR time 53760.03 s
* Plume Segment 20 is associated with release path 2 at MELCOR time 57360.03 s
* Plume Segment 21 is associated with release path 2 at MELCOR time 60960.03 s
* Plume Segment 22 is associated with release path 2 at MELCOR time 64560.03 s
* Plume Segment 23 is associated with release path 2 at MELCOR time 68160.03 s
* Plume Segment 24 is associated with release path 2 at MELCOR time 71760.03 s
* Plume Segment 25 is associated with release path 2 at MELCOR time 75360.03 s
* Plume Segment 26 is associated with release path 2 at MELCOR time 78960.03 s
* Plume Segment 27 is associated with release path 2 at MELCOR time 82560.03 s
* Plume Segment 28 is associated with release path 2 at MELCOR time 86160.03 s
* Start Time of Release
RDPDELAY001 3.3727E+03
RDPDELAY002 3.3727E+03
RDPDELAY003 6.96E+03
RDPDELAY004 6.96E+03
RDPDELAY005 1.056E+04
RDPDELAY006 1.056E+04
RDPDELAY007 1.416E+04
RDPDELAY008 1.416E+04
RDPDELAY009 1.776E+04
RDPDELAY010 2.136E+04
RDPDELAY011 2.496E+04
RDPDELAY012 2.856E+04
RDPDELAY013 3.216E+04
RDPDELAY014 3.576E+04
RDPDELAY015 3.936E+04
RDPDELAY016 4.296E+04
RDPDELAY017 4.656E+04
RDPDELAY018 5.016E+04
RDPDELAY019 5.376E+04
RDPDELAY020 5.736E+04
RDPDELAY021 6.096E+04
RDPDELAY022 6.456E+04
RDPDELAY023 6.816E+04
RDPDELAY024 7.176E+04
RDPDELAY025 7.536E+04
RDPDELAY026 7.896E+04
RDPDELAY027 8.256E+04
RDPDELAY028 8.616E+04
*
* MELCOR Height associated with ground level:8.15 (m)
*  Release path: 1 MELCOR Height: 1.33E+01 (m)
*  Release path: 2 MELCOR Height: 1.73E+01 (m)
* Adjusted plume segment height
```

```
RDPLHITE001 5.15E+00
RDPLHITE002 9.15E+00
RDPLHITE003 5.15E+00
RDPLHITE004 9.15E+00
RDPLHITE005 5.15E+00
RDPLHITE006 9.15E+00
RDPLHITE007 5.15E+00
RDPLHITE008 9.15E+00
RDPLHITE009 9.15E+00
RDPLHITE010 9.15E+00
RDPLHITE011 9.15E+00
RDPLHITE012 9.15E+00
RDPLHITE013 9.15E+00
RDPLHITE014 9.15E+00
RDPLHITE015 9.15E+00
RDPLHITE016 9.15E+00
RDPLHITE017 9.15E+00
RDPLHITE018 9.15E+00
RDPLHITE019 9.15E+00
RDPLHITE020 9.15E+00
RDPLHITE021 9.15E+00
RDPLHITE022 9.15E+00
RDPLHITE023 9.15E+00
RDPLHITE024 9.15E+00
RDPLHITE025 9.15E+00
RDPLHITE026 9.15E+00
RDPLHITE027 9.15E+00
RDPLHITE028 9.15E+00
*
* Risk dominant plume segment
RDMAXRIS001 6
*
* Flag indicating plume segment buoyancy model
* RDPLMMOD001 HEAT
*
RDPLMMOD001 DENSITY
*
* Rate of release of sensible heat in Watts (J/s)
RDPLHEAT001 1.337E+03
RDPLHEAT002 2.096E+03
RDPLHEAT003 8.7888E+02
RDPLHEAT004 2.8512E+03
RDPLHEAT005 1.473E+02
RDPLHEAT006 2.7086E+03
RDPLHEAT007 2.4E+00
RDPLHEAT008 2.6364E+03
RDPLHEAT009 2.556E+03
RDPLHEAT010 2.5064E+03
RDPLHEAT011 2.4831E+03
RDPLHEAT012 2.4741E+03
RDPLHEAT013 2.4723E+03
RDPLHEAT014 2.4721E+03
RDPLHEAT015 2.4715E+03
RDPLHEAT016 2.4705E+03
RDPLHEAT017 2.4687E+03
RDPLHEAT018 2.4656E+03
RDPLHEAT019 2.4619E+03
RDPLHEAT020 2.4571E+03
RDPLHEAT021 2.4523E+03
RDPLHEAT022 2.4471E+03
RDPLHEAT023 2.4418E+03
RDPLHEAT024 2.4372E+03
RDPLHEAT025 2.4314E+03
RDPLHEAT026 2.4266E+03
RDPLHEAT027 2.4221E+03
RDPLHEAT028 2.4197E+03
*
* Mass Flow Rate (kg/s)
RDPLMFLA001 3.299E-04
RDPLMFLA002 5.1721E-04
RDPLMFLA003 2.1689E-04
```

```
RDPLMFLA004 7.0363E-04
RDPLMFLA005 3.6347E-05
RDPLMFLA006 6.6841E-04
RDPLMFLA007 1E-06 *manually increased to minimum MACCS value (original value: 5.9977E-07)
RDPLMFLA008 6.5058E-04
RDPLMFLA009 6.3073E-04
RDPLMFLA010 6.1847E-04
RDPLMFLA011 6.1271E-04
RDPLMFLA012 6.1048E-04
RDPLMFLA013 6.1003E-04
RDPLMFLA014 6.0996E-04
RDPLMFLA015 6.0981E-04
RDPLMFLA016 6.0956E-04
RDPLMFLA017 6.091E-04
RDPLMFLA018 6.0834E-04
RDPLMFLA019 6.0742E-04
RDPLMFLA020 6.0623E-04
RDPLMFLA021 6.0503E-04
RDPLMFLA022 6.0373E-04
RDPLMFLA023 6.0243E-04
RDPLMFLA024 6.0128E-04
RDPLMFLA025 5.9986E-04
RDPLMFLA026 5.9866E-04
RDPLMFLA027 5.9753E-04
RDPLMFLA028 5.969E-04
*
* Gas Density (kg/m3)
RDPLMDEN001 1.1436E+00
RDPLMDEN002 1.1444E+00
RDPLMDEN003 1.1457E+00
RDPLMDEN004 1.1456E+00
RDPLMDEN005 1.1452E+00
RDPLMDEN006 1.1451E+00
RDPLMDEN007 1.1449E+00
RDPLMDEN008 1.1447E+00
RDPLMDEN009 1.1444E+00
RDPLMDEN010 1.1441E+00
RDPLMDEN011 1.1439E+00
RDPLMDEN012 1.1436E+00
RDPLMDEN013 1.1434E+00
RDPLMDEN014 1.1432E+00
RDPLMDEN015 1.143E+00
RDPLMDEN016 1.1428E+00
RDPLMDEN017 1.1426E+00
RDPLMDEN018 1.1424E+00
RDPLMDEN019 1.1422E+00
RDPLMDEN020 1.142E+00
RDPLMDEN021 1.1418E+00
RDPLMDEN022 1.1417E+00
RDPLMDEN023 1.1415E+00
RDPLMDEN024 1.1413E+00
RDPLMDEN025 1.1412E+00
RDPLMDEN026 1.141E+00
RDPLMDEN027 1.1409E+00
RDPLMDEN028 1.1408E+00
*
* MELCOR Chemical Classes Considered: Xe Cs Ba I Te Ru Mo Ce La U Cd Sn B
* Release fraction and core inventory are zero for Chemical Classes:
*       Xe      Cs      Ba      I       Te      Ru      Mo      Ce      La      U       Cd      Sn
        B
RDRELFRC001 2.1958E-07 1.8745E-07 3.2965E-11 7.741E-08 3.061E-08 7.3153E-11 5.7105E-08 9.0462E-15
7.9863E-15 2.253E-11 1.1371E-08 3.4594E-08 0.0E+00
RDRELFRC002 1.7174E-06 1.4513E-06 2.2644E-10 5.5901E-07 1.7622E-07 4.7216E-10 4.4513E-07 7.1094E-
14 6.4179E-14 1.8182E-10 8.1583E-08 2.7258E-07 0.0E+00
RDRELFRC003 1.958E-06 1.6297E-06 2.3635E-10 5.9527E-07 1.7753E-07 5.2485E-10 5.0348E-07 8.1231E-
14 7.369E-14 2.1267E-10 8.5892E-08 3.0943E-07 0.0E+00
RDRELFRC004 6.4796E-06 5.3694E-06 7.6682E-10 1.9378E-06 5.7597E-07 1.7409E-09 1.6617E-06 2.6891E-
13 2.4404E-13 7.0791E-10 2.7866E-07 1.0218E-06 0.0E+00
RDRELFRC005 3.7838E-07 3.055E-07 3.9632E-11 1.0238E-07 2.9766E-08 1.0302E-10 9.5514E-08 1.5735E-
14 1.431E-14 4.272E-11 1.44E-08 5.8926E-08 0.0E+00
```

```
RDRELFRC006 6.9683E-06 5.6244E-06 7.288E-10 1.8832E-06 5.4737E-07 1.8975E-09 1.7586E-06 2.8979E-
13 2.6355E-13 7.8703E-10 2.648E-07 1.085E-06 0.0E+00
RDRELFRC007 8.2218E-10 6.6302E-10 8.582E-14 2.2186E-10 6.4446E-11 2.2382E-13 2.0736E-10 3.4179E-
17 3.109E-17 9.287E-14 3.1186E-11 1.2793E-10 0.0E+00
RDRELFRC008 6.8E-06 5.4844E-06 7.0929E-10 1.834E-06 5.3272E-07 1.8521E-09 1.7151E-06 2.828E-13
2.572E-13 7.6852E-10 2.5771E-07 1.0582E-06 0.0E+00
RDRELFRC009 6.6098E-06 5.3249E-06 6.8753E-10 1.7791E-06 5.1638E-07 1.8009E-09 1.6654E-06 2.749E-
13 2.5003E-13 7.4755E-10 2.498E-07 1.0276E-06 0.0E+00
RDRELFRC010 6.4977E-06 5.2277E-06 6.7403E-10 1.7455E-06 5.0625E-07 1.7708E-09 1.6352E-06 2.7024E-
13 2.458E-13 7.3535E-10 2.449E-07 1.009E-06 0.0E+00
RDRELFRC011 6.4495E-06 5.1829E-06 6.676E-10 1.73E-06 5.0142E-07 1.7581E-09 1.6212E-06 2.6825E-13
2.4399E-13 7.3029E-10 2.4256E-07 1.0004E-06 0.0E+00
RDRELFRC012 6.4356E-06 5.1665E-06 6.6502E-10 1.7242E-06 4.9949E-07 1.7546E-09 1.6161E-06 2.6767E-
13 2.4348E-13 7.2901E-10 2.4162E-07 9.9734E-07 0.0E+00
RDRELFRC013 6.4388E-06 5.1642E-06 6.6438E-10 1.7233E-06 4.99E-07 1.7558E-09 1.6154E-06 2.6781E-13
2.4361E-13 7.2964E-10 2.4139E-07 9.9697E-07 0.0E+00
RDRELFRC014 6.445E-06 5.1647E-06 6.6414E-10 1.7234E-06 4.9883E-07 1.7577E-09 1.6156E-06 2.6807E-
13 2.4385E-13 7.3057E-10 2.413E-07 9.9711E-07 0.0E+00
RDRELFRC015 6.4491E-06 5.1638E-06 6.6381E-10 1.7232E-06 4.9858E-07 1.759E-09 1.6153E-06 2.6825E-
13 2.4401E-13 7.3124E-10 2.4118E-07 9.97E-07 0.0E+00
RDRELFRC016 6.4513E-06 5.1619E-06 6.6338E-10 1.7226E-06 4.9826E-07 1.7598E-09 1.6147E-06 2.6834E-
13 2.441E-13 7.3166E-10 2.4103E-07 9.9667E-07 0.0E+00
RDRELFRC017 6.4507E-06 5.1579E-06 6.6271E-10 1.7214E-06 4.9775E-07 1.7598E-09 1.6134E-06 2.6832E-
13 2.4409E-13 7.3176E-10 2.4078E-07 9.9594E-07 0.0E+00
RDRELFRC018 6.4462E-06 5.1511E-06 6.617E-10 1.7193E-06 4.97E-07 1.7587E-09 1.6113E-06 2.6813E-13
2.4392E-13 7.3139E-10 2.4042E-07 9.9466E-07 0.0E+00
RDRELFRC019 6.4397E-06 5.1428E-06 6.6053E-10 1.7167E-06 4.9612E-07 1.7571E-09 1.6087E-06 2.6786E-
13 2.4368E-13 7.3078E-10 2.3999E-07 9.931E-07 0.0E+00
RDRELFRC020 6.4305E-06 5.1323E-06 6.5906E-10 1.7134E-06 4.9502E-07 1.7547E-09 1.6053E-06 2.6749E-
13 2.4333E-13 7.2988E-10 2.3946E-07 9.911E-07 0.0E+00
RDRELFRC021 6.4208E-06 5.1214E-06 6.5757E-10 1.71E-06 4.939E-07 1.7522E-09 1.6019E-06 2.6708E-13
2.4297E-13 7.2891E-10 2.3891E-07 9.8904E-07 0.0E+00
RDRELFRC022 6.41E-06 5.1098E-06 6.5598E-10 1.7064E-06 4.9272E-07 1.7494E-09 1.5982E-06 2.6664E-13
2.4257E-13 7.2782E-10 2.3834E-07 9.8682E-07 0.0E+00
RDRELFRC023 6.3985E-06 5.0979E-06 6.5439E-10 1.7027E-06 4.9152E-07 1.7464E-09 1.5945E-06 2.6616E-
13 2.4214E-13 7.2662E-10 2.3776E-07 9.8456E-07 0.0E+00
RDRELFRC024 6.3878E-06 5.0871E-06 6.5294E-10 1.6993E-06 4.9043E-07 1.7435E-09 1.5911E-06 2.6572E-
13 2.4174E-13 7.255E-10 2.3723E-07 9.825E-07 0.0E+00
RDRELFRC025 6.3743E-06 5.074E-06 6.512E-10 1.6952E-06 4.8913E-07 1.74E-09 1.587E-06 2.6516E-13
2.4123E-13 7.2407E-10 2.366E-07 9.8E-07 0.0E+00
RDRELFRC026 6.3638E-06 5.0629E-06 6.4972E-10 1.6918E-06 4.8801E-07 1.7372E-09 1.5835E-06 2.6472E-
13 2.4084E-13 7.2299E-10 2.3606E-07 9.7789E-07 0.0E+00
RDRELFRC027 6.3536E-06 5.0523E-06 6.483E-10 1.6886E-06 4.8695E-07 1.7345E-09 1.5801E-06 2.643E-13
2.4045E-13 7.2193E-10 2.3555E-07 9.7587E-07 0.0E+00
RDRELFRC028 4.2317E-07 3.3643E-07 4.3169E-11 1.1245E-07 3.2424E-08 1.1553E-10 1.0522E-07 1.7604E-
14 1.6015E-14 4.8088E-11 1.5684E-08 6.4983E-08 0.0E+00
*
* Scaling Factor to adjust core inventory for power level
RDCORSCA001 1
*
* Number of radionuclides belonging to chemical classes
ISNUMISO001 71
*
* Data in melmaccs.ini is used to  map radionuclide to the corresponding chemical class
*
* Radionuclide and associated chemical group
ISOTPGRP001 Kr-85 1
ISOTPGRP002 Kr-85m 1
ISOTPGRP003 Kr-87 1
ISOTPGRP004 Kr-88 1
ISOTPGRP005 Xe-133 1
ISOTPGRP006 Xe-135 1
ISOTPGRP007 Xe-135m 1
ISOTPGRP008 Cs-134 2
ISOTPGRP009 Cs-136 2
ISOTPGRP010 Cs-137 2
ISOTPGRP011 Rb-86 2
ISOTPGRP012 Rb-88 2
ISOTPGRP013 Ba-139 3
ISOTPGRP014 Ba-140 3
ISOTPGRP015 Sr-89 3
```

```
ISOTPGRP016 Sr-90 3
ISOTPGRP017 Sr-91 3
ISOTPGRP018 Sr-92 3
ISOTPGRP019 Ba-137m 3
ISOTPGRP020 I-131 4
ISOTPGRP021 I-132 4
ISOTPGRP022 I-133 4
ISOTPGRP023 I-134 4
ISOTPGRP024 I-135 4
ISOTPGRP025 Te-127 5
ISOTPGRP026 Te-127m 5
ISOTPGRP027 Te-129 5
ISOTPGRP028 Te-129m 5
ISOTPGRP029 Te-131m 5
ISOTPGRP030 Te-132 5
ISOTPGRP031 Te-131 5
ISOTPGRP032 Rh-105 6
ISOTPGRP033 Ru-103 6
ISOTPGRP034 Ru-105 6
ISOTPGRP035 Ru-106 6
ISOTPGRP036 Rh-103m 6
ISOTPGRP037 Rh-106 6
ISOTPGRP038 Nb-95 7
ISOTPGRP039 Co-58 7
ISOTPGRP040 Co-60 7
ISOTPGRP041 Mo-99 7
ISOTPGRP042 Tc-99m 7
ISOTPGRP043 Nb-97 7
ISOTPGRP044 Nb-97m 7
ISOTPGRP045 Ce-141 8
ISOTPGRP046 Ce-143 8
ISOTPGRP047 Ce-144 8
ISOTPGRP048 Np-239 8
ISOTPGRP049 Pu-238 8
ISOTPGRP050 Pu-239 8
ISOTPGRP051 Pu-240 8
ISOTPGRP052 Pu-241 8
ISOTPGRP053 Zr-95 8
ISOTPGRP054 Zr-97 8
ISOTPGRP055 Am-241 9
ISOTPGRP056 Cm-242 9
ISOTPGRP057 Cm-244 9
ISOTPGRP058 La-140 9
ISOTPGRP059 La-141 9
ISOTPGRP060 La-142 9
ISOTPGRP061 Nd-147 9
ISOTPGRP062 Pr-143 9
ISOTPGRP063 Y-90 9
ISOTPGRP064 Y-91 9
ISOTPGRP065 Y-92 9
ISOTPGRP066 Y-93 9
ISOTPGRP067 Y-91m 9
ISOTPGRP068 Pr-144 9
ISOTPGRP069 Pr-144m 9
ISOTPGRP070 Sb-127 11
ISOTPGRP071 Sb-129 11
*
* Initial Xe mass/inventory mass = 1.012339
* Initial Cs mass/inventory mass = 1.012197
* Initial Ba mass/inventory mass = 1.010072
* Initial I mass/inventory mass = 1.019834
* Initial Te mass/inventory mass = 1.013758
* Initial Ru mass/inventory mass = 1.016678
* Initial Mo mass/inventory mass = 1.012999
* Initial Ce mass/inventory mass = 1.004475
* Initial La mass/inventory mass = 1.012686
* Initial U mass/inventory mass = 1.002136
* Initial Cd mass/inventory mass = 1.043774
* Initial Sn mass/inventory mass = 1.038157
* Initial B mass/inventory mass = 0
*
```

```
* Initial Core Mass from MELCOR Chemical Class Xe 1.323171kg
* Initial Core Mass from MELCOR Chemical Class Cs 1.1842487kg
* Initial Core Mass from MELCOR Chemical Class Ba 0.7210849kg
* Initial Core Mass from MELCOR Chemical Class I 0.052650443kg
* Initial Core Mass from MELCOR Chemical Class Te 0.138303kg
* Initial Core Mass from MELCOR Chemical Class Ru 0.7598208kg
* Initial Core Mass from MELCOR Chemical Class Mo 1.2262999kg
* Initial Core Mass from MELCOR Chemical Class Ce 6.754585kg
* Initial Core Mass from MELCOR Chemical Class La 2.286655kg
* Initial Core Mass from MELCOR Chemical Class U 4560.8894kg
* Initial Core Mass from MELCOR Chemical Class Cd 0.01083308kg
* Initial Core Mass from MELCOR Chemical Class Sn 0.01696736kg
* Initial Core Mass from MELCOR Chemical Class B 0kg
*
* Maximum error in mass scaling is for the B group.  Error=100 percent
* Data in Inventory (.inv file) used to calculate core inventory (Becquerels)
RDCORINV001 Kr-85 1.1836E+14
RDCORINV002 Kr-85m 1.9702E+15
RDCORINV003 Kr-87 3.858E+15
RDCORINV004 Kr-88 5.2814E+15
RDCORINV005 Xe-133 1.0525E+16
RDCORINV006 Xe-135 1.0338E+16
RDCORINV007 Xe-135m 1.8728E+15
RDCORINV008 Cs-134 1.2546E+13
RDCORINV009 Cs-136 1.7827E+13
RDCORINV010 Cs-137 1.0561E+15
RDCORINV011 Rb-86 1.5093E+12
RDCORINV012 Rb-88 5.3555E+15
RDCORINV013 Ba-139 9.9038E+15
RDCORINV014 Ba-140 9.6048E+15
RDCORINV015 Sr-89 7.0261E+15
RDCORINV016 Sr-90 9.7169E+14
RDCORINV017 Sr-91 8.8199E+15
RDCORINV018 Sr-92 9.0068E+15
RDCORINV019 Ba-137m 9.9785E+14
RDCORINV020 I-131 4.7167E+15
RDCORINV021 I-132 7.094E+15
RDCORINV022 I-133 1.0565E+16
RDCORINV023 I-134 1.2301E+16
RDCORINV024 I-135 1.0075E+16
RDCORINV025 Te-127 3.0382E+14
RDCORINV026 Te-127m 4.9137E+13
RDCORINV027 Te-129 9.6398E+14
RDCORINV028 Te-129m 1.6804E+14
RDCORINV029 Te-131m 6.339E+14
RDCORINV030 Te-132 6.9767E+15
RDCORINV031 Te-131 4.2385E+15
RDCORINV032 Rh-105 2.0313E+15
RDCORINV033 Ru-103 5.3792E+15
RDCORINV034 Ru-105 2.1028E+15
RDCORINV035 Ru-106 9.8933E+14
RDCORINV036 Rh-103m 5.304E+15
RDCORINV037 Rh-106 9.8933E+14
RDCORINV038 Nb-95 9.9699E+15
RDCORINV039 Co-58 0.0E+00
RDCORINV040 Co-60 0.0E+00
RDCORINV041 Mo-99 9.5951E+15
RDCORINV042 Tc-99m 8.5831E+15
RDCORINV043 Nb-97 9.3702E+15
RDCORINV044 Nb-97m 8.883E+15
RDCORINV045 Ce-141 9.0312E+15
RDCORINV046 Ce-143 9.0312E+15
RDCORINV047 Ce-144 8.2508E+15
RDCORINV048 Np-239 7.6933E+16
RDCORINV049 Pu-238 9.4029E+10
RDCORINV050 Pu-239 1.0964E+13
RDCORINV051 Pu-240 5.5005E+10
RDCORINV052 Pu-241 1.0778E+11
RDCORINV053 Zr-95 9.886E+15
RDCORINV054 Zr-97 9.2542E+15
RDCORINV055 Am-241 2.2144E+08
```

```
RDCORINV056 Cm-242 3.6458E+08
RDCORINV057 Cm-244 3.9718E+03
RDCORINV058 La-140 9.6296E+15
RDCORINV059 La-141 9.1425E+15
RDCORINV060 La-142 8.9177E+15
RDCORINV061 Nd-147 3.5596E+15
RDCORINV062 Pr-143 9.1051E+15
RDCORINV063 Y-90 9.742E+14
RDCORINV064 Y-91 8.8053E+15
RDCORINV065 Y-92 9.1425E+15
RDCORINV066 Y-93 9.7046E+15
RDCORINV067 Y-91m 5.2082E+15
RDCORINV068 Pr-144 8.3182E+15
RDCORINV069 Pr-144m 7.9435E+13
RDCORINV070 Sb-127 3.051E+14
RDCORINV071 Sb-129 1.0389E+15
*
* PARENT means decay products are released at the same fraction as their parent
RDAPLFRC001 PARENT
*
```

APPENDIX H
MELMACCS INVENTORY FILE (HEAT PIPE REACTOR INL DESIGN A)

This appendix shows the contents of the “HPR INL-A inventories.inv” file created for this analysis. “HPR INL-A inventories.inv” is the MelMACCS inventory data for the heat pipe reactor (HPR) (Idaho National Laboratory (INL) Design A). This file was created from a Python script from Oak Ridge National Laboratory used to process the “INL-A_core_t6-depl_ce_v7.1.ii.json” data file, which in turn comes from a SCALE depletion calculation of the INL Design A of the HPR. The MelMACCS inventory file has been updated slightly to correct the labels and to add more description.

```
/CORE-LABEL
HPR_BOC "Heat Pipe Reactor (INL-A), 5MW Full Power, 3 days beginning of cycle"
HPR_MOC "Heat Pipe Reactor (INL-A), 5MW Full Power, 2.08 years middle of cycle"
HPR_EOC "Heat Pipe Reactor (INL-A), 5MW Full Power, 5 years end of cycle (2GWd/MTIHM)"
/END

/CORE-DESC HPR_BOC
 data file:  INL-A_core_t6-depl_ce_v7.1.ii.json
 response name:  AT_POWER
 user-selected time index:  1
 user-selected time(s):  259200
 cutoff for grams:  1e-12
 cutoff for curies:  1e-15
 mass vs. time for response:
    index      time(s)      mass(g) target
     0000  0.00000e+00  5.18587e+06
     0001  2.59200e+05  5.18587e+06 <------
     0002  1.33655e+07  5.18587e+06
     0003  2.64718e+07  5.18586e+06
     0004  3.95781e+07  5.18586e+06
     0005  5.26844e+07  5.18586e+06
     0006  6.57906e+07  5.18586e+06
     0007  7.88969e+07  5.18585e+06
     0008  9.20464e+07  5.18585e+06
     0009  1.05196e+08  5.18585e+06
     0010  1.18345e+08  5.18585e+06
     0011  1.31495e+08  5.18585e+06
     0012  1.44644e+08  5.18584e+06
     0013  1.57794e+08  5.18584e+06
/END


/CORE HPR_BOC MASS ACTIVATION
*Isotope Mass(g)
Be      10      3.29E-12
C       12      7.53E-05
C       13      4.20E-03
C       14      5.92E-05
F       19      5.24E-07
H       1       8.47E-07
H       2       9.31E-08
H       3       2.17E-05
He      3       5.08E-09
He      4       1.84E-03
N       14      2.97E-11
N       15      7.23E-07
N       16      5.34E-10
O       16      6.14E+05
O       17      2.49E+02
O       18      1.42E+03
O       19      7.84E-11


/CORE HPR_BOC ACTIVITY ACTIVATION
```

```
*Isotope Activity(Ci)
B       12      1.76E-10
Be      10      7.78E-14
Be      11      6.34E-11
Be      8       9.14E-14
C       14      2.65E-04
C       15      1.15E-01
Cr      66      1.06E-05
Cr      67      3.19E-06
F       20      3.18E-08
H       3       2.09E-01
He      6       1.45E-14
Mn      66      1.47E-03
Mn      67      1.32E-03
Mn      68      2.74E-04
Mn      69      3.64E-05
N       16      5.28E+01
O       19      1.73E+00


/CORE HPR_BOC MASS ACTINIDE
*Isotope Mass(g)
Am      241     2.00E-12
Am      242m    1.98E-12
Am      243     1.99E-12
Cm      242     3.51E-12
Cm      243     1.99E-12
Cm      244     2.00E-12
Np      236     1.43E-12
Np      236m    3.24E-12
Np      237     7.50E-03
Np      238     3.60E-08
Np      239     5.19E+00
Np      240     6.48E-07
Np      240m    1.25E-07
Pa      231     4.03E-06
Pa      232     1.40E-11
Pa      233     8.12E-12
Pa      234     6.93E-10
Pa      234m    1.47E-10
Pa      235     7.52E-09
Pu      238     1.38E-08
Pu      239     2.62E+00
Pu      240     5.12E-05
Pu      241     2.67E-10
Pu      242     2.31E-12
Th      229     1.45E-12
Th      230     1.56E-04
Th      231     3.15E-06
Th      232     8.36E-07
Th      234     4.39E-06
U       232     5.59E-11
U       233     1.40E-05
U       234     6.85E+03
U       235     9.03E+05
U       235m    1.36E-04
U       236     3.86E+00
U       237     4.63E-02
U       238     3.66E+06
U       239     6.16E-02


/CORE HPR_BOC ACTIVITY ACTINIDE
*Isotope Activity(Ci)
Am      241     6.86E-12
Am      242     7.11E-08
Am      242m    2.08E-11
Am      243     3.97E-13
Am      244     5.62E-13
Am      244m    8.07E-12
Cm      242     1.16E-08
```

```
Cm      243     1.01E-10
Cm      244     1.62E-10
Np      235     9.06E-13
Np      236     1.41E-14
Np      236m    1.91E-06
Np      237     5.27E-06
Np      238     9.33E-03
Np      239     1.20E+06
Np      240     8.20E+00
Np      240m    1.35E+01
Pa      229     1.04E-12
Pa      230     2.66E-10
Pa      231     1.90E-07
Pa      232     5.97E-06
Pa      233     1.69E-07
Pa      234     1.39E-03
Pa      234m    1.02E-01
Pa      235     2.46E-01
Pu      236     5.29E-10
Pu      237     5.30E-10
Pu      237m    6.70E-09
Pu      238     2.36E-07
Pu      239     1.63E-01
Pu      240     1.16E-05
Pu      241     2.77E-08
Pu      242     9.13E-15
Pu      243     3.62E-12
Th      226     5.56E-13
Th      227     5.49E-13
Th      228     2.03E-12
Th      229     3.07E-13
Th      230     3.22E-06
Th      231     1.67E+00
Th      232     9.17E-14
Th      233     8.71E-07
Th      234     1.02E-01
U       230     5.53E-13
U       231     2.74E-13
U       232     1.25E-09
U       233     1.35E-07
U       234     4.27E+01
U       235     1.95E+00
U       235m    4.19E+03
U       236     2.50E-04
U       237     3.78E+03
U       238     1.23E+00
U       239     2.07E+06


/CORE HPR_BOC MASS FISSION
*Isotope Mass(g)
Ag      107     9.43E-12
Ag      109     3.59E-03
Ag      109m    1.05E-06
Ag      110     3.29E-12
Ag      110m    5.24E-10
Ag      111     2.12E-03
Ag      111m    8.85E-07
Ag      112     1.18E-04
Ag      113     1.41E-04
Ag      113m    7.33E-07
Ag      114     4.41E-08
Ag      115     1.20E-05
Ag      115m    7.69E-09
Ag      116     2.33E-06
Ag      116m    7.87E-09
Ag      117     6.38E-07
Ag      117m    5.46E-09
Ag      118     2.93E-08
Ag      118m    5.73E-09
Ag      119     1.64E-08
```

Ag	120	5.20E-09
Ag	120m	5.31E-10
Ag	121	3.04E-09
Ag	122	5.36E-10
Ag	122m	1.81E-10
Ag	123	2.78E-10
Ag	124	8.61E-11
Ag	125	1.46E-11
Ag	126	1.85E-12
As	74	3.63E-12
As	75	7.28E-05
As	76	5.81E-09
As	77	2.82E-04
As	78	4.11E-05
As	79	8.18E-06
As	80	5.80E-07
As	81	1.92E-06
As	82	1.44E-06
As	82m	1.50E-07
As	83	1.39E-06
As	84	3.20E-07
As	85	1.46E-07
As	86	1.43E-07
As	87	7.47E-09
As	88	3.62E-09
As	89	9.56E-12
Ba	132	1.44E-11
Ba	134	1.07E-09
Ba	135	5.78E-09
Ba	135m	1.67E-09
Ba	136	1.70E-04
Ba	136m	1.23E-11
Ba	137	6.80E-05
Ba	137m	9.52E-08
Ba	138	6.04E-01
Ba	139	1.63E-02
Ba	140	5.29E-01
Ba	141	3.33E-03
Ba	142	1.88E-03
Ba	143	4.13E-05
Ba	144	2.61E-05
Ba	145	4.94E-06
Ba	146	1.29E-06
Ba	147	1.48E-07
Ba	148	1.58E-08
Ba	149	1.09E-09
Ba	150	9.77E-11
Ba	151	1.35E-11
Br	79	1.48E-06
Br	80	4.73E-11
Br	80m	5.39E-10
Br	81	1.06E-02
Br	82	2.04E-06
Br	82m	2.34E-09
Br	83	1.38E-03
Br	84	5.83E-04
Br	84m	1.79E-06
Br	85	6.90E-05
Br	86	3.08E-05
Br	87	3.60E-05
Br	88	9.51E-06
Br	89	1.79E-06
Br	90	4.30E-07
Br	91	4.89E-08
Br	92	5.36E-09
Br	93	6.00E-10
Br	94	2.23E-11
Cd	110	9.79E-09
Cd	111	3.27E-04
Cd	112	1.18E-03
Cd	113	1.84E-03

Cd	113m	2.03E-05
Cd	114	1.72E-03
Cd	115	1.14E-03
Cd	115m	1.01E-04
Cd	116	1.83E-03
Cd	117	7.36E-05
Cd	117m	2.19E-05
Cd	118	3.13E-05
Cd	119	1.12E-06
Cd	119m	4.55E-07
Cd	120	5.30E-07
Cd	121	8.96E-08
Cd	121m	2.50E-08
Cd	122	5.47E-08
Cd	123	1.77E-08
Cd	124	9.93E-09
Cd	125	2.46E-09
Cd	126	1.84E-09
Cd	127	1.15E-09
Cd	128	3.80E-10
Cd	129	7.40E-12
Cd	130	5.11E-09
Cd	131	3.98E-10
Ce	138	3.46E-11
Ce	139	9.70E-11
Ce	140	1.41E-02
Ce	141	4.87E-01
Ce	142	5.20E-01
Ce	143	2.84E-01
Ce	144	5.14E-01
Ce	145	3.79E-04
Ce	146	1.33E-03
Ce	147	6.16E-05
Ce	148	5.08E-05
Ce	149	2.56E-06
Ce	150	1.08E-06
Ce	151	1.45E-07
Ce	152	3.12E-08
Ce	153	4.08E-09
Ce	154	3.92E-10
Ce	155	2.33E-11
Ce	156	1.16E-12
Cs	131	1.64E-12
Cs	132	4.55E-09
Cs	133	4.94E-02
Cs	134	7.69E-07
Cs	134m	2.25E-08
Cs	135	4.11E-01
Cs	135m	3.40E-07
Cs	136	3.97E-04
Cs	136m	2.91E-08
Cs	137	5.65E-01
Cs	138	6.80E-03
Cs	138m	1.69E-05
Cs	139	1.80E-03
Cs	140	1.90E-04
Cs	141	5.59E-05
Cs	142	2.53E-06
Cs	143	1.49E-06
Cs	144	2.96E-07
Cs	145	4.23E-08
Cs	146	3.42E-09
Cs	147	4.38E-10
Cs	148	2.04E-11
Cu	65	1.57E-10
Cu	66	4.84E-11
Cu	67	1.12E-07
Cu	68	4.66E-11
Cu	68m	4.89E-12
Cu	69	4.17E-10
Cu	70	1.74E-10

Cu	70m	2.16E-11
Cu	71	1.48E-10
Cu	72	1.03E-10
Cu	73	1.47E-10
Cu	74	6.79E-11
Cu	75	6.16E-11
Cu	76	3.04E-11
Cu	77	1.13E-11
Cu	78	2.24E-12
Dy	160	2.69E-10
Dy	161	4.25E-06
Dy	162	1.02E-05
Dy	163	5.33E-06
Dy	164	3.08E-06
Dy	165	8.24E-08
Dy	166	8.47E-07
Dy	167	1.57E-09
Dy	168	1.35E-09
Dy	169	6.11E-11
Dy	170	2.46E-11
Dy	171	2.42E-12
Dy	172	1.48E-12
Er	166	1.22E-07
Er	167	7.08E-07
Er	167m	1.13E-12
Er	168	4.64E-07
Er	169	2.57E-07
Er	170	1.58E-07
Er	171	1.33E-08
Er	172	8.38E-08
Eu	151	5.77E-07
Eu	152	1.64E-11
Eu	152m	4.89E-12
Eu	153	7.33E-03
Eu	154	7.32E-08
Eu	154m	1.79E-10
Eu	155	4.57E-03
Eu	156	1.77E-03
Eu	157	3.27E-04
Eu	158	8.90E-06
Eu	159	1.42E-06
Eu	160	1.91E-08
Eu	161	4.26E-09
Eu	162	5.06E-10
Eu	163	1.60E-10
Eu	164	2.35E-11
Eu	165	6.09E-12
Ga	69	4.29E-07
Ga	71	1.42E-06
Ga	72	5.04E-07
Ga	73	1.02E-06
Ga	74	6.95E-08
Ga	74m	2.93E-11
Ga	75	5.23E-08
Ga	76	4.70E-08
Ga	77	3.89E-08
Ga	78	2.50E-08
Ga	79	1.82E-08
Ga	80	7.03E-09
Ga	81	3.42E-09
Ga	82	1.13E-09
Ga	83	5.82E-11
Ga	84	2.28E-10
Gd	152	1.41E-11
Gd	154	1.82E-11
Gd	155	2.74E-06
Gd	156	1.06E-04
Gd	157	7.92E-04
Gd	158	5.71E-04
Gd	159	8.06E-05
Gd	160	9.17E-05

Gd	161	3.81E-08
Gd	162	2.87E-08
Gd	163	2.00E-09
Gd	164	7.36E-10
Gd	165	8.71E-11
Gd	166	2.16E-11
Gd	167	6.17E-12
Ge	70	1.66E-11
Ge	72	8.20E-07
Ge	73	9.45E-06
Ge	73m	2.86E-11
Ge	74	2.57E-05
Ge	75	2.07E-06
Ge	75m	8.10E-10
Ge	76	2.68E-04
Ge	77	1.30E-04
Ge	77m	2.10E-09
Ge	78	3.96E-05
Ge	79	1.95E-07
Ge	79m	1.68E-07
Ge	80	1.01E-06
Ge	81	2.96E-07
Ge	81m	8.85E-09
Ge	82	1.89E-07
Ge	83	2.67E-08
Ge	84	1.02E-08
Ge	85	8.72E-10
Ge	86	1.37E-08
Ge	87	7.58E-11
Ho	165	1.68E-06
Ho	166	1.63E-07
Ho	166m	8.56E-11
Ho	167	4.66E-08
Ho	168	4.65E-10
Ho	169	4.53E-10
Ho	170	1.41E-10
Ho	170m	1.21E-12
Ho	171	2.60E-11
Ho	172	1.82E-11
I	126	1.45E-11
I	127	2.04E-03
I	128	6.82E-10
I	129	4.50E-02
I	130	3.55E-06
I	130m	1.35E-08
I	131	2.12E-01
I	132	8.36E-03
I	132m	2.25E-05
I	133	2.23E-01
I	133m	2.02E-06
I	134	1.22E-02
I	134m	3.71E-05
I	135	7.54E-02
I	136	1.24E-04
I	136m	3.09E-05
I	137	3.97E-05
I	138	5.37E-06
I	139	1.02E-06
I	140	9.80E-08
I	141	1.30E-08
I	142	1.03E-09
I	143	1.15E-10
I	144	1.19E-12
In	113	3.70E-09
In	115	4.98E-04
In	115m	8.99E-05
In	116m	7.09E-11
In	117	1.57E-05
In	117m	5.26E-05
In	118	5.18E-08
In	118m	2.12E-10

In	119	6.56E-07
In	119m	6.79E-06
In	120	3.24E-08
In	120m	9.22E-09
In	121	1.48E-07
In	121m	1.08E-06
In	122	1.67E-08
In	122m	1.31E-08
In	123	3.85E-08
In	123m	3.00E-07
In	124	3.33E-08
In	124m	1.01E-08
In	125	1.59E-08
In	125m	7.53E-08
In	126	1.12E-08
In	126m	6.11E-09
In	127	2.40E-08
In	127m	2.68E-08
In	128	8.55E-09
In	128m	6.30E-09
In	129	9.17E-09
In	129m	1.70E-08
In	130	1.14E-08
In	130m	5.01E-09
In	131	1.96E-09
In	131m	1.45E-09
In	132	1.12E-09
In	133	7.14E-11
In	134	3.52E-12
Kr	80	6.88E-09
Kr	81	6.31E-11
Kr	82	1.80E-06
Kr	83	2.68E-02
Kr	83m	1.05E-03
Kr	84	5.52E-02
Kr	85	1.42E-02
Kr	85m	6.38E-03
Kr	86	1.09E-01
Kr	87	3.65E-03
Kr	88	1.13E-02
Kr	89	2.66E-04
Kr	90	4.87E-05
Kr	91	9.55E-06
Kr	92	1.09E-06
Kr	93	2.50E-07
Kr	94	1.09E-08
Kr	95	8.59E-10
Kr	96	9.27E-10
Kr	97	2.87E-12
Kr	98	2.14E-11
La	137	7.00E-10
La	138	2.17E-06
La	139	5.70E-01
La	140	3.06E-02
La	141	4.21E-02
La	142	1.64E-02
La	143	2.62E-03
La	144	1.17E-04
La	145	5.10E-05
La	146	6.10E-06
La	146m	3.92E-06
La	147	2.45E-06
La	148	3.34E-07
La	149	8.77E-08
La	150	1.54E-08
La	151	2.40E-09
La	152	1.58E-10
La	153	1.26E-11
Mo	100	4.23E-01
Mo	101	1.73E-03
Mo	102	1.16E-03

Mo	103	8.60E-05
Mo	104	4.98E-05
Mo	105	1.75E-05
Mo	106	2.09E-06
Mo	107	3.80E-07
Mo	108	4.06E-08
Mo	109	7.81E-09
Mo	110	1.37E-09
Mo	111	1.73E-10
Mo	112	3.18E-11
Mo	113	1.25E-12
Mo	94	2.70E-11
Mo	95	1.26E-04
Mo	96	1.62E-05
Mo	97	2.65E-01
Mo	98	3.81E-01
Mo	99	2.82E-01
Nb	100	3.34E-06
Nb	100m	3.14E-07
Nb	101	1.37E-05
Nb	102	5.13E-06
Nb	102m	3.99E-07
Nb	103	1.37E-06
Nb	104	1.13E-06
Nb	104m	1.50E-07
Nb	105	4.95E-07
Nb	106	2.93E-08
Nb	107	2.20E-09
Nb	108	1.66E-10
Nb	109	6.26E-11
Nb	110	2.79E-12
Nb	92	1.45E-12
Nb	93	2.11E-10
Nb	93m	5.14E-10
Nb	94	1.33E-08
Nb	94m	1.12E-11
Nb	95	6.28E-03
Nb	95m	5.89E-05
Nb	96	1.14E-05
Nb	97	8.84E-03
Nb	97m	1.14E-04
Nb	98	6.04E-06
Nb	98m	3.30E-05
Nb	99	2.06E-05
Nb	99m	1.31E-04
Nd	142	2.27E-09
Nd	143	1.46E-02
Nd	144	1.87E-03
Nd	145	3.32E-01
Nd	146	2.92E-01
Nd	147	2.02E-01
Nd	148	1.70E-01
Nd	149	3.90E-03
Nd	150	7.22E-02
Nd	151	1.91E-04
Nd	152	1.13E-04
Nd	153	3.19E-06
Nd	154	1.16E-06
Nd	155	1.54E-07
Nd	156	3.25E-08
Nd	157	2.57E-09
Nd	158	3.29E-10
Nd	159	2.23E-11
Nd	160	1.43E-12
Ni	65	8.34E-12
Ni	66	3.09E-08
Ni	67	1.90E-11
Ni	68	4.27E-11
Ni	69	2.57E-11
Ni	70	2.06E-11
Ni	71	1.12E-11

Ni	72	9.39E-12
Ni	73	4.82E-12
Ni	74	2.04E-12
Pd	104	1.34E-08
Pd	105	3.66E-02
Pd	106	1.26E-04
Pd	107	2.15E-02
Pd	108	9.08E-03
Pd	109	1.31E-03
Pd	109m	9.40E-12
Pd	110	3.65E-03
Pd	111	1.93E-05
Pd	111m	1.09E-07
Pd	112	8.05E-04
Pd	113	1.04E-06
Pd	114	1.35E-06
Pd	115	2.46E-07
Pd	116	9.58E-08
Pd	117	3.31E-08
Pd	118	9.93E-09
Pd	119	2.14E-09
Pd	120	9.76E-10
Pd	121	1.09E-10
Pd	122	1.90E-11
Pd	123	5.68E-12
Pm	146	6.42E-11
Pm	147	1.97E-02
Pm	148	3.89E-08
Pm	148m	3.83E-08
Pm	149	7.05E-02
Pm	150	1.90E-07
Pm	151	2.16E-02
Pm	152	4.10E-05
Pm	152m	3.24E-07
Pm	153	3.33E-05
Pm	154	4.96E-06
Pm	154m	4.70E-07
Pm	155	1.04E-06
Pm	156	3.00E-07
Pm	157	4.79E-08
Pm	158	6.84E-09
Pm	159	5.70E-10
Pm	160	1.10E-10
Pm	161	1.03E-11
Pr	141	1.46E-02
Pr	142	3.01E-09
Pr	142m	2.95E-11
Pr	143	2.53E-01
Pr	144	2.17E-05
Pr	144m	8.93E-08
Pr	145	4.51E-02
Pr	146	2.38E-03
Pr	147	9.95E-04
Pr	148	1.27E-04
Pr	148m	2.28E-06
Pr	149	8.45E-05
Pr	150	2.39E-06
Pr	151	4.11E-06
Pr	152	3.38E-07
Pr	153	1.65E-07
Pr	154	1.93E-08
Pr	155	1.85E-09
Pr	156	2.46E-10
Pr	157	2.56E-11
Ra	226	5.80E-12
Rb	100	5.89E-10
Rb	83	1.55E-11
Rb	84	4.86E-10
Rb	85	5.13E-02
Rb	86	8.38E-07
Rb	86m	1.47E-10

Rb	87	1.40E-01
Rb	88	1.19E-03
Rb	89	1.35E-03
Rb	90	2.46E-04
Rb	90m	6.87E-05
Rb	91	1.06E-04
Rb	92	7.15E-06
Rb	93	7.33E-06
Rb	94	1.76E-06
Rb	95	1.19E-07
Rb	96	2.24E-08
Rb	97	2.83E-09
Rb	98	5.01E-10
Rb	99	3.48E-11
Rh	101	1.64E-12
Rh	102	2.55E-11
Rh	102m	2.44E-11
Rh	103	5.95E-03
Rh	103m	2.23E-04
Rh	104	8.79E-12
Rh	104m	5.40E-12
Rh	105	4.67E-02
Rh	105m	5.73E-06
Rh	106	4.21E-08
Rh	106m	6.42E-09
Rh	107	1.57E-04
Rh	108	8.50E-07
Rh	108m	4.91E-10
Rh	109	2.18E-06
Rh	110	2.02E-10
Rh	110m	5.78E-07
Rh	111	1.51E-07
Rh	112	2.44E-08
Rh	113	2.95E-08
Rh	114	1.30E-08
Rh	115	5.36E-09
Rh	116	1.80E-09
Rh	117	5.68E-10
Rh	118	1.50E-10
Rh	119	2.46E-11
Rh	120	4.42E-12
Ru	100	5.11E-07
Ru	101	3.52E-01
Ru	102	3.07E-01
Ru	103	2.27E-01
Ru	104	1.54E-01
Ru	105	8.08E-03
Ru	106	4.47E-02
Ru	107	2.72E-05
Ru	108	1.38E-05
Ru	109	9.41E-07
Ru	110	2.34E-07
Ru	111	2.78E-08
Ru	112	1.72E-08
Ru	113	4.81E-09
Ru	114	1.34E-09
Ru	115	7.04E-10
Ru	116	5.46E-11
Ru	117	6.80E-12
Ru	118	1.26E-12
Ru	99	3.15E-06
Sb	120m	1.37E-11
Sb	121	1.02E-03
Sb	122	3.21E-08
Sb	122m	3.44E-11
Sb	123	2.23E-03
Sb	124	4.42E-06
Sb	124m	1.68E-09
Sb	125	2.84E-03
Sb	126	5.65E-05
Sb	126m	7.13E-07

Sb	127	1.21E-02
Sb	128	3.44E-04
Sb	128m	1.10E-04
Sb	129	4.83E-03
Sb	129m	5.77E-06
Sb	130	8.64E-04
Sb	130m	1.88E-04
Sb	131	1.81E-03
Sb	132	1.57E-04
Sb	132m	1.43E-04
Sb	133	1.63E-04
Sb	134	1.76E-07
Sb	134m	2.23E-06
Sb	135	2.08E-07
Sb	136	1.58E-08
Sb	137	1.33E-08
Sb	138	3.93E-11
Sb	139	2.09E-12
Se	76	7.15E-09
Se	77	1.76E-04
Se	77m	1.16E-10
Se	78	1.27E-03
Se	79	2.71E-03
Se	79m	3.47E-06
Se	80	6.88E-03
Se	81	6.59E-05
Se	81m	1.31E-05
Se	82	1.74E-02
Se	83	1.93E-04
Se	83m	8.08E-07
Se	84	5.89E-05
Se	85	1.05E-05
Se	86	6.07E-06
Se	87	1.38E-06
Se	88	1.94E-07
Se	89	1.20E-08
Se	90	1.25E-09
Se	91	2.27E-10
Se	92	7.43E-12
Sm	147	1.44E-05
Sm	148	4.61E-09
Sm	149	3.81E-02
Sm	150	3.42E-06
Sm	151	2.43E-02
Sm	152	2.98E-02
Sm	153	1.16E-02
Sm	154	9.14E-03
Sm	155	3.43E-05
Sm	156	4.33E-04
Sm	157	2.99E-06
Sm	158	1.00E-06
Sm	159	1.35E-08
Sm	160	3.91E-09
Sm	161	4.62E-10
Sm	162	4.50E-11
Sm	163	7.93E-12
Sm	164	1.14E-12
Sn	115	2.61E-05
Sn	116	2.54E-09
Sn	117	1.69E-03
Sn	117m	3.41E-06
Sn	118	1.83E-03
Sn	119	1.83E-03
Sn	119m	6.04E-05
Sn	120	1.93E-03
Sn	121	8.52E-04
Sn	121m	1.33E-04
Sn	122	2.26E-03
Sn	123	1.42E-04
Sn	123m	3.03E-05
Sn	124	3.43E-03

Sn	125	1.23E-03
Sn	125m	8.61E-06
Sn	126	6.02E-03
Sn	127	3.89E-04
Sn	127m	8.46E-06
Sn	128	6.12E-04
Sn	128m	5.34E-07
Sn	129	2.45E-05
Sn	129m	3.97E-05
Sn	130	7.02E-05
Sn	130m	3.21E-05
Sn	131	1.57E-05
Sn	131m	1.57E-05
Sn	132	1.28E-05
Sn	133	1.18E-07
Sn	134	1.73E-08
Sn	135	6.74E-10
Sn	136	1.93E-11
Sn	137	1.93E-12
Sr	100	4.75E-09
Sr	101	3.74E-10
Sr	102	2.00E-11
Sr	85	4.75E-12
Sr	86	4.76E-08
Sr	87	6.55E-08
Sr	87m	6.97E-10
Sr	88	1.92E-01
Sr	89	2.60E-01
Sr	90	3.29E-01
Sr	91	6.57E-02
Sr	92	1.92E-02
Sr	93	9.36E-04
Sr	94	1.54E-04
Sr	95	4.42E-05
Sr	96	1.55E-06
Sr	97	3.05E-07
Sr	98	2.37E-07
Sr	99	2.34E-08
Tb	158	1.71E-11
Tb	159	1.53E-04
Tb	160	1.89E-08
Tb	161	2.69E-05
Tb	162	2.60E-08
Tb	163	3.49E-08
Tb	164	3.09E-09
Tb	165	1.24E-09
Tb	166	1.55E-10
Tb	167	7.66E-11
Tb	168	1.78E-11
Tb	169	2.06E-12
Tb	170	1.03E-12
Tc	100	7.88E-11
Tc	101	1.69E-03
Tc	102	9.03E-06
Tc	102m	7.13E-07
Tc	103	7.03E-05
Tc	104	9.44E-04
Tc	105	2.33E-04
Tc	106	8.89E-06
Tc	107	2.56E-06
Tc	108	2.60E-07
Tc	109	2.23E-08
Tc	110	1.34E-08
Tc	111	1.66E-09
Tc	112	5.49E-10
Tc	113	9.01E-11
Tc	114	1.48E-11
Tc	115	1.46E-12
Tc	98	4.34E-08
Tc	99	9.95E-02
Tc	99m	2.06E-02

Te	122	1.32E-08
Te	123	9.83E-11
Te	123m	3.43E-10
Te	124	9.18E-07
Te	125	2.23E-06
Te	125m	6.61E-07
Te	126	1.00E-04
Te	127	8.56E-04
Te	127m	5.66E-04
Te	128	3.13E-02
Te	129	1.11E-03
Te	129m	8.19E-03
Te	130	1.58E-01
Te	131	1.95E-03
Te	131m	1.81E-02
Te	132	2.88E-01
Te	133	1.33E-03
Te	133m	5.72E-03
Te	134	8.62E-03
Te	135	3.29E-05
Te	136	1.36E-05
Te	137	6.17E-07
Te	138	8.81E-08
Te	139	3.25E-09
Te	140	2.31E-09
Te	141	6.16E-11
Te	142	1.13E-12
Tm	169	2.95E-08
Tm	171	7.51E-08
Tm	172	3.80E-08
Xe	128	6.91E-08
Xe	129	1.67E-11
Xe	129m	7.39E-12
Xe	130	1.17E-05
Xe	131	2.78E-02
Xe	131m	2.87E-04
Xe	132	9.66E-02
Xe	133	3.10E-01
Xe	133m	7.55E-03
Xe	134	6.78E-01
Xe	134m	4.17E-09
Xe	135	1.07E-01
Xe	135m	5.50E-04
Xe	136	5.78E-01
Xe	137	7.11E-04
Xe	138	2.68E-03
Xe	139	1.01E-04
Xe	140	2.56E-05
Xe	141	1.26E-06
Xe	142	3.67E-07
Xe	143	1.16E-08
Xe	144	1.01E-08
Xe	145	1.46E-10
Xe	146	2.08E-11
Y	100	2.59E-07
Y	101	6.82E-08
Y	102	3.71E-08
Y	103	1.39E-09
Y	104	1.43E-10
Y	105	1.19E-11
Y	88	9.45E-11
Y	89	5.39E-03
Y	89m	9.09E-11
Y	90	2.58E-05
Y	90m	1.45E-08
Y	91	2.76E-01
Y	91m	3.41E-03
Y	92	2.54E-02
Y	93	7.74E-02
Y	93m	6.03E-07
Y	94	2.45E-03

```
Y       95      1.37E-03
Y       96      8.15E-06
Y        96m    6.00E-06
Y       97      4.34E-06
Y        97m    7.67E-07
Y       98      4.44E-07
Y        98m    8.91E-07
Y       99      1.30E-06
Yb      171     9.76E-11
Yb      172     1.15E-08
Zn      66      1.63E-08
Zn      67      5.12E-08
Zn      68      2.70E-07
Zn      69      8.25E-09
Zn       69m    1.18E-10
Zn      70      7.68E-07
Zn      71      1.12E-09
Zn       71m    4.14E-09
Zn      72      2.09E-06
Zn      73      1.35E-09
Zn      74      1.31E-08
Zn      75      3.53E-09
Zn      76      5.66E-09
Zn      77      2.64E-09
Zn      78      1.86E-09
Zn      79      5.81E-10
Zn      80      6.50E-11
Zn      81      4.54E-12
Zr      100     1.51E-05
Zr      101     2.95E-06
Zr      102     2.57E-06
Zr      103     3.80E-07
Zr      104     8.42E-08
Zr      105     2.50E-08
Zr      106     2.89E-11
Zr      107     2.79E-12
Zr      90      7.17E-06
Zr      91      4.20E-03
Zr      92      3.13E-01
Zr      93      3.06E-01
Zr      94      3.91E-01
Zr      95      3.95E-01
Zr      96      4.04E-01
Zr      97      1.23E-01
Zr      98      6.39E-05
Zr      99      4.43E-06


/CORE HPR_BOC ACTIVITY FISSION
*Isotope Activity(Ci)
Ac      225     1.07E-15
Ac      226     3.39E-15
Ac      227     1.89E-11
Ac      228     3.44E-13
Ag      106     4.88E-13
Ag      106m    1.00E-13
Ag      107m    4.56E-10
Ag      108     1.08E-06
Ag      108m    3.39E-12
Ag      109m    2.75E+03
Ag      110     1.37E-02
Ag      110m    2.49E-06
Ag      111     3.36E+02
Ag      111m    1.39E+03
Ag      112     1.05E+03
Ag      113     7.27E+02
Ag      113m    1.07E+03
Ag      114     9.50E+02
Ag      115     9.85E+02
Ag      115m    4.19E+01
Ag      116     9.56E+02
```

Ag	116m	3.83E+01
Ag	117	8.46E+02
Ag	117m	9.87E+01
Ag	118	7.46E+02
Ag	118m	2.74E+02
Ag	119	7.41E+02
Ag	120	3.98E+02
Ag	120m	1.56E+02
Ag	121	3.63E+02
Ag	122	9.37E+01
Ag	122m	8.36E+01
Ag	123	8.51E+01
Ag	124	4.56E+01
Ag	125	7.95E+00
Ag	126	1.55E+00
Ag	127	2.38E-01
Ag	128	3.25E-02
Ag	129	5.44E-03
Ag	130	2.10E-01
As	72	6.46E-10
As	73	1.51E-09
As	74	3.61E-07
As	76	9.14E-03
As	77	2.96E+02
As	78	1.09E+03
As	79	2.16E+03
As	80	5.39E+03
As	81	8.02E+03
As	82	1.04E+04
As	82m	1.51E+03
As	83	1.41E+04
As	84	1.03E+04
As	85	9.57E+03
As	86	1.99E+04
As	87	1.73E+03
As	88	4.15E+03
As	89	2.05E+01
As	90	5.42E-01
As	91	8.40E-02
As	92	6.58E-03
At	217	1.08E-15
Ba	133	1.18E-10
Ba	135m	1.36E-03
Ba	136m	3.31E+00
Ba	137m	5.12E+01
Ba	139	2.66E+05
Ba	140	3.87E+04
Ba	141	2.43E+05
Ba	142	2.35E+05
Ba	143	2.25E+05
Ba	144	1.78E+05
Ba	145	8.92E+04
Ba	146	4.49E+04
Ba	147	1.27E+04
Ba	148	1.97E+03
Ba	149	2.40E+02
Ba	150	2.45E+01
Ba	151	3.88E+00
Ba	152	6.18E-02
Ba	153	2.96E-03
Bi	211	3.27E-14
Bi	212	1.93E-13
Bi	213	1.07E-15
Bi	214	9.12E-13
Br	77	1.81E-09
Br	77m	2.83E-09
Br	78	5.40E-07
Br	79m	5.95E-05
Br	80	6.29E-03
Br	80m	4.78E-03
Br	82	2.21E+00

Br	82m	8.75E-01
Br	83	2.17E+04
Br	84	4.11E+04
Br	84m	6.69E+02
Br	85	5.27E+04
Br	86	7.36E+04
Br	87	8.41E+04
Br	88	7.49E+04
Br	89	5.15E+04
Br	90	2.81E+04
Br	91	1.12E+04
Br	92	1.92E+03
Br	93	7.13E+02
Br	94	3.83E+01
Br	95	6.51E-01
Br	96	2.08E-01
Br	97	2.97E-03
Cd	109	6.49E-15
Cd	111m	1.81E-07
Cd	113m	4.56E-03
Cd	115	5.80E+02
Cd	115m	2.58E+00
Cd	117	7.92E+02
Cd	117m	1.75E+02
Cd	118	9.91E+02
Cd	119	6.59E+02
Cd	119m	3.27E+02
Cd	120	9.81E+02
Cd	121	6.19E+02
Cd	121m	2.81E+02
Cd	122	9.66E+02
Cd	123	7.73E+02
Cd	124	7.23E+02
Cd	125	3.26E+02
Cd	126	3.19E+02
Cd	127	2.77E+02
Cd	128	1.20E+02
Cd	129	2.40E+00
Cd	130	2.74E+03
Cd	131	5.04E+02
Cd	132	7.37E-01
Ce	137	2.15E-09
Ce	139	6.63E-07
Ce	139m	3.28E-05
Ce	141	1.39E+04
Ce	143	1.89E+05
Ce	144	1.64E+03
Ce	145	1.63E+05
Ce	146	1.27E+05
Ce	147	8.38E+04
Ce	148	6.92E+04
Ce	149	3.66E+04
Ce	150	2.04E+04
Ce	151	6.14E+03
Ce	152	1.66E+03
Ce	153	3.08E+02
Ce	154	3.71E+01
Ce	155	3.60E+00
Ce	156	2.27E-01
Ce	157	9.14E-03
Co	65	1.60E-04
Co	66	4.20E-02
Co	67	1.29E-01
Co	68	1.51E-01
Co	69	1.41E-01
Co	70	9.47E-02
Co	71	5.17E-02
Co	72	2.00E-02
Co	73	8.26E-03
Co	74	1.23E-03
Co	75	1.75E-04

Cs	129	3.52E-15
Cs	131	1.69E-07
Cs	132	6.95E-04
Cs	134	9.95E-04
Cs	134m	1.81E-01
Cs	135	4.74E-04
Cs	135m	8.95E+00
Cs	136	2.90E+01
Cs	136m	1.27E+02
Cs	137	4.90E+01
Cs	138	2.78E+05
Cs	138m	7.91E+03
Cs	139	2.63E+05
Cs	140	2.41E+05
Cs	141	1.80E+05
Cs	142	1.19E+05
Cs	143	6.55E+04
Cs	144	2.33E+04
Cs	145	5.61E+03
Cs	146	8.24E+02
Cs	147	1.46E+02
Cs	148	1.06E+01
Cs	149	1.98E-01
Cs	150	1.97E-02
Cs	151	3.45E-03
Cu	66	2.69E-02
Cu	67	8.47E-02
Cu	68	2.49E-01
Cu	68m	3.61E-03
Cu	69	3.99E-01
Cu	70	6.29E-01
Cu	70m	1.05E-01
Cu	71	1.20E+00
Cu	72	2.44E+00
Cu	73	5.43E+00
Cu	74	5.92E+00
Cu	75	7.58E+00
Cu	76	6.93E+00
Cu	77	3.53E+00
Cu	78	9.67E-01
Cu	79	1.68E-01
Cu	80	1.71E-02
Dy	159	4.59E-11
Dy	165	6.71E-01
Dy	165m	2.43E-04
Dy	166	1.96E-01
Dy	167	2.84E-01
Dy	168	1.73E-01
Dy	169	1.05E-01
Dy	170	5.45E-02
Dy	171	2.66E-02
Dy	172	3.23E-02
Er	163	2.26E-15
Er	165	1.08E-09
Er	167m	3.37E-02
Er	169	2.12E-02
Er	171	3.25E-02
Er	172	3.10E-02
Eu	152	2.84E-09
Eu	152m	1.08E-05
Eu	154	1.98E-05
Eu	154m	4.76E-03
Eu	155	2.22E+00
Eu	156	9.78E+01
Eu	157	4.30E+02
Eu	158	2.31E+02
Eu	159	9.28E+01
Eu	160	3.55E+01
Eu	161	1.15E+01
Eu	162	3.32E+00
Eu	163	1.44E+00

Eu	164	5.69E-01
Eu	165	1.81E-01
Eu	166	4.83E-02
Eu	167	1.06E-02
Fe	65	1.60E-04
Fe	66	2.20E-02
Fe	67	4.34E-02
Fe	68	2.61E-02
Fe	69	9.23E-03
Fe	70	2.54E-03
Fe	71	4.48E-04
Fe	72	6.39E-05
Fr	221	1.08E-15
Fr	223	2.61E-13
Ga	68	1.53E-08
Ga	70	1.53E-05
Ga	72	1.56E+00
Ga	72m	7.17E-02
Ga	73	9.01E+00
Ga	74	2.18E+01
Ga	74m	4.71E-01
Ga	75	6.25E+01
Ga	76	2.14E+02
Ga	77	4.32E+02
Ga	78	7.11E+02
Ga	79	9.13E+02
Ga	80	5.92E+02
Ga	81	3.92E+02
Ga	82	2.60E+02
Ga	83	2.57E+01
Ga	84	3.60E+02
Ga	85	4.33E-01
Ga	86	1.05E+00
Gd	153	4.15E-11
Gd	159	8.60E+01
Gd	161	1.22E+01
Gd	162	3.96E+00
Gd	163	2.04E+00
Gd	164	1.13E+00
Gd	165	5.78E-01
Gd	166	3.05E-01
Gd	167	1.39E-01
Gd	168	4.82E-02
Gd	169	1.09E-02
Ge	71	3.44E-08
Ge	71m	1.03E-07
Ge	73m	8.87E+00
Ge	75	6.28E+01
Ge	75m	2.56E+00
Ge	77	4.69E+02
Ge	77m	5.82E+00
Ge	78	1.08E+03
Ge	79	1.47E+03
Ge	79m	6.16E+02
Ge	80	4.84E+03
Ge	81	5.44E+03
Ge	81m	1.62E+02
Ge	82	5.71E+03
Ge	83	1.96E+03
Ge	84	1.44E+03
Ge	85	2.17E+02
Ge	86	1.89E+04
Ge	87	7.02E+01
Ge	88	1.81E+00
Ge	89	1.76E-02
Ho	161	8.92E-13
Ho	161m	8.08E-14
Ho	162	1.35E-09
Ho	162m	1.64E-09
Ho	163	4.98E-14
Ho	163m	2.95E-09

Ho	164	5.40E-07
Ho	164m	4.39E-07
Ho	166	1.15E-01
Ho	166m	1.54E-10
Ho	167	2.82E-01
Ho	168	1.74E-01
Ho	169	1.07E-01
Ho	170	5.64E-02
Ho	170m	1.86E-03
Ho	171	3.23E-02
Ho	172	4.77E-02
I	123	2.58E-09
I	124	1.39E-15
I	125	4.20E-09
I	126	1.16E-06
I	128	4.01E-02
I	129	7.95E-06
I	130	6.93E+00
I	130m	2.21E+00
I	131	2.63E+04
I	132	8.66E+04
I	132m	3.86E+02
I	133	2.52E+05
I	133m	1.91E+04
I	134	3.26E+05
I	134m	1.48E+04
I	135	2.67E+05
I	136	1.23E+05
I	136m	5.47E+04
I	137	1.34E+05
I	138	7.06E+04
I	139	3.63E+04
I	140	9.19E+03
I	141	2.42E+03
I	142	3.68E+02
I	143	3.05E+01
I	144	4.82E-01
In	112	1.16E-12
In	112m	9.44E-13
In	113m	1.22E-14
In	114	6.45E-08
In	114m	6.16E-09
In	115	3.52E-15
In	115m	5.46E+02
In	116	1.25E-03
In	116m	2.12E-03
In	117	5.84E+02
In	117m	7.28E+02
In	118	9.91E+02
In	118m	7.59E-02
In	119	4.32E+02
In	119m	5.96E+02
In	120	9.90E+02
In	120m	1.88E+01
In	121	5.98E+02
In	121m	4.35E+02
In	122	1.03E+03
In	122m	1.17E+02
In	123	5.73E+02
In	123m	5.81E+02
In	124	9.71E+02
In	124m	2.48E+02
In	125	6.10E+02
In	125m	5.58E+02
In	126	6.53E+02
In	126m	3.34E+02
In	127	1.95E+03
In	127m	6.49E+02
In	128	8.97E+02
In	128m	7.72E+02
In	129	1.31E+03

In	129m	1.21E+03
In	130	3.41E+03
In	130m	8.05E+02
In	131	6.03E+02
In	131m	3.57E+02
In	132	4.64E+02
In	133	3.67E+01
In	134	2.12E+00
In	135	7.49E-02
Kr	100	3.75E-02
Kr	79	8.45E-10
Kr	79m	5.57E-10
Kr	81	1.22E-12
Kr	81m	6.01E-06
Kr	83m	2.18E+04
Kr	85	5.54E+00
Kr	85m	5.26E+04
Kr	87	1.04E+05
Kr	88	1.42E+05
Kr	89	1.79E+05
Kr	90	1.89E+05
Kr	91	1.38E+05
Kr	92	7.26E+04
Kr	93	2.36E+04
Kr	94	6.16E+03
Kr	95	8.95E+02
Kr	96	1.36E+03
Kr	97	5.29E+00
Kr	98	5.36E+01
Kr	99	8.84E-02
La	135	2.90E-08
La	137	3.05E-11
La	138	5.51E-14
La	140	1.70E+04
La	141	2.39E+05
La	142	2.38E+05
La	143	2.43E+05
La	144	2.24E+05
La	145	1.60E+05
La	146	7.52E+04
La	146m	3.03E+04
La	147	4.63E+04
La	148	2.02E+04
La	149	6.32E+03
La	150	1.35E+03
La	151	2.30E+02
La	152	2.60E+01
La	153	2.71E+00
La	154	1.16E-01
La	155	3.28E-03
Mo	101	2.21E+05
Mo	102	1.89E+05
Mo	103	1.40E+05
Mo	104	9.02E+04
Mo	105	5.30E+04
Mo	106	2.55E+04
Mo	107	1.15E+04
Mo	108	3.90E+03
Mo	109	1.53E+03
Mo	110	4.67E+02
Mo	111	8.80E+01
Mo	112	1.12E+01
Mo	113	1.25E+00
Mo	114	5.10E-02
Mo	115	4.11E-03
Mo	93m	6.96E-11
Mo	99	1.36E+05
Nb	100	2.52E+05
Nb	100m	1.19E+04
Nb	101	2.15E+05
Nb	102	1.32E+05

Nb	102m	3.40E+04
Nb	103	1.00E+05
Nb	104	2.50E+04
Nb	104m	1.73E+04
Nb	105	1.80E+04
Nb	106	3.35E+03
Nb	107	7.73E+02
Nb	108	9.01E+01
Nb	109	3.41E+01
Nb	110	1.69E+00
Nb	111	1.20E+00
Nb	112	1.22E-02
Nb	113	2.17E-03
Nb	91	2.05E-14
Nb	92m	1.95E-14
Nb	93m	1.23E-07
Nb	94	2.50E-09
Nb	94m	3.59E-03
Nb	95	2.47E+02
Nb	95m	2.24E+01
Nb	96	1.59E+01
Nb	97	2.38E+05
Nb	97m	2.25E+05
Nb	98	2.43E+05
Nb	98m	1.24E+03
Nb	99	1.57E+05
Nb	99m	9.96E+04
Nd	141	4.61E-13
Nd	141m	9.28E-14
Nd	144	2.03E-15
Nd	147	1.63E+04
Nd	149	4.75E+04
Nd	151	1.91E+04
Nd	152	1.23E+04
Nd	153	7.46E+03
Nd	154	3.28E+03
Nd	155	1.26E+03
Nd	156	4.29E+02
Nd	157	9.70E+01
Nd	158	1.77E+01
Nd	159	2.05E+00
Nd	160	1.71E-01
Nd	161	8.14E-03
Ni	65	1.60E-04
Ni	66	2.69E-02
Ni	67	1.53E-01
Ni	68	2.45E-01
Ni	69	3.69E-01
Ni	70	5.54E-01
Ni	71	6.95E-01
Ni	72	9.38E-01
Ni	73	8.87E-01
Ni	74	4.57E-01
Ni	75	1.62E-01
Ni	76	5.83E-02
Ni	77	8.14E-03
Ni	78	1.08E-03
Pb	211	3.27E-14
Pb	212	1.91E-13
Pb	214	9.12E-13
Pd	103	2.11E-13
Pd	107	1.11E-05
Pd	107m	2.02E-05
Pd	109	2.75E+03
Pd	109m	3.46E-03
Pd	111	1.40E+03
Pd	111m	5.60E-01
Pd	112	1.07E+03
Pd	113	1.11E+03
Pd	114	9.20E+02
Pd	115	9.66E+02

Pd	116	7.90E+02
Pd	117	7.43E+02
Pd	118	5.00E+02
Pd	119	2.21E+02
Pd	120	1.84E+02
Pd	121	3.58E+01
Pd	122	1.00E+01
Pd	123	2.14E+00
Pd	124	3.54E-01
Pm	145	2.19E-12
Pm	146	2.85E-08
Pm	147	1.83E+01
Pm	148	6.39E-03
Pm	148m	8.20E-04
Pm	149	2.79E+04
Pm	150	1.48E+00
Pm	151	1.58E+04
Pm	152	1.23E+04
Pm	152m	5.32E+01
Pm	153	7.79E+03
Pm	154	3.50E+03
Pm	154m	2.14E+02
Pm	155	1.82E+03
Pm	156	8.13E+02
Pm	157	3.26E+02
Pm	158	1.02E+02
Pm	159	2.75E+01
Pm	160	4.97E+00
Pm	161	6.78E-01
Pm	162	5.75E-02
Pm	163	6.17E-03
Po	212	1.24E-13
Po	213	1.05E-15
Po	214	1.47E-12
Po	215	3.27E-14
Po	216	3.29E-13
Po	218	9.12E-13
Pr	139	3.80E-13
Pr	140	3.15E-06
Pr	142	3.48E-03
Pr	142m	2.67E-03
Pr	143	1.70E+04
Pr	144	1.64E+03
Pr	144m	1.62E+01
Pr	145	1.63E+05
Pr	146	1.27E+05
Pr	147	9.50E+04
Pr	148	7.07E+04
Pr	148m	1.44E+03
Pr	149	4.72E+04
Pr	150	2.91E+04
Pr	151	1.63E+04
Pr	152	6.91E+03
Pr	153	2.84E+03
Pr	154	6.14E+02
Pr	155	1.58E+02
Pr	156	2.43E+01
Pr	157	3.08E+00
Pr	158	2.00E-01
Pr	159	9.46E-03
Ra	222	5.56E-13
Ra	223	3.27E-14
Ra	224	3.29E-13
Ra	225	1.57E-14
Ra	226	5.73E-12
Ra	227	7.46E-11
Rb	100	1.30E+03
Rb	101	2.45E-01
Rb	102	2.27E-02
Rb	81	7.99E-11
Rb	83	2.83E-07

Rb	84	2.30E-05
Rb	86	6.83E-02
Rb	86m	3.17E-01
Rb	87	1.19E-08
Rb	88	1.43E+05
Rb	89	1.88E+05
Rb	90	1.95E+05
Rb	90m	3.34E+04
Rb	91	2.24E+05
Rb	92	1.95E+05
Rb	93	1.52E+05
Rb	94	7.81E+04
Rb	95	3.74E+04
Rb	96	1.30E+04
Rb	97	1.95E+03
Rb	98	5.06E+02
Rb	99	7.35E+01
Rh	101	1.76E-09
Rh	101m	1.09E-10
Rh	102	1.57E-07
Rh	102m	2.29E-08
Rh	103m	7.25E+03
Rh	104	2.26E-02
Rh	104m	2.25E-03
Rh	105	3.95E+04
Rh	105m	1.54E+04
Rh	106	1.49E+02
Rh	106m	8.69E-02
Rh	107	1.28E+04
Rh	108	5.29E+03
Rh	108m	1.43E-01
Rh	109	2.83E+03
Rh	110	6.49E+00
Rh	110m	2.08E+03
Rh	111	1.40E+03
Rh	112	1.17E+03
Rh	113	1.05E+03
Rh	114	6.97E+02
Rh	115	5.32E+02
Rh	116	2.57E+02
Rh	117	1.25E+02
Rh	118	5.41E+01
Rh	119	1.37E+01
Rh	120	3.06E+00
Rh	121	4.90E-01
Rh	122	6.13E-02
Rn	218	5.56E-13
Rn	219	3.27E-14
Rn	220	3.29E-13
Rn	222	9.12E-13
Ru	103	7.33E+03
Ru	105	5.44E+04
Ru	106	1.48E+02
Ru	107	1.28E+04
Ru	108	5.29E+03
Ru	109	2.83E+03
Ru	110	2.07E+03
Ru	111	1.33E+03
Ru	112	9.90E+02
Ru	113	6.01E+02
Ru	114	2.56E+02
Ru	115	9.34E+01
Ru	116	2.60E+01
Ru	117	4.62E+00
Ru	118	9.81E-01
Ru	119	9.67E-02
Ru	120	9.30E-03
Sb	118	1.20E-10
Sb	118m	2.04E-10
Sb	119	1.61E-07
Sb	120	5.78E-06

Sb	120m	2.59E-06
Sb	122	1.26E-02
Sb	122m	1.27E-02
Sb	124	7.73E-02
Sb	124m	1.64E+00
Sb	125	2.95E+00
Sb	126	4.74E+00
Sb	126m	5.56E+01
Sb	127	3.22E+03
Sb	128	9.35E+02
Sb	128m	1.55E+04
Sb	129	2.67E+04
Sb	129m	4.76E+02
Sb	130	3.16E+04
Sb	130m	4.32E+04
Sb	131	1.13E+05
Sb	132	8.00E+04
Sb	132m	4.99E+04
Sb	133	9.24E+04
Sb	134	1.90E+04
Sb	134m	1.87E+04
Sb	135	1.03E+04
Sb	136	1.42E+03
Sb	137	2.43E+03
Sb	138	1.91E+01
Sb	139	1.34E+00
Se	75	2.57E-10
Se	77m	9.84E-01
Se	79	4.15E-05
Se	79m	2.11E+03
Se	81	8.30E+03
Se	81m	5.33E+02
Se	83	1.96E+04
Se	83m	1.57E+03
Se	84	4.05E+04
Se	85	4.38E+04
Se	86	5.58E+04
Se	87	3.26E+04
Se	88	1.62E+04
Se	89	3.70E+03
Se	90	9.77E+02
Se	91	1.04E+02
Se	92	9.80E+00
Se	93	6.92E-01
Se	94	2.73E-02
Sm	147	3.31E-13
Sm	151	6.39E-01
Sm	153	5.12E+03
Sm	155	1.87E+03
Sm	156	9.26E+02
Sm	157	4.46E+02
Sm	158	2.25E+02
Sm	159	8.43E+01
Sm	160	2.87E+01
Sm	161	6.74E+00
Sm	162	1.31E+00
Sm	163	3.14E-01
Sm	164	6.40E-02
Sm	165	8.16E-03
Sn	113m	7.83E-15
Sn	117m	2.80E-01
Sn	119m	2.26E-01
Sn	121	8.17E+02
Sn	121m	8.99E-03
Sn	123	1.17E+00
Sn	123m	1.16E+03
Sn	125	1.34E+02
Sn	125m	1.36E+03
Sn	126	7.43E-05
Sn	127	4.58E+03
Sn	127m	3.03E+03

Sn	128	1.52E+04
Sn	128m	7.25E+03
Sn	129	1.60E+04
Sn	129m	8.39E+03
Sn	130	2.73E+04
Sn	130m	2.73E+04
Sn	131	2.42E+04
Sn	131m	2.32E+04
Sn	132	2.76E+04
Sn	133	6.87E+03
Sn	134	1.39E+03
Sn	135	1.06E+02
Sn	136	6.39E+00
Sn	137	8.38E-01
Sr	100	2.65E+03
Sr	101	3.54E+02
Sr	102	3.21E+01
Sr	103	7.47E-01
Sr	104	8.88E-02
Sr	105	1.65E-02
Sr	83	4.04E-14
Sr	85	1.13E-07
Sr	85m	1.93E-06
Sr	87m	8.93E-03
Sr	89	7.56E+03
Sr	90	4.54E+01
Sr	91	2.35E+05
Sr	92	2.42E+05
Sr	93	2.55E+05
Sr	94	2.46E+05
Sr	95	2.20E+05
Sr	96	1.70E+05
Sr	97	8.27E+04
Sr	98	4.19E+04
Sr	99	9.87E+03
Tb	155	1.21E-13
Tb	156	1.11E-09
Tb	156m	1.06E-10
Tb	157	2.37E-11
Tb	158	2.15E-10
Tb	158m	6.56E-07
Tb	160	2.13E-04
Tb	161	3.16E+00
Tb	162	3.98E+00
Tb	163	2.07E+00
Tb	164	1.18E+00
Tb	165	6.70E-01
Tb	166	4.21E-01
Tb	167	2.67E-01
Tb	168	1.46E-01
Tb	169	6.86E-02
Tb	170	2.28E-02
Tb	171	6.17E-03
Tc	100	5.75E-01
Tc	101	2.21E+05
Tc	102	1.89E+05
Tc	102m	3.02E+02
Tc	103	1.42E+05
Tc	104	9.34E+04
Tc	105	5.48E+04
Tc	106	2.66E+04
Tc	107	1.27E+04
Tc	108	5.26E+03
Tc	109	2.69E+03
Tc	110	1.50E+03
Tc	111	5.83E+02
Tc	112	1.98E+02
Tc	113	5.62E+01
Tc	114	9.75E+00
Tc	115	1.96E+00
Tc	116	1.98E-01

Tc	117	8.26E-03
Tc	118	1.98E-03
Tc	97m	9.11E-09
Tc	98	3.77E-11
Tc	99	1.70E-03
Tc	99m	1.09E+05
Te	121	1.18E-09
Te	121m	1.44E-10
Te	123m	3.05E-06
Te	125m	1.20E-02
Te	127	2.26E+03
Te	127m	5.35E+00
Te	129	2.33E+04
Te	129m	2.47E+02
Te	131	1.12E+05
Te	131m	1.30E+04
Te	132	8.89E+04
Te	133	1.51E+05
Te	133m	1.46E+05
Te	134	2.90E+05
Te	135	1.45E+05
Te	136	6.45E+04
Te	137	2.04E+04
Te	138	5.15E+03
Te	139	7.61E+02
Te	140	6.12E+02
Te	141	2.31E+01
Te	142	4.48E-01
Tl	207	3.26E-14
Tl	208	6.94E-14
Tm	166	1.14E-15
Tm	167	2.36E-14
Tm	168	1.02E-11
Tm	170	1.82E-09
Tm	171	8.19E-05
Tm	172	1.09E-02
Xe	127	3.55E-10
Xe	127m	3.20E-09
Xe	129m	8.43E-07
Xe	131m	2.42E+01
Xe	133	5.80E+04
Xe	133m	3.39E+03
Xe	134m	1.21E+03
Xe	135	2.72E+05
Xe	135m	5.01E+04
Xe	137	2.56E+05
Xe	138	2.60E+05
Xe	139	2.07E+05
Xe	140	1.52E+05
Xe	141	5.81E+04
Xe	142	2.37E+04
Xe	143	3.05E+03
Xe	144	6.87E+02
Xe	145	6.06E+01
Xe	146	4.36E+00
Xe	147	1.44E-01
Y	100	3.98E+04
Y	101	1.69E+04
Y	102	1.14E+04
Y	103	6.62E+02
Y	104	8.65E+01
Y	105	1.45E+01
Y	106	2.26E-02
Y	107	5.11E-03
Y	108	2.04E-05
Y	87	2.25E-07
Y	87m	1.51E-14
Y	88	1.32E-06
Y	89m	7.36E-01
Y	90	1.41E+01
Y	90m	1.58E-01

```
Y       91      6.77E+03
Y        91m    1.42E+05
Y       92      2.44E+05
Y       93      2.57E+05
Y        93m    8.92E+04
Y       94      2.62E+05
Y       95      2.63E+05
Y       96      1.80E+05
Y        96m    7.35E+04
Y       97      1.35E+05
Y        97m    7.63E+04
Y       98      9.34E+04
Y        98m    5.13E+04
Y       99      1.01E+05
Zn      69      3.99E-01
Zn       69m    3.89E-04
Zn      71      1.21E+00
Zn       71m    4.61E-02
Zn      72      1.96E+00
Zn      73      8.91E+00
Zn      74      2.09E+01
Zn      75      5.21E+01
Zn      76      1.48E+02
Zn      77      1.86E+02
Zn      78      1.83E+02
Zn      79      8.35E+01
Zn      80      1.70E+01
Zn      81      1.98E+00
Zn      82      7.71E-01
Zn      83      4.30E-02
Zr      100     2.40E+05
Zr      101     1.43E+05
Zr      102     9.80E+04
Zr      103     3.20E+04
Zr      104     7.62E+03
Zr      105     4.48E+03
Zr      106     1.14E+01
Zr      107     1.97E+00
Zr      108     1.05E-01
Zr      109     2.97E-02
Zr      110     1.06E-03
Zr      88      3.15E-12
Zr      89      4.33E-08
Zr       89m    3.28E-12
Zr       90m    1.22E-05
Zr      93      7.69E-04
Zr      95      8.50E+03
Zr      97      2.37E+05
Zr      98      2.40E+05
Zr      99      2.41E+05

/CORE-DESC HPR_MOC
 data file:  INL-A_core_t6-depl_ce_v7.1.ii.json
 response name:  AT_POWER
 user-selected time index:  6
 user-selected time(s):  65790648
 cutoff for grams:  1e-12
 cutoff for curies:  1e-15
 mass vs. time for response:
    index      time(s)      mass(g) target
     0000  0.00000e+00  5.18587e+06
     0001  2.59200e+05  5.18587e+06
     0002  1.33655e+07  5.18587e+06
     0003  2.64718e+07  5.18586e+06
     0004  3.95781e+07  5.18586e+06
     0005  5.26844e+07  5.18586e+06
     0006  6.57906e+07  5.18586e+06 <------
     0007  7.88969e+07  5.18585e+06
     0008  9.20464e+07  5.18585e+06
     0009  1.05196e+08  5.18585e+06
     0010  1.18345e+08  5.18585e+06
```

```
     0011  1.31495e+08  5.18585e+06
     0012  1.44644e+08  5.18584e+06
     0013  1.57794e+08  5.18584e+06
/END


/CORE HPR_MOC MASS ACTIVATION
*Isotope Mass(g)
B       11      1.92E-11
Be      10      2.13E-07
Be      9       2.33E-09
C       12      1.92E-02
C       13      1.07E+00
C       14      1.50E-02
F       19      1.33E-04
H       1       2.20E-04
H       2       2.39E-05
H       3       5.20E-03
He      3       3.10E-04
He      4       4.69E-01
N       14      1.91E-06
N       15      1.86E-04
N       16      5.48E-10
Ne      20      3.26E-10
O       16      6.14E+05
O       17      2.49E+02
O       18      1.42E+03
O       19      7.85E-11


/CORE HPR_MOC ACTIVITY ACTIVATION
*Isotope Activity(Ci)
B       12      4.60E-08
Be      10      5.03E-09
Be      11      1.69E-08
Be      8       2.62E-09
C       14      6.74E-02
C       15      1.15E-01
Cr      66      1.06E-05
Cr      67      3.20E-06
F       20      8.09E-06
H       3       5.00E+01
He      6       9.50E-10
Li      8       5.78E-15
Mn      66      1.47E-03
Mn      67      1.32E-03
Mn      68      2.74E-04
Mn      69      3.64E-05
N       13      3.88E-12
N       16      5.42E+01
O       19      1.73E+00


/CORE HPR_MOC MASS ACTINIDE
*Isotope Mass(g)
Am      241     5.53E-05
Am      242     7.33E-10
Am      242m    1.58E-08
Am      243     2.35E-09
Cm      242     6.13E-08
Cm      243     2.91E-11
Cm      244     9.02E-12
Np      235     3.01E-10
Np      236     9.60E-07
Np      236m    1.29E-08
Np      237     1.40E+01
Np      238     1.96E-04
Np      239     8.91E+00
Np      240     1.11E-06
Np      240m    2.14E-07
```

```
Pa      230     8.12E-11
Pa      231     1.83E-03
Pa      232     1.55E-08
Pa      233     4.58E-07
Pa      234     1.61E-09
Pa      234m    1.77E-09
Pa      235     7.52E-09
Pu      236     1.50E-06
Pu      237     2.52E-09
Pu      238     2.45E-02
Pu      239     1.99E+03
Pu      240     1.15E+00
Pu      241     2.17E-03
Pu      242     1.34E-06
Pu      243     4.57E-12
Th      227     8.35E-11
Th      228     1.87E-08
Th      229     9.29E-08
Th      230     3.96E-02
Th      231     3.72E-06
Th      232     2.41E-04
Th      233     6.68E-12
Th      234     5.31E-05
U       230     7.25E-12
U       232     3.32E-06
U       233     3.55E-03
U       234     6.84E+03
U       235     8.98E+05
U       235m    1.36E-04
U       236     9.78E+02
U       237     1.88E-01
U       238     3.66E+06
U       239     6.18E-02

/CORE HPR_MOC ACTIVITY ACTINIDE
*Isotope Activity(Ci)
Am      239     8.95E-13
Am      240     1.16E-08
Am      241     1.90E-04
Am      242     5.92E-04
Am      242m    1.66E-07
Am      243     4.70E-10
Am      244     2.76E-09
Am      244m    4.11E-08
Am      245     3.92E-15
Cm      241     8.13E-12
Cm      242     2.03E-04
Cm      243     1.47E-09
Cm      244     7.30E-10
Cm      245     1.70E-15
Np      234     1.93E-13
Np      235     4.22E-07
Np      236     9.51E-09
Np      236m    7.59E-03
Np      237     9.82E-03
Np      238     5.09E+01
Np      239     2.07E+06
Np      240     1.40E+01
Np      240m    2.33E+01
Np      241     3.41E-10
Pa      229     1.29E-09
Pa      230     2.65E-06
Pa      231     8.63E-05
Pa      232     6.62E-03
Pa      233     9.52E-03
Pa      234     3.22E-03
Pa      234m    1.23E+00
Pa      235     2.46E-01
Pu      236     7.96E-04
Pu      237     3.04E-05
```

```
Pu      237m    7.23E-06
Pu      238     4.19E-01
Pu      239     1.23E+02
Pu      240     2.62E-01
Pu      241     2.25E-01
Pu      242     5.29E-09
Pu      243     1.19E-05
Pu      245     3.92E-15
Th      226     1.98E-07
Th      227     2.57E-06
Th      228     1.54E-05
Th      229     1.98E-08
Th      230     8.17E-04
Th      231     1.98E+00
Th      232     2.65E-11
Th      233     2.42E-04
Th      234     1.23E+00
U       230     1.98E-07
U       231     7.02E-09
U       232     7.42E-05
U       233     3.42E-05
U       234     4.26E+01
U       235     1.94E+00
U       235m    4.18E+03
U       236     6.32E-02
U       237     1.53E+04
U       238     1.23E+00
U       239     2.07E+06

/CORE HPR_MOC MASS FISSION
*Isotope Mass(g)
Ac      227     3.87E-08
Ag      107     6.17E-07
Ag      108m    4.82E-08
Ag      109     1.27E+00
Ag      109m    1.13E-06
Ag      110     1.16E-09
Ag      110m    2.98E-05
Ag      111     8.95E-03
Ag      111m    9.02E-07
Ag      112     1.34E-04
Ag      113     1.42E-04
Ag      113m    7.37E-07
Ag      114     4.44E-08
Ag      115     1.21E-05
Ag      115m    7.68E-09
Ag      116     2.34E-06
Ag      116m    7.93E-09
Ag      117     6.40E-07
Ag      117m    5.51E-09
Ag      118     2.94E-08
Ag      118m    5.74E-09
Ag      119     1.64E-08
Ag      120     5.20E-09
Ag      120m    5.33E-10
Ag      121     3.04E-09
Ag      122     5.36E-10
Ag      122m    1.81E-10
Ag      123     2.79E-10
Ag      124     8.61E-11
Ag      125     1.46E-11
Ag      126     1.86E-12
As      73      3.10E-12
As      74      6.57E-11
As      75      1.90E-02
As      76      3.80E-08
As      77      4.22E-04
As      78      4.10E-05
As      79      8.18E-06
As      80      5.80E-07
```

As	81	1.92E-06
As	82	1.44E-06
As	82m	1.50E-07
As	83	1.39E-06
As	84	3.20E-07
As	85	1.45E-07
As	86	1.43E-07
As	87	7.46E-09
As	88	3.62E-09
As	89	9.56E-12
Ba	132	2.84E-07
Ba	133	5.87E-10
Ba	134	1.42E-02
Ba	135	5.08E-05
Ba	135m	3.80E-09
Ba	136	1.73E-01
Ba	136m	1.29E-10
Ba	137	3.40E+00
Ba	137m	2.14E-05
Ba	138	1.56E+02
Ba	139	1.63E-02
Ba	140	3.52E+00
Ba	141	3.33E-03
Ba	142	1.88E-03
Ba	143	4.13E-05
Ba	144	2.60E-05
Ba	145	4.93E-06
Ba	146	1.29E-06
Ba	147	1.48E-07
Ba	148	1.58E-08
Ba	149	1.09E-09
Ba	150	9.78E-11
Ba	151	1.35E-11
Bi	209	5.54E-12
Bi	212	1.03E-12
Br	79	3.79E-04
Br	80	6.26E-11
Br	80m	6.24E-10
Br	81	2.71E+00
Br	82	7.97E-06
Br	82m	1.64E-08
Br	83	1.41E-03
Br	84	5.82E-04
Br	84m	1.80E-06
Br	85	6.89E-05
Br	86	3.08E-05
Br	87	3.60E-05
Br	88	9.49E-06
Br	89	1.78E-06
Br	90	4.29E-07
Br	91	4.88E-08
Br	92	5.36E-09
Br	93	5.99E-10
Br	94	2.24E-11
Cd	108	8.12E-08
Cd	109	5.91E-11
Cd	110	1.09E-03
Cd	111	6.24E-01
Cd	111m	2.31E-12
Cd	112	5.51E-01
Cd	113	5.03E-01
Cd	113m	5.52E-03
Cd	114	4.39E-01
Cd	115	1.89E-03
Cd	115m	2.24E-03
Cd	116	4.66E-01
Cd	117	7.40E-05
Cd	117m	2.20E-05
Cd	118	3.13E-05
Cd	119	1.12E-06
Cd	119m	4.56E-07

Cd	120	5.31E-07
Cd	121	8.97E-08
Cd	121m	2.51E-08
Cd	122	5.48E-08
Cd	123	1.77E-08
Cd	124	9.92E-09
Cd	125	2.46E-09
Cd	126	1.83E-09
Cd	127	1.15E-09
Cd	128	3.79E-10
Cd	129	7.41E-12
Cd	130	5.10E-09
Cd	131	3.97E-10
Ce	138	9.00E-09
Ce	139	7.12E-06
Ce	139m	1.28E-11
Ce	140	1.42E+02
Ce	141	8.53E+00
Ce	142	1.37E+02
Ce	143	3.66E-01
Ce	144	5.96E+01
Ce	145	3.79E-04
Ce	146	1.33E-03
Ce	147	6.16E-05
Ce	148	5.08E-05
Ce	149	2.56E-06
Ce	150	1.08E-06
Ce	151	1.45E-07
Ce	152	3.12E-08
Ce	153	4.08E-09
Ce	154	3.93E-10
Ce	155	2.33E-11
Ce	156	1.16E-12
Cs	131	1.07E-11
Cs	132	3.66E-07
Cs	133	1.50E+02
Cs	134	5.81E-02
Cs	134m	3.16E-06
Cs	135	1.50E+02
Cs	135m	3.61E-07
Cs	136	4.27E-03
Cs	136m	3.06E-08
Cs	137	1.40E+02
Cs	138	6.80E-03
Cs	138m	1.70E-05
Cs	139	1.80E-03
Cs	140	1.90E-04
Cs	141	5.59E-05
Cs	142	2.53E-06
Cs	143	1.48E-06
Cs	144	2.96E-07
Cs	145	4.23E-08
Cs	146	3.42E-09
Cs	147	4.37E-10
Cs	148	2.04E-11
Cu	65	4.20E-08
Cu	66	8.08E-11
Cu	67	2.02E-07
Cu	68	4.67E-11
Cu	68m	4.92E-12
Cu	69	4.18E-10
Cu	70	1.74E-10
Cu	70m	2.18E-11
Cu	71	1.48E-10
Cu	72	1.04E-10
Cu	73	1.47E-10
Cu	74	6.79E-11
Cu	75	6.16E-11
Cu	76	3.04E-11
Cu	77	1.13E-11
Cu	78	2.24E-12

Dy	158	1.55E-11
Dy	159	1.37E-11
Dy	160	7.53E-05
Dy	161	7.96E-03
Dy	162	2.71E-03
Dy	163	1.41E-03
Dy	164	8.05E-04
Dy	165	8.63E-08
Dy	165m	1.01E-12
Dy	166	1.93E-06
Dy	167	1.60E-09
Dy	168	1.36E-09
Dy	169	6.14E-11
Dy	170	2.47E-11
Dy	171	2.42E-12
Dy	172	1.48E-12
Er	164	5.29E-10
Er	166	2.92E-04
Er	167	1.94E-04
Er	167m	1.18E-12
Er	168	1.19E-04
Er	169	1.31E-06
Er	170	4.01E-05
Er	171	1.34E-08
Er	172	1.32E-07
Eu	151	9.26E-02
Eu	152	1.64E-04
Eu	152m	1.94E-07
Eu	153	4.80E+00
Eu	154	1.20E-02
Eu	154m	2.59E-08
Eu	155	1.01E+00
Eu	156	1.71E-02
Eu	157	3.47E-04
Eu	158	9.05E-06
Eu	159	1.45E-06
Eu	160	1.96E-08
Eu	161	4.40E-09
Eu	162	5.24E-10
Eu	163	1.64E-10
Eu	164	2.37E-11
Eu	165	6.11E-12
Ga	69	1.11E-04
Ga	71	3.62E-04
Ga	72	1.01E-06
Ga	73	1.02E-06
Ga	74	6.96E-08
Ga	74m	2.97E-11
Ga	75	5.23E-08
Ga	76	4.70E-08
Ga	77	3.89E-08
Ga	78	2.49E-08
Ga	79	1.82E-08
Ga	80	7.02E-09
Ga	81	3.41E-09
Ga	82	1.13E-09
Ga	83	5.82E-11
Ga	84	2.27E-10
Gd	151	3.37E-12
Gd	152	6.55E-05
Gd	153	3.07E-08
Gd	154	6.79E-04
Gd	155	1.61E-01
Gd	156	5.76E-01
Gd	157	2.86E-01
Gd	158	1.49E-01
Gd	159	8.90E-05
Gd	160	2.36E-02
Gd	161	3.97E-08
Gd	162	3.07E-08
Gd	163	2.12E-09

Gd	164	7.66E-10
Gd	165	8.90E-11
Gd	166	2.18E-11
Gd	167	6.20E-12
Ge	70	1.91E-08
Ge	71	1.97E-12
Ge	72	9.41E-04
Ge	73	2.66E-03
Ge	73m	2.87E-11
Ge	74	6.55E-03
Ge	75	2.07E-06
Ge	75m	8.12E-10
Ge	76	6.80E-02
Ge	77	1.32E-04
Ge	77m	2.11E-09
Ge	78	3.95E-05
Ge	79	1.95E-07
Ge	79m	1.68E-07
Ge	80	1.01E-06
Ge	81	2.96E-07
Ge	81m	8.84E-09
Ge	82	1.89E-07
Ge	83	2.67E-08
Ge	84	1.02E-08
Ge	85	8.72E-10
Ge	86	1.37E-08
Ge	87	7.56E-11
Ho	163	1.14E-10
Ho	165	4.58E-04
Ho	166	6.37E-07
Ho	166m	7.84E-08
Ho	167	4.82E-08
Ho	168	4.71E-10
Ho	169	4.56E-10
Ho	170	1.41E-10
Ho	170m	1.23E-12
Ho	171	2.61E-11
Ho	172	1.82E-11
I	125	7.04E-12
I	126	2.42E-08
I	127	4.00E+00
I	128	1.61E-07
I	129	1.40E+01
I	130	1.24E-05
I	130m	8.04E-08
I	131	1.01E+00
I	132	1.82E-02
I	132m	2.31E-05
I	133	2.47E-01
I	133m	2.02E-06
I	134	1.22E-02
I	134m	3.73E-05
I	135	7.54E-02
I	136	1.24E-04
I	136m	3.09E-05
I	137	3.97E-05
I	138	5.37E-06
I	139	1.02E-06
I	140	9.80E-08
I	141	1.30E-08
I	142	1.03E-09
I	143	1.15E-10
I	144	1.20E-12
In	113	2.87E-04
In	114m	2.59E-08
In	115	4.59E-01
In	115m	1.60E-04
In	116	1.49E-10
In	116m	5.69E-08
In	117	1.57E-05
In	117m	5.29E-05

In	118	5.19E-08
In	118m	2.18E-10
In	119	6.58E-07
In	119m	6.80E-06
In	120	3.25E-08
In	120m	9.31E-09
In	121	1.48E-07
In	121m	1.09E-06
In	122	1.67E-08
In	122m	1.32E-08
In	123	3.86E-08
In	123m	3.00E-07
In	124	3.33E-08
In	124m	1.01E-08
In	125	1.60E-08
In	125m	7.55E-08
In	126	1.12E-08
In	126m	6.14E-09
In	127	2.39E-08
In	127m	2.68E-08
In	128	8.56E-09
In	128m	6.32E-09
In	129	9.15E-09
In	129m	1.70E-08
In	130	1.14E-08
In	130m	5.01E-09
In	131	1.96E-09
In	131m	1.45E-09
In	132	1.12E-09
In	133	7.15E-11
In	134	3.52E-12
Kr	80	2.16E-06
Kr	81	1.93E-08
Kr	82	1.94E-03
Kr	83	7.47E+00
Kr	83m	1.08E-03
Kr	84	1.42E+01
Kr	85	3.69E+00
Kr	85m	6.40E-03
Kr	86	2.76E+01
Kr	87	3.65E-03
Kr	88	1.13E-02
Kr	89	2.66E-04
Kr	90	4.86E-05
Kr	91	9.53E-06
Kr	92	1.09E-06
Kr	93	2.50E-07
Kr	94	1.09E-08
Kr	95	8.59E-10
Kr	96	9.25E-10
Kr	97	2.93E-12
Kr	98	2.14E-11
La	137	2.50E-07
La	138	5.71E-04
La	139	1.49E+02
La	140	4.63E-01
La	141	4.30E-02
La	142	1.64E-02
La	143	2.62E-03
La	144	1.17E-04
La	145	5.10E-05
La	146	6.09E-06
La	146m	3.92E-06
La	147	2.45E-06
La	148	3.33E-07
La	149	8.76E-08
La	150	1.54E-08
La	151	2.40E-09
La	152	1.58E-10
La	153	1.26E-11
Mo	100	1.07E+02

Mo	101	1.74E-03
Mo	102	1.16E-03
Mo	103	8.62E-05
Mo	104	5.00E-05
Mo	105	1.76E-05
Mo	106	2.10E-06
Mo	107	3.82E-07
Mo	108	4.08E-08
Mo	109	7.81E-09
Mo	110	1.37E-09
Mo	111	1.73E-10
Mo	112	3.18E-11
Mo	113	1.25E-12
Mo	93	1.27E-12
Mo	94	2.05E-05
Mo	95	8.31E+01
Mo	96	3.40E-02
Mo	97	9.88E+01
Mo	98	9.68E+01
Mo	99	5.32E-01
Nb	100	3.34E-06
Nb	100m	3.15E-07
Nb	101	1.37E-05
Nb	102	5.13E-06
Nb	102m	4.00E-07
Nb	103	1.38E-06
Nb	104	1.13E-06
Nb	104m	1.50E-07
Nb	105	4.96E-07
Nb	106	2.93E-08
Nb	107	2.20E-09
Nb	108	1.67E-10
Nb	109	6.25E-11
Nb	110	2.79E-12
Nb	91	2.04E-12
Nb	92	4.74E-10
Nb	93	2.52E-06
Nb	93m	4.35E-05
Nb	94	6.26E-06
Nb	94m	3.32E-11
Nb	95	6.77E+00
Nb	95m	7.56E-03
Nb	96	2.16E-05
Nb	97	9.29E-03
Nb	97m	1.20E-04
Nb	98	6.04E-06
Nb	98m	3.30E-05
Nb	99	2.06E-05
Nb	99m	1.31E-04
Nd	142	1.47E-02
Nd	143	1.37E+02
Nd	144	7.14E+01
Nd	145	9.57E+01
Nd	146	7.50E+01
Nd	147	1.17E+00
Nd	148	4.31E+01
Nd	149	3.90E-03
Nd	150	1.83E+01
Nd	151	1.92E-04
Nd	152	1.13E-04
Nd	153	3.20E-06
Nd	154	1.16E-06
Nd	155	1.54E-07
Nd	156	3.26E-08
Nd	157	2.58E-09
Nd	158	3.30E-10
Nd	159	2.23E-11
Nd	160	1.43E-12
Ni	65	8.35E-12
Ni	66	5.16E-08
Ni	67	1.90E-11

Ni	68	4.28E-11
Ni	69	2.58E-11
Ni	70	2.07E-11
Ni	71	1.12E-11
Ni	72	9.40E-12
Ni	73	4.82E-12
Ni	74	2.04E-12
Pb	206	1.43E-12
Pb	207	6.61E-10
Pb	208	3.35E-09
Pb	210	1.77E-10
Pb	212	1.08E-11
Pd	102	3.45E-07
Pd	103	2.25E-10
Pd	104	3.93E-02
Pd	105	2.33E+01
Pd	106	5.35E+00
Pd	107	5.57E+00
Pd	107m	4.70E-11
Pd	108	2.35E+00
Pd	109	1.41E-03
Pd	109m	1.95E-10
Pd	110	9.40E-01
Pd	111	1.97E-05
Pd	111m	1.21E-07
Pd	112	8.96E-04
Pd	113	1.04E-06
Pd	114	1.36E-06
Pd	115	2.47E-07
Pd	116	9.62E-08
Pd	117	3.32E-08
Pd	118	9.95E-09
Pd	119	2.14E-09
Pd	120	9.75E-10
Pd	121	1.10E-10
Pd	122	1.90E-11
Pd	123	5.69E-12
Pm	145	1.26E-10
Pm	146	2.36E-05
Pm	147	4.26E+01
Pm	148	7.04E-04
Pm	148m	4.32E-03
Pm	149	1.18E-01
Pm	150	2.36E-07
Pm	151	2.62E-02
Pm	152	4.11E-05
Pm	152m	3.36E-07
Pm	153	3.34E-05
Pm	154	4.97E-06
Pm	154m	4.78E-07
Pm	155	1.04E-06
Pm	156	3.03E-07
Pm	157	4.82E-08
Pm	158	6.88E-09
Pm	159	5.72E-10
Pm	160	1.10E-10
Pm	161	1.03E-11
Po	210	1.62E-12
Pr	140	7.22E-11
Pr	141	1.30E+02
Pr	142	4.67E-05
Pr	142m	2.08E-07
Pr	143	3.61E+00
Pr	144	2.51E-03
Pr	144m	1.00E-05
Pr	145	4.52E-02
Pr	146	2.38E-03
Pr	147	9.95E-04
Pr	148	1.27E-04
Pr	148m	2.31E-06
Pr	149	8.45E-05

Pr	150	2.39E-06
Pr	151	4.11E-06
Pr	152	3.38E-07
Pr	153	1.65E-07
Pr	154	1.93E-08
Pr	155	1.85E-09
Pr	156	2.46E-10
Pr	157	2.56E-11
Ra	223	4.87E-11
Ra	224	9.46E-11
Ra	226	3.73E-07
Rb	100	5.88E-10
Rb	83	8.18E-10
Rb	84	3.17E-08
Rb	85	1.45E+01
Rb	86	2.01E-04
Rb	86m	1.08E-09
Rb	87	3.64E+01
Rb	88	1.19E-03
Rb	89	1.35E-03
Rb	90	2.45E-04
Rb	90m	6.86E-05
Rb	91	1.05E-04
Rb	92	7.14E-06
Rb	93	7.32E-06
Rb	94	1.75E-06
Rb	95	1.19E-07
Rb	96	2.24E-08
Rb	97	2.83E-09
Rb	98	5.01E-10
Rb	99	3.48E-11
Rh	101	3.37E-10
Rh	102	1.70E-06
Rh	102m	1.32E-06
Rh	103	5.48E+01
Rh	103m	4.33E-03
Rh	104	7.86E-08
Rh	104m	3.79E-08
Rh	105	6.32E-02
Rh	105m	5.83E-06
Rh	106	5.74E-06
Rh	106m	1.17E-08
Rh	107	1.61E-04
Rh	108	8.80E-07
Rh	108m	7.30E-09
Rh	109	2.28E-06
Rh	110	2.45E-10
Rh	110m	5.93E-07
Rh	111	1.54E-07
Rh	112	2.47E-08
Rh	113	2.97E-08
Rh	114	1.31E-08
Rh	115	5.38E-09
Rh	116	1.80E-09
Rh	117	5.69E-10
Rh	118	1.51E-10
Rh	119	2.47E-11
Rh	120	4.43E-12
Rn	222	2.36E-12
Ru	100	7.95E-02
Ru	101	9.02E+01
Ru	102	7.82E+01
Ru	103	4.41E+00
Ru	104	3.93E+01
Ru	105	8.22E-03
Ru	106	6.13E+00
Ru	107	2.78E-05
Ru	108	1.43E-05
Ru	109	9.80E-07
Ru	110	2.40E-07
Ru	111	2.82E-08

Ru	112	1.73E-08
Ru	113	4.84E-09
Ru	114	1.35E-09
Ru	115	7.06E-10
Ru	116	5.47E-11
Ru	117	6.81E-12
Ru	118	1.26E-12
Ru	98	9.97E-10
Ru	99	3.77E-03
Sb	120	2.04E-12
Sb	120m	5.35E-10
Sb	121	4.74E-01
Sb	122	2.43E-06
Sb	122m	2.03E-10
Sb	123	6.02E-01
Sb	124	1.61E-04
Sb	124m	1.69E-09
Sb	125	8.05E-01
Sb	126	3.69E-04
Sb	126m	7.14E-07
Sb	127	2.94E-02
Sb	128	3.56E-04
Sb	128m	1.10E-04
Sb	129	4.86E-03
Sb	129m	5.78E-06
Sb	130	8.64E-04
Sb	130m	1.88E-04
Sb	131	1.81E-03
Sb	132	1.57E-04
Sb	132m	1.43E-04
Sb	133	1.63E-04
Sb	134	1.75E-07
Sb	134m	2.23E-06
Sb	135	2.07E-07
Sb	136	1.58E-08
Sb	137	1.32E-08
Sb	138	3.93E-11
Sb	139	2.10E-12
Se	74	4.80E-10
Se	75	1.48E-12
Se	76	1.08E-05
Se	77	1.48E-01
Se	77m	1.74E-10
Se	78	3.43E-01
Se	79	6.90E-01
Se	79m	3.47E-06
Se	80	1.75E+00
Se	81	6.59E-05
Se	81m	1.32E-05
Se	82	4.42E+00
Se	83	1.93E-04
Se	83m	8.07E-07
Se	84	5.88E-05
Se	85	1.04E-05
Se	86	6.06E-06
Se	87	1.38E-06
Se	88	1.93E-07
Se	89	1.20E-08
Se	90	1.25E-09
Se	91	2.27E-10
Se	92	7.43E-12
Sm	145	1.74E-12
Sm	146	6.81E-06
Sm	147	1.25E+01
Sm	148	7.27E-02
Sm	149	2.83E+01
Sm	150	9.93E-02
Sm	151	1.15E+01
Sm	152	7.64E+00
Sm	153	1.78E-02
Sm	154	2.33E+00

Sm	155	3.46E-05
Sm	156	4.40E-04
Sm	157	3.04E-06
Sm	158	1.02E-06
Sm	159	1.37E-08
Sm	160	3.96E-09
Sm	161	4.67E-10
Sm	162	4.55E-11
Sm	163	7.96E-12
Sm	164	1.14E-12
Sn	112	6.08E-12
Sn	114	1.69E-07
Sn	115	2.29E-02
Sn	116	6.43E-04
Sn	117	4.58E-01
Sn	117m	2.48E-05
Sn	118	4.73E-01
Sn	119	4.75E-01
Sn	119m	7.16E-03
Sn	120	4.90E-01
Sn	121	1.02E-03
Sn	121m	3.34E-02
Sn	122	5.74E-01
Sn	123	8.85E-03
Sn	123m	3.03E-05
Sn	124	8.73E-01
Sn	125	6.40E-03
Sn	125m	8.63E-06
Sn	126	1.53E+00
Sn	127	3.91E-04
Sn	127m	8.48E-06
Sn	128	6.13E-04
Sn	128m	5.35E-07
Sn	129	2.46E-05
Sn	129m	3.97E-05
Sn	130	7.02E-05
Sn	130m	3.20E-05
Sn	131	1.57E-05
Sn	131m	1.57E-05
Sn	132	1.28E-05
Sn	133	1.18E-07
Sn	134	1.73E-08
Sn	135	6.75E-10
Sn	136	1.93E-11
Sn	137	1.93E-12
Sr	100	4.75E-09
Sr	101	3.73E-10
Sr	102	2.00E-11
Sr	84	1.16E-08
Sr	85	1.87E-10
Sr	86	2.84E-03
Sr	87	1.79E-05
Sr	87m	8.42E-10
Sr	88	5.08E+01
Sr	89	6.48E+00
Sr	90	8.15E+01
Sr	91	6.60E-02
Sr	92	1.92E-02
Sr	93	9.35E-04
Sr	94	1.54E-04
Sr	95	4.41E-05
Sr	96	1.54E-06
Sr	97	3.04E-07
Sr	98	2.37E-07
Sr	99	2.33E-08
Tb	157	5.24E-10
Tb	158	3.20E-08
Tb	159	6.03E-02
Tb	160	2.29E-05
Tb	161	1.08E-04
Tb	162	2.79E-08

Tb	163	3.72E-08
Tb	164	3.25E-09
Tb	165	1.29E-09
Tb	166	1.60E-10
Tb	167	7.77E-11
Tb	168	1.79E-11
Tb	169	2.06E-12
Tb	170	1.03E-12
Tc	100	5.41E-08
Tc	101	1.69E-03
Tc	102	9.04E-06
Tc	102m	7.17E-07
Tc	103	7.04E-05
Tc	104	9.48E-04
Tc	105	2.34E-04
Tc	106	9.00E-06
Tc	107	2.60E-06
Tc	108	2.64E-07
Tc	109	2.26E-08
Tc	110	1.35E-08
Tc	111	1.66E-09
Tc	112	5.50E-10
Tc	113	9.02E-11
Tc	114	1.48E-11
Tc	115	1.46E-12
Tc	97	4.14E-10
Tc	97m	4.70E-11
Tc	98	2.33E-05
Tc	99	1.04E+02
Tc	99m	4.34E-02
Te	121	1.69E-12
Te	121m	6.36E-12
Te	122	2.33E-04
Te	123	1.69E-07
Te	123m	3.87E-08
Te	124	1.35E-03
Te	125	2.18E-01
Te	125m	9.65E-03
Te	126	3.97E-02
Te	127	3.05E-03
Te	127m	1.37E-01
Te	128	8.23E+00
Te	129	1.22E-03
Te	129m	1.48E-01
Te	130	4.04E+01
Te	131	1.97E-03
Te	131m	2.34E-02
Te	132	6.03E-01
Te	133	1.33E-03
Te	133m	5.71E-03
Te	134	8.61E-03
Te	135	3.29E-05
Te	136	1.36E-05
Te	137	6.16E-07
Te	138	8.80E-08
Te	139	3.25E-09
Te	140	2.30E-09
Te	141	6.17E-11
Te	142	1.13E-12
Tm	168	1.15E-11
Tm	169	7.18E-05
Tm	170	3.51E-08
Tm	171	1.58E-05
Tm	172	1.70E-07
Xe	126	2.22E-07
Xe	127	4.67E-11
Xe	128	2.22E-03
Xe	129	8.97E-07
Xe	129m	1.45E-09
Xe	130	8.83E-03
Xe	131	6.54E+01

Xe	131m	1.62E-02
Xe	132	1.00E+02
Xe	133	1.50E+00
Xe	133m	1.80E-02
Xe	134	1.77E+02
Xe	134m	4.22E-09
Xe	135	1.09E-01
Xe	135m	5.48E-04
Xe	136	1.47E+02
Xe	137	7.11E-04
Xe	138	2.68E-03
Xe	139	1.01E-04
Xe	140	2.56E-05
Xe	141	1.25E-06
Xe	142	3.67E-07
Xe	143	1.16E-08
Xe	144	1.01E-08
Xe	145	1.46E-10
Xe	146	2.08E-11
Y	100	2.59E-07
Y	101	6.81E-08
Y	102	3.71E-08
Y	103	1.39E-09
Y	104	1.44E-10
Y	105	1.19E-11
Y	87	1.55E-12
Y	88	1.52E-07
Y	89	6.13E+01
Y	89m	2.24E-09
Y	90	2.06E-02
Y	90m	2.63E-08
Y	91	9.59E+00
Y	91m	3.34E-03
Y	92	2.53E-02
Y	93	7.83E-02
Y	93m	6.02E-07
Y	94	2.45E-03
Y	95	1.36E-03
Y	96	8.14E-06
Y	96m	6.00E-06
Y	97	4.33E-06
Y	97m	7.67E-07
Y	98	4.44E-07
Y	98m	8.91E-07
Y	99	1.30E-06
Yb	170	5.83E-08
Yb	171	6.68E-06
Yb	172	3.36E-05
Zn	66	1.19E-05
Zn	67	4.12E-05
Zn	68	6.85E-05
Zn	69	8.28E-09
Zn	69m	1.24E-10
Zn	70	1.95E-04
Zn	71	1.13E-09
Zn	71m	4.22E-09
Zn	72	3.19E-06
Zn	73	1.36E-09
Zn	74	1.31E-08
Zn	75	3.53E-09
Zn	76	5.65E-09
Zn	77	2.63E-09
Zn	78	1.86E-09
Zn	79	5.80E-10
Zn	80	6.49E-11
Zn	81	4.54E-12
Zr	100	1.51E-05
Zr	101	2.94E-06
Zr	102	2.57E-06
Zr	103	3.80E-07
Zr	104	8.42E-08

```
Zr      105     2.50E-08
Zr      106     2.90E-11
Zr      107     2.80E-12
Zr      89      6.60E-11
Zr      90      2.04E+00
Zr      91      7.72E+01
Zr      92      9.08E+01
Zr      93      9.74E+01
Zr      94      9.98E+01
Zr      95      1.24E+01
Zr      96      1.03E+02
Zr      97      1.29E-01
Zr      98      6.39E-05
Zr      99      4.43E-06

/CORE HPR_MOC ACTIVITY FISSION
*Isotope Activity(Ci)
Ac      224     2.22E-15
Ac      225     2.05E-08
Ac      226     3.23E-10
Ac      227     2.80E-06
Ac      228     3.56E-08
Ag      106     5.15E-10
Ag      106m    9.77E-10
Ag      107m    9.73E-08
Ag      108     3.88E-04
Ag      108m    3.64E-07
Ag      109m    2.95E+03
Ag      110     4.85E+00
Ag      110m    1.42E-01
Ag      111     1.41E+03
Ag      111m    1.42E+03
Ag      112     1.19E+03
Ag      113     7.34E+02
Ag      113m    1.07E+03
Ag      114     9.55E+02
Ag      115     9.89E+02
Ag      115m    4.19E+01
Ag      116     9.59E+02
Ag      116m    3.86E+01
Ag      117     8.48E+02
Ag      117m    9.95E+01
Ag      118     7.47E+02
Ag      118m    2.75E+02
Ag      119     7.43E+02
Ag      120     3.98E+02
Ag      120m    1.57E+02
Ag      121     3.63E+02
Ag      122     9.38E+01
Ag      122m    8.37E+01
Ag      123     8.52E+01
Ag      124     4.56E+01
Ag      125     7.96E+00
Ag      126     1.56E+00
Ag      127     2.38E-01
Ag      128     3.26E-02
Ag      129     5.45E-03
Ag      130     2.09E-01
As      72      9.03E-10
As      73      6.91E-08
As      74      6.54E-06
As      76      5.98E-02
As      77      4.43E+02
As      78      1.09E+03
As      79      2.16E+03
As      80      5.38E+03
As      81      8.02E+03
As      82      1.04E+04
As       82m    1.52E+03
As      83      1.41E+04
```

As	84	1.02E+04
As	85	9.55E+03
As	86	1.98E+04
As	87	1.73E+03
As	88	4.14E+03
As	89	2.06E+01
As	90	5.42E-01
As	91	8.41E-02
As	92	6.59E-03
At	217	2.05E-08
At	218	7.27E-11
Ba	131	3.46E-11
Ba	133	1.50E-07
Ba	135m	3.08E-03
Ba	136m	3.47E+01
Ba	137m	1.15E+04
Ba	139	2.66E+05
Ba	140	2.57E+05
Ba	141	2.43E+05
Ba	142	2.35E+05
Ba	143	2.25E+05
Ba	144	1.78E+05
Ba	145	8.90E+04
Ba	146	4.48E+04
Ba	147	1.27E+04
Ba	148	1.97E+03
Ba	149	2.41E+02
Ba	150	2.45E+01
Ba	151	3.89E+00
Ba	152	6.18E-02
Ba	153	2.96E-03
Bi	210	1.33E-08
Bi	211	2.50E-06
Bi	212	1.51E-05
Bi	213	2.05E-08
Bi	214	3.63E-07
Br	77	5.76E-09
Br	77m	4.89E-09
Br	78	8.30E-07
Br	79m	7.46E-05
Br	80	8.33E-03
Br	80m	5.54E-03
Br	82	8.65E+00
Br	82m	6.13E+00
Br	83	2.23E+04
Br	84	4.11E+04
Br	84m	6.71E+02
Br	85	5.26E+04
Br	86	7.35E+04
Br	87	8.39E+04
Br	88	7.48E+04
Br	89	5.14E+04
Br	90	2.80E+04
Br	91	1.12E+04
Br	92	1.92E+03
Br	93	7.13E+02
Br	94	3.85E+01
Br	95	6.51E-01
Br	96	2.08E-01
Br	97	2.98E-03
Cd	107	1.23E-11
Cd	109	1.54E-07
Cd	111m	8.05E-05
Cd	113	1.98E-13
Cd	113m	1.24E+00
Cd	115	9.63E+02
Cd	115m	5.72E+01
Cd	117	7.96E+02
Cd	117m	1.76E+02
Cd	118	9.94E+02
Cd	119	6.61E+02

Cd	119m	3.27E+02
Cd	120	9.83E+02
Cd	121	6.20E+02
Cd	121m	2.82E+02
Cd	122	9.67E+02
Cd	123	7.73E+02
Cd	124	7.23E+02
Cd	125	3.26E+02
Cd	126	3.19E+02
Cd	127	2.77E+02
Cd	128	1.19E+02
Cd	129	2.40E+00
Cd	130	2.73E+03
Cd	131	5.03E+02
Cd	132	7.38E-01
Ce	137	9.78E-09
Ce	139	4.86E-02
Ce	139m	1.89E-02
Ce	141	2.43E+05
Ce	143	2.43E+05
Ce	144	1.90E+05
Ce	145	1.63E+05
Ce	146	1.27E+05
Ce	147	8.38E+04
Ce	148	6.92E+04
Ce	149	3.66E+04
Ce	150	2.04E+04
Ce	151	6.14E+03
Ce	152	1.66E+03
Ce	153	3.08E+02
Ce	154	3.71E+01
Ce	155	3.60E+00
Ce	156	2.28E-01
Ce	157	9.16E-03
Co	65	1.60E-04
Co	66	4.20E-02
Co	67	1.30E-01
Co	68	1.51E-01
Co	69	1.41E-01
Co	70	9.48E-02
Co	71	5.18E-02
Co	72	2.00E-02
Co	73	8.27E-03
Co	74	1.23E-03
Co	75	1.75E-04
Cs	129	1.81E-12
Cs	131	1.10E-06
Cs	132	5.60E-02
Cs	134	7.52E+01
Cs	134m	2.54E+01
Cs	135	1.73E-01
Cs	135m	9.50E+00
Cs	136	3.12E+02
Cs	136m	1.34E+02
Cs	137	1.22E+04
Cs	138	2.77E+05
Cs	138m	7.95E+03
Cs	139	2.63E+05
Cs	140	2.40E+05
Cs	141	1.80E+05
Cs	142	1.19E+05
Cs	143	6.54E+04
Cs	144	2.33E+04
Cs	145	5.61E+03
Cs	146	8.24E+02
Cs	147	1.46E+02
Cs	148	1.06E+01
Cs	149	1.98E-01
Cs	150	1.97E-02
Cs	151	3.45E-03
Cu	66	4.50E-02

Cu	67	1.53E-01
Cu	68	2.49E-01
Cu	68m	3.63E-03
Cu	69	4.00E-01
Cu	70	6.32E-01
Cu	70m	1.07E-01
Cu	71	1.21E+00
Cu	72	2.45E+00
Cu	73	5.43E+00
Cu	74	5.92E+00
Cu	75	7.57E+00
Cu	76	6.91E+00
Cu	77	3.52E+00
Cu	78	9.66E-01
Cu	79	1.69E-01
Cu	80	1.71E-02
Dy	157	2.57E-13
Dy	159	7.78E-08
Dy	165	7.03E-01
Dy	165m	9.14E-04
Dy	166	4.47E-01
Dy	167	2.91E-01
Dy	168	1.75E-01
Dy	169	1.05E-01
Dy	170	5.47E-02
Dy	171	2.66E-02
Dy	172	3.24E-02
Er	163	7.78E-13
Er	165	3.28E-07
Er	167m	3.52E-02
Er	169	1.08E-01
Er	171	3.27E-02
Er	172	4.88E-02
Eu	149	1.27E-10
Eu	152	2.85E-02
Eu	152m	4.30E-01
Eu	154	3.24E+00
Eu	154m	6.88E-01
Eu	155	4.91E+02
Eu	156	9.41E+02
Eu	157	4.56E+02
Eu	158	2.35E+02
Eu	159	9.49E+01
Eu	160	3.64E+01
Eu	161	1.19E+01
Eu	162	3.44E+00
Eu	163	1.47E+00
Eu	164	5.74E-01
Eu	165	1.82E-01
Eu	166	4.84E-02
Eu	167	1.06E-02
Fe	65	1.60E-04
Fe	66	2.20E-02
Fe	67	4.34E-02
Fe	68	2.61E-02
Fe	69	9.24E-03
Fe	70	2.54E-03
Fe	71	4.49E-04
Fe	72	6.40E-05
Fr	221	2.05E-08
Fr	222	1.94E-14
Fr	223	3.86E-08
Ga	67	1.94E-13
Ga	68	2.92E-08
Ga	70	1.21E-04
Ga	72	3.12E+00
Ga	72m	1.08E-01
Ga	73	9.03E+00
Ga	74	2.18E+01
Ga	74m	4.77E-01
Ga	75	6.25E+01

Ga	76	2.14E+02
Ga	77	4.32E+02
Ga	78	7.10E+02
Ga	79	9.12E+02
Ga	80	5.91E+02
Ga	81	3.91E+02
Ga	82	2.60E+02
Ga	83	2.57E+01
Ga	84	3.59E+02
Ga	85	4.34E-01
Ga	86	1.05E+00
Gd	151	2.35E-08
Gd	152	1.43E-15
Gd	153	1.09E-04
Gd	159	9.50E+01
Gd	161	1.27E+01
Gd	162	4.24E+00
Gd	163	2.16E+00
Gd	164	1.17E+00
Gd	165	5.91E-01
Gd	166	3.09E-01
Gd	167	1.40E-01
Gd	168	4.83E-02
Gd	169	1.09E-02
Ge	69	5.10E-13
Ge	71	3.17E-07
Ge	71m	1.14E-07
Ge	73m	8.90E+00
Ge	75	6.28E+01
Ge	75m	2.56E+00
Ge	77	4.74E+02
Ge	77m	5.84E+00
Ge	78	1.08E+03
Ge	79	1.47E+03
Ge	79m	6.16E+02
Ge	80	4.83E+03
Ge	81	5.43E+03
Ge	81m	1.62E+02
Ge	82	5.70E+03
Ge	83	1.96E+03
Ge	84	1.44E+03
Ge	85	2.16E+02
Ge	86	1.89E+04
Ge	87	7.00E+01
Ge	88	1.80E+00
Ge	89	1.76E-02
Ho	161	7.13E-10
Ho	161m	5.96E-11
Ho	162	1.28E-08
Ho	162m	1.31E-08
Ho	163	5.46E-11
Ho	163m	3.57E-08
Ho	164	3.48E-06
Ho	164m	2.40E-06
Ho	166	4.49E-01
Ho	166m	1.41E-07
Ho	167	2.92E-01
Ho	168	1.76E-01
Ho	169	1.08E-01
Ho	170	5.66E-02
Ho	170m	1.90E-03
Ho	171	3.24E-02
Ho	172	4.78E-02
I	121	1.12E-15
I	123	1.61E-08
I	124	3.10E-14
I	125	1.24E-07
I	126	1.94E-03
I	128	9.46E+00
I	129	2.48E-03
I	130	2.42E+01

I	130m	1.32E+01
I	131	1.25E+05
I	132	1.88E+05
I	132m	3.96E+02
I	133	2.80E+05
I	133m	1.91E+04
I	134	3.26E+05
I	134m	1.49E+04
I	135	2.67E+05
I	136	1.23E+05
I	136m	5.47E+04
I	137	1.33E+05
I	138	7.06E+04
I	139	3.63E+04
I	140	9.19E+03
I	141	2.42E+03
I	142	3.68E+02
I	143	3.06E+01
I	144	4.83E-01
In	111	4.13E-14
In	111m	8.06E-15
In	112	9.13E-08
In	112m	7.42E-08
In	113m	3.61E-11
In	114	9.97E-04
In	114m	6.00E-04
In	115	3.24E-12
In	115m	9.75E+02
In	116	1.03E+00
In	116m	1.70E+00
In	117	5.85E+02
In	117m	7.32E+02
In	118	9.94E+02
In	118m	7.80E-02
In	119	4.33E+02
In	119m	5.98E+02
In	120	9.92E+02
In	120m	1.90E+01
In	121	5.99E+02
In	121m	4.36E+02
In	122	1.03E+03
In	122m	1.19E+02
In	123	5.75E+02
In	123m	5.81E+02
In	124	9.72E+02
In	124m	2.49E+02
In	125	6.11E+02
In	125m	5.59E+02
In	126	6.54E+02
In	126m	3.35E+02
In	127	1.95E+03
In	127m	6.50E+02
In	128	8.98E+02
In	128m	7.74E+02
In	129	1.31E+03
In	129m	1.21E+03
In	130	3.40E+03
In	130m	8.06E+02
In	131	6.02E+02
In	131m	3.57E+02
In	132	4.64E+02
In	133	3.68E+01
In	134	2.12E+00
In	135	7.50E-02
Kr	100	3.74E-02
Kr	79	2.69E-09
Kr	79m	1.35E-09
Kr	81	3.73E-10
Kr	81m	9.48E-06
Kr	83m	2.23E+04
Kr	85	1.44E+03

Kr	85m	5.27E+04
Kr	87	1.03E+05
Kr	88	1.42E+05
Kr	89	1.79E+05
Kr	90	1.89E+05
Kr	91	1.38E+05
Kr	92	7.25E+04
Kr	93	2.36E+04
Kr	94	6.16E+03
Kr	95	8.95E+02
Kr	96	1.36E+03
Kr	97	5.40E+00
Kr	98	5.35E+01
Kr	99	8.85E-02
La	133	5.68E-14
La	135	6.67E-08
La	137	1.09E-08
La	138	1.45E-11
La	140	2.58E+05
La	141	2.44E+05
La	142	2.38E+05
La	143	2.42E+05
La	144	2.24E+05
La	145	1.60E+05
La	146	7.51E+04
La	146m	3.03E+04
La	147	4.63E+04
La	148	2.02E+04
La	149	6.32E+03
La	150	1.35E+03
La	151	2.31E+02
La	152	2.61E+01
La	153	2.72E+00
La	154	1.16E-01
La	155	3.29E-03
Lu	172	1.11E-13
Lu	172m	5.63E-14
Mo	100	5.26E-14
Mo	101	2.21E+05
Mo	102	1.89E+05
Mo	103	1.40E+05
Mo	104	9.06E+04
Mo	105	5.32E+04
Mo	106	2.56E+04
Mo	107	1.15E+04
Mo	108	3.91E+03
Mo	109	1.53E+03
Mo	110	4.67E+02
Mo	111	8.81E+01
Mo	112	1.12E+01
Mo	113	1.25E+00
Mo	114	5.11E-02
Mo	115	4.12E-03
Mo	93	1.22E-12
Mo	93m	5.20E-10
Mo	99	2.56E+05
Nb	100	2.51E+05
Nb	100m	1.19E+04
Nb	101	2.15E+05
Nb	102	1.32E+05
Nb	102m	3.41E+04
Nb	103	1.00E+05
Nb	104	2.50E+04
Nb	104m	1.74E+04
Nb	105	1.81E+04
Nb	106	3.36E+03
Nb	107	7.74E+02
Nb	108	9.03E+01
Nb	109	3.40E+01
Nb	110	1.68E+00
Nb	111	1.21E+00

Nb	112	1.22E-02
Nb	113	2.17E-03
Nb	90	1.70E-13
Nb	91	1.18E-11
Nb	91m	2.36E-14
Nb	92	5.31E-14
Nb	92m	2.09E-08
Nb	93m	1.04E-02
Nb	94	1.17E-06
Nb	94m	1.06E-02
Nb	95	2.66E+05
Nb	95m	2.88E+03
Nb	96	3.02E+01
Nb	97	2.50E+05
Nb	97m	2.37E+05
Nb	98	2.43E+05
Nb	98m	1.24E+03
Nb	99	1.57E+05
Nb	99m	9.96E+04
Nd	140	2.76E-12
Nd	141	3.55E-06
Nd	141m	6.12E-07
Nd	144	7.75E-11
Nd	147	9.50E+04
Nd	149	4.75E+04
Nd	150	5.53E-15
Nd	151	1.92E+04
Nd	152	1.23E+04
Nd	153	7.47E+03
Nd	154	3.29E+03
Nd	155	1.26E+03
Nd	156	4.30E+02
Nd	157	9.72E+01
Nd	158	1.77E+01
Nd	159	2.05E+00
Nd	160	1.72E-01
Nd	161	8.15E-03
Ni	65	1.60E-04
Ni	66	4.50E-02
Ni	67	1.53E-01
Ni	68	2.45E-01
Ni	69	3.70E-01
Ni	70	5.56E-01
Ni	71	6.96E-01
Ni	72	9.38E-01
Ni	73	8.87E-01
Ni	74	4.57E-01
Ni	75	1.62E-01
Ni	76	5.82E-02
Ni	77	8.13E-03
Ni	78	1.08E-03
Pb	207m	1.59E-12
Pb	209	2.05E-08
Pb	210	1.36E-08
Pb	211	2.50E-06
Pb	212	1.51E-05
Pb	214	3.63E-07
Pd	101	3.73E-11
Pd	103	1.68E-05
Pd	107	2.87E-03
Pd	107m	2.33E-01
Pd	109	2.95E+03
Pd	109m	7.18E-02
Pd	111	1.43E+03
Pd	111m	6.21E-01
Pd	112	1.19E+03
Pd	113	1.12E+03
Pd	114	9.25E+02
Pd	115	9.70E+02
Pd	116	7.94E+02
Pd	117	7.45E+02

Pd	118	5.01E+02
Pd	119	2.21E+02
Pd	120	1.83E+02
Pd	121	3.59E+01
Pd	122	1.00E+01
Pd	123	2.14E+00
Pd	124	3.54E-01
Pm	143	3.00E-14
Pm	144	5.81E-11
Pm	145	1.75E-08
Pm	146	1.05E-02
Pm	147	3.96E+04
Pm	148	1.16E+02
Pm	148m	9.22E+01
Pm	149	4.69E+04
Pm	150	1.84E+00
Pm	151	1.92E+04
Pm	152	1.23E+04
Pm	152m	5.52E+01
Pm	153	7.81E+03
Pm	154	3.51E+03
Pm	154m	2.18E+02
Pm	155	1.83E+03
Pm	156	8.20E+02
Pm	157	3.28E+02
Pm	158	1.02E+02
Pm	159	2.76E+01
Pm	160	4.98E+00
Pm	161	6.80E-01
Pm	162	5.76E-02
Pm	163	6.18E-03
Po	210	7.27E-09
Po	211	6.89E-09
Po	212	9.65E-06
Po	213	2.00E-08
Po	214	5.62E-07
Po	215	2.50E-06
Po	216	1.51E-05
Po	218	3.63E-07
Pr	139	3.21E-10
Pr	140	2.86E-02
Pr	142	5.39E+01
Pr	142m	1.89E+01
Pr	143	2.43E+05
Pr	144	1.90E+05
Pr	144m	1.82E+03
Pr	145	1.63E+05
Pr	146	1.27E+05
Pr	147	9.50E+04
Pr	148	7.06E+04
Pr	148m	1.46E+03
Pr	149	4.72E+04
Pr	150	2.91E+04
Pr	151	1.63E+04
Pr	152	6.92E+03
Pr	153	2.84E+03
Pr	154	6.15E+02
Pr	155	1.58E+02
Pr	156	2.43E+01
Pr	157	3.08E+00
Pr	158	2.00E-01
Pr	159	9.47E-03
Ra	222	1.98E-07
Ra	223	2.50E-06
Ra	224	1.51E-05
Ra	225	2.13E-08
Ra	226	3.69E-07
Ra	227	3.24E-07
Ra	228	2.98E-12
Rb	100	1.30E+03
Rb	101	2.45E-01

Rb	102	2.27E-02
Rb	81	5.50E-10
Rb	83	1.50E-05
Rb	84	1.50E-03
Rb	86	1.64E+01
Rb	86m	2.32E+00
Rb	87	3.11E-06
Rb	88	1.43E+05
Rb	89	1.88E+05
Rb	90	1.95E+05
Rb	90m	3.34E+04
Rb	91	2.24E+05
Rb	92	1.95E+05
Rb	93	1.52E+05
Rb	94	7.80E+04
Rb	95	3.73E+04
Rb	96	1.29E+04
Rb	97	1.95E+03
Rb	98	5.06E+02
Rb	99	7.36E+01
Rh	101	3.62E-07
Rh	101m	8.32E-09
Rh	102	1.05E-02
Rh	102m	1.24E-03
Rh	103m	1.41E+05
Rh	104	2.02E+02
Rh	104m	1.58E+01
Rh	105	5.34E+04
Rh	105m	1.57E+04
Rh	106	2.03E+04
Rh	106m	1.58E-01
Rh	107	1.30E+04
Rh	108	5.48E+03
Rh	108m	2.12E+00
Rh	109	2.95E+03
Rh	110	7.86E+00
Rh	110m	2.14E+03
Rh	111	1.43E+03
Rh	112	1.19E+03
Rh	113	1.06E+03
Rh	114	7.01E+02
Rh	115	5.34E+02
Rh	116	2.58E+02
Rh	117	1.25E+02
Rh	118	5.42E+01
Rh	119	1.37E+01
Rh	120	3.06E+00
Rh	121	4.90E-01
Rh	122	6.14E-02
Rn	217	1.43E-12
Rn	218	1.98E-07
Rn	219	2.50E-06
Rn	220	1.51E-05
Rn	222	3.63E-07
Ru	103	1.42E+05
Ru	105	5.53E+04
Ru	106	2.03E+04
Ru	107	1.30E+04
Ru	108	5.48E+03
Ru	109	2.94E+03
Ru	110	2.13E+03
Ru	111	1.35E+03
Ru	112	9.98E+02
Ru	113	6.05E+02
Ru	114	2.57E+02
Ru	115	9.37E+01
Ru	116	2.61E+01
Ru	117	4.63E+00
Ru	118	9.82E-01
Ru	119	9.68E-02
Ru	120	9.31E-03

Ru	97	1.11E-12
Sb	117	1.39E-13
Sb	118	3.91E-10
Sb	118m	6.28E-10
Sb	119	3.18E-07
Sb	120	2.01E-04
Sb	120m	1.01E-04
Sb	122	9.54E-01
Sb	122m	7.48E-02
Sb	124	2.83E+00
Sb	124m	1.65E+00
Sb	125	8.35E+02
Sb	126	3.10E+01
Sb	126m	5.57E+01
Sb	127	7.86E+03
Sb	128	9.69E+02
Sb	128m	1.55E+04
Sb	129	2.68E+04
Sb	129m	4.76E+02
Sb	130	3.17E+04
Sb	130m	4.32E+04
Sb	131	1.13E+05
Sb	132	8.00E+04
Sb	132m	4.98E+04
Sb	133	9.24E+04
Sb	134	1.89E+04
Sb	134m	1.86E+04
Sb	135	1.03E+04
Sb	136	1.42E+03
Sb	137	2.42E+03
Sb	138	1.91E+01
Sb	139	1.34E+00
Se	73	2.74E-15
Se	73m	1.59E-15
Se	75	2.16E-08
Se	77m	1.47E+00
Se	79	1.06E-02
Se	79m	2.11E+03
Se	81	8.30E+03
Se	81m	5.34E+02
Se	83	1.96E+04
Se	83m	1.57E+03
Se	84	4.04E+04
Se	85	4.38E+04
Se	86	5.57E+04
Se	87	3.25E+04
Se	88	1.62E+04
Se	89	3.70E+03
Se	90	9.76E+02
Se	91	1.04E+02
Se	92	9.80E+00
Se	93	6.91E-01
Se	94	2.73E-02
Sm	145	4.62E-09
Sm	146	1.62E-10
Sm	147	2.88E-07
Sm	148	2.51E-14
Sm	151	3.04E+02
Sm	153	7.84E+03
Sm	155	1.88E+03
Sm	156	9.41E+02
Sm	157	4.53E+02
Sm	158	2.29E+02
Sm	159	8.57E+01
Sm	160	2.91E+01
Sm	161	6.82E+00
Sm	162	1.32E+00
Sm	163	3.15E-01
Sm	164	6.42E-02
Sm	165	8.17E-03
Sn	113	2.53E-11

Sn	113m	3.14E-11
Sn	117m	2.04E+00
Sn	119m	2.68E+01
Sn	121	9.75E+02
Sn	121m	2.25E+00
Sn	123	7.28E+01
Sn	123m	1.16E+03
Sn	125	6.94E+02
Sn	125m	1.37E+03
Sn	126	1.89E-02
Sn	127	4.59E+03
Sn	127m	3.04E+03
Sn	128	1.52E+04
Sn	128m	7.26E+03
Sn	129	1.61E+04
Sn	129m	8.40E+03
Sn	130	2.73E+04
Sn	130m	2.73E+04
Sn	131	2.42E+04
Sn	131m	2.32E+04
Sn	132	2.76E+04
Sn	133	6.86E+03
Sn	134	1.39E+03
Sn	135	1.06E+02
Sn	136	6.40E+00
Sn	137	8.37E-01
Sr	100	2.65E+03
Sr	101	3.54E+02
Sr	102	3.21E+01
Sr	103	7.48E-01
Sr	104	8.89E-02
Sr	105	1.65E-02
Sr	83	7.98E-11
Sr	85	4.42E-06
Sr	85m	2.41E-06
Sr	87m	1.08E-02
Sr	89	1.88E+05
Sr	90	1.13E+04
Sr	91	2.36E+05
Sr	92	2.42E+05
Sr	93	2.55E+05
Sr	94	2.45E+05
Sr	95	2.19E+05
Sr	96	1.70E+05
Sr	97	8.26E+04
Sr	98	4.18E+04
Sr	99	9.86E+03
Tb	155	7.11E-10
Tb	156	4.15E-08
Tb	156m	3.76E-09
Tb	157	1.68E-08
Tb	158	4.02E-07
Tb	158m	2.37E-05
Tb	160	2.58E-01
Tb	161	1.27E+01
Tb	162	4.26E+00
Tb	163	2.20E+00
Tb	164	1.24E+00
Tb	165	6.97E-01
Tb	166	4.34E-01
Tb	167	2.71E-01
Tb	168	1.46E-01
Tb	169	6.88E-02
Tb	170	2.29E-02
Tb	171	6.18E-03
Tc	100	3.95E+02
Tc	101	2.21E+05
Tc	102	1.89E+05
Tc	102m	3.04E+02
Tc	103	1.42E+05
Tc	104	9.38E+04

Tc	105	5.53E+04
Tc	106	2.69E+04
Tc	107	1.30E+04
Tc	108	5.34E+03
Tc	109	2.72E+03
Tc	110	1.50E+03
Tc	111	5.84E+02
Tc	112	1.98E+02
Tc	113	5.63E+01
Tc	114	9.79E+00
Tc	115	1.96E+00
Tc	116	1.98E-01
Tc	117	8.28E-03
Tc	118	1.99E-03
Tc	95	2.88E-13
Tc	96	1.77E-13
Tc	97	3.62E-13
Tc	97m	6.96E-07
Tc	98	2.02E-08
Tc	99	1.79E+00
Tc	99m	2.29E+05
Te	119	9.23E-15
Te	121	9.50E-08
Te	121m	4.18E-08
Te	123m	3.45E-04
Te	125m	1.76E+02
Te	127	8.05E+03
Te	127m	1.29E+03
Te	128	2.61E-15
Te	129	2.56E+04
Te	129m	4.47E+03
Te	131	1.13E+05
Te	131m	1.68E+04
Te	132	1.86E+05
Te	133	1.51E+05
Te	133m	1.46E+05
Te	134	2.89E+05
Te	135	1.45E+05
Te	136	6.44E+04
Te	137	2.04E+04
Te	138	5.14E+03
Te	139	7.61E+02
Te	140	6.11E+02
Te	141	2.32E+01
Te	142	4.49E-01
Tl	206	1.78E-14
Tl	207	2.49E-06
Tl	208	5.41E-06
Tl	209	4.50E-10
Tl	210	7.63E-11
Tm	166	3.44E-13
Tm	167	2.18E-10
Tm	168	9.57E-08
Tm	170	2.09E-04
Tm	171	1.72E-02
Tm	172	4.88E-02
Xe	125	7.10E-11
Xe	125m	1.79E-11
Xe	127	1.32E-06
Xe	127m	2.39E-07
Xe	129m	1.66E-04
Xe	131m	1.36E+03
Xe	133	2.81E+05
Xe	133m	8.09E+03
Xe	134m	1.23E+03
Xe	135	2.76E+05
Xe	135m	4.99E+04
Xe	137	2.56E+05
Xe	138	2.60E+05
Xe	139	2.07E+05
Xe	140	1.52E+05

Xe	141	5.80E+04
Xe	142	2.37E+04
Xe	143	3.05E+03
Xe	144	6.87E+02
Xe	145	6.06E+01
Xe	146	4.36E+00
Xe	147	1.44E-01
Y	100	3.97E+04
Y	101	1.69E+04
Y	102	1.14E+04
Y	103	6.63E+02
Y	104	8.65E+01
Y	105	1.45E+01
Y	106	2.27E-02
Y	107	5.12E-03
Y	108	2.05E-05
Y	87	6.99E-07
Y	87m	3.66E-11
Y	88	2.12E-03
Y	89m	1.82E+01
Y	90	1.12E+04
Y	90m	2.88E-01
Y	91	2.36E+05
Y	91m	1.39E+05
Y	92	2.44E+05
Y	93	2.59E+05
Y	93m	8.92E+04
Y	94	2.62E+05
Y	95	2.63E+05
Y	96	1.79E+05
Y	96m	7.35E+04
Y	97	1.35E+05
Y	97m	7.63E+04
Y	98	9.34E+04
Y	98m	5.13E+04
Y	99	1.01E+05
Yb	169	5.04E-11
Yb	169m	5.97E-12
Zn	69	4.00E-01
Zn	69m	4.10E-04
Zn	71	1.22E+00
Zn	71m	4.71E-02
Zn	72	2.99E+00
Zn	73	8.93E+00
Zn	74	2.10E+01
Zn	75	5.21E+01
Zn	76	1.47E+02
Zn	77	1.85E+02
Zn	78	1.83E+02
Zn	79	8.33E+01
Zn	80	1.70E+01
Zn	81	1.98E+00
Zn	82	7.71E-01
Zn	83	4.30E-02
Zr	100	2.40E+05
Zr	101	1.43E+05
Zr	102	9.79E+04
Zr	103	3.20E+04
Zr	104	7.62E+03
Zr	105	4.47E+03
Zr	106	1.14E+01
Zr	107	1.97E+00
Zr	108	1.05E-01
Zr	109	2.96E-02
Zr	110	1.06E-03
Zr	88	4.33E-10
Zr	89	2.97E-05
Zr	89m	9.89E-07
Zr	90m	3.83E-02
Zr	93	2.45E-01
Zr	95	2.67E+05

```
Zr      96      1.91E-14
Zr      97      2.50E+05
Zr      98      2.40E+05
Zr      99      2.40E+05

/CORE-DESC HPR_EOC
 data file:  INL-A_core_t6-depl_ce_v7.1.ii.json
 response name:  AT_POWER
 user-selected time index:  13
 user-selected time(s):  157793870.0
 cutoff for grams:  1e-12
 cutoff for curies:  1e-15
 mass vs. time for response:
    index      time(s)      mass(g) target
     0000  0.00000e+00  5.18587e+06
     0001  2.59200e+05  5.18587e+06
     0002  1.33655e+07  5.18587e+06
     0003  2.64718e+07  5.18586e+06
     0004  3.95781e+07  5.18586e+06
     0005  5.26844e+07  5.18586e+06
     0006  6.57906e+07  5.18586e+06
     0007  7.88969e+07  5.18585e+06
     0008  9.20464e+07  5.18585e+06
     0009  1.05196e+08  5.18585e+06
     0010  1.18345e+08  5.18585e+06
     0011  1.31495e+08  5.18585e+06
     0012  1.44644e+08  5.18584e+06
     0013  1.57794e+08  5.18584e+06 <------
/END


/CORE HPR_EOC MASS ACTIVATION
*Isotope Mass(g)
B       10      1.02E-12
B       11      2.40E-10
Be      10      1.23E-06
Be      9       1.34E-08
C       12      4.63E-02
C       13      2.56E+00
C       14      3.61E-02
F       19      3.19E-04
H       1       5.28E-04
H       2       5.75E-05
H       3       1.15E-02
He      3       1.69E-03
He      4       1.13E+00
N       14      1.10E-05
N       15      4.47E-04
N       16      5.51E-10
Ne      20      1.88E-09
O       16      6.14E+05
O       17      2.49E+02
O       18      1.42E+03
O       19      7.87E-11


/CORE HPR_EOC ACTIVITY ACTIVATION
*Isotope Activity(Ci)
B       12      1.11E-07
Be      10      2.90E-08
Be      11      4.14E-08
Be      8       1.51E-08
C       14      1.62E-01
C       15      1.16E-01
Cr      66      1.06E-05
Cr      67      3.20E-06
F       20      1.95E-05
H       3       1.11E+02
He      6       5.49E-09
Li      8       7.22E-14
```

```
Mn      66      1.47E-03
Mn      67      1.32E-03
Mn      68      2.75E-04
Mn      69      3.64E-05
N       13      2.25E-11
N       16      5.45E+01
O       19      1.74E+00

/CORE HPR_EOC MASS ACTINIDE
*Isotope Mass(g)
Am      240     1.41E-12
Am      241     1.72E-03
Am      242     2.26E-08
Am      242m    1.17E-06
Am      243     1.80E-07
Cm      242     2.94E-06
Cm      243     3.25E-09
Cm      244     1.31E-09
Cm      245     3.09E-12
Np      235     1.18E-09
Np      236     5.77E-06
Np      236m    3.26E-08
Np      237     3.54E+01
Np      238     5.04E-04
Np      239     8.94E+00
Np      240     1.11E-06
Np      240m    2.16E-07
Pa      230     2.00E-10
Pa      231     4.41E-03
Pa      232     3.78E-08
Pa      233     1.20E-06
Pa      234     1.61E-09
Pa      234m    1.77E-09
Pa      235     7.49E-09
Pu      236     7.42E-06
Pu      237     6.68E-09
Pu      238     1.48E-01
Pu      239     4.76E+03
Pu      240     6.51E+00
Pu      241     2.80E-02
Pu      242     4.22E-05
Pu      243     1.44E-10
Th      227     4.90E-10
Th      228     2.24E-07
Th      229     5.34E-07
Th      230     9.48E-02
Th      231     3.79E-06
Th      232     6.77E-04
Th      233     1.85E-11
Th      234     5.31E-05
U       230     1.84E-11
U       232     2.07E-05
U       233     8.50E-03
U       234     6.83E+03
U       235     8.92E+05
U       235m    1.36E-04
U       236     2.34E+03
U       237     2.06E-01
U       238     3.65E+06
U       239     6.20E-02

/CORE HPR_EOC ACTIVITY ACTINIDE
*Isotope Activity(Ci)
Am      239     2.85E-11
Am      240     3.62E-07
Am      241     5.91E-03
Am      242     1.82E-02
Am      242m    1.22E-05
Am      243     3.59E-08
```

```
Am      244     2.12E-07
Am      244m    3.15E-06
Am      245     7.28E-13
Cm      241     4.48E-10
Cm      242     9.73E-03
Cm      243     1.64E-07
Cm      244     1.06E-07
Cm      245     5.31E-13
Np      234     1.06E-12
Np      235     1.66E-06
Np      236     5.71E-08
Np      236m    1.93E-02
Np      237     2.49E-02
Np      238     1.31E+02
Np      239     2.07E+06
Np      240     1.41E+01
Np      240m    2.34E+01
Np      241     4.37E-09
Pa      229     3.10E-09
Pa      230     6.54E-06
Pa      231     2.09E-04
Pa      232     1.61E-02
Pa      233     2.50E-02
Pa      234     3.22E-03
Pa      234m    1.23E+00
Pa      235     2.45E-01
Pu      236     3.93E-03
Pu      237     8.06E-05
Pu      237m    1.91E-05
Pu      238     2.53E+00
Pu      239     2.95E+02
Pu      240     1.48E+00
Pu      241     2.90E+00
Pu      242     1.67E-07
Pu      243     3.73E-04
Pu      245     7.28E-13
Th      226     5.03E-07
Th      227     1.51E-05
Th      228     1.83E-04
Th      229     1.14E-07
Th      230     1.96E-03
Th      231     2.01E+00
Th      232     7.42E-11
Th      233     6.68E-04
Th      234     1.23E+00
U       230     5.01E-07
U       231     4.35E-08
U       232     4.63E-04
U       233     8.19E-05
U       234     4.25E+01
U       235     1.93E+00
U       235m    4.18E+03
U       236     1.51E-01
U       237     1.68E+04
U       238     1.23E+00
U       239     2.08E+06

/CORE HPR_EOC MASS FISSION
*Isotope Mass(g)
Ac      225     2.16E-12
Ac      227     2.18E-07
Ag      107     3.58E-06
Ag      108     1.33E-12
Ag      108m    2.83E-07
Ag      109     3.14E+00
Ag      109m    1.19E-06
Ag      110     2.87E-09
Ag      110m    1.01E-04
Ag      111     9.19E-03
Ag      111m    9.26E-07
```

Ag	112	1.35E-04
Ag	113	1.43E-04
Ag	113m	7.44E-07
Ag	114	4.47E-08
Ag	115	1.21E-05
Ag	115m	7.68E-09
Ag	116	2.35E-06
Ag	116m	8.01E-09
Ag	117	6.42E-07
Ag	117m	5.56E-09
Ag	118	2.94E-08
Ag	118m	5.77E-09
Ag	119	1.65E-08
Ag	120	5.21E-09
Ag	120m	5.34E-10
Ag	121	3.04E-09
Ag	122	5.37E-10
Ag	122m	1.81E-10
Ag	123	2.79E-10
Ag	124	8.60E-11
Ag	125	1.47E-11
Ag	126	1.86E-12
As	73	3.85E-12
As	74	1.14E-10
As	75	4.56E-02
As	76	8.22E-08
As	77	4.21E-04
As	78	4.09E-05
As	79	8.17E-06
As	80	5.79E-07
As	81	1.91E-06
As	82	1.44E-06
As	82m	1.50E-07
As	83	1.38E-06
As	84	3.19E-07
As	85	1.45E-07
As	86	1.42E-07
As	87	7.43E-09
As	88	3.60E-09
As	89	9.56E-12
Ba	132	1.60E-06
Ba	133	1.15E-08
Ba	134	1.62E-01
Ba	135	3.22E-04
Ba	135m	1.57E-08
Ba	136	5.28E-01
Ba	136m	1.97E-10
Ba	137	1.91E+01
Ba	137m	4.97E-05
Ba	138	3.73E+02
Ba	139	1.63E-02
Ba	140	3.51E+00
Ba	141	3.33E-03
Ba	142	1.88E-03
Ba	143	4.12E-05
Ba	144	2.60E-05
Ba	145	4.92E-06
Ba	146	1.28E-06
Ba	147	1.48E-07
Ba	148	1.58E-08
Ba	149	1.09E-09
Ba	150	9.78E-11
Ba	151	1.35E-11
Bi	209	8.34E-11
Bi	210	1.13E-12
Bi	212	1.24E-11
Br	79	9.13E-04
Br	80	8.46E-11
Br	80m	7.45E-10
Br	81	6.51E+00
Br	82	1.54E-05

Br	82m	3.62E-08
Br	83	1.41E-03
Br	84	5.81E-04
Br	84m	1.81E-06
Br	85	6.87E-05
Br	86	3.07E-05
Br	87	3.59E-05
Br	88	9.47E-06
Br	89	1.78E-06
Br	90	4.28E-07
Br	91	4.87E-08
Br	92	5.35E-09
Br	93	5.97E-10
Br	94	2.26E-11
Cd	108	4.81E-07
Cd	109	6.19E-10
Cd	110	6.47E-03
Cd	111	1.53E+00
Cd	111m	6.62E-12
Cd	112	1.33E+00
Cd	113	1.21E+00
Cd	113m	1.24E-02
Cd	114	1.06E+00
Cd	115	1.90E-03
Cd	115m	2.25E-03
Cd	116	1.12E+00
Cd	117	7.43E-05
Cd	117m	2.21E-05
Cd	118	3.14E-05
Cd	119	1.13E-06
Cd	119m	4.57E-07
Cd	120	5.32E-07
Cd	121	8.99E-08
Cd	121m	2.52E-08
Cd	122	5.48E-08
Cd	123	1.77E-08
Cd	124	9.90E-09
Cd	125	2.45E-09
Cd	126	1.83E-09
Cd	127	1.15E-09
Cd	128	3.78E-10
Cd	129	7.42E-12
Cd	130	5.08E-09
Cd	131	3.95E-10
Ce	138	2.23E-08
Ce	139	2.10E-05
Ce	139m	3.12E-11
Ce	140	3.45E+02
Ce	141	8.53E+00
Ce	142	3.28E+02
Ce	143	3.66E-01
Ce	144	6.98E+01
Ce	145	3.79E-04
Ce	146	1.33E-03
Ce	147	6.15E-05
Ce	148	5.07E-05
Ce	149	2.56E-06
Ce	150	1.08E-06
Ce	151	1.44E-07
Ce	152	3.12E-08
Ce	153	4.08E-09
Ce	154	3.93E-10
Ce	155	2.33E-11
Ce	156	1.16E-12
Cs	131	1.39E-11
Cs	132	8.71E-07
Cs	133	3.61E+02
Cs	134	2.59E-01
Cs	134m	7.60E-06
Cs	135	3.61E+02
Cs	135m	3.90E-07

Cs	136	6.52E-03
Cs	136m	3.26E-08
Cs	137	3.25E+02
Cs	138	6.79E-03
Cs	138m	1.71E-05
Cs	139	1.80E-03
Cs	140	1.90E-04
Cs	141	5.59E-05
Cs	142	2.52E-06
Cs	143	1.48E-06
Cs	144	2.95E-07
Cs	145	4.22E-08
Cs	146	3.42E-09
Cs	147	4.36E-10
Cs	148	2.04E-11
Cu	65	1.01E-07
Cu	66	8.09E-11
Cu	67	2.03E-07
Cu	68	4.67E-11
Cu	68m	4.95E-12
Cu	69	4.19E-10
Cu	70	1.75E-10
Cu	70m	2.21E-11
Cu	71	1.49E-10
Cu	72	1.04E-10
Cu	73	1.47E-10
Cu	74	6.80E-11
Cu	75	6.15E-11
Cu	76	3.03E-11
Cu	77	1.12E-11
Cu	78	2.23E-12
Dy	158	1.89E-10
Dy	159	8.66E-11
Dy	160	4.96E-04
Dy	161	1.97E-02
Dy	162	6.87E-03
Dy	163	3.52E-03
Dy	164	2.01E-03
Dy	165	9.14E-08
Dy	165m	2.09E-12
Dy	166	2.04E-06
Dy	167	1.66E-09
Dy	168	1.38E-09
Dy	169	6.19E-11
Dy	170	2.48E-11
Dy	171	2.43E-12
Dy	172	1.48E-12
Er	164	2.59E-09
Er	166	7.25E-04
Er	167	4.73E-04
Er	167m	1.24E-12
Er	168	2.89E-04
Er	169	1.32E-06
Er	170	9.65E-05
Er	171	1.35E-08
Er	172	1.32E-07
Eu	151	5.27E-01
Eu	152	2.15E-03
Eu	152m	1.10E-06
Eu	153	1.16E+01
Eu	154	6.44E-02
Eu	154m	6.24E-08
Eu	155	2.00E+00
Eu	156	1.75E-02
Eu	157	3.54E-04
Eu	158	9.26E-06
Eu	159	1.50E-06
Eu	160	2.03E-08
Eu	161	4.59E-09
Eu	162	5.48E-10
Eu	163	1.68E-10

Eu	164	2.39E-11
Eu	165	6.14E-12
Ga	69	2.68E-04
Ga	70	2.13E-12
Ga	71	8.71E-04
Ga	72	1.02E-06
Ga	73	1.02E-06
Ga	74	6.98E-08
Ga	74m	3.02E-11
Ga	75	5.23E-08
Ga	76	4.69E-08
Ga	77	3.88E-08
Ga	78	2.49E-08
Ga	79	1.81E-08
Ga	80	7.00E-09
Ga	81	3.40E-09
Ga	82	1.13E-09
Ga	83	5.82E-11
Ga	84	2.26E-10
Gd	151	6.50E-11
Gd	152	9.17E-04
Gd	153	6.86E-07
Gd	154	8.90E-03
Gd	155	8.13E-01
Gd	156	1.43E+00
Gd	157	6.94E-01
Gd	158	3.64E-01
Gd	159	9.20E-05
Gd	160	5.77E-02
Gd	161	4.20E-08
Gd	162	3.35E-08
Gd	163	2.27E-09
Gd	164	8.06E-10
Gd	165	9.16E-11
Gd	166	2.22E-11
Gd	167	6.22E-12
Ge	70	9.60E-08
Ge	71	3.07E-12
Ge	72	2.27E-03
Ge	73	6.38E-03
Ge	73m	2.88E-11
Ge	74	1.57E-02
Ge	75	2.07E-06
Ge	75m	8.14E-10
Ge	76	1.63E-01
Ge	77	1.31E-04
Ge	77m	2.12E-09
Ge	78	3.95E-05
Ge	79	1.94E-07
Ge	79m	1.68E-07
Ge	80	1.01E-06
Ge	81	2.95E-07
Ge	81m	8.82E-09
Ge	82	1.88E-07
Ge	83	2.66E-08
Ge	84	1.02E-08
Ge	85	8.71E-10
Ge	86	1.36E-08
Ge	87	7.53E-11
Ho	163	5.68E-10
Ho	165	1.13E-03
Ho	166	6.78E-07
Ho	166m	3.82E-07
Ho	167	4.98E-08
Ho	168	4.79E-10
Ho	169	4.60E-10
Ho	170	1.42E-10
Ho	170m	1.27E-12
Ho	171	2.61E-11
Ho	172	1.82E-11
I	125	7.20E-12

I	126	6.07E-08
I	127	9.85E+00
I	128	3.97E-07
I	129	3.39E+01
I	130	2.50E-05
I	130m	1.76E-07
I	131	1.01E+00
I	132	1.82E-02
I	132m	2.40E-05
I	133	2.47E-01
I	133m	2.03E-06
I	134	1.22E-02
I	134m	3.75E-05
I	135	7.54E-02
I	136	1.23E-04
I	136m	3.09E-05
I	137	3.97E-05
I	138	5.37E-06
I	139	1.02E-06
I	140	9.79E-08
I	141	1.30E-08
I	142	1.03E-09
I	143	1.15E-10
I	144	1.20E-12
In	113	1.58E-03
In	114	3.77E-12
In	114m	1.34E-07
In	115	1.11E+00
In	115m	1.61E-04
In	116	3.59E-10
In	116m	1.37E-07
In	117	1.58E-05
In	117m	5.31E-05
In	118	5.21E-08
In	118m	2.26E-10
In	119	6.60E-07
In	119m	6.82E-06
In	120	3.26E-08
In	120m	9.44E-09
In	121	1.49E-07
In	121m	1.09E-06
In	122	1.67E-08
In	122m	1.34E-08
In	123	3.88E-08
In	123m	3.00E-07
In	124	3.33E-08
In	124m	1.02E-08
In	125	1.60E-08
In	125m	7.57E-08
In	126	1.12E-08
In	126m	6.17E-09
In	127	2.39E-08
In	127m	2.69E-08
In	128	8.57E-09
In	128m	6.33E-09
In	129	9.13E-09
In	129m	1.70E-08
In	130	1.13E-08
In	130m	5.01E-09
In	131	1.95E-09
In	131m	1.45E-09
In	132	1.12E-09
In	133	7.15E-11
In	134	3.52E-12
Kr	80	6.21E-06
Kr	81	5.80E-08
Kr	82	7.94E-03
Kr	83	1.79E+01
Kr	83m	1.08E-03
Kr	84	3.40E+01
Kr	85	8.07E+00

Kr	85m	6.38E-03
Kr	86	6.62E+01
Kr	87	3.64E-03
Kr	88	1.13E-02
Kr	89	2.65E-04
Kr	90	4.85E-05
Kr	91	9.51E-06
Kr	92	1.08E-06
Kr	93	2.49E-07
Kr	94	1.09E-08
Kr	95	8.58E-10
Kr	96	9.22E-10
Kr	97	3.01E-12
Kr	98	2.13E-11
La	137	8.47E-07
La	138	1.44E-03
La	139	3.58E+02
La	140	4.63E-01
La	141	4.30E-02
La	142	1.64E-02
La	143	2.61E-03
La	144	1.16E-04
La	145	5.09E-05
La	146	6.08E-06
La	146m	3.92E-06
La	147	2.45E-06
La	148	3.33E-07
La	149	8.76E-08
La	150	1.54E-08
La	151	2.40E-09
La	152	1.58E-10
La	153	1.26E-11
Mo	100	2.57E+02
Mo	101	1.74E-03
Mo	102	1.16E-03
Mo	103	8.64E-05
Mo	104	5.03E-05
Mo	105	1.78E-05
Mo	106	2.12E-06
Mo	107	3.84E-07
Mo	108	4.10E-08
Mo	109	7.80E-09
Mo	110	1.36E-09
Mo	111	1.73E-10
Mo	112	3.19E-11
Mo	113	1.25E-12
Mo	93	1.50E-11
Mo	94	1.48E-04
Mo	95	2.26E+02
Mo	96	1.95E-01
Mo	97	2.37E+02
Mo	98	2.32E+02
Mo	99	5.32E-01
Nb	100	3.34E-06
Nb	100m	3.17E-07
Nb	101	1.37E-05
Nb	102	5.12E-06
Nb	102m	4.01E-07
Nb	103	1.38E-06
Nb	104	1.13E-06
Nb	104m	1.51E-07
Nb	105	4.97E-07
Nb	106	2.94E-08
Nb	107	2.21E-09
Nb	108	1.67E-10
Nb	109	6.23E-11
Nb	110	2.79E-12
Nb	91	8.77E-12
Nb	92	1.51E-09
Nb	93	2.43E-05
Nb	93m	2.40E-04

Nb	94	1.68E-05
Nb	94m	3.62E-11
Nb	95	6.77E+00
Nb	95m	7.55E-03
Nb	96	2.19E-05
Nb	97	9.28E-03
Nb	97m	1.20E-04
Nb	98	6.04E-06
Nb	98m	3.31E-05
Nb	99	2.06E-05
Nb	99m	1.31E-04
Nd	141	2.47E-12
Nd	142	9.10E-02
Nd	143	3.33E+02
Nd	144	2.44E+02
Nd	145	2.29E+02
Nd	146	1.80E+02
Nd	147	1.17E+00
Nd	148	1.03E+02
Nd	149	3.90E-03
Nd	150	4.40E+01
Nd	151	1.92E-04
Nd	152	1.14E-04
Nd	153	3.21E-06
Nd	154	1.17E-06
Nd	155	1.55E-07
Nd	156	3.27E-08
Nd	157	2.58E-09
Nd	158	3.30E-10
Nd	159	2.24E-11
Nd	160	1.43E-12
Ni	65	8.36E-12
Ni	66	5.17E-08
Ni	67	1.90E-11
Ni	68	4.29E-11
Ni	69	2.59E-11
Ni	70	2.08E-11
Ni	71	1.12E-11
Ni	72	9.40E-12
Ni	73	4.81E-12
Ni	74	2.03E-12
Pb	206	5.23E-11
Pb	207	9.93E-09
Pb	208	1.00E-07
Pb	210	1.85E-09
Pb	212	1.31E-10
Pd	102	3.25E-06
Pd	103	1.48E-09
Pd	104	2.47E-01
Pd	105	5.61E+01
Pd	106	1.99E+01
Pd	107	1.36E+01
Pd	107m	1.75E-10
Pd	108	5.80E+00
Pd	109	1.49E-03
Pd	109m	4.70E-10
Pd	110	2.30E+00
Pd	111	2.02E-05
Pd	111m	1.38E-07
Pd	112	9.08E-04
Pd	113	1.05E-06
Pd	114	1.37E-06
Pd	115	2.48E-07
Pd	116	9.68E-08
Pd	117	3.33E-08
Pd	118	9.97E-09
Pd	119	2.15E-09
Pd	120	9.74E-10
Pd	121	1.10E-10
Pd	122	1.90E-11
Pd	123	5.70E-12

Pm	145	9.84E-10
Pm	146	9.78E-05
Pm	147	7.46E+01
Pm	148	1.23E-03
Pm	148m	7.85E-03
Pm	149	1.18E-01
Pm	150	2.58E-07
Pm	151	2.63E-02
Pm	152	4.12E-05
Pm	152m	3.53E-07
Pm	153	3.35E-05
Pm	154	5.00E-06
Pm	154m	4.89E-07
Pm	155	1.05E-06
Pm	156	3.06E-07
Pm	157	4.88E-08
Pm	158	6.94E-09
Pm	159	5.76E-10
Pm	160	1.11E-10
Pm	161	1.04E-11
Po	210	2.35E-11
Pr	140	1.80E-10
Pr	141	3.24E+02
Pr	142	1.17E-04
Pr	142m	5.20E-07
Pr	143	3.61E+00
Pr	144	2.94E-03
Pr	144m	1.17E-05
Pr	145	4.52E-02
Pr	146	2.38E-03
Pr	147	9.94E-04
Pr	148	1.27E-04
Pr	148m	2.36E-06
Pr	149	8.45E-05
Pr	150	2.39E-06
Pr	151	4.12E-06
Pr	152	3.38E-07
Pr	153	1.65E-07
Pr	154	1.93E-08
Pr	155	1.85E-09
Pr	156	2.47E-10
Pr	157	2.56E-11
Ra	223	2.94E-10
Ra	224	1.14E-09
Ra	225	3.26E-12
Ra	226	2.14E-06
Rb	100	5.85E-10
Rb	83	1.10E-09
Rb	84	6.89E-08
Rb	85	3.56E+01
Rb	86	4.94E-04
Rb	86m	2.44E-09
Rb	87	8.71E+01
Rb	88	1.18E-03
Rb	89	1.34E-03
Rb	90	2.45E-04
Rb	90m	6.85E-05
Rb	91	1.05E-04
Rb	92	7.13E-06
Rb	93	7.31E-06
Rb	94	1.75E-06
Rb	95	1.18E-07
Rb	96	2.23E-08
Rb	97	2.82E-09
Rb	98	5.01E-10
Rb	99	3.49E-11
Rh	101	6.21E-10
Rh	102	5.77E-06
Rh	102m	7.03E-06
Rh	103	1.38E+02
Rh	103m	4.35E-03

Rh	104	1.98E-07
Rh	104m	9.55E-08
Rh	105	6.39E-02
Rh	105m	5.90E-06
Rh	106	7.43E-06
Rh	106m	1.58E-08
Rh	107	1.66E-04
Rh	108	9.22E-07
Rh	108m	1.69E-08
Rh	109	2.41E-06
Rh	110	3.05E-10
Rh	110m	6.14E-07
Rh	111	1.58E-07
Rh	112	2.50E-08
Rh	113	3.00E-08
Rh	114	1.32E-08
Rh	115	5.41E-09
Rh	116	1.81E-09
Rh	117	5.70E-10
Rh	118	1.51E-10
Rh	119	2.47E-11
Rh	120	4.43E-12
Rn	222	1.37E-11
Ru	100	4.60E-01
Ru	101	2.16E+02
Ru	102	1.88E+02
Ru	103	4.42E+00
Ru	104	9.45E+01
Ru	105	8.31E-03
Ru	106	7.94E+00
Ru	107	2.86E-05
Ru	108	1.50E-05
Ru	109	1.03E-06
Ru	110	2.49E-07
Ru	111	2.89E-08
Ru	112	1.75E-08
Ru	113	4.88E-09
Ru	114	1.36E-09
Ru	115	7.08E-10
Ru	116	5.48E-11
Ru	117	6.82E-12
Ru	118	1.26E-12
Ru	98	6.32E-09
Ru	99	1.03E-02
Sb	120	4.85E-12
Sb	120m	1.24E-09
Sb	121	1.14E+00
Sb	122	5.79E-06
Sb	122m	4.42E-10
Sb	123	1.46E+00
Sb	124	2.12E-04
Sb	124m	1.70E-09
Sb	125	1.42E+00
Sb	126	3.73E-04
Sb	126m	7.17E-07
Sb	127	2.95E-02
Sb	128	3.59E-04
Sb	128m	1.10E-04
Sb	129	4.88E-03
Sb	129m	5.78E-06
Sb	130	8.65E-04
Sb	130m	1.88E-04
Sb	131	1.81E-03
Sb	132	1.57E-04
Sb	132m	1.43E-04
Sb	133	1.63E-04
Sb	134	1.75E-07
Sb	134m	2.23E-06
Sb	135	2.07E-07
Sb	136	1.58E-08
Sb	137	1.32E-08

Sb	138	3.93E-11
Sb	139	2.10E-12
Se	74	1.74E-09
Se	75	2.52E-12
Se	76	5.15E-05
Se	77	3.57E-01
Se	77m	1.74E-10
Se	78	8.23E-01
Se	79	1.65E+00
Se	79m	3.47E-06
Se	80	4.19E+00
Se	81	6.59E-05
Se	81m	1.32E-05
Se	82	1.06E+01
Se	83	1.92E-04
Se	83m	8.07E-07
Se	84	5.87E-05
Se	85	1.04E-05
Se	86	6.05E-06
Se	87	1.37E-06
Se	88	1.93E-07
Se	89	1.19E-08
Se	90	1.25E-09
Se	91	2.27E-10
Se	92	7.43E-12
Sm	145	2.15E-11
Sm	146	8.15E-05
Sm	147	5.91E+01
Sm	148	4.31E-01
Sm	149	6.79E+01
Sm	150	5.60E-01
Sm	151	2.73E+01
Sm	152	1.84E+01
Sm	153	1.79E-02
Sm	154	5.59E+00
Sm	155	3.50E-05
Sm	156	4.47E-04
Sm	157	3.10E-06
Sm	158	1.04E-06
Sm	159	1.40E-08
Sm	160	4.04E-09
Sm	161	4.75E-10
Sm	162	4.61E-11
Sm	163	8.00E-12
Sm	164	1.15E-12
Sn	112	8.16E-11
Sn	114	2.03E-06
Sn	115	5.51E-02
Sn	116	3.73E-03
Sn	117	1.10E+00
Sn	117m	2.49E-05
Sn	118	1.14E+00
Sn	119	1.15E+00
Sn	119m	8.48E-03
Sn	120	1.18E+00
Sn	121	1.02E-03
Sn	121m	7.84E-02
Sn	122	1.38E+00
Sn	123	9.18E-03
Sn	123m	3.04E-05
Sn	124	2.10E+00
Sn	125	6.46E-03
Sn	125m	8.67E-06
Sn	126	3.68E+00
Sn	127	3.93E-04
Sn	127m	8.52E-06
Sn	128	6.14E-04
Sn	128m	5.36E-07
Sn	129	2.46E-05
Sn	129m	3.98E-05
Sn	130	7.01E-05

Sn	130m	3.20E-05
Sn	131	1.57E-05
Sn	131m	1.57E-05
Sn	132	1.28E-05
Sn	133	1.18E-07
Sn	134	1.73E-08
Sn	135	6.74E-10
Sn	136	1.93E-11
Sn	137	1.93E-12
Sr	100	4.74E-09
Sr	101	3.73E-10
Sr	102	2.00E-11
Sr	84	5.54E-08
Sr	85	2.61E-10
Sr	86	1.66E-02
Sr	87	4.80E-05
Sr	87m	1.33E-09
Sr	88	1.22E+02
Sr	89	6.47E+00
Sr	90	1.89E+02
Sr	91	6.59E-02
Sr	92	1.92E-02
Sr	93	9.33E-04
Sr	94	1.54E-04
Sr	95	4.40E-05
Sr	96	1.54E-06
Sr	97	3.04E-07
Sr	98	2.37E-07
Sr	99	2.33E-08
Tb	157	2.37E-09
Tb	158	1.71E-07
Tb	159	1.47E-01
Tb	160	6.01E-05
Tb	161	1.14E-04
Tb	162	3.05E-08
Tb	163	4.03E-08
Tb	164	3.47E-09
Tb	165	1.36E-09
Tb	166	1.67E-10
Tb	167	7.90E-11
Tb	168	1.80E-11
Tb	169	2.07E-12
Tb	170	1.03E-12
Tc	100	1.30E-07
Tc	101	1.69E-03
Tc	102	9.05E-06
Tc	102m	7.24E-07
Tc	103	7.07E-05
Tc	104	9.54E-04
Tc	105	2.37E-04
Tc	106	9.15E-06
Tc	107	2.66E-06
Tc	108	2.69E-07
Tc	109	2.29E-08
Tc	110	1.35E-08
Tc	111	1.67E-09
Tc	112	5.50E-10
Tc	113	9.02E-11
Tc	114	1.49E-11
Tc	115	1.46E-12
Tc	97	1.63E-09
Tc	97m	8.09E-11
Tc	98	9.76E-05
Tc	99	2.51E+02
Tc	99m	4.34E-02
Te	121	6.67E-12
Te	121m	2.68E-11
Te	122	1.32E-03
Te	123	1.18E-06
Te	123m	1.15E-07
Te	124	3.94E-03

Te	125	1.05E+00
Te	125m	1.82E-02
Te	126	9.67E-02
Te	127	3.07E-03
Te	127m	1.38E-01
Te	128	1.98E+01
Te	129	1.23E-03
Te	129m	1.49E-01
Te	130	9.69E+01
Te	131	1.97E-03
Te	131m	2.35E-02
Te	132	6.03E-01
Te	133	1.33E-03
Te	133m	5.71E-03
Te	134	8.60E-03
Te	135	3.29E-05
Te	136	1.36E-05
Te	137	6.16E-07
Te	138	8.79E-08
Te	139	3.25E-09
Te	140	2.30E-09
Te	141	6.17E-11
Te	142	1.13E-12
Tm	168	3.15E-11
Tm	169	1.75E-04
Tm	170	1.01E-07
Tm	171	2.51E-05
Tm	172	1.71E-07
Xe	126	1.37E-06
Xe	127	3.03E-10
Xe	128	1.33E-02
Xe	129	7.40E-06
Xe	129m	8.68E-09
Xe	130	3.83E-02
Xe	131	1.58E+02
Xe	131m	1.62E-02
Xe	132	2.42E+02
Xe	133	1.50E+00
Xe	133m	1.81E-02
Xe	134	4.26E+02
Xe	134m	4.29E-09
Xe	135	1.09E-01
Xe	135m	5.48E-04
Xe	136	3.52E+02
Xe	137	7.11E-04
Xe	138	2.68E-03
Xe	139	1.01E-04
Xe	140	2.56E-05
Xe	141	1.25E-06
Xe	142	3.66E-07
Xe	143	1.16E-08
Xe	144	1.01E-08
Xe	145	1.47E-10
Xe	146	2.08E-11
Y	100	2.58E-07
Y	101	6.81E-08
Y	102	3.70E-08
Y	103	1.39E-09
Y	104	1.43E-10
Y	105	1.19E-11
Y	87	2.22E-12
Y	88	4.46E-07
Y	89	1.56E+02
Y	89m	2.24E-09
Y	90	4.78E-02
Y	90m	4.43E-08
Y	91	9.58E+00
Y	91m	3.33E-03
Y	92	2.53E-02
Y	93	7.82E-02
Y	93m	6.01E-07

```
Y       94      2.44E-03
Y       95      1.36E-03
Y       96      8.13E-06
Y        96m    6.00E-06
Y       97      4.33E-06
Y        97m    7.66E-07
Y       98      4.44E-07
Y        98m    8.91E-07
Y       99      1.30E-06
Yb      170     4.48E-07
Yb      171     2.90E-05
Yb      172     8.11E-05
Zn      66      2.87E-05
Zn      67      9.92E-05
Zn      68      1.65E-04
Zn      69      8.31E-09
Zn       69m    1.28E-10
Zn      70      4.70E-04
Zn      71      1.13E-09
Zn       71m    4.33E-09
Zn      72      3.22E-06
Zn      73      1.36E-09
Zn      74      1.32E-08
Zn      75      3.53E-09
Zn      76      5.64E-09
Zn      77      2.62E-09
Zn      78      1.85E-09
Zn      79      5.78E-10
Zn      80      6.48E-11
Zn      81      4.54E-12
Zr      100     1.51E-05
Zr      101     2.94E-06
Zr      102     2.56E-06
Zr      103     3.79E-07
Zr      104     8.42E-08
Zr      105     2.49E-08
Zr      106     2.91E-11
Zr      107     2.81E-12
Zr      89      3.76E-10
Zr      90      1.15E+01
Zr      91      1.98E+02
Zr      92      2.18E+02
Zr      93      2.34E+02
Zr      94      2.39E+02
Zr      95      1.24E+01
Zr      96      2.46E+02
Zr      97      1.29E-01
Zr      98      6.39E-05
Zr      99      4.43E-06

/CORE HPR_EOC ACTIVITY FISSION
*Isotope Activity(Ci)
Ac      224     1.36E-14
Ac      225     1.25E-07
Ac      226     1.56E-09
Ac      227     1.58E-05
Ac      228     2.02E-07
Ag      105     1.29E-15
Ag      106     1.74E-09
Ag      106m    2.66E-09
Ag      107m    2.34E-07
Ag      108     9.70E-04
Ag      108m    2.14E-06
Ag      109m    3.13E+03
Ag      110     1.20E+01
Ag      110m    4.81E-01
Ag      111     1.45E+03
Ag      111m    1.45E+03
Ag      112     1.21E+03
Ag      113     7.40E+02
```

Ag	113m	1.08E+03
Ag	114	9.62E+02
Ag	115	9.94E+02
Ag	115m	4.19E+01
Ag	116	9.63E+02
Ag	116m	3.90E+01
Ag	117	8.51E+02
Ag	117m	1.01E+02
Ag	118	7.49E+02
Ag	118m	2.76E+02
Ag	119	7.44E+02
Ag	120	3.98E+02
Ag	120m	1.57E+02
Ag	121	3.64E+02
Ag	122	9.39E+01
Ag	122m	8.38E+01
Ag	123	8.53E+01
Ag	124	4.55E+01
Ag	125	7.97E+00
Ag	126	1.56E+00
Ag	127	2.39E-01
Ag	128	3.26E-02
Ag	129	5.46E-03
Ag	130	2.08E-01
As	72	1.11E-09
As	73	8.59E-08
As	74	1.13E-05
As	76	1.29E-01
As	77	4.42E+02
As	78	1.09E+03
As	79	2.16E+03
As	80	5.38E+03
As	81	8.01E+03
As	82	1.03E+04
As	82m	1.52E+03
As	83	1.40E+04
As	84	1.02E+04
As	85	9.52E+03
As	86	1.98E+04
As	87	1.72E+03
As	88	4.13E+03
As	89	2.05E+01
As	90	5.42E-01
As	91	8.41E-02
As	92	6.60E-03
At	216	1.23E-15
At	217	1.25E-07
At	218	4.21E-10
Ba	131	2.00E-10
Ba	133	2.93E-06
Ba	135m	1.27E-02
Ba	136m	5.29E+01
Ba	137m	2.67E+04
Ba	139	2.65E+05
Ba	140	2.57E+05
Ba	141	2.43E+05
Ba	142	2.35E+05
Ba	143	2.24E+05
Ba	144	1.77E+05
Ba	145	8.89E+04
Ba	146	4.47E+04
Ba	147	1.27E+04
Ba	148	1.97E+03
Ba	149	2.41E+02
Ba	150	2.45E+01
Ba	151	3.89E+00
Ba	152	6.19E-02
Ba	153	2.96E-03
Bi	210	1.40E-07
Bi	211	1.50E-05
Bi	212	1.82E-04

Bi	213	1.25E-07
Bi	214	2.10E-06
Br	77	9.50E-09
Br	77m	7.78E-09
Br	78	1.24E-06
Br	79m	9.58E-05
Br	80	1.13E-02
Br	80m	6.61E-03
Br	82	1.67E+01
Br	82m	1.36E+01
Br	83	2.22E+04
Br	84	4.10E+04
Br	84m	6.75E+02
Br	85	5.25E+04
Br	86	7.33E+04
Br	87	8.37E+04
Br	88	7.46E+04
Br	89	5.13E+04
Br	90	2.80E+04
Br	91	1.12E+04
Br	92	1.91E+03
Br	93	7.11E+02
Br	94	3.88E+01
Br	95	6.51E-01
Br	96	2.08E-01
Br	97	2.99E-03
Cd	107	7.31E-11
Cd	109	1.61E-06
Cd	111m	2.31E-04
Cd	113	4.76E-13
Cd	113m	2.79E+00
Cd	115	9.68E+02
Cd	115m	5.75E+01
Cd	117	8.00E+02
Cd	117m	1.76E+02
Cd	118	9.97E+02
Cd	119	6.62E+02
Cd	119m	3.29E+02
Cd	120	9.85E+02
Cd	121	6.21E+02
Cd	121m	2.83E+02
Cd	122	9.68E+02
Cd	123	7.72E+02
Cd	124	7.21E+02
Cd	125	3.26E+02
Cd	126	3.18E+02
Cd	127	2.76E+02
Cd	128	1.19E+02
Cd	129	2.40E+00
Cd	130	2.72E+03
Cd	131	5.01E+02
Cd	132	7.39E-01
Ce	137	2.05E-08
Ce	139	1.43E-01
Ce	139m	4.63E-02
Ce	141	2.43E+05
Ce	143	2.43E+05
Ce	144	2.22E+05
Ce	145	1.63E+05
Ce	146	1.27E+05
Ce	147	8.38E+04
Ce	148	6.91E+04
Ce	149	3.66E+04
Ce	150	2.04E+04
Ce	151	6.13E+03
Ce	152	1.66E+03
Ce	153	3.08E+02
Ce	154	3.71E+01
Ce	155	3.60E+00
Ce	156	2.28E-01
Ce	157	9.16E-03

Co	65	1.60E-04
Co	66	4.21E-02
Co	67	1.30E-01
Co	68	1.51E-01
Co	69	1.41E-01
Co	70	9.50E-02
Co	71	5.18E-02
Co	72	2.00E-02
Co	73	8.27E-03
Co	74	1.23E-03
Co	75	1.75E-04
Cs	129	4.34E-12
Cs	131	1.43E-06
Cs	132	1.33E-01
Cs	134	3.35E+02
Cs	134m	6.10E+01
Cs	135	4.16E-01
Cs	135m	1.03E+01
Cs	136	4.76E+02
Cs	136m	1.42E+02
Cs	137	2.82E+04
Cs	138	2.77E+05
Cs	138m	8.00E+03
Cs	139	2.63E+05
Cs	140	2.40E+05
Cs	141	1.80E+05
Cs	142	1.19E+05
Cs	143	6.53E+04
Cs	144	2.33E+04
Cs	145	5.60E+03
Cs	146	8.23E+02
Cs	147	1.46E+02
Cs	148	1.06E+01
Cs	149	1.98E-01
Cs	150	1.98E-02
Cs	151	3.45E-03
Cu	66	4.51E-02
Cu	67	1.53E-01
Cu	68	2.50E-01
Cu	68m	3.65E-03
Cu	69	4.01E-01
Cu	70	6.35E-01
Cu	70m	1.08E-01
Cu	71	1.22E+00
Cu	72	2.46E+00
Cu	73	5.43E+00
Cu	74	5.92E+00
Cu	75	7.56E+00
Cu	76	6.89E+00
Cu	77	3.51E+00
Cu	78	9.64E-01
Cu	79	1.69E-01
Cu	80	1.71E-02
Dy	157	7.23E-13
Dy	159	4.93E-07
Dy	165	7.44E-01
Dy	165m	1.90E-03
Dy	166	4.73E-01
Dy	167	3.01E-01
Dy	168	1.78E-01
Dy	169	1.06E-01
Dy	170	5.49E-02
Dy	171	2.67E-02
Dy	172	3.24E-02
Er	163	2.56E-12
Er	165	8.21E-07
Er	167m	3.69E-02
Er	169	1.09E-01
Er	171	3.28E-02
Er	172	4.88E-02
Eu	149	1.22E-10

Eu	152	3.74E-01
Eu	152m	2.44E+00
Eu	154	1.74E+01
Eu	154m	1.66E+00
Eu	155	9.73E+02
Eu	156	9.64E+02
Eu	157	4.66E+02
Eu	158	2.40E+02
Eu	159	9.78E+01
Eu	160	3.76E+01
Eu	161	1.24E+01
Eu	162	3.60E+00
Eu	163	1.51E+00
Eu	164	5.79E-01
Eu	165	1.83E-01
Eu	166	4.85E-02
Eu	167	1.06E-02
Fe	65	1.60E-04
Fe	66	2.20E-02
Fe	67	4.34E-02
Fe	68	2.61E-02
Fe	69	9.25E-03
Fe	70	2.54E-03
Fe	71	4.49E-04
Fe	72	6.41E-05
Fr	220	1.23E-15
Fr	221	1.25E-07
Fr	222	9.36E-14
Fr	223	2.18E-07
Ga	67	4.66E-13
Ga	68	4.91E-08
Ga	70	2.70E-04
Ga	72	3.14E+00
Ga	72m	1.09E-01
Ga	73	9.05E+00
Ga	74	2.19E+01
Ga	74m	4.86E-01
Ga	75	6.25E+01
Ga	76	2.14E+02
Ga	77	4.31E+02
Ga	78	7.08E+02
Ga	79	9.10E+02
Ga	80	5.89E+02
Ga	81	3.90E+02
Ga	82	2.59E+02
Ga	83	2.57E+01
Ga	84	3.58E+02
Ga	85	4.34E-01
Ga	86	1.04E+00
Gd	151	4.54E-07
Gd	152	2.00E-14
Gd	153	2.44E-03
Gd	159	9.81E+01
Gd	161	1.34E+01
Gd	162	4.63E+00
Gd	163	2.32E+00
Gd	164	1.23E+00
Gd	165	6.08E-01
Gd	166	3.15E-01
Gd	167	1.40E-01
Gd	168	4.84E-02
Gd	169	1.09E-02
Ge	69	2.46E-12
Ge	71	4.95E-07
Ge	71m	1.28E-07
Ge	73m	8.92E+00
Ge	75	6.29E+01
Ge	75m	2.57E+00
Ge	77	4.74E+02
Ge	77m	5.87E+00
Ge	78	1.08E+03

Ge	79	1.46E+03
Ge	79m	6.15E+02
Ge	80	4.82E+03
Ge	81	5.42E+03
Ge	81m	1.62E+02
Ge	82	5.68E+03
Ge	83	1.96E+03
Ge	84	1.44E+03
Ge	85	2.16E+02
Ge	86	1.88E+04
Ge	87	6.98E+01
Ge	88	1.80E+00
Ge	89	1.77E-02
Hg	206	2.85E-15
Ho	161	1.71E-09
Ho	161m	1.43E-10
Ho	162	2.89E-08
Ho	162m	2.91E-08
Ho	163	2.73E-10
Ho	163m	8.18E-08
Ho	164	7.65E-06
Ho	164m	5.19E-06
Ho	166	4.78E-01
Ho	166m	6.87E-07
Ho	167	3.02E-01
Ho	168	1.79E-01
Ho	169	1.09E-01
Ho	170	5.68E-02
Ho	170m	1.96E-03
Ho	171	3.25E-02
Ho	172	4.78E-02
I	121	6.79E-15
I	123	3.51E-08
I	124	6.60E-14
I	125	1.27E-07
I	126	4.87E-03
I	128	2.34E+01
I	129	5.99E-03
I	130	4.87E+01
I	130m	2.89E+01
I	131	1.25E+05
I	132	1.88E+05
I	132m	4.11E+02
I	133	2.80E+05
I	133m	1.91E+04
I	134	3.26E+05
I	134m	1.50E+04
I	135	2.67E+05
I	136	1.23E+05
I	136m	5.47E+04
I	137	1.33E+05
I	138	7.05E+04
I	139	3.62E+04
I	140	9.18E+03
I	141	2.42E+03
I	142	3.68E+02
I	143	3.06E+01
I	144	4.83E-01
In	111	2.41E-13
In	111m	4.52E-14
In	112	5.06E-07
In	112m	4.12E-07
In	113m	3.82E-10
In	114	5.20E-03
In	114m	3.11E-03
In	115	7.81E-12
In	115m	9.80E+02
In	116	2.48E+00
In	116m	4.09E+00
In	117	5.88E+02
In	117m	7.35E+02

In	118	9.97E+02
In	118m	8.10E-02
In	119	4.35E+02
In	119m	5.99E+02
In	120	9.95E+02
In	120m	1.92E+01
In	121	6.02E+02
In	121m	4.37E+02
In	122	1.03E+03
In	122m	1.20E+02
In	123	5.77E+02
In	123m	5.81E+02
In	124	9.72E+02
In	124m	2.51E+02
In	125	6.12E+02
In	125m	5.61E+02
In	126	6.55E+02
In	126m	3.37E+02
In	127	1.95E+03
In	127m	6.52E+02
In	128	9.00E+02
In	128m	7.76E+02
In	129	1.31E+03
In	129m	1.21E+03
In	130	3.39E+03
In	130m	8.06E+02
In	131	6.01E+02
In	131m	3.56E+02
In	132	4.63E+02
In	133	3.68E+01
In	134	2.12E+00
In	135	7.50E-02
Kr	100	3.72E-02
Kr	79	4.97E-09
Kr	79m	2.49E-09
Kr	81	1.12E-09
Kr	81m	1.50E-05
Kr	83m	2.22E+04
Kr	85	3.16E+03
Kr	85m	5.26E+04
Kr	87	1.03E+05
Kr	88	1.41E+05
Kr	89	1.78E+05
Kr	90	1.88E+05
Kr	91	1.38E+05
Kr	92	7.23E+04
Kr	93	2.35E+04
Kr	94	6.16E+03
Kr	95	8.94E+02
Kr	96	1.36E+03
Kr	97	5.56E+00
Kr	98	5.33E+01
Kr	99	8.86E-02
La	133	1.36E-13
La	135	1.16E-07
La	137	3.68E-08
La	138	3.66E-11
La	140	2.57E+05
La	141	2.44E+05
La	142	2.38E+05
La	143	2.42E+05
La	144	2.24E+05
La	145	1.60E+05
La	146	7.50E+04
La	146m	3.03E+04
La	147	4.62E+04
La	148	2.01E+04
La	149	6.32E+03
La	150	1.35E+03
La	151	2.31E+02
La	152	2.61E+01

La	153	2.72E+00
La	154	1.16E-01
La	155	3.29E-03
Lu	172	2.68E-13
Lu	172m	1.35E-13
Mo	100	1.26E-13
Mo	101	2.21E+05
Mo	102	1.89E+05
Mo	103	1.40E+05
Mo	104	9.10E+04
Mo	105	5.36E+04
Mo	106	2.59E+04
Mo	107	1.16E+04
Mo	108	3.93E+03
Mo	109	1.52E+03
Mo	110	4.67E+02
Mo	111	8.81E+01
Mo	112	1.12E+01
Mo	113	1.25E+00
Mo	114	5.12E-02
Mo	115	4.13E-03
Mo	93	1.44E-11
Mo	93m	1.16E-09
Mo	99	2.56E+05
Nb	100	2.51E+05
Nb	100m	1.20E+04
Nb	101	2.15E+05
Nb	102	1.32E+05
Nb	102m	3.42E+04
Nb	103	1.01E+05
Nb	104	2.51E+04
Nb	104m	1.74E+04
Nb	105	1.81E+04
Nb	106	3.36E+03
Nb	107	7.75E+02
Nb	108	9.04E+01
Nb	109	3.39E+01
Nb	110	1.68E+00
Nb	111	1.21E+00
Nb	112	1.22E-02
Nb	113	2.17E-03
Nb	90	4.08E-13
Nb	91	5.07E-11
Nb	91m	8.44E-14
Nb	92	1.69E-13
Nb	92m	1.21E-07
Nb	93m	5.74E-02
Nb	94	3.15E-06
Nb	94m	1.16E-02
Nb	95	2.66E+05
Nb	95m	2.88E+03
Nb	96	3.07E+01
Nb	97	2.50E+05
Nb	97m	2.37E+05
Nb	98	2.43E+05
Nb	98m	1.24E+03
Nb	99	1.57E+05
Nb	99m	9.96E+04
Nd	140	1.87E-11
Nd	141	2.21E-05
Nd	141m	3.81E-06
Nd	144	2.65E-10
Nd	147	9.50E+04
Nd	149	4.75E+04
Nd	150	1.33E-14
Nd	151	1.92E+04
Nd	152	1.23E+04
Nd	153	7.49E+03
Nd	154	3.31E+03
Nd	155	1.27E+03
Nd	156	4.31E+02

Nd	157	9.74E+01
Nd	158	1.77E+01
Nd	159	2.05E+00
Nd	160	1.72E-01
Nd	161	8.16E-03
Ni	65	1.60E-04
Ni	66	4.50E-02
Ni	67	1.53E-01
Ni	68	2.46E-01
Ni	69	3.71E-01
Ni	70	5.58E-01
Ni	71	6.98E-01
Ni	72	9.39E-01
Ni	73	8.86E-01
Ni	74	4.56E-01
Ni	75	1.62E-01
Ni	76	5.80E-02
Ni	77	8.12E-03
Ni	78	1.08E-03
Pb	207m	4.83E-11
Pb	209	1.25E-07
Pb	210	1.42E-07
Pb	211	1.50E-05
Pb	212	1.82E-04
Pb	214	2.10E-06
Pd	101	3.53E-10
Pd	103	1.11E-04
Pd	107	6.97E-03
Pd	107m	8.69E-01
Pd	109	3.13E+03
Pd	109m	1.73E-01
Pd	111	1.46E+03
Pd	111m	7.10E-01
Pd	112	1.21E+03
Pd	113	1.13E+03
Pd	114	9.32E+02
Pd	115	9.74E+02
Pd	116	7.98E+02
Pd	117	7.47E+02
Pd	118	5.02E+02
Pd	119	2.21E+02
Pd	120	1.83E+02
Pd	121	3.59E+01
Pd	122	1.00E+01
Pd	123	2.14E+00
Pd	124	3.55E-01
Pm	143	1.01E-13
Pm	144	2.15E-10
Pm	145	1.37E-07
Pm	146	4.33E-02
Pm	147	6.92E+04
Pm	148	2.02E+02
Pm	148m	1.68E+02
Pm	149	4.70E+04
Pm	150	2.01E+00
Pm	151	1.92E+04
Pm	152	1.24E+04
Pm	152m	5.80E+01
Pm	153	7.84E+03
Pm	154	3.53E+03
Pm	154m	2.23E+02
Pm	155	1.85E+03
Pm	156	8.29E+02
Pm	157	3.32E+02
Pm	158	1.03E+02
Pm	159	2.78E+01
Pm	160	5.00E+00
Pm	161	6.82E-01
Pm	162	5.77E-02
Pm	163	6.19E-03
Po	210	1.06E-07

Po	211	4.15E-08
Po	212	1.17E-04
Po	213	1.22E-07
Po	214	2.61E-06
Po	215	1.50E-05
Po	216	1.82E-04
Po	218	2.10E-06
Pr	139	7.73E-10
Pr	140	7.15E-02
Pr	142	1.35E+02
Pr	142m	4.72E+01
Pr	143	2.43E+05
Pr	144	2.22E+05
Pr	144m	2.12E+03
Pr	145	1.63E+05
Pr	146	1.27E+05
Pr	147	9.49E+04
Pr	148	7.06E+04
Pr	148m	1.49E+03
Pr	149	4.72E+04
Pr	150	2.91E+04
Pr	151	1.63E+04
Pr	152	6.92E+03
Pr	153	2.84E+03
Pr	154	6.15E+02
Pr	155	1.58E+02
Pr	156	2.43E+01
Pr	157	3.08E+00
Pr	158	2.00E-01
Pr	159	9.48E-03
Ra	222	5.03E-07
Ra	223	1.50E-05
Ra	224	1.82E-04
Ra	225	1.27E-07
Ra	226	2.12E-06
Ra	227	1.81E-06
Ra	228	1.72E-11
Rb	100	1.30E+03
Rb	101	2.45E-01
Rb	102	2.28E-02
Rb	81	1.21E-09
Rb	83	2.02E-05
Rb	84	3.27E-03
Rb	86	4.03E+01
Rb	86m	5.25E+00
Rb	87	7.45E-06
Rb	88	1.43E+05
Rb	89	1.87E+05
Rb	90	1.94E+05
Rb	90m	3.33E+04
Rb	91	2.23E+05
Rb	92	1.95E+05
Rb	93	1.52E+05
Rb	94	7.78E+04
Rb	95	3.73E+04
Rb	96	1.29E+04
Rb	97	1.94E+03
Rb	98	5.06E+02
Rb	99	7.36E+01
Rh	101	6.67E-07
Rh	101m	2.90E-08
Rh	102	3.57E-02
Rh	102m	6.59E-03
Rh	103m	1.41E+05
Rh	104	5.08E+02
Rh	104m	3.98E+01
Rh	105	5.40E+04
Rh	105m	1.59E+04
Rh	106	2.63E+04
Rh	106m	2.14E-01
Rh	107	1.34E+04

Rh	108	5.74E+03
Rh	108m	4.90E+00
Rh	109	3.12E+03
Rh	110	9.78E+00
Rh	110m	2.21E+03
Rh	111	1.46E+03
Rh	112	1.20E+03
Rh	113	1.07E+03
Rh	114	7.07E+02
Rh	115	5.36E+02
Rh	116	2.59E+02
Rh	117	1.25E+02
Rh	118	5.42E+01
Rh	119	1.37E+01
Rh	120	3.07E+00
Rh	121	4.91E-01
Rh	122	6.15E-02
Rn	217	8.76E-12
Rn	218	5.03E-07
Rn	219	1.50E-05
Rn	220	1.82E-04
Rn	222	2.10E-06
Ru	103	1.43E+05
Ru	105	5.59E+04
Ru	106	2.63E+04
Ru	107	1.34E+04
Ru	108	5.73E+03
Ru	109	3.10E+03
Ru	110	2.20E+03
Ru	111	1.39E+03
Ru	112	1.01E+03
Ru	113	6.10E+02
Ru	114	2.59E+02
Ru	115	9.39E+01
Ru	116	2.61E+01
Ru	117	4.63E+00
Ru	118	9.83E-01
Ru	119	9.69E-02
Ru	120	9.33E-03
Ru	97	3.75E-12
Sb	117	5.21E-13
Sb	118	7.75E-10
Sb	118m	1.23E-09
Sb	119	4.56E-07
Sb	120	4.79E-04
Sb	120m	2.34E-04
Sb	122	2.28E+00
Sb	122m	1.63E-01
Sb	124	3.71E+00
Sb	124m	1.67E+00
Sb	125	1.48E+03
Sb	126	3.13E+01
Sb	126m	5.59E+01
Sb	127	7.90E+03
Sb	128	9.76E+02
Sb	128m	1.56E+04
Sb	129	2.69E+04
Sb	129m	4.77E+02
Sb	130	3.17E+04
Sb	130m	4.32E+04
Sb	131	1.13E+05
Sb	132	8.00E+04
Sb	132m	4.98E+04
Sb	133	9.23E+04
Sb	134	1.89E+04
Sb	134m	1.86E+04
Sb	135	1.03E+04
Sb	136	1.42E+03
Sb	137	2.41E+03
Sb	138	1.91E+01
Sb	139	1.34E+00

Se	73	1.01E-14
Se	73m	5.89E-15
Se	75	3.67E-08
Se	77m	1.47E+00
Se	79	2.54E-02
Se	79m	2.11E+03
Se	81	8.29E+03
Se	81m	5.35E+02
Se	83	1.95E+04
Se	83m	1.57E+03
Se	84	4.03E+04
Se	85	4.37E+04
Se	86	5.55E+04
Se	87	3.24E+04
Se	88	1.62E+04
Se	89	3.69E+03
Se	90	9.75E+02
Se	91	1.04E+02
Se	92	9.80E+00
Se	93	6.89E-01
Se	94	2.73E-02
Sm	145	5.71E-08
Sm	146	1.94E-09
Sm	147	1.36E-06
Sm	148	1.49E-13
Sm	151	7.20E+02
Sm	153	7.91E+03
Sm	155	1.90E+03
Sm	156	9.56E+02
Sm	157	4.62E+02
Sm	158	2.33E+02
Sm	159	8.75E+01
Sm	160	2.97E+01
Sm	161	6.93E+00
Sm	162	1.34E+00
Sm	163	3.17E-01
Sm	164	6.43E-02
Sm	165	8.18E-03
Sn	111	8.93E-15
Sn	113	3.35E-10
Sn	113m	3.14E-10
Sn	117m	2.05E+00
Sn	119m	3.18E+01
Sn	121	9.80E+02
Sn	121m	5.28E+00
Sn	123	7.55E+01
Sn	123m	1.16E+03
Sn	125	7.01E+02
Sn	125m	1.37E+03
Sn	126	4.55E-02
Sn	127	4.62E+03
Sn	127m	3.06E+03
Sn	128	1.53E+04
Sn	128m	7.28E+03
Sn	129	1.61E+04
Sn	129m	8.41E+03
Sn	130	2.73E+04
Sn	130m	2.73E+04
Sn	131	2.42E+04
Sn	131m	2.32E+04
Sn	132	2.76E+04
Sn	133	6.85E+03
Sn	134	1.39E+03
Sn	135	1.06E+02
Sn	136	6.40E+00
Sn	137	8.35E-01
Sr	100	2.65E+03
Sr	101	3.53E+02
Sr	102	3.21E+01
Sr	103	7.48E-01
Sr	104	8.90E-02

Sr	105	1.65E-02
Sr	83	1.92E-10
Sr	85	6.18E-06
Sr	85m	3.19E-06
Sr	87m	1.70E-02
Sr	89	1.88E+05
Sr	90	2.60E+04
Sr	91	2.36E+05
Sr	92	2.41E+05
Sr	93	2.54E+05
Sr	94	2.45E+05
Sr	95	2.19E+05
Sr	96	1.70E+05
Sr	97	8.24E+04
Sr	98	4.18E+04
Sr	99	9.85E+03
Tb	155	1.72E-09
Tb	156	9.53E-08
Tb	156m	8.89E-09
Tb	157	7.62E-08
Tb	158	2.14E-06
Tb	158m	5.71E-05
Tb	160	6.78E-01
Tb	161	1.34E+01
Tb	162	4.66E+00
Tb	163	2.38E+00
Tb	164	1.33E+00
Tb	165	7.34E-01
Tb	166	4.53E-01
Tb	167	2.75E-01
Tb	168	1.47E-01
Tb	169	6.89E-02
Tb	170	2.29E-02
Tb	171	6.19E-03
Tc	100	9.51E+02
Tc	101	2.22E+05
Tc	102	1.90E+05
Tc	102m	3.07E+02
Tc	103	1.43E+05
Tc	104	9.43E+04
Tc	105	5.58E+04
Tc	106	2.74E+04
Tc	107	1.32E+04
Tc	108	5.44E+03
Tc	109	2.76E+03
Tc	110	1.50E+03
Tc	111	5.84E+02
Tc	112	1.98E+02
Tc	113	5.63E+01
Tc	114	9.83E+00
Tc	115	1.97E+00
Tc	116	1.98E-01
Tc	117	8.29E-03
Tc	118	1.99E-03
Tc	95	6.90E-13
Tc	96	7.26E-13
Tc	97	1.43E-12
Tc	97m	1.20E-06
Tc	98	8.49E-08
Tc	99	4.30E+00
Tc	99m	2.29E+05
Te	119	5.58E-14
Te	121	3.76E-07
Te	121m	1.76E-07
Te	123m	1.03E-03
Te	125m	3.32E+02
Te	127	8.10E+03
Te	127m	1.31E+03
Te	128	6.28E-15
Te	129	2.57E+04
Te	129m	4.48E+03

Te	131	1.13E+05
Te	131m	1.69E+04
Te	132	1.86E+05
Te	133	1.51E+05
Te	133m	1.46E+05
Te	134	2.89E+05
Te	135	1.45E+05
Te	136	6.43E+04
Te	137	2.04E+04
Te	138	5.14E+03
Te	139	7.61E+02
Te	140	6.09E+02
Te	141	2.32E+01
Te	142	4.49E-01
Tl	206	1.89E-13
Tl	207	1.50E-05
Tl	208	6.54E-05
Tl	209	2.75E-09
Tl	210	4.42E-10
Tm	166	8.23E-13
Tm	167	5.29E-10
Tm	168	2.63E-07
Tm	170	6.06E-04
Tm	171	2.73E-02
Tm	172	4.89E-02
Xe	125	4.39E-10
Xe	125m	1.11E-10
Xe	127	8.57E-06
Xe	127m	1.42E-06
Xe	129m	9.90E-04
Xe	131m	1.36E+03
Xe	133	2.81E+05
Xe	133m	8.10E+03
Xe	134m	1.25E+03
Xe	135	2.76E+05
Xe	135m	5.00E+04
Xe	137	2.56E+05
Xe	138	2.59E+05
Xe	139	2.07E+05
Xe	140	1.52E+05
Xe	141	5.79E+04
Xe	142	2.37E+04
Xe	143	3.05E+03
Xe	144	6.87E+02
Xe	145	6.07E+01
Xe	146	4.36E+00
Xe	147	1.44E-01
Y	100	3.97E+04
Y	101	1.69E+04
Y	102	1.14E+04
Y	103	6.63E+02
Y	104	8.65E+01
Y	105	1.45E+01
Y	106	2.27E-02
Y	107	5.13E-03
Y	108	2.05E-05
Y	87	1.00E-06
Y	87m	1.08E-10
Y	88	6.21E-03
Y	89m	1.81E+01
Y	90	2.60E+04
Y	90m	4.84E-01
Y	91	2.35E+05
Y	91m	1.39E+05
Y	92	2.44E+05
Y	93	2.59E+05
Y	93m	8.90E+04
Y	94	2.62E+05
Y	95	2.62E+05
Y	96	1.79E+05
Y	96m	7.35E+04

Y	97	1.34E+05
Y	97m	7.62E+04
Y	98	9.33E+04
Y	98m	5.13E+04
Y	99	1.01E+05
Yb	169	4.24E-10
Yb	169m	4.60E-11
Zn	69	4.02E-01
Zn	69m	4.24E-04
Zn	71	1.23E+00
Zn	71m	4.83E-02
Zn	72	3.01E+00
Zn	73	8.95E+00
Zn	74	2.10E+01
Zn	75	5.21E+01
Zn	76	1.47E+02
Zn	77	1.85E+02
Zn	78	1.82E+02
Zn	79	8.31E+01
Zn	80	1.69E+01
Zn	81	1.98E+00
Zn	82	7.69E-01
Zn	83	4.31E-02
Zr	100	2.40E+05
Zr	101	1.43E+05
Zr	102	9.78E+04
Zr	103	3.20E+04
Zr	104	7.62E+03
Zr	105	4.46E+03
Zr	106	1.15E+01
Zr	107	1.97E+00
Zr	108	1.05E-01
Zr	109	2.95E-02
Zr	110	1.06E-03
Zr	88	9.43E-10
Zr	89	1.69E-04
Zr	89m	5.60E-06
Zr	90m	9.87E-02
Zr	93	5.87E-01
Zr	95	2.66E+05
Zr	96	4.58E-14
Zr	97	2.49E+05
Zr	98	2.40E+05
Zr	99	2.40E+05